



Sample Illness & Injury Prevention Plan

This is the entire text of SafetyPlanBuilder.

Professional OSHA Safety Plan & Training Handbook

Safety Plan Builder software helps you publish a custom illness and injury prevention manual to quickly and easily comply with OSHA, avoid lawsuits, train your employees, and provide a safe workplace. Covers 55 Safe Work Practice categories. All elements of your safety plan are pre-written. Select the appropriate sections for your business or industry, then customize the paragraphs. Menus help you select the paragraphs appropriate to your state. Contains over 250 pre-written pages of industry-specific Safe Work Practices. Publish your complete plan in a few minutes and be safety compliant in all 50 states. Windows or Macintosh. Downloadable.

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 This is a sample memo to send to all employees

Important Notice

Date **[Date]**

To: **[All Employees/Contractors/Suppliers]**

From: **[Owner/Founder]**

Subject: **Our Injury & Illness Prevention Plan**

We have just published our official [Company] Injury & Illness Prevention Plan!

The idea is to make sure that we all work together in an environment that supports our business and keeps everyone safe and healthy.

This is a very important document.

There is a lot of information here and it is relevant to your job.

Please review it thoroughly.

You are responsible for its contents.

Thank you very much for your cooperation.

Receipt & Acknowledgment of [Company] Illness & Injury Prevention Handbook

- 🔊 We recommend that you require all employees to sign a release stating that they have been given a copy of your Safety Handbook and agree to abide by it.
- 🔊 File this form in the employees personnel file once it has been signed and returned.
- 🔊 Prevent employees from doing something dangerous, then suing you for it.

Please read the following statements, sign below and return to your [manager / supervisor / team leader / designated company representative].

I Understand & Acknowledge [Company] Safety Policies & Procedures

- I have received and read a copy of the [Company] Injury & Illness Prevention Handbook.
- I understand that the information in this document supersedes previous documents and verbal instructions.
- I understand further that the policies and procedures described in this document are subject to change at the sole discretion of [Company] at any time.

Safety Practices

I also acknowledge that I have read and understand all of the Safety Practices contained in this Injury & Illness Prevention Handbook and I agree to abide by these policies. If I have not complied with the procedures and policies as described, I agree to hold [Company] harmless for injuries that I may sustain as a result of such actions.

I also agree to immediately report, in writing, any discrepancies in practices or conditions directly to my immediate [supervisor/manager] and/or the [Company] Responsible Safety Officer.

Confidential Information

I am aware that during the course of my employment confidential information will be made available to me, for instance, product designs, marketing strategies, customer lists, pricing policies and other related information. I understand that this information is proprietary and critical to the success of [Company] and must not be given out or used outside of [Company]'s premises or with non-[Company] employees. In the event of termination of employment, whether voluntary or involuntary, I hereby agree not to utilize or exploit this information with any other individual or company.

Employee's Printed Name

Position

Employee's Signature

Date



[Company Legal Name]

Injury & Illness Prevention Program

[Safety Officer]
Responsible Safety Officer

[Company]
[Address]
[City], [State] [Zip]
[Telephone]
[email]

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Injury & Illness Prevention Program

Written Plan

Every employer should have a written Injury & Illness Prevention plan. This is our plan. Please read it carefully. While no plan can guarantee an accident free work place, following the safety procedures set forth in this manual will significantly reduce the risk of danger to you and your co-workers. Thank you for all our safety.

Introduction to Our Program

State and federal law, as well as company policy, make the safety and health of our employees the first consideration in operating our business. Safety and health in our business must be a part of every operation, and every employee's responsibility at all levels. It is the intent of [Company] to comply with all laws concerning the operation of the business and the health and safety of our employees and the public. To do this, we must constantly be aware of conditions in all work areas that can produce or lead to injuries. No employee is required to work at a job known to be unsafe or dangerous to their health. Your cooperation in detecting hazards, reporting dangerous conditions and controlling workplace hazards is a condition of employment. Inform your supervisor immediately of any situation beyond your ability or authority to correct. Employees will not be disciplined or suffer any retaliation for reporting a safety violation in good faith.

Safety First Priority

The personal safety and health of each employee is of primary importance. Prevention of occupationally-induced injuries and illnesses is of such consequence that it will be given precedence over operating productivity. To the greatest degree possible, management will provide all mechanical and physical protection required for personal safety and health, but our employees must bear primary responsibility for working safely. A little common sense and caution can prevent most accidents from occurring.

Individual Cooperation Necessary

[Company] maintains a safety and health program conforming to the best practices of our field. To be successful, such a program must embody proper attitudes towards injury and illness prevention on the part of supervisors and employees. It requires the cooperation in all safety and health matters, not only of the employer and employee, but between the employee and all co-workers. Only through such a cooperative effort can a safety program in the best interest of all be established and preserved. Safety is no accident; think safety and the job will be safer.

Safety Program Goals

The objective of [Company] is a safety and health program that will reduce the number of injuries and illnesses to an absolute minimum, not merely in keeping with, but surpassing the best experience of similar operations by others. Our goal is zero accidents and injuries.

Safety Policy Statement

It is the policy of [Company] that accident prevention shall be considered of primary importance in all phases of operation and administration. It is the intention of [Company]'s management to provide safe and healthy working conditions and to establish and insist upon safe practices at all times by all employees. The prevention of accidents is an objective affecting all levels of our company and its operations. It is, therefore, a basic requirement that each supervisor make the safety of all employees an integral part of his or her regular management function.

It is equally the duty of each employee to accept and follow established safety regulations and procedures. Every effort will be made to provide adequate training to employees. However, if an employee is ever in doubt about how to do a job or task safely, it is his or her duty to ask a qualified person for assistance. Employees are expected to assist management in accident prevention activities. Unsafe conditions must be reported immediately. Fellow employees that need help should be assisted. Everyone is responsible for the housekeeping duties that pertain to their jobs. Every injury that occurs on the job, even a slight cut or strain, must be reported to management and/or the Responsible Safety Officer as soon as possible. Under no circumstances, except emergency trips to the hospital, should an employee leave the work site without reporting an injury. When you have an accident, everyone is hurt. Please work safely. Safety is everyone's business.

Safety Rules for All Employees

It is the policy of [Company] that everything possible will be done to protect you from accidents, injuries and/or occupational disease while on the job. Safety is a cooperative undertaking requiring an ever-present safety consciousness on the part of every employee. If an employee is injured, positive action must be taken promptly to see that the employee receives adequate treatment. No one likes to see a fellow employee injured by an accident. Therefore, all operations must be planned to prevent accidents.

To carry out this policy, the following rules will apply:

All employees shall follow the safe practices and rules contained in this manual and such other rules and practices communicated on the job.

All employees shall report all unsafe conditions or practices to the proper authority, including the supervision on the project, and, if corrective action is not taken immediately, a governmental authority with proper jurisdiction over such practices.

The RSO shall be responsible for implementing these policies by insisting that employees observe and obey all rules and regulations necessary to maintain a safe work place and safe work habits and practices.

Good housekeeping must be practiced at all times in the work area. Clean up all waste and eliminate any dangers in the work area.

Suitable clothing and footwear must be worn at all times. Personal protection equipment (hardhats, respirators, eye protection) will be worn whenever needed.

All employees will participate in a safety meeting conducted by their supervisor once every ten working days.

Anyone under the influence of intoxicating liquor or drugs, including prescription drugs which might impair motor skills and judgment, shall not be allowed on the job.

Horseplay, scuffling, and other acts which tend to have an adverse influence on safety or well-being of other employees are prohibited.

Work shall be well planned and supervised to avoid injuries in the handling of heavy materials and while using equipment.

No one shall be permitted to work while the employee's ability or alertness is so impaired by fatigue, illness, or other causes that it might expose the employee or others to injury.

There will be no consumption of liquor or beer on the job.

Employees should be alert to see that all guards and other protective devices are in proper places and adjusted, and shall report deficiencies promptly to the RSO.

Employees shall not handle or tamper with any electrical equipment, machinery, or air or water lines in a manner not within the scope of their duties, unless they have received specific instructions.

All injuries should be reported to the RSO so that arrangements can be made for medical or first aid treatment.

When lifting heavy objects, use the large muscles of the leg instead of the smaller muscles of the back.

Do not throw things, especially material and equipment. Dispose of all waste properly and carefully. Bend all exposed nails so they do not hurt anyone removing the waste.

Do not wear shoes with thin or torn soles.

Responsible Safety Officer

The identity of the person who is responsible for the [Company] safety program is [Safety Officer] . This person must be someone of sufficient authority to implement the program. In addition to other titles, this person is called the Responsible Safety Officer.

Designated

In accordance with [Company]'s safety and injury prevention program, [Safety Officer] has been designated as the Responsible Safety Officer, and has responsibility and authority to do the following in the name of [Company]:

- 1) Develop and implement rules of safe practices for each function within the company.
- 2) Develop and implement safe operating rules for use of electrical and mechanical equipment consistent with manufacturer's recommendations and specifications.
- 3) Develop and implement a system to encourage employees to report unsafe conditions immediately.
- 4) Conduct a thorough investigation of each accident, whether or not it results in an injury, to determine the cause of the accident and to prevent recurrence. In cases of a known injury accident, the investigation shall proceed only after consultation with [Company] attorneys, who shall direct the investigation (the product of which investigation shall be considered the work product of the attorney).
- 5) Instruct supervisors in safety responsibilities.
- 6) Develop and implement a program of employee safety education.
- 7) Conduct scheduled and unscheduled inspections to identify and correct unsafe working conditions. Special attention shall be given to notice of serious concealed dangers.
- 8) Maintain records of training, periodic inspections, corrective actions and investigations as required by law. The Responsible Safety Officer for [Company] is [Safety Officer] . [Company] will inform every person of the name of the Responsible Safety Officer and post his or her name and telephone/office number on the bulletin board where all other safety information is routinely maintained.

Duties

Overall responsibility and authority for implementing the injury and illness prevention program is vested

in [Safety Officer] , the Responsible Safety Officer. Management fully supports the Responsible Safety Officer. As part of the job, the Responsible Safety Officer will supplement this written injury and illness prevention program by: establishing workplace objectives and safety recognition programs; working with all government officials in both accident investigation and safety inspection procedures; maintaining safety and individual training records; encouraging reporting of unsafe conditions and promoting a safe workplace. Some of these responsibilities will be delegated to your immediate supervisor for implementation.

Employee Compliance

This written plan contains incentives designed to promote employee participation in the safety program. These incentives are not part of your regular compensation and are not intended to discourage you from reporting accidents.

Agreement to Participate

Every employer is required to provide a safe and healthful workplace. [Company] is committed to fulfilling this requirement. A safe and healthful workplace is one of the highest priorities of [Company]. The information in this manual constitutes a written injury and illness prevention program. While [Company] cannot anticipate every workplace hazard, the following general principals should guide your conduct. To be safe, you must never stop being safety conscious. Study the guidelines contained in this manual. Discuss the workplace situation with the RSO. Attend all company sponsored training and safety meetings. Read all posters and warnings. Listen to instructions carefully. Follow the Code of Safe Work Place Practices contained herein. Participate in accident investigations as requested. Accept responsibility for the safety of others. Maintain all required documentation. By signing the acknowledgement at the end of this handbook, each employee promises to read and implement this injury and illness prevention program. If you don't understand any policy, please ask your supervisor.

Accident Free Workplace

To help us all meet our goal of an accident free workplace, we have instituted a contest: we will offer a prize for each month in which there is not a single time-loss accident at work. The prize will be awarded at random. Each month, the prize will be announced in advance. All employees who worked more than 1 hour in the month are eligible. Failure to report an industrial injury will suspend the prize for two months.

Employee Safety Suggestion Box

From time to time, [Company] will award a prize for the best safety suggestion. To be eligible, please give your written safety suggestions to your supervisor during the safety meetings. All these safety suggestions will be discussed at the meeting. The supervisor whose employee wins the best safety suggestion will also be given a prize. The group that consistently has the best safety suggestions will also be recognized. Management is the sole judge of the value of safety suggestions, and will implement as many of the good suggestions as possible.

Training

Employee safety training is another requirement of an effective injury and illness prevention program. While [Company] believes in skills training, we also want to emphasize safety training. All employees should start the safety training by reading this manual and discussing any problems or safety concerns with your direct supervisor. You may wish to make notes in the margins of this manual where it applies to your work.

Safety & Health Training

Training is one of the most important elements of any injury and illness prevention program. Such training is designed to enable employees to learn their jobs properly, bring new ideas to the workplace, reinforce existing safety policies and put the injury and illness prevention program into action. Training is required for both supervision and employees alike. The content of each training session will vary, but each session will attempt to teach the following:

- a) The success of [Company]'s injury and illness prevention program depends on the actions of individual employees as well as a commitment by the Company.
- b) Each employee's immediate supervisor will review the safe work procedures unique to that employee's job, and how these safe work procedures protect against risk and danger.
- c) Each employee will learn when personal protective equipment is required or necessary, and how to use and maintain the equipment in good condition.
- d) Each employee will learn what to do in case of emergencies occurring in the workplace. Supervisors are also vested with special duties concerning the safety of employees.

The supervisors are key figures in the establishment and success of [Company]'s injury and illness prevention program. They have primary responsibility for actually implementing the injury and illness prevention program, especially as it relates directly to the workplace. Supervisors are responsible for being familiar with safety and health hazards to which employees are exposed, how to recognize them, the potential effects of these hazards, and rules and procedures for maintaining a safe workplace. Supervisors shall convey this information to the employees at the workplace, and shall investigate accidents according to the accident investigation policies contained in this manual.

Periodic Safety Training Meetings

[Company] has safety meetings every 3 months. The purpose of the meeting is to convey safety information and answer employee questions. The format of most meetings will be to review, in language understandable to every employee, the content of the injury prevention program, special work site hazards, serious concealed dangers, and material safety data sheets. Each week, the RSO will review a portion of the company's safe work practices contained in this booklet, or other safety related information.

Whenever a new practice or procedure is introduced into the workplace, it will be thoroughly reviewed for safety. A sign-up sheet will be passed around each meeting, and notes of the meeting will be distributed afterwards. A copy of the notes will also be placed in the file of each employee who attends the meeting. Employee attendance is mandatory and is compensable unless part of an official state approved training program or pre-employment requirement.

Employee Responsibility for Training

Teaching safety is a two-way street. [Company] can preach safety, but only employees can practice safety. Safety education requires employee participation. Every 3 months, a meeting of all employees will be conducted for the purpose of safety instruction. The employees will discuss the application of the Company's injury and illness prevention program to actual job assignments. They will also read and discuss a section of the manual and review application of general safety rules to specific situations. Remember, the following general rules apply in all situations:

- a) No employee should undertake a job that appears to be unsafe.
- b) No employee is expected to undertake a job until he/she has received adequate safety instructions, and is authorized to perform the task.

- c) No employee should use chemicals without fully understanding their toxic properties and without the knowledge required to work with these chemicals safely.
- d) Mechanical safeguards must be kept in place.
- e) Employees must report any unsafe conditions to the job site supervisor and the Responsible Safety Officer.
- f) Any work-related injury or illness must be reported to management at once.
- g) Personal protective equipment must be used when and where required. All such equipment must be properly maintained.

Communication

Employers should communicate to employees their commitment to safety and to make sure that employees are familiar with the elements of the safety program. [Company] communicates with its employees orally, in the form of directions and statements from your supervisor, written, in the form of directives and this manual, and by example. If you see a supervisor or management do something unsafe, please tell that person. We sometimes forget actions speak louder than words.

Accident Prevention Policy Posting

Each employee has a personal responsibility to prevent accidents. You have a responsibility to your family, to your fellow workers and to the Company. You will be expected to observe safe practice rules and instructions relating to the efficient handling of your work. Your responsibilities include the following:

- Incorporate safety into every job procedure. No job is done efficiently unless it has been done safely.
- Know and obey safe practice rules.
- Know that disciplinary action may result from a violation of the safety rules.
- Report all injuries immediately, no matter how slight the injury may be.
- Caution fellow workers when they perform unsafe acts.
- Don't take chances.
- Ask questions when there is any doubt concerning safety.
- Don't tamper with anything you do not understand.
- Report all unsafe conditions or equipment to your supervisor immediately.

Accident Prevention Policy Posting

A copy of this manual will be posted in the work area. It is the policy of [Company] to provide a safe and clean workplace and to maintain sound operating practices. Concentrated efforts shall produce safe working conditions and result in efficient, productive operations. Safeguarding the health and welfare of our employees cannot be stressed too strongly. Accident prevention is the responsibility of all of us. Department heads and supervisors at all levels shall be responsible for continuous efforts directed toward the prevention of accidents. Employees are responsible for performing their jobs in a safe manner. The observance of safe and clean work practices, coupled with ongoing compliance of all established safety standards and codes, will reduce accidents and make our Company a better place to work.

Safety Meetings

[Company] has safety meetings every 3 months. The purpose of the meeting is to convey safety information and answer employee questions. The format of most meetings will be to review, in language understandable to every employee, the content of the injury prevention program, special work site hazards, serious concealed dangers, and material safety data sheets. Each week, the RSO will review a portion of the company's safe work practices contained in this booklet, or other safety related information essential to accomplish the goals of the program. [Company] requires all its employees to accept responsibility for their own safety, as well as that of others in the workplace. It is your responsibility to read this manual and to become familiar with the Code of Safe Work Practices and Specific Safety Rules contained in this manual, as well as any posted government Safety Orders.

Hazard Identification & Abatement

This written safety and health plan sets out a system for identifying workplace hazards and correcting them in a timely fashion. Please review it carefully with your supervisor. Remember, safety is everyone's responsibility.

Safety Audits

The best method to establish a safer workplace is to study past accidents and worker compensation complaints. By focusing on past injuries, [Company] hopes to avoid similar problems in the future. Therefore, whenever there is an accident, and in many cases upon review of past accidents, you may be requested to participate in a safety audit interview. During the interview, there will be questions about the nature of the investigation and the workplace safety related to the incident. Please answer these questions honestly and completely. Also, please volunteer any personal observations and/or suggestions for improved workplace safety. Based upon the study of past accidents and industry recommendations, a safety training program has been implemented. In addition to other preventative practices, there will be a group discussion of the cause of the accident and methods to avoid the type of accidents and injury situations experienced in the past. Work rules will be reviewed and modified based upon the study of these accidents. In addition to historical information, workplace safety depends on workplace observation.

Your supervisor is responsible for inspecting your working area daily before and while you are working, but this does not mean you are no longer responsible for inspecting the workplace also. Each day, before you begin work, you must inspect the area for any dangerous conditions. Inform your supervisor of anything significant, so other employees and guests are advised. You may also be given written communications regarding unsafe conditions or serious concealed dangers. Review this communication carefully and adjust your workplace behavior to avoid any danger or hazards.

If you are unclear or unsure of the significance of this written communication, contact your supervisor and review your planned actions before starting to work. It is better to wait and check, then to go ahead and possibly cause an injury to yourself and others. Managers must provide written notice to employees of any serious concealed dangers of which they have actual knowledge. In addition to providing written notice of all serious concealed dangers to employees managers are required to report serious concealed dangers to either OSHA or an appropriate administrative agency within fifteen days, or immediately if such danger would cause imminent harm, unless the danger is abated. Merely identifying the problem is not sufficient. The danger must be reported to the appropriate supervisor and the Responsible Safety Officer, who then will correct the problem. If the danger cannot be corrected, then all employees will be warned to take protective action so that the danger will not result in any injuries.

Workplace Inspections

In addition to the examination of records, work place safety inspections will occur periodically every 3

months, when conditions change, or when a new process or procedure is implemented. During these inspections, there will be a review of the injury and illness prevention policy and [Company] code of safe work practices.

Accident Investigation

A primary tool used by [Company] to identify the areas responsible for accidents is a thorough and properly completed accident investigation. The results of each investigation will be reduced to writing and submitted for review by management and [Company]'s insurance risk management advisors, and, if the accident resulted in serious injury, to [Company] attorneys. If the accident resulted in serious injury, the procedure will be directed by the attorneys to provide the most reliable evidence or description legally permissible. All investigations pursuant to the directions of legal counsel will be protected by all applicable privileges, if any. The attorney will provide more detail on this topic during the investigation.

Every job location will have on site at least one camera, preferably either a video or a sixty second type, with enough film to take pictures immediately after any occurrence. Some workplaces will have a video camera. A written report should be prepared from notes and diagrams made at the scene, or a portable [tape/voice] recorder will be used to record direct eyewitness statements as near to the actual time of observation as possible. All statements should include the time and date given, and the town or county where the statement was made. If the statement is intended to be used in court proceedings, a suitable jurat is required, otherwise, a simple statement that the description is sworn to be true under penalty of perjury with the date, place and time should be included. All pictures should be similarly identified. Let people know on tape that they are being recorded.

Also, make sure that the names and addresses and day and evening phone numbers of all eye witnesses are noted or recorded. If a formal police report or other official investigation is conducted by any government agency, get the name and badge number of the official, or a business card, and find out when a copy of the official report will be available to the public. If you are requested to make a statement, you have the right to have the Company lawyer attend your statement at no cost to you.

A satisfactory accident report will answer the following questions:

- 1) What happened? The investigation report should begin by describing the accident, the injury sustained, the eyewitnesses, the date, time and location of the incident and the date and time of the report. Remember: who, what, when, where and how are the questions that the report must answer.
- 2) Why did the accident occur? The ultimate cause of the accident may not be known for several days after all the data are analyzed. However, if an obvious cause suggests itself, include your conclusions as a hypothesis at the time you give your information to the person in charge of the investigation.
- 3) What should be done? Once a report determines the cause of the accident, it should suggest a method for avoiding future accidents of a similar character. This is a decision by the Responsible Safety Officer and the supervisor on the project, as well as top management. Once a solution has been adopted, it is everyone's responsibility to implement it.
- 4) What has been done? A follow up report will be issued after a reasonable amount of time to determine if the suggested solution was implemented, and if so, whether the likelihood of accident has been reduced.

Records

[Company] maintains records of employee training, hazard identification and abatement, and accident investigation.

OSHA Records Required

Copies of required accident investigations and certification of employee safety training shall be maintained by the Responsible Safety Officer. A written report will be maintained on each accident, injury or on-the-job illness requiring medical treatment. A record of each such injury or illness is recorded on OSHA Log and Summary of Occupational Injuries Form 200 according to its instructions. Supplemental records of each injury are maintained on OSHA Form 101, or Employers Report of Injury or Illness Form 5020. Every year, a summary of all reported injuries or illnesses is posted no later than February 1, for one month, until March 1, on OSHA Form 200. These records are maintained for five years from the date of preparation.

General Statement on Safety

[Company] strives to maintain a safe place to work and to employ safe workers. It is your responsibility to conduct your work in a safe, responsible manner. Immediately report all accidents occurring on Company premises to your supervisor.

General Statement on Safety

Each employee has an individual responsibility to prevent accidents. It is to the benefit of all employees and [Company] that you report any situation or condition you believe may present a safety hazard, including any known or concealed dangers in your work area. [Company] encourages you to report your concern either to your immediate supervisor or to a member of the Safety Committee. The supervisor or Safety Committee will take immediate action to investigate the matter.

Safety Equipment

Proper safety equipment is necessary for your protection. The Company provides the best protective equipment it is possible to obtain. Use all safeguards, safety appliances, or devices furnished for your protection and comply with all regulations that may concern or affect your safety. Wear your gear properly -- all snaps and straps fastened, cuffs not cut or rolled. Your supervisor will advise you as to what protective equipment is required for your job. Certain jobs require standard safety apparel and appliances for the protection of the employee.

Your supervisor is aware of the requirements and will furnish you with the necessary approved protective appliances. These items shall be worn and effectively maintained as a condition of your continued employment and part of our mutual obligation to comply with the Occupational Safety and Health Act. Safety goggles, glasses and face shields shall correspond to the degree of hazard, i.e., chemical splashes, welding flashes, impact hazard, dust, etc. Do not alter or replace an approved appliance without permission from your supervisor. Rubber gloves and rubber aprons shall be worn when working with acids, caustics or other corrosive materials. Specified footwear must be worn. No jewelry shall be worn around power equipment. Hearing protection appliances (approved muffs or plugs) shall be worn by all employees working within any area identified as having excess noise levels. Your supervisor will instruct you in the proper use of the appliance.

Protective Clothing

Proper safety equipment is necessary for your protection. The Company provides the best protective equipment it is possible to obtain. Use all safeguards, safety appliances, or devices furnished for your protection and carry out all regulations that may concern or affect your safety. Wear your gear properly - all snaps and traps fastened, cuffs not cut or rolled. Your supervisor will advise you as to what protective equipment is required for your job.

Smoking & Fire Safety

Fire is one of the worst enemies of any facility. Learn the location of the fire extinguishers. Learn how to use them. You can help prevent fires by observing the smoking rules:

- Smoking is not allowed on the site, except in designated areas.
- Smoking is not permitted in rest rooms.
- If you are not sure about where you may smoke, ask the supervisor.

Reporting

All serious accidents must be reported to OSHA. In cases of hospitalization or death, a full investigation with copies to governmental authorities will be required. In less serious cases, the investigation report must be presented to the company for disclosure to its insurance carrier and for remedial action at the work site.

General Code of Safe Work Practices

General Fire Safety

Our local fire department is well acquainted with our facility, its location and specific hazards. All fire doors and shutters must be maintained in good operating condition. Fire doors and shutters should be unobstructed and protected against obstructions, including their counterweights. Fire door and shutter fusible links must be in place. All automatic sprinkler water control valves, if any, air and water pressures should be checked routinely. The maintenance of automatic sprinkler systems is assigned to the Responsible Safety Officer. Sprinkler heads should be protected by metal guards if they could possibly be exposed to damage. Proper clearance must be maintained below sprinkler heads. Portable fire extinguishers are provided in adequate number and type and are located throughout the facility. Fire extinguishers are mounted in readily accessible locations. Fire extinguishers are recharged regularly and the date of last inspection noted on their tags. All employees are periodically instructed in the use of extinguishers and fire protection procedures. Notify the Responsible Safety Officer of any damage to fire protection equipment.

Cold

Prolonged exposure to freezing or cold temperatures can result in serious health problems such as trench foot, frostbite and hypothermia. In extreme cases, including cold water immersion, exposure can result in death. Danger signs include uncontrolled shivering, slurred speech, clumsy movements, fatigue and confused behavior. If these signs are observed, call for emergency help.

Some tips:

- Recognize environmental and workplace conditions that can be dangerous.
- Learn the signs and symptoms of cold-induced illnesses/injuries and what to do to for yourself and others.
- Wear proper clothing for cold, wet and windy conditions including layers so you can adjust to changing conditions.
- Be sure to take frequent short breaks in warm dry shelters to allow the body to warm up.
- Try to schedule work for the warmest part of the day.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Use the buddy system—work in pairs so that one worker can recognize danger signs.
- Drink warm, sweet beverages (sugar water, sports-type drinks) and avoid drinks with caffeine (coffee, tea, sodas or hot chocolate) or alcohol.
- Eat warm, high-calorie foods such as hot pasta dishes.
- Remember, you face increased risks when you take certain medications, are in poor physical condition or suffer from illnesses such as diabetes, hypertension or cardiovascular disease.

🔊 OSHA's Cold Stress Card provides a quick reference guide and recommendations. Available in English and Spanish, this laminated fold-up card is free to employers, workers and the public. For free copies of OSHA's Cold Stress Card in English or Spanish, click on OSHA's website, www.osha.gov, or call 800-321-OSHA.

Powder Actuated Tools

🔊 Like an older nail gun...

The employees using powder-actuated tools must be properly trained and will be issued a card as proof of that training. Some of the powder-actuated tools being used have written approval of the Division of Occupational Safety and Health. Check to see which tools require a certification and which certificates have been issued. Each powder-actuated tool should be stored in its own locked container when not being used. Signs measuring at least 7" x 10" and in bold face typed reading "POWDER-ACTUATED TOOL IN USE" must be placed conspicuously when the tool is being used. All powder-actuated tools must be left unloaded until they are actually ready to be used. Each day before using, each powder-actuated tool must be inspected for obstructions or defects. The powder-actuated tool operators must have and must use appropriate personal protective equipment such as hard hats, safety goggles, safety shoes and ear protectors whenever they are using these machines.

Machine Guarding

Before operating any machine, every employee must have completed a training program on safe methods of machine operations. It is the primary purpose of supervision to ensure that employees are following safe machine operating procedures. There will be a regular program of safety inspection of machinery and equipment. All machinery and equipment must be kept clean and properly maintained. There must be sufficient clearance provided around and between machines to allow for safe operations, set up, servicing, material handling and waste removal.

All equipment and machinery should be securely placed, and anchored when necessary, to prevent tipping or other movement that could result in personal injury. Most of the time, machinery should be bolted to the floor to prevent falling during an earthquake, and the electrical cord to the machinery fixed with a breaker or other shut-off device to stop power in case of machine movement. There must be a power shut-off switch within reach of the operator's position at each machine. Electrical power to each machine shall be capable of being locked out for maintenance, repair or security. The non-current carrying metal parts of electrically operated machines must be bonded and grounded. The foot-operated switches are guarded and/or arranged to prevent accidental actuation by personnel or falling objects. All manually operated valves and switches controlling the operation of equipment and machines must be clearly identified and readily accessible.

All EMERGENCY stop buttons are colored **RED**. All the pulleys and belts which are within 7 feet of the floor or working level are properly guarded. All moving chains and gears must be properly guarded. All splash guards mounted on machines that use coolant must be positioned to prevent coolant from splashing the employees. The supervisor will instruct every employee in the work area on the methods provided to protect the operator and other employees in the machine area from hazards created by the operation of a machine, such as nip points, rotating parts, flying chips and sparks. The machinery guards must be secure and arranged so they do not present a hazard. All special hand tools used for placing and removing material must protect the operator's hands. All revolving drums, barrels and containers should be guarded by an enclosure that is interlocked with the drive mechanisms, so that revolution cannot occur unless the guard enclosure is in place. All arbors and mandrels must have firm and secure bearings and be free of play.

A protective mechanism has been installed to prevent machines from automatically starting when power is restored after a power failure or shutdown. Machines should be constructed so as to be free from excessive vibration when the size tool is mounted and run at full speed. If the machinery is cleaned with compressed air, the air must be pressure controlled and personal protective equipment or other safeguards used to protect operators and other workers from eye and bodily injury. All fan blades should be protected by a guard having openings no larger than 1/2 inch when operating within 7 feet of the floor. Saws used for ripping equipment must be installed with anti-kickback devices and spreaders. All radial arm saws

must be arranged so that the cutting head will gently return to the back of the table when released.

Lock-out / Block-out Procedures

All machinery or equipment capable of movement must be de-energized or disengaged and blocked or locked out during cleaning, servicing, adjusting or setting up operations, whenever required. The locking out of the control circuits in lieu of locking out main power disconnects is prohibited. All equipment control valve handles must be provided with a means for locking out. The lock-out procedure requires that stored energy (i.e. mechanical, hydraulic, air) be released or blocked before equipment is locked out for repairs. Appropriate employees are provided with individually keyed personal safety locks. Employees are required to keep personal control of their key(s) while they have safety locks in use. Employees must check the safety of the lockout by attempting a start up after making sure no one is exposed. Where the power disconnect does not also disconnect the electrical control circuit, the appropriate electrical enclosures must be identified. The control circuit can also be disconnected and locked out.

Welding, Cutting & Brazing

Only authorized and trained personnel are permitted to use welding, cutting or brazing equipment. All operators must have a copy of the appropriate operating instructions and are directed to follow them. Compressed gas cylinders should be regularly examined for obvious signs of defects, deep rusting, or leakage. Use care in handling and storing cylinders, safety valves, relief valves and the like, to prevent damage. Precaution must be taken to prevent mixture of air or oxygen with flammable gases, except at a burner or in a standard torch. Only approved apparatus (torches, regulators, pressure-reducing valves, acetylene generators, manifolds) may be used. Cylinders must be kept away from sources of heat. It is prohibited to use cylinders as rollers or supports. Empty cylinders must be appropriately marked, their valves closed and valve-protection caps on.

Signs reading: "DANGER-NO SMOKING, MATCHES, OR OPEN LIGHTS," or equivalent must be posted. Cylinders, cylinder valves, couplings, regulators, hoses and apparatus must be kept free of oily or greasy substances. Care must be taken not to drop or strike cylinders. Unless secured on special trucks, all regulators must be removed and valve-protection caps put in place before moving cylinders. All cylinders without fixed hand wheels must have keys, handles, or non-adjustable wrenches on stem valves when in service.

Liquefied gases must be stored and shipped valve-end up with valve covers in place. Before a regulator is removed, the valve must be closed and gas released from the regulator. All employees are instructed never to crack a fuel-gas cylinder valve near sources of ignition. Red is used to identify the acetylene (and other fuel-gas) hose, green for oxygen hose, and black for inert gas and air hose. All pressure-reducing regulators must be used only for the gas and pressures for which they are intended.

Arc Welders

The open circuit (No Load) voltage of arc welding and cutting machines must be as low as possible and not in excess of the recommended limits. Under wet conditions, automatic controls for reducing no-load voltage must be used. Grounding of the machine frame and safety ground connections of portable machines must be checked periodically. Electrodes must be removed from the holders when not in use. All electric power to the welder must be shut off when no one is in attendance. Suitable fire extinguishing equipment must be available for immediate use before starting to ignite the welding torch. The welder is strictly forbidden to coil or loop welding electrode cable around his/her body. All wet welding machines must be thoroughly dried and tested before being used. All work and electrode lead cables must be frequently inspected for wear and damage, and replaced when needed. All connecting cable lengths must

have adequate insulation.

When the object to be welded cannot be moved and fire hazards cannot be removed, shields must be used to confine heat, sparks and slag. Fire watchers will be assigned when welding or cutting is performed in locations where a serious fire might develop. All combustible floors must be kept wet, covered by damp sand, or protected by fire-resistant shields. When floors are wet down, personnel should be protected from possible electrical shock. When welding is done on metal walls, precautions must be taken to protect combustibles on the other side. Before hot work is begun, used drums, barrels, tanks and other containers must be so thoroughly cleaned that no substances remain that could explode, ignite or produce toxic vapors. It is required that eye protection helmets, hand shields and goggles meet appropriate standards. Employees exposed to the hazards created by welding, cutting or brazing operations must be protected with personal protective equipment and clothing. Check for adequate ventilation where welding or cutting is performed. When working in confined spaces, environmental monitoring tests should be taken and means provided for quick removal of welders in case of emergency.

Compressors & Compressed Air

All compressors must be equipped with pressure relief valves and pressure gauges. All compressor air intakes must be installed and equipped to ensure that only clean, uncontaminated air enters the compressor. Every air receiver must be provided with a drain pipe and valve at the lowest point for the removal of accumulated oil and water. Compressed air receivers must be periodically drained of moisture and oil. All safety valves shall be tested frequently and at regular intervals to determine whether they are in good operating condition. A current operating permit issued by the Division of Occupational Safety and Health shall be maintained. The inlet of air receivers and piping systems must be kept free of accumulated oil and carbonaceous materials.

Compressed Gas & Cylinders

Cylinders with a water weight capacity over 30 pounds must be equipped with means for connecting a valve protector device, or with a collar or recess to protect the valve. Cylinders must be legibly marked to identify clearly the gas contained. Compressed gas cylinders should be stored only in areas which are protected from external heat sources such as flame impingement, intense radiant heat, electric arcs or high temperature lines. Cylinders must not be located or stored in areas where they will be damaged by passing or falling objects, or subject to tampering by unauthorized persons.

Cylinders must be stored or transported in a manner to prevent them from creating a hazard by tipping, falling or rolling. All cylinders containing liquefied fuel gas must be stored or transported in a position so that the safety relief device is always in direct contact with the vapor space in the cylinder. Valve protectors must always be placed on cylinders when the cylinders are not in use or connected for use. All valves must be closed off before a cylinder is moved, when the cylinder is empty, and at the completion of each job. Low pressure fuel-gas cylinders must be checked periodically for corrosion, general distortion, cracks, or any other defect that might indicate a weakness or render them unfit for service. The periodic check of low pressure fuel-gas cylinders includes a close inspection of the cylinder's bottom.

Hoists & Auxiliary Equipment

Every overhead electrical hoist shall be equipped with a limit device to stop the hook travel at its highest and lowest points of safe travel. Check these limits without a load to ensure the device is working correctly. Each hoist should automatically stop and hold any load up to 125 percent of its rated load if its actuating force is removed. Check this periodically under controlled conditions. Make sure that the rated load of each hoist is legibly marked and visible to the operator. Stops should be provided at the safe limits of travel for trolley hoists. The controls of hoists should be plainly marked to indicate direction of travel

or motion. Every cage-controlled hoist must be equipped with an effective warning device. Close-fitting guards or other suitable devices should be installed on hoists to assure hoist ropes will be maintained in the sheave grooves. All hoist chains or ropes must be of sufficient length to handle the full range of movement for the application, while maintaining two full wraps on the drum at all times. All nip points or contact points between hoist ropes and sheaves which are permanently located within 7 feet of the floor, ground or working platform must be guarded. It is prohibited to use chains or rope slings that are kinked or twisted. The operator should avoid carrying loads over people. Only employees who have been trained in the proper use of hoists are allowed to operate them.

Industrial Trucks / Forklifts

Only trained personnel should be allowed to operate industrial trucks. Lift Truck Operating rules must be posted and will be strictly enforced. When operating any industrial truck, substantial overhead protective equipment will be provided on high lift rider equipment. Directional lighting is also provided on each industrial truck that operates in an area with less than 2 foot candles per square foot of general lighting. Each industrial truck must have a warning horn, whistle, gong or other device which can be clearly heard above the normal noise in the area where operated.

Before using a forklift, check that the brakes on each industrial truck are capable of bringing the vehicle to a complete and safe stop when fully loaded. The parking brake must effectively prevent the vehicle from moving when unattended. When motorized hand and hand/rider truck are operated, and when the operator releases the steering mechanism, make sure that both the brakes are applied and power to the motor shut off. Maintenance records are available so that a driver can check on the servicing of the truck in case of questions.

When an industrial truck operates in areas where flammable gases, vapors, combustible dust, or ignitable fibers may be present in the atmosphere, the vehicle must be approved for such locations with a tag showing such approval posted on the vehicle itself. Industrial trucks with internal combustion engines, operated in buildings or enclosed areas, should be carefully checked to ensure that the operation of the vehicle does not cause harmful concentration of dangerous gases or fumes.

Spraying Operations

In any spraying operation there should be adequate ventilation before starting any spraying job. As to the conditions of the area where the spray job is to be done, consideration should be taken before beginning work. If the area is enclosed, does it require mechanical ventilation? Before working, make sure that the area is free of combustible materials, and that there are "No Smoking" signs adequately posted and easily seen. If mechanical ventilation is provided when spraying in enclosed areas, air should not be recirculated so as to avoid contamination. There should be adequate space and ventilation for all drying areas. Also in an enclosed area, spray operations must be at least 20 feet from flames, sparks, operating electrical motors and other ignition sources. The spray area should be free of any hot surfaces.

Any solvent used in the cleaning process should not have a flash point of 100 degrees or less. If portable lamps are used to illuminate the spray areas they must be approved for the location and must be suitable for use in a hazardous area. Approved respiratory equipment will be provided and must be used when appropriate during spraying operations. If a sprinkler system is within the confines of the spraying area operation, it should be in working order and will be inspected semi-annually to make sure that it is in operating condition.

If a spraying booth is used for the spraying operation, it must be made of metal, masonry or other noncombustible material. Make sure that "NO SMOKING" signs are posted in spray areas, paint rooms, paint booths and paint storage areas. The spray booth must be completely ventilated. Booth floors and baffles must be easily cleaned and noncombustible. Ducts and access doors must be easily cleaned.

Lighting fixtures for both outside and inside the spray booth must be enclosed in clear see-through sealed panels. Electric motors for exhaust fans must be placed outside the booth. Belts and pulleys must be completely enclosed. Drying apparatus should be located in a well ventilated area in the booth and properly grounded. Infrared drying apparatus must be kept out of the spray area during a spraying operation.

Confined Spaces

Before entry into a confined space, all impellers, agitators, or other moving equipment contained in the confined space must be locked-out. Ventilation must be either natural or mechanically provided into the confined space. All hazardous or corrosive substances that contain inert, toxic, flammable or corrosive materials must be valved off, blanked, disconnected and separated. Atmospheric tests should be performed to check for oxygen content, toxicity and explosive concentration. Atmospheric tests must be performed on a regular basis in a confined area where entry is required. The area must also be checked for decaying vegetation or animal matter that could produce methane. Adequate lighting must be provided within the space. If the confined area is located below the ground or near where motor vehicles are operating, care must be taken that vehicle exhaust or carbon monoxide does not enter the space.

When personnel enter a confined area, assigned safety standby employees who are alert to the work being done, are able to sound an alarm if necessary and to render assistance, must be in the area. These standby employees must be trained to assist in handling lifelines, respiratory equipment, CPR, first aid, and be able to employ rescue equipment that will remove the individual from the confined area. Standby personnel should be in teams of two during such an operation or else within the vicinity if working separately. There must also be an effective communication system utilized while the operation is occurring.

When equipment which utilizes oxygen, such as salamanders, torches or furnaces, is used in a confined space, adequate ventilation must be provided to guarantee oxygen content and combustion for the equipment. When this equipment is used, adequate measures must be taken to assure that exhaust gases are vented outside the enclosure. When gas welding or burning is used, hoses must be checked for leaks. Compressed bottled gas must be outside the area and torches must be lit outside the area also. The atmosphere must be tested each time before lighting a torch.

Environmental Controls

All employees must be aware of the hazards involved when working with chemicals and the remedies that need to be used when an accident does occur. A training program will give instructions on how to handle the chemical being used and first aid to be applied to victims of chemical exposure. First aid and caution signs will be conspicuously posted so as to alert individuals on a constant basis. Charts identifying the chemicals utilized in the workplace, their symptoms and effects must also be posted. The workers must know what the acceptable level of exposure to a chemical is and what safety systems must be in place when working with a chemical. Staff should also be aware of new chemical products which may be available that are less harmful, and they must ensure that facilities are adequately ventilated when using chemicals on the premises. Spray painting operations done in spray rooms or booths must be equipped with an appropriate exhaust system. Periodic inspections must be made of the booth and noted on an inspection tag posted on the booth.

If welding is done, the welder should be certified. In the area of operation where the welding is taking place, the welder must be aware of ventilation available, the type of respirator that can be used in the area, and if exposure time or other means will suffice as a safe and adequate measure when welding as to the fumes that will be emitted. Welders should also be supplied with protective clothing and a flash shield during welding operations. When forklifts and other vehicles are used in buildings or other enclosed areas, carbon monoxide levels must be kept below maximum acceptable concentration. Noise levels also

present a potential hazard. Noise levels within a facility must be at acceptable levels and if not, steps must be taken to reduce the level using recommended engineering controls.

When fibrous materials such as asbestos are being handled, the necessary precautions must be taken to protect the employee from the material. The material must be labeled, along with signs conspicuously posted that these materials are being used in the area. Employees should be aware of effective methods used to prevent emission of airborne asbestos fibers, silica dust and other similar hazardous materials. Some of the recommended methods of controlling the emission of these materials are by using water and vacuuming, rather than blowing and sweeping, the materials. Machinery such as grinders, saws and other tools that produce a fine airborne dust must be vented to an industrial collector or central exhaust system. In any ventilation system the system should be designed and operated at an airflow and volume necessary for proper application and effectiveness. In the design of the ventilation system the ducts and belts must be free of obstructions and slippage.

As with all operations, there must be written standards on the procedures for the equipment, description of the job task, usage of the protective equipment provided, such as the selection and use of respirators, and when they are needed. Any water that is provided to an employee throughout the facility should be clearly identified as to whether it is for drinking, washing or cooking. All restrooms must be kept clean and sanitary. Employees should be screened before taking positions that may expose them to hazards they are not physically capable of handling.

An employee who takes an assignment which requires physical labor must be trained to lift heavy loads properly so as not to damage themselves physically. If the work assignment involves dealing with equipment that produces ultra-violet radiation, the employee must be properly protected or given the correct protective clothing. An employee posted to an assignment on a roadway where there is heavy traffic must be given the designated protective clothing (bright colored traffic orange warning vest) and safety training regarding the hazards of this job.

Hazardous Chemical Exposures

In any company which utilizes chemical substances, a training program on the handling, hazards, storage, exposure risks, symptoms of chemical exposure, and first aid needs to be part of any new employees training. There must also be follow-up training sessions as to any new chemical or processes that may be initiated by the company. Follow-up training sessions act as a reinforcement of safety standards that need to be followed on a daily basis. In a training program, employees will learn acceptable levels of chemical exposure, proper storage and labeling of chemicals, and usage of protective clothing and equipment for handling chemicals. They will also learn about potential fire and toxicity hazards, when not to have a chemical in a confined area, or to store in closed containers, usage of eye wash fountains and safety showers, and the necessary posting of open, and dangerous areas.

Airborne Contaminants

It is important that an employee recognize the Threshold Limit Values or Permissible Exposure Limits of airborne contaminants and physical agents in the workplace. A procedural manual or set of instructions must be part of the program, with periodic inspections that clearly indicate whether an employee may be mishandling a chemical or endangering himself or others. Part of the manual or procedures must establish a standard of when and how to deal with chemical spills, neutralizing, and disposing of spills or overflows. These procedures must also be posted in an area that is easily accessible for reference usage.

First Aid training and equipment will be routine in any facility where chemicals are used. Employees must know how to handle equipment in emergency situations, what equipment needs to be used and whether the equipment is adequate for the situation. Respirators may be used either as protective safety equipment or for emergency usage. Therefore, the employee should recognize that respirators need to be

stored in a clean, sanitary and convenient location and inspected on a regular basis. Also what respirators are approved by NIOSH for their particular applications. With a first aid program an employee will recognize when a problem may be occurring by exposure to a chemical ranging from headaches, nausea, dermatitis problems to other factors of discomfort when they use solvents or chemicals. In the design of a facility that transports chemicals from storage to vats, the content of pipes and storage containers must be clearly marked. Within that facility design there must be an emergency shut off system in case of accident. Each employee will be trained as to these emergency shut-off systems.

Ventilation is another major factor in the design of any facility. Whether by natural means or mechanical, the system must be designed to control dust, fumes, solvents, gases, smoke or vapors which may be generated in the workplace. It is also important that a medical or biological monitoring system be in operation as part of the safety standards. If internal combustion engines are used in the facility, or if there is a chance of leakage or mixture with a chemical that could create a toxic gas, atmospheric gas levels must be monitored. If toxic chemicals are used and stored in the facility they should be located in an isolated area to guarantee safety.

Hazardous Substances Communication

When hazardous substances are used in the workplace, a hazard communication program dealing with Material Safety Data Sheets (MSDS), labeling and employee training will be in operation. MSDS materials will be readily available for each hazardous substance used. A training program plus regular question and answer sessions on dealing with hazardous materials will be given to keep employees informed. The program will include an explanation of what an MSDS is and how to use and obtain one; MSDS contents for each hazardous substance or class of substances; explanation of the "Right to Know"; identification of where employees can see the employer's written hazard communication program and where hazardous substances are present in their work area; the health hazards of substances in the work area, how to detect their presence, and specific protective measures to be used; as well as informing them of hazards of non-routine tasks and unlabeled pipes.

Electrical

The workplace will be aware of the OSHA Electrical Safety Orders and will comply with the same. Employees will be required to report any hazard to life or property that is observed in connection with a job, electrical equipment or lines. Employees will be expected to make preliminary inspections or appropriate tests to determine conditions before starting work. When equipment or lines are to be serviced, maintained or adjusted, employees must be aware of open switches. Lockouts must be tagged whenever possible. Equipment such as electrical tools or appliance must be grounded or of the double insulated type. Extension cords being used must have a grounding conductor. The workplace supervisor must be aware if multiple plug adaptors are prohibited. If ground-fault circuit interrupters are installed on each temporary 15 or 20 ampere, 120 volt AC circuit at locations where construction, demolition, modifications, alterations or excavations are being performed, temporary circuits must be protected by suitable disconnecting switches or plug connectors with permanent wiring at the junction.

Electricians must be aware of the following:

Exposed wiring and cords with frayed or deteriorated insulation must be repaired or replaced. Flexible cords and cables must be free of splices or taps. Clamps or other securing means must be provided on flexible cords or cables at plugs, receptacles, tools, equipment. The cord jacket must be held securely in place. All cord, cable and raceway connections must be intact and secure. In wet or damp locations, electrical tools and equipment must be appropriate for the use or location, or otherwise protected. The location of electrical power lines and cables (overhead, underground, under floor, other side of walls) must be determined before digging, drilling or similar work is begun. All metal measuring tapes, ropes,

hand lines or similar devices with metallic thread woven into the fabric are prohibited for use where they could come in contact with energized parts of equipment or circuit conductors.

The use of metal ladders is prohibited in areas where the ladder or the person using the ladder could come in contact with energized parts of equipment, fixtures or conductors. All disconnecting switches and circuit breakers must be labeled to indicate their use or equipment served. A means for disconnecting equipment must always be opened before fuses are replaced. All interior wiring systems must include provisions for grounding metal parts or electrical raceways, equipment and enclosures. All electrical raceways and enclosures must be fastened securely in place. All energized parts of electrical circuits and equipment must be guarded against accidental contact by approved cabinets or enclosures. Sufficient access and working space will be provided and maintained around all electrical equipment to permit ready and safe operations and maintenance. All unused openings (including conduit knockouts) in electrical enclosures and fittings must be closed with appropriate covers, plugs or plates. Electrical enclosures such as switches, receptacles, and junction boxes must be provided with tight-fitting covers or plates.

Motors

Disconnecting switches for electrical motors in excess of two horsepower must be capable of opening the circuit when the motor is in a stalled condition without exploding. (Switches must be horsepower rated equal to or in excess of the motor hp rating.) Low voltage protection must be provided in the control device of motor driven machines or equipment which could cause injury from inadvertent starting. A motor disconnecting switch or circuit breaker must be located within sight of the motor control device.

Motors:

- a) must be located within sight of their controller;
- b) must have their controller disconnecting means capable of being locked in the open position;
- c) or must have separate disconnecting means installed in the circuit within sight of the motor.

A controller for a motor in excess of two horsepower must be rated equal to but not in excess of the motor it services. Employees who regularly work on or around energized electrical equipment or lines will be instructed in cardio-pulmonary resuscitation (CPR) methods. Employees will be trained on how to work on energized lines or equipment over 600 volts.

Noise

Noise levels are measured using a sound level meter or an octave bank analyzer and records kept. Engineering controls will be used to reduce excessive noise levels. When engineering controls are not feasible, administrative controls (i.e, worker rotation) will be used to minimize individual employee exposure to noise. An ongoing preventive health program will be utilized to educate employees in safe levels of noise, exposure, effects of noise on their health, and use of personal protection. Approved hearing protective equipment (noise attenuating devices) will be available to every employee working in areas where continuous noise levels exceed 85 dB. To be effective, ear protectors must be properly fitted and employees will be instructed in their use and care.

Fueling

Where flammable liquids are used, employees will be trained to deal with spillage during fueling operations, how it is to be cleaned, the types and designs of fueling hoses and the specific types of fuel it can handle, whether fueling is being done with a nozzle that is a gravity flow system or self-closing, how to avoid spills and recognition that if a spill does occur, the safety of restarting an engine. Employees

must be aware that an open flame or light near any fuel is prohibited when fueling or the transfer of fuel is occurring. "NO SMOKING" signs will be posted conspicuously.

Piping Systems

Substances that are transported through piping need to be identified by color or labeling. Signs must be posted identifying the substance being transported through the pipes as to whether it is hazardous and where turn-off valves, connections and outlets are located. All tags used for labeling will be of a durable material with distinguishable and clearly written print. When non-potable water is piped through a facility, outlets or taps, notices will be posted to alert employees that it is unsafe and not to be used for drinking, washing or personal use. When pipelines are heated by electricity, steam or other external sources, warning signs or tags placed at unions, valves, or other serviceable parts will be part of the system.

Material Handling

In the handling of materials, employees must know the following: There must be safe clearance for equipment through aisles and doorways. Aisle ways must be designated, permanently marked, and kept clear to allow unhindered passage. Motorized vehicles and mechanized equipment will be inspected daily or prior to use. Vehicles must be shut off and brakes must be set prior to loading or unloading. Containers of combustibles or flammables, when stacked while being moved, must be separated by dunnage sufficient to provide stability. If dock boards (bridge plates) are used when loading or unloading operations are taking place between vehicles and docks, precautions must be observed.

Trucks and trailers will be secured from movement during loading and unloading operations. Dock plates and loading ramps will be constructed and maintained with sufficient strength to support imposed loading. Hand trucks must be maintained in safe operating condition. Chutes must be equipped with sideboards of sufficient height to prevent the handled materials from falling off. At the delivery end of rollers or chutes, provisions must be made to brake the movement of the handled materials. Pallets must be inspected before being loaded or moved. Hooks with safety latches or other arrangements will be used when hoisting materials, so that slings or load attachments won't accidentally slip off the hoist hooks. Securing chains, ropes, chockers or slings must be adequate for the job to be performed. When hoisting material or equipment, provisions must be made to assure no one will be passing under the suspended loads. Material Safety Data Sheets will be available to employees handling hazardous substances.

Transporting Employees & Materials

When employees are transporting either employees or materials, they must have an operator's license for that classification of vehicle and be certified or trained in the operation of that vehicle. For a safety program to be effective, they must also have knowledge of First Aid courses and safety equipment, as well as the vehicle and how it operates. As employees are transported by truck, provisions must be provided to prevent their falling from the vehicle. Vehicles should be in good working condition, inspected on a regular basis and must be equipped with lamps, brakes, horns, mirrors, windshields and turn signals in good working order. If the vehicle transports numerous individuals it must be equipped with handrails, steps, stirrups or similar devices, placed and arranged so that employees can safely mount or dismount. Safety measures to ensure passenger safety should be observed. When cutting tools with sharp edges are carried in the passenger compartment, they must be placed in closed boxes or secured containers. Carrying flares and two reflective type flares and a fire extinguisher must be part of the standard emergency equipment carried in the vehicle at all times.

Ventilation

In the operation of any facility ventilation system, there needs to be a design to integrate several systems of control which will expel contaminants and provide clean air. The systems must take into consideration the volume and velocity that will be needed to successfully remove contaminants. The system must not fail in the case of an emergency situation where two contaminants are exposed to each other when a fire or explosion occurs. In the design of the system, clean-out ports or doors that are provided at intervals will not exceed 12 feet in all horizontal runs of exhaust ducts. The system must be operational so that it will not offset the functions of other operations.

Sanitizing Equipment & Clothing

In any operation where protective clothing is used, a set of standards of the handling, cleaning, and disposal of the clothing will be developed. In the line of work where an employee is exposed to a hazardous substance, is the employee required to change or take a shower? If so, both a change and shower room will be provided along with appropriate disposal areas of collection for the cleaning and sanitizing of the clothing. When working in a facility where employees need protective clothing, a training course will be held. Employees will also know where and when they can eat or smoke in such a facility. Conspicuously posted signs will be arranged throughout the plant.

Infection Control

When a facility is engaged in using a laboratory or any research that involves the handling of infectious diseases, or other biotechnological materials, the personnel will be trained in the handling of such materials. Technicians must have training in the handling of these materials as safety precautions must be observed on a constant basis. The facilities will be designed to comply with the needed and standardized practices that are used by the industry and recognized by state licensing agencies.

The standards used and developed by the facility must also take into consideration environmental hazards and laws which are applicable. Technicians normally will handle cultures which contain human specimens as blood or body fluids that carry infectious bacteria. The practices of a laboratory will include proper ventilation, emergency equipment, necessary protective clothing, refrigeration, hand-washing sinks, bio-hazard tags, labels, needle containers, detergents/disinfectants and a manual on emergency procedures in case of an accident.

The training of the technician will include universal precautions, how to manage and handle a needle stick exposure, HVB evaluations, antibody testing and vaccinations and how to dispose of these materials when finished with testing or evaluation. The workplace must be equipped with the proper equipment to meet the safety precautions universally recognized by the state licensing agency. A general practice of cleaning and disinfecting the equipment and environment must be observed.

Ergonomics

With the introduction of computers into the workplace, new areas of physical debilitation have been recognized. These new potential hazards have required a redesigning of both the workplace and how employees work. A set of standards will be developed and practiced with this new technology. Furniture will be adjustable, positioned and arranged to minimize strain on all parts of the body. The glare of a computer screen will be minimized by a glare screen to prevent eye strain. Repetitive motions can harm, back, shoulders, neck, wrists and other parts of the body, so employees will not proceed with a task when they are physically feeling an impairment. Each employee will be entitled to a rest break.

Ventilation for Indoor Air Quality

HVAC systems should provide at least the quantity of outdoor air required by the State Building Standards code, Title 24, Part 2. The HVAC systems should be inspected annually for any potential problems and there should be an approved inspection certificate available for review. Records should be retained for a minimum five year period.

Crane Checklist

With the operation of cranes there are several functional areas to be considered. Cranes should be inspected on a biannual basis with the inspection certificate available when a question arises. The crane must be utilized in an operation which does not violate OSHA regulations. Cranes will be visually inspected for defective components prior to any work shift. Electrically operated cranes will be effectively grounded, preventive maintenance established, have a clearly visible load; operating controls clearly identified; a fire extinguisher provided at the operator's station; rated capacity visibly marked; an audible warning device mounted on the crane, and sufficient illumination. Crane design shall be such that the boom will not fall over backwards when equipped with boom stops.

Safety Posters

[Company] is required to post certain employment related information. The required information is maintained on bulletin board where employees can find the following required posters: Various state and federal orders regulating the Wages, Hours and Working Conditions in certain industries. Pay Day Notice Anti-Discrimination Poster Equal Employment Opportunity is the Law (EEOC form) OSHA Safety and Health Protection on the Job Notice of Workers Compensation Carrier Notice to Employees: Unemployment Insurance and Disability Insurance Notice: Employee Polygraph Protection Act (form WH 1462) Access to Medical and Exposure Records Notice to Employees: Time Off to Vote In addition to the above listed notices, a copy of this injury prevention program, a log and summary of Occupational Injuries and Illnesses, a copy of [Company]'s code of Safe Work Practices and a Fire Prevention and Evacuation Plan will be posted.

Material Data Safety Sheets for [Company]'s premises are available on the [MSDS location]. When employees are required to work on the premises of any other employer, such as a service call or installation situation, the job site will maintain a collection of Material Data Safety Sheets that describe any hazards unique to that site. Check with the other employer's job site coordinator or supervisor for the exact location of the MSDS information.

In addition to these required safety postings, **emergency numbers are maintained in the [emergency # location].** In most cases of real emergency call 911. State your name, the nature of the emergency, and exact location of the injury. Answer all questions completely. Do NOT use 911 for routine calls to police or fire departments.

Licenses & Permits

In addition to other postings required by law, [Company] maintains a copy of all necessary business licenses, permits, and notices required by the National Labor Relations Board or other governmental bodies, notices of citations during abatement periods, and other required information which are posted during the appropriate times on bulletin board.

Personal Protective Equipment Clothing

- 1) Where there is a danger of flying particles or corrosive materials, employees must wear protective goggles and/or face shields provided [or approved] by [Company].

- 2) Employees are required to wear safety glasses at all times in areas where there is a risk of eye injuries such as punctures, contusions or burns.
- 3) Employees who need corrective lenses are required to wear only approved safety glasses, protective goggles, or other medically approved precautionary procedures when working in areas with harmful exposures, or risk of eye injury.
- 4) Employees are required to wear protective gloves, aprons, shields and other means provided in areas where they may be subject to cuts, corrosive liquids and/or harmful chemicals.
- 5) Hard hats must be worn in areas subject to falling objects, and at all times while at construction sites.
- 6) Appropriate footwear including steel toed shoes must be worn in an area where there is any risk of foot injuries from hot, corrosive, poisonous substances, falling objects, crushing or penetrating action.
- 7) When necessary employees must use the approved respirators which are provided for regular and emergency use.
- 8) All safety equipment must be maintained in sanitary condition and ready for use. Report any defective equipment immediately.
- 9) **An eye wash facility is located in the [eye wash location].** If any irritant gets into an employee's eyes, call for medical assistance immediately and flush the eye out with clean water.
- 10) A shower is provided for emergencies. Ask your supervisor for more details on use of this facility.
- 11) Food may not be eaten in work areas, or in places where there is any danger of exposure to toxic materials or other health hazards. Ask your supervisor to identify safe eating places.
- 12) In cases where the noise level exceeds certain levels, ear protection is required.
- 13) In cases of cleaning toxic or hazardous materials, protective clothing provided must be worn.

Hardhats

In [Company], hardhats are required [at all times, in designated areas, when appropriate]. Hardhats are common in our industry. There was a time, about one hundred years ago, when no one wore a hardhat. But, over time, the value of hardhats to save lives was firmly proven, so that the entire industry now accepts this safety device as a natural article of clothing, like a football player wearing a helmet during a game. Sometimes a person fails to wear a hardhat, either through forgetfulness or through underestimating the risk of head injury which can be prevented by wearing one. Remember that all it takes is a carelessly dropped tool or piece of material coming down on your head to cause severe injury or even death. There are a number of workers disabled with various type of head injuries and vision problems because they didn't wear a hardhat. When you wear a hardhat, wear it right. Keep it squarely on your head with the inside band properly adjusted. See you supervisor if you are having trouble adjusting the hardhat.

Work Environment

Work sites must be clean and orderly. Work surfaces must be kept dry or appropriate means taken to assure the surfaces are slip-resistant. Spills must be cleaned up immediately. All combustible scrap, debris and waste must be stored safely and removed promptly. Combustible dust must be cleaned up with a vacuum system to prevent the dust from going into suspension. The accumulated combustible dust must be removed routinely. Metallic or conductive dust must be prevented from entering or accumulating on or around electrical enclosures or equipment. Waste containers must be covered. Oily and paint soaked rags are combustible and should be discarded in sealable metal containers only. Paint spray booths, dip tanks and paint areas must be cleaned regularly. All oil and gas fired devices should be equipped with flame failure controls that will prevent flow of fuel if pilots or main burners are not working. Ask your supervisor where these controls are located. Make sure all pits and floor openings are either covered or

otherwise guarded.

Walkways

All aisles and passageways must be kept clear. Also, aisles and passageways should be clearly marked. Wet surfaces must be covered with non-slip material and all holes properly covered or marked with warning guards. All spills must be cleaned up immediately, and a caution sign placed on all wet or drying surfaces. In cases of passageways used by forklifts, trucks or other machinery, use a separate aisle for walking, if available. If no separately marked aisle is available, use extreme caution.

Remember, walking in a passageway used by machinery is like walking in the middle of a street used by cars: You may have the right of way, but the heavier vehicle can't always see you and can't always stop in time. The key to moving around in such circumstances is to stop, look and listen and then to move when there is no danger. Make eye contact with the drivers of moving vehicles so that you know that they know you are there. Equipment must be properly stored so that sharp edges do not protrude into walkways. Changes in elevations must be clearly marked, as must passageways near dangerous operations like welding, machinery operation or painting. If there is a low ceiling, a warning sign must be posted. If the walkway or stairway is more than thirty inches above the floor or ground, it must have a guardrail. If an employee is aware of any breach of these standards, please inform the workplace supervisor.

Floor & Wall Openings

Be careful when working near floor and wall openings. All floor openings (holes) should be guarded by a cover, guardrail or equivalent barrier on all sides except at the entrance to stairways and ladders. Toe boards must be installed around the edges of a permanent floor opening. Skylights must be able to withstand at least 200 pounds pressure. Glass used in windows, doors, and walls (including glass block) must be able to withstand a human impact, and if required by code, be shatterproof "safety glass." Before beginning work at a new location, inspect it to insure that all floor openings which must remain open, such as floor drains, are covered with grates or similar covers. In roadways and driveways, covers with capacity to carry a truck rear axle load of at least 20,000 pounds must protect all manholes and trenches. In office buildings, fire resistive construction requires that the doors and hallway closures be properly rated and be equipped with self-closing features. Be sure that there are at least two fire emergency exits accessible from your location at all times.

Work Area

Fire extinguishers must remain accessible at all times. Means of egress should be kept unblocked, well-lighted and unlocked during work hours. Excessive combustibles (paper) may be not stored in work areas. Aisles and hallways must kept clear at all times. Designated employees have been trained to respond to a fire or other emergency. Workplaces are to be kept free of debris, floor storage and electrical cords. Adequate aisle space is to be maintained. File cabinet drawers should be opened one at a time and closed when work is finished. Proper lifting techniques are to be used by employees to avoid over exertion and strain when carrying loads. No alcohol or any intoxicating substance may be consumed prior to or during work.

Driving

Drive safely. If vehicles are used during the work day, seat belts and shoulder harnesses are to be worn at all times. Vehicles must be locked when unattended to avoid criminal misconduct. Do not exceed the speed limit. Vehicles must be parked in legal spaces and must not obstruct traffic. Defensive driving must be practiced by all employees. Employees should park their vehicles in well-lighted areas at/or near entrances to avoid criminal misconduct.

Vehicle Maintenance

Work safely when repairing vehicles. Where tires are mounted and/or inflated on drop center wheels, a safe practice procedure must be posted and enforced. Where tires are mounted and/or inflated on wheels with split rims and/or retainer rings, a safe practice procedure must be posted and enforced. Each tire inflation hose must have a clip-on chuck with at least 24 inches of hose between the chuck and an in-line hand valve and gauge. The tire inflation control valve should automatically shut off the air flow when the valve is released. A tire restraining device such as a cage, rack or other effective means must be used while inflating tires mounted on split rims, or rims using retainer rings. Employees are strictly forbidden from taking a position directly over or in front of a tire while it's being inflated. Proper lifting techniques must be used by employees to avoid over-exertion when lifting packages.

Cleanliness

All work sites must be clean and orderly. All work surfaces must be kept dry or appropriate means taken to assure that surfaces are slip-resistant. All spill materials or liquids should be cleaned up immediately and combustible scrap, debris and waste stored safely and removed from the work site promptly. Any accumulations of combustible dust must be routinely removed from elevated surfaces including the overhead structure of buildings. Combustible dust should be cleaned up with a vacuum system to prevent the dust going into suspension. Metallic or conductive dust must be prevented from entering or accumulating on or around electrical enclosures or equipment. Covered metal waste cans are provided for oily and paint-soaked waste. Use them. All oil and gas fired devices must be equipped with flame failure controls that will prevent flow of fuel if pilots or main burners are not working. Paint spray booths, dip tanks, etc., must be cleaned regularly. Washing facilities are provided, so wash your hands after handling materials.

Tool Maintenance

Faulty or improperly used hand tools are a safety hazard. All employees shall be responsible for ensuring that tools and equipment (both company and employee-owned) used by them or other employees at their workplace are in good condition. Hand tools such as chisels, punches, etc., which develop mushroom heads during use, must be reconditioned or replaced as necessary. Broken or fractured handles on hammers, axes and similar equipment must be replaced promptly. Worn or bent wrenches should be replaced regularly. Appropriate handles must be used on files and similar tools. Appropriate safety glasses, face shields, etc., must be worn while using hand tools or equipment which might produce flying materials or be subject to breakage. Eye and face protection must be worn when driving in tempered spuds or nails. Check your tools often for wear or defect. Jacks must be checked periodically to assure they are in good operating condition. Tool handles must be wedged tightly into the heads of tools. Tool cutting edges should be kept sharp enough so the tool will move smoothly without binding or skipping. When not in use, tools should be stored in a dry, secure location.

Ladders

Check ladders each and every time before you climb. Ladders should be maintained in good condition: joints between steps and side rails should be tight; hardware and fittings securely attached; and movable parts operating freely without binding or undue play. Non-slip safety feet are provided on each ladder. Ladder rungs and steps should be free of grease and oil. Employees are prohibited from using ladders that are broken, missing steps, rungs, or cleats, or that have broken side rails or other faulty equipment. It is prohibited to place a ladder in front of doors opening toward the ladder except when the door is blocked open, locked or guarded. It is prohibited to place ladders on boxes, barrels, or other unstable bases to obtain additional height. Face the ladder when ascending or descending. Be careful when you climb a ladder. Do not use the top step of ordinary stepladders as a step. When portable rung ladders are used to

gain access to elevated platforms, roofs, etc., the ladder must always extend at least 3 feet above the elevated surface. It is required that when portable rung or cleat type ladders are used, the base must be so placed that slipping will not occur, unless it is lashed or otherwise held in place.

All portable metal ladders must be legibly marked with signs reading “CAUTION” – “Do Not Use Around Electrical Equipment.” Employees are prohibited from using ladders as guys, braces, skids, gin poles, or for other than their intended purposes. Only adjust extension ladders while standing at a base (not while standing on the ladder or from a position above the ladder). Metal ladders should be inspected for tears and signs of corrosion. Rungs of ladders should be uniformly spaced at 12 inches, center to center.

Portable Power Tools

Portable power tools pose a special danger to employees because they are deceptively small and light, yet they can do great bodily harm if used improperly or poorly maintained. These rules apply to all power tools, but are especially important when handling portable saws, drills and power screw drivers. Check your equipment before you use it. All grinders, saws and similar equipment should be equipped with appropriate safety guards. Power tools should not be used without the correct shield, guard, or attachment, recommended by the manufacturer. Portable circular saws must be equipped with guards above and below the base shoe. Circular saw guards should be checked periodically and before each use to assure they are not wedged up, thus leaving the lower portion of the blade unguarded. All rotating or moving parts of equipment should be guarded to prevent physical contact.

All cord-connected, electrically-operated tools and equipment should be effectively grounded or of the approved double insulated type. Effective guards must be in place over belts, pulleys, chains, sprockets, on equipment such as concrete mixers, air compressors, etc. If portable fans are provided, they must be equipped with full guards or screens having openings 1/2 inch or less. Do not attempt to lift heavy objects without proper equipment. Hoisting equipment will be made available for lifting heavy objects, with hoist ratings and characteristics appropriate for the task.

Power tools are either battery operated or wired. If battery operated, don't under-estimate their power. A small electric drill or power screw driver can cause a severe injury if it lands in the wrong place. While not usually a shock hazard, the battery pack contains toxic chemicals and does emit a low voltage electric current. Don't drop or incinerate the battery pack, or a tool with a self-contained power source. Hard wired equipment can be portable or fixed. Typically used with extension cords, the more powerful hard wired equipment presents a double safety problem: the actual equipment plus its electrical power source. Ground-fault circuit interrupters must be provided on all temporary electrical 15 and 20 ampere circuits used during periods of construction. Pneumatic and hydraulic hoses on power-operated tools should be checked regularly for deterioration or damage.

Abrasive Wheel Equipment (Grinders)

The work rest used should be kept adjusted to within 1/8 inch of the wheel. The adjustable tongue on the top side of the grinder should be kept adjusted to within 1/4 inch of the wheel. The side guards should cover the spindle, nut and flange and 75 percent of the wheel diameter. Bench and pedestal grinders should be permanently mounted. Goggles or face shields should always be worn when grinding. The maximum RPM rating of each abrasive wheel should be compatible with the RPM rating of the grinder motor. Fixed or permanently mounted grinders must be connected to their electrical supply system with metallic conduit or by other permanent wiring method.

Each grinder should have an individual on and off control switch. The switch should be easily accessible anytime you operate the machine. Each electrically operated grinder is effectively grounded. Do not defeat the grounding mechanism, especially by using non-three prong plug adapters. Note the method by

which new abrasive wheels are mounted. Visually inspect and ring test new abrasive wheels. The dust collectors and powered exhausts provided on grinders must be used in operations that produce large amounts of dust. The splash guards mounted on grinders that use a coolant should be mounted so that no one is ever splashed with the coolant. The work area around a grinder must be kept clean at all times. It is your responsibility as operator of any machine to ensure the necessary safety precautions are taken before using the machine.

Combustible Materials

All combustible scrap, debris and waste materials (oily rags, etc.) must be stored in covered metal receptacles and removed from the work site promptly. Proper storage to minimize the risk of fire, including spontaneous combustion must be practiced. Only approved containers and tanks are to be used for the storage and handling of flammable and combustible liquids. All connections on drums and combustible liquid piping, vapor and liquid must be kept tight. All flammable liquids should be kept in closed containers when not in use (e.g., parts-cleaning tanks, pans, etc.). Bulk drums of flammable liquids must be grounded and bonded to containers during dispensing.

Storage rooms for flammable and combustible liquids must have explosion-proof lights. Storage rooms for flammable and combustible liquids should have mechanical or gravity ventilation. Liquefied petroleum gas must be stored, handled, and used in accordance with safe practices and standards. No smoking signs must be posted on liquefied petroleum gas tanks. Liquefied petroleum storage tanks should be guarded to prevent damage from vehicles. All solvent wastes and flammable liquids should be kept in fire-resistant, covered containers until they are removed from the work site.

Vacuuming should be used whenever possible rather than blowing or sweeping combustible dust. Fire separators should be placed between containers of combustibles or flammables when stacked one upon another to assure their support and stability. Fuel gas cylinders and oxygen cylinders must be separated by distance, fire resistant barriers, etc., while in storage. Fire extinguishers are selected for the types of materials and placed in areas where they are to be used.

These fire extinguishers are classified as follows:

Class A - Ordinary combustible materials fires.

Class B - Flammable liquid, gas or grease fires.

Class C - Energized-electrical equipment fires.

Appropriate fire extinguishers must be mounted within 75 ft. of outside areas containing flammable liquids, and within 10 ft. of any inside storage area for such materials. All extinguishers must be serviced, maintained and tagged at intervals not to exceed one year. Extinguishers should be placed free from obstructions or blockage. All extinguishers must be fully charged and in their designated places unless in use. Where sprinkler systems are permanently installed, are the nozzle heads arranged so that water will not be sprayed into operating electrical switch boards and equipment? Check to see that heads have not been bent or twisted from their original position.

“NO SMOKING” rules will be enforced in areas involving storage and use of hazardous materials. “NO SMOKING” signs have been posted where appropriate in areas where flammable or combustible materials are used and/or stored. Safety cans must be used for dispensing flammable or combustible liquids at point of use. All spills of flammable or combustible liquids must be cleaned up promptly. Storage tanks should be adequately vented to prevent the development of excessive vacuum or pressure as a result of filling, emptying, or atmosphere temperature changes. Storage tanks are equipped with emergency venting that will relieve excessive internal pressure caused by fire exposure.

Mechanical Lockout / Tagout

Point of operation devices shall protect the operator by:

- Preventing and/or stopping normal stroking of the press if the operator's hands are inadvertently placed in the point of operation; or
- Preventing the operator from inadvertently reaching into the point of operation or withdrawing his/her hands if they are inadvertently located in the point of operation, as the dies close; or
- Preventing the operator from inadvertently reaching into the point of operation at all times; or
- Requiring application of both of the operator's hands to machine operating controls and locating such controls at such a safety distance from the point of operation that the slide completes the downward travel or stops before the operator can reach into the point of operation with his/her hands; or
- Enclosing the point of operation before a press stroke can be initiated and maintaining this closed condition until the motion of the slide had ceased; or

Enclosing the point of operation before a press stroke can be initiated, so as to prevent an operator from reaching into the point of operation prior to die closure or prior to cessation of slide motion during the downward stroke. A gate or movable barrier device shall protect the operator. A presence sensing point of operation device shall protect the operator by interlocking into the control circuit to prevent or stop slide motion if the operator's hand or other part of his/her body is within the sensing field of the device during the down-stroke of the press slide. The device may not be used on machines using full revolution clutches. The device may not be used as a tripping means to initiate slide motion. The device shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required, but does prevent the initiation of a successive stroke until the failure is corrected. The failure shall be indicated by the system.

Muting (bypassing of the protective function) of such device, during the upstroke of the press slide, is permitted for the purpose of parts ejection, circuit checking, and feeding only. The safety distance from the sensing field to the point of operation shall be greater than the distance determined by the following formula: $D_s = 63 \text{ inches/second} \times T_s$ where: D_s = minimum safety distance (inches); 63 inches/second = hand speed constant; and T_s = stopping time of the press measured at approximately 90° position of crankshaft rotation (seconds).

Guards shall be used to protect all areas of entry to the point of operation not protected by the presence sensing device. The pull-out device shall protect the operator and shall include attachments for each of the operator's hands. Attachments shall be connected to and operated only by the press slide or upper die. Attachment shall be adjusted to prevent the operator from reaching into the point of operation or to withdraw the operator's hands from the point of operation before the dies close. A separate pull-out device shall be provided for each operator if more than one operator is used on a press. Each pull-out device in use shall be visually inspected and checked for proper adjustment at the start of each operator shift, following a new die set-up, and when operators are changed.

Necessary maintenance or repair or both shall be performed and completed before the press is operated. The sweep device, shall protect the operator as specified in this subsection, by removing his/her hands safely to a safe position if they are inadvertently located in the point of operation, as the dies close or prior to tripping the clutch. Devices operating in this manner shall have a barrier, attached to the sweep arm in such a manner as to prevent the operator from reaching into the point of operation, past the trailing edge of the sweep arm on the downward stroke of the press. This device may not be used for point of operation safeguarding. The sweep device must be activated by the slide or by motion of a foot pedal trip rod. The sweep device must be designed, installed and operated so as to prevent the operator from reaching into the point of operation before the dies close. The sweep device must be installed so that it

will not itself create an impact or shear hazard between the sweep arm and the press tie rods, dies, or any other part of the press or barrier.

Partial enclosure conforming with this subsection, as to the area of entry which they protect, must be provided on both sides of the point of operation to prevent the operator from reaching around or behind the sweep device and into the point of operation after the dies start to close. Partial enclosures shall not themselves create a pinch point or shear hazard. A holdout or a restraint device shall protect the operator and shall include attachments for each of the operator's hands. Such attachments shall be securely anchored and adjusted in such a way that the operator is restrained from reaching into the point of operation. A separate set of restraints shall be provided for each operator if more than one operator is required on a press. The two hand control device shall protect the operator.

When used in press operations requiring more than one operator, separate two hand controls shall be provided for each operator, and shall be designed to require concurrent application of all operators' controls to activate the slide. The removal of a hand from any control button shall cause the slide to stop. The safety distance between each two hand control device and the point of operation shall be greater than the distance determined by the following formula: $Ds = 63 \text{ inches/second} \times Ts$, where: Ds = minimum safety distance (inches); 63 inches/second = hand speed constant; and Ts = stopping time of the press measured at approximately 90° position of crankshaft rotation (seconds).

First Aid Kits

First-aid kits and required contents are maintained in a serviceable condition. Unit-type kits have all items in the first-aid kit individually wrapped, sealed, and packaged in comparable sized packages. The commercial or cabinet-type kits do not require all items to be individually wrapped and sealed, but only those which must be kept sterile. Items such as scissors, tweezers, tubes of ointments with caps, or rolls of adhesive tape, need not be individually wrapped, sealed, or disposed of after a single use or application. Individual packaging and sealing shall be required only for those items which must be kept sterile in a first-aid kit.

First-aid kits shall contain at least the following items:

10 Package Kit:

- 1 Pkg. Adhesive bandages, 1" (16 per pkg.)
- 1 Pkg. Bandage compress, 4" (1 per pkg.)
- 1 Pkg. Scissors* and tweezers (1 each per pkg.)
- 1 Pkg. Triangular bandage, 40" (1 per pkg.)
- 1 Pkg. Antiseptic soap or pads (3 per pkg.)
- 5 Pkgs. of consulting physician's choice

16 Package Kit:

- 1 Pkg. Absorbent gauze, 24" x 72" (1 per pkg.)
- 1 Pkg. Adhesive bandages, 1" (16 per pkg.)
- 2 Pkgs. Bandage compresses, 4" (1 per pkg.)
- 1 Pkg. Eye dressing (1 per pkg.)
- 1 Pkg. Scissors* and tweezers (1 each per pkg.)

- 2 Pkgs. Triangular bandages, 40" (1 per pkg.)
- 1 Pkg. Antiseptic soap or pads (3 per pkg.)
- 7 Pkgs. of consulting physician's choice

24 Package Kit:

- 2 Pkgs. Absorbent gauze, 24" x 72" (1 per pkg.)
- 2 Pkgs. Adhesive bandages, 1" (16 per pkg.)
- 2 Pkgs. Bandage compresses, 4" (1 per pkg.)
- 1 Pkg. Eye dressing (1 per pkg.)
- 1 Pkg. Scissors* and tweezers (1 each per pkg.)
- 6 Pkgs. Triangular bandages (1 per pkg.)
- 1 Pkg. Antiseptic soap or pads (3 per pkg.)
- 9 Pkgs. of consulting physician's choice

36 Package Kit:

- 4 Pkgs. Absorbent gauze, 24" x 72" (1 per pkg.)
- 2 Pkgs. Adhesive bandages, 1" (16 per pkg.)
- 5 Pkgs. Bandage compresses, 4" (1 per pkg.)
- 2 Pkgs. Eye dressing (1 per pkg.)
- 1 Pkg. Scissors* and tweezers (1 each per pkg.)
- 8 Pkgs. Triangular bandages, 40" (1 per pkg.)
- 1 Pkg. Antiseptic soap or pads (3 per pkg.)
- 13 Pkgs. of consulting physician's choice Scissors shall be capable of cutting 2 layers of 15 oz. cotton cloth or its equivalent.

The first-aid kits are maintained at the ten, sixteen, twenty-four or thirty-six package level. Where the eyes or body of any person may be exposed to injurious chemicals and/or materials, suitable facilities for quick drenching or flushing of the eyes and body are provided, within the work area, for immediate emergency use. A poster shall be fastened and maintained either on or in the cover of each first- aid kit and at or near all phones plainly stating, the phone numbers of available doctors, hospitals, and ambulance services within the district of the work site.

First Aid Station

If a fixed establishment employs more than 200 employees at one central location, First-aid stations shall be located as close as practicable to the highest concentration of personnel. First-aid stations shall be well marked and available to personnel during all working hours. One person holding a valid first-aid certificate shall be responsible for the proper use and maintenance of the first-aid station. First-aid stations shall be equipped with a minimum of two first-aid kits, the size of which shall be dependent upon the number of personnel normally employed at the work site. One first-aid kit may be a permanent wall-

mounted kit, but in all cases the station shall be equipped with at least one portable first-aid kit. When required by the circumstances, the station shall be equipped with two wool blankets and a stretcher in addition to first-aid kits. A roster, denoting the telephone numbers and addresses of doctors, hospitals and ambulance services available to the work site, shall be posted at each first-aid station.

Late Night Crime Prevention

All establishments operating between the hours of 11:00 p.m. and 6:00 a.m. should provide crime prevention training to their employees. Crime prevention training shall be a part of the accident prevention program. Training will be made available to ensure that the purpose and function of robbery and violence prevention are understood by employees and that the knowledge and skills required for their safety have been provided. The training and training materials outline security policies, safety and security procedures, and personal safety and crime avoidance techniques. Formal instruction through a training seminar or training video presentation will be made available and upon completion the employee shall sign off on the date, time, and place of training. The training documentation will be placed in the employee's personnel file.

The following elements will be covered in the crime prevention training program:

- An explanation of the importance of keeping the location clean, neat, and uncluttered thereby making it as unattractive as possible to robbers.
- An explanation of the purpose of maintaining an unobstructed view of the cash register from outside the store, provided the cash register is located in a position visible from the street. Instruction on reasons for operating only minimum number of cash registers at night.
- Keeping the cash register fund to a minimum.
- Taking extra precautions after dark, i.e., keep alert, observe lighting and dark corners, spot possible hiding places.
- Violence prevention procedures in case of robbery.
- A refresher course on crime prevention on or near the employee's anniversary date.
- Videotape and crime prevention material shall be available for employee's review at their request.

In addition to providing crime prevention training as defined in this section, the company posts a conspicuous sign in the window or door which states that there is a safe on the premises and it is not accessible to the employees on the premises and that the cash register contains only the minimal amount of cash needed to conduct business. All displays, and any other material posted in window(s) or door(s) should be arranged so as to provide a clear and unobstructed view of the cash register; provided the cash register is located in such a position so as to be visible from the street. If there is any cash on the premises after dark, the Company has a drop-safe, limited access safe, or comparable device on the premises. Please use it. In addition, the outside lights will be on for that portion of the approach and parking area that is necessary to accommodate customers during all night hours the late night retail establishment is open.

Company Fire Brigades

In some industries, the company establishes a fire fighting brigade. The company does this by drafting a policy statement that announces the existence of a fire brigade; the basic organizational structure; the type, amount, and frequency of training to be provided to fire brigade members; the expected number of members in the fire brigade; and the functions that the fire brigade is to perform at the workplace. The

organizational statement is available for inspection by government officials and by employees or their designated representatives.

Employees who are expected to do interior structural fire fighting must be physically capable of performing duties which may be assigned to them during emergencies. The employer shall not permit employees with known heart disease, epilepsy, or emphysema, to participate in fire brigade emergency activities unless a physician's certificate of the employees' fitness to participate in such activities is provided. Approved self-contained breathing apparatus shall be provided to and worn by fire brigade members while working inside buildings or confined spaces where toxic products of combustion or an oxygen deficiency may be present. Such apparatus shall also be worn during emergency situations involving toxic substances.

Approved self-contained breathing apparatus may be equipped with either a "buddy-breathing" device or a quick disconnect valve, even if these devices are not certified by NIOSH. If these accessories are used, they shall not cause damage to the apparatus, or restrict the air flow of the apparatus, or obstruct the normal operation of the apparatus. Approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet DOT and NIOSH criteria. Self-contained breathing apparatus shall have a minimum service life rating of thirty minutes in accordance with the methods and requirements of the mine safety and health administration (MSHA) and NIOSH, except for escape self-contained breathing apparatus (ESCBA) used only for emergency escape purposes. Self-contained breathing apparatus shall be provided with an indicator which automatically sounds an audible alarm when the remaining service life of the apparatus is reduced to within a range of twenty to twenty-five percent of its rated service time.

Positive Pressure Breathing Apparatus

Self-contained breathing apparatus ordered or purchased after January 1, 1982, for use by fire brigade members performing interior structural fire fighting operations, are of the pressure-demand or other positive-pressure type. Effective July 1, 1983, only pressure-demand or other positive-pressure self-contained breathing apparatus shall be worn by fire brigade members performing interior structural fire fighting. This does not prohibit the use of a self-contained breathing apparatus where the apparatus can be switched from a demand to a positive-pressure mode. However, such apparatus shall be in the positive-pressure mode when fire brigade members are performing interior structural fire fighting operations.

Negative-pressure self-contained breathing apparatus with a rated service life of more than two hours and which have a minimum protection factor of 5,000, as determined by an acceptable quantitative fit test performed on each individual, is acceptable for use only during those interior structural fire fighting situations for which the employer demonstrates that long duration breathing apparatus is necessary. Quantitative fit test procedures shall be available for inspection by the director or authorized representative. Such negative-pressure breathing apparatus will continue to be acceptable for eighteen months after a positive-pressure breathing apparatus with the same or longer rated service life is certified by NIOSH. After this eighteen-month period, all self-contained breathing apparatus used for these long duration situations shall be of the positive-pressure type.

This section does not require an employer to organize a fire brigade.

It is suggested that pre-fire planning be conducted by the local fire department and/or the workplace fire brigade in order for them to be familiar with the workplace and process hazards. Involvement with the local fire department or fire prevention bureau is encouraged to facilitate coordination and cooperation between members of the fire brigade and those who might be called upon for assistance during a fire emergency.

Body protection

Fire brigade members may wear a fire-resistive coat in combination with fully extended boots, or they may wear a fire-resistive coat in combination with protective trousers. Fire-resistive coats and protective trousers meeting all of the requirements contained in NFPA 1971-1975, "Protective Clothing for Structural Fire Fighters," are acceptable as meeting the requirements of this standard. The lining is required to be permanently attached to the outer shell. However, it is permissible to attach the lining to the outer shell material by stitching in one area such as at the neck. Fastener tape or snap fasteners may be used to secure the rest of the lining to the outer shell to facilitate cleaning. Reference to permanent lining does not refer to a winter liner which is a detachable extra lining used to give added protection to the wearer against the effects of cold weather and wind.

Hand protection

Fire fighters should wear protective gloves or a glove system. A glove system consists of a combination of different gloves. The usual components of a glove system consist of a pair of gloves, which provide thermal insulation to the hand, worn in combination with a second pair of gloves which provide protection against flame, cut and puncture. Protective gloves should provide dexterity and a sense of feel for objects. Criteria and test methods for dexterity are contained in the NIOSH publications, "The Development of Criteria for Firefighters' Gloves; Vol. I: Glove Requirements," and "Vol. II: Glove Criteria and Test Methods." These NIOSH publications also contain a permissible modified version of Federal Test Method 191, Method 5903, (paragraph of Appendix E) for flame resistance when gloves, rather than glove material, are tested for flame resistance.

Head, eye & face protection

Head protective devices which meet the requirements contained in NFPA No. 1972 are acceptable as meeting the requirements of this standard for head protection. Head protective devices are required to be provided with ear flaps so that the ear flaps will be available if needed. It is recommended that ear protection always be used while fighting interior structural fires. Many head protective devices are equipped with face shields to protect the eyes and face. These face shields are permissible as meeting the eye and face protection requirements of this paragraph as long as such face shields meet the requirements of the general safety and health standards. Additionally, full face pieces, helmets or hoods of approved breathing apparatus are also acceptable as meeting the eye and face protection requirements. It is recommended that a flame resistant protective head covering such as a hood or snood, which will not adversely affect the seal of a respirator face piece, be worn during interior structural fire fighting operations to protect the sides of the face and hair.

Responsible Safety Officer

General Statement

The Responsible Safety Officer is the person who has been delegated the authority to develop and administer [Company]'s health and safety program.

Duties

By law, the Responsible Safety Officer is the person designated by the company with the duty and authority to implement and maintain [Company]'s Injury and Illness Prevention Program. The Responsible Safety Officer is assigned the responsibility of providing technical guidance and services in the field of health and safety needed by [Company] management. To fulfill this objective the Responsible Safety Officer is required to:

- 1) Provide management at all levels with the information, advice, and assistance needed to formulate [Company]'s health and safety policy, directives, procedures, and standards.
- 2) Assist management at all levels in establishing and maintaining a healthful and safe working environment free from unacceptable risks, in conformance with OSHA health and safety guidelines and in compliance with applicable standards, codes, and regulations.
- 3) Monitor operations within [Company] and, where appropriate at off-site facilities, provide management with the information needed to maintain a healthful and safe working environment, free from unacceptable risks.
- 4) Develop and provide general safety education and training programs. Assist in the development of specific job safety training programs.
- 5) Develop plans and train response personnel to control emergency situations (earthquake, radiation, injury, fire, etc.).
- 6) Provide health and safety support services assigned by the Company Officer to whom the Responsible Safety Officer reports.
- 7) Maintain a staff of specialists or consultants knowledgeable in all areas of safety.
- 8) Prepare and maintain [Company]'s Health and Safety Manual and other documents that relate to safety. Specify proper protective equipment for issuing to employees.
- 9) Check plans of all new projects for construction safety, industrial safety, and other safety reviews as required by OSHA and [Company] regulations.
- 10) Stop hazardous operations where life hazard or major property damage is imminent and follow with documented evidence.

To carry out its responsibilities, the Responsible Safety Officer maintains a staff of specialists and outside consultants in the appropriate environment, health, and safety disciplines.

These disciplines include: Construction Safety, Engineering Services, Environmental Protection, Industrial Hygiene, Laser Safety, Mechanical Safety, Non-destructive Testing, Occupational Safety, Radiation Safety, Safety Training, and Education Seismic Safety

Five Functions

The functions of the Responsible Safety Officer are divided into five areas:

1. Operations
2. Health Physics
3. Engineering Services/Occupational Safety
4. Industrial Hygiene
5. Environmental Protection

Some of these functions may be delegated in whole or in part to staff and/or outside consultants.

Operations

This area deals with the day-to-day safety operations of the [Company]. It includes the following personnel: Field Supervisors or Field Safety Officers help in the planning or preparation of hazardous projects and analysis of difficult safety problems. They provide on-site training; protective equipment and other safety-related equipment for hazardous operations; maintenance of environmental monitoring devices; evaluation of ventilation and air cleaning equipment; and radioactive or chemical source inventory. Decontamination and Waste Disposal Contractors provide services to decontaminate special equipment; assistance with clean-up of radioactive or hazardous chemical spills; collection and disposal of radioactive materials and hazardous chemicals. Special Transportation Contractor provides services for receiving and shipping of radioisotopes and consultation on the regulations concerning transportation of hazardous chemicals.

Radiation Physics

This area is composed of the following functions: The Radiation Physics Section is primarily concerned with the radiation safety aspects of accelerators. The areas of immediate concern are the following:

- Radiation intensity in occupied areas
- Adequacy of radiation safety interlock systems
- Access control to radiation areas
- Proper sign and warning systems
- Review and approval of facility radiation Operational Safety Procedures

In addition, the Radiation Physics Section performs the following functions:

- Experimental beam line safety analysis
- Shielding calculations for proposed new accelerators Radiation damage studies Development of measurement instruments and techniques
- Experimental source term measurements
- Neutron energy spectral measurements

The X-Ray Safety Section evaluates the use of x-ray equipment at [Company]. This is accomplished by periodic radiation surveys, physical inspection of x-ray facilities and logbooks, approval of Operational Safety Procedures, and the receipt of Certification of Training documents. This Section also advises on matters of instrument selection, measurement techniques, and safety apparatus design (interlocks, barriers, monitors, etc.). This Section files and distributes all documentation generated by the above operations.

Engineering Occupational Safety

The primary concern of this area is the general safety of [Company]. Its responsibilities include:

- Occupational Safety: Investigation, statistical analysis, and review of personal injury, property damage, and vehicle accident reports.
- Recommendation on protective clothing and equipment for eyes, head, feet, and hands to prevent traumatic injury.
- Evaluation of material-handling and storage facilities, such as manual and mechanical handling devices, slings, ropes, chains, and hooks.
- Review of design, layout, and code compliance of new or modified facilities and buildings and follow-up inspections of construction sites.
- Recommendation on proper use and care of ladders, ramps, elevated walks, and work platforms.
- Review of traffic safety, such as traffic signs and markings, traffic patterns, and layout planning.
- Determination of qualified operators of special vehicles and equipment.
- Mechanical Safety: Review/design/inspection of hazardous equipment.
- Advise on vehicle safety (design, consultation).
- Recommendation of adherence to mechanical design codes, standards, and procedures.
- Provision of non-destructive testing services.
- Reviews of Operational Safety Procedure relating to hazardous equipment.
- Seismic Safety: Design of anchoring or restraining devices. Inspections and consultations. Interface with building and construction contractors.

Industrial Hygiene

This function must recognize, evaluate, and recommend control for occupational health hazards. Outside consultants are responsible for providing the following services:

- Toxicology of occupational chemical hazards
- Control of non-ionizing electromagnetic spectrum hazards, such as lasers, ultraviolet, infrared, and microwave-radio frequency radiation
- Evaluation of ventilation for comfort, dilution, and local exhaust
- Noise and sound analysis
- Illumination evaluation
- Environmental sanitation, such as food, water, and vector and pest control
- Measurement of physiological stresses, such as temperature extremes
- Provision of protective equipment, such as respiratory, hearing, and special eye protection
- Control of bio-hazards
- Laser safety

Environmental Protection

This area is involved with the identification and quantification of environmental quality concerns, development and maintenance of operating permits, assessment of pollution abatement programs, and liaison with environmental protection agencies. It includes the following services:

- Environmental monitoring, surveillance and analysis of contaminants in air, rain, surface water, soil, and stack exhaust
- Air pollution control
- Water pollution control
- Polychlorinated biphenyl inventory in transformers and capacitors.
- Underground tank monitoring and reporting
- Treatment facilities permitting and sampling for regulatory compliance
- Environmental remediation of contaminated sites.

Common Functions

All the functions of the Responsible Safety Officer include the following areas of responsibilities:

- Environmental Monitoring, including both workplace and office data collection and measurement techniques.
- Decontamination and Waste Disposal.
- Safety Resource Library Maintenance.
- The Responsible Safety Officer should either maintain or have the Company maintain a library that contains copies of codes, standards, safety manuals, and reports that regulate [Company]'s safety program. The library also contains copies of texts and reports regarding health and safety.
- Industrial Hygiene and Environmental Protection.
- Health Physics laboratory. Maintain extra protective clothing, safety glasses and safety shoes for guests and existing employees needing temporary replacement of their protective equipment.

Safety Training

[Company] policy and federal law require that [Company] staff, participating guests, and visitors receive appropriate health and safety training. Managers are responsible for ensuring that employees and guests under their supervision receive this training so they are fully informed about possible occupational health hazards and know how to work safely. Training must include [Company]'s health and safety orientation for new employees plus any additional training specific to the nature of hazards on the job; employees must complete this training before they can work unsupervised. All new employees must attend the new employee orientation within the first month of employment.

OSHA and other federal regulations spell out several specific health and safety training requirements for special hazards. These include, but are not limited to, radiation safety, hazard communication for exposure to hazardous substances, asbestos exposure, respirator use, hearing conservation, laser safety, confined space hazards, and certification for using material in moving equipment such as forklifts and overhead cranes. Employees who do hazardous work, such as working with high-voltage power supplies, or who are members of building emergency teams are required to have CPR and First Aid certification.

Managers should identify training needs for the job classifications for which they are responsible. Please refer to specific chapters in this manual for further information on training requirements. Consult with the Responsible Safety Officer staff about other training needs and requirements. Training not provided by Responsible Safety Officer, such as on-the-job training, is the responsibility of line management. This includes information on procedural changes or system modifications that impact safety.

Responsible Safety Officer provides several health and safety training courses, technical assistance on training needs, and resources to help supervisors fulfill their training responsibilities. An announcement describing health and safety courses offered by Responsible Safety Officer is distributed quarterly. Educational resources such as fact sheets, hazard summaries, and other written materials, as well as videos and slide shows, are available from Responsible Safety Officer.

Supervisors can get a catalog from Responsible Safety Officer describing audio-visual materials that may be used to supplement safety training programs. ALL health and safety training must be documented. Supervisors must note the participants' names and employee numbers, topics discussed, instructor(s), and date. Supervisors are responsible for maintaining training records. A copy of this information should be sent to the Responsible Safety Officer training/education coordinator for inclusion in [Company]'s training data base.

Hazard Warnings

Introduction

Every reasonable method to warn employees of hazards and dangers and to inform them of the actions required must be utilized. Signs, characteristic lights, and audible alarms as additional safeguards for built-in mechanical and physical protection must be used. To ensure uniform response by personnel, the warning signs and devices must be of the same type for similar hazards. Obtaining and installing the warning systems is the responsibility of the Responsible Safety Officer as well as group using them.

Signs: Contents & Configuration

Signs must conform to the colors, symbols, lettering size, and proportions as specified by [Company], except that radiation signs must conform to the requirements stated in 10 CFR 20. Every warning sign must include the following components:

- An approved heading that indicates the relative hazard
- A statement of the type of hazard
- A statement of what to do or not to do in the area

Sign Selection

The sign portfolio maintained by the Responsible Safety Officer may be used to help in selecting suitable signs. The Responsible Safety Officer will also advise regarding the types needed and their sources of supply. The Responsible Safety Officer stocks some signs. Special signs are custom made in the [Company] shops or are purchased from outside vendors.

Danger Signs

Danger signs are used only where injury or damage is certain to occur if approved operating instructions and procedures are not followed. Personnel must be warned of the serious consequences of ignoring the message. The top of this sign says DANGER in white letters on a red oval that is edged by a rectangular black border. The body of the sign is white with the message printed in black.

Caution Signs

Caution signs are used where injury or damage is possible and employees must be on their guard. The top of this sign says CAUTION in yellow letters on a black rectangle. The body of the sign is yellow with the message printed in black.

Informational Signs

Informational signs are used where instructions are needed. The heading says NOTICE in white letters on a green rectangle when the message relates to safety and on a blue rectangle for other messages. The body of the sign is white with the message printed in black.

Directional Signs

Directional signs are used to indicate exits, fire escapes, evacuation routes, stairways, location of first aid, etc. The direction symbol appears near the top in white on a green rectangle. The body of the sign must have a color contrasting with the general background.

Warning Devices

Warning devices such as lights and audible alarms must be installed where they are needed to warn personnel against remaining in or entering hazardous areas. Personnel must be instructed about the meaning and the response required when an alarm sounds. An explanatory sign (describing hazard and action to take) must be posted near a warning light that when ON indicates danger, caution, high explosives, or radioactivity. In a highly illuminated area, the warning light should be surrounded by a disk or wide-angled cone of a contrasting color.

Evacuation Alarm System

The facility supervisor and Responsible Safety Officer shall jointly decide the type of evacuation alarm system when needed.

Evacuation Alarm

All buildings on site are equipped with a means of notifying personnel to leave the building, which is usually the public address system. Every dangerous operation area, indoor and outdoor, must be provided with devices to notify personnel to leave the area. The general evacuation alarm is a steady klaxon horn sound that means, "Everyone leave the building immediately and go to the prearranged assembly point or as directed by the public address system." The extensiveness and reliability of the alarm system must be proportional to the magnitude of the credible accidents that could occur from the operations in or near the building.

Evacuation Alarm - Automatic

An automatic evacuation alarm must be installed that is triggered by a detector directly sensitive to the nature of the hazard for any operation in which an accident could rapidly endanger employees outside the immediate area. Such an operation must not proceed unless the alarm system is functional. Manual activation capability and a public address back-up system must be provided in the building. This alarm system must be protected by an automatic emergency power supply.

Manual Alarm System

A manually operated alarm system must be installed for operations in which accidents would not cause immediate danger to personnel outside the area of the incident but that could develop into dangerous situations. A public address system operable from the building and from the Fire Department and Protective Services must be provided.

Emergencies

Organization

[Company] requires that during every emergency an organized effort be made to protect personnel from further injury and to minimize property damage. All of [Company]'s resources can be made available to respond to an emergency. Each supervisor must know what to do during an emergency in his or her area and must be certain that his or her employees understand their roles.

Master Emergency Response Plan

[Company]'s Master Emergency Response Plan delineates lines of authority and responsibility for emergency response. In this context, a major emergency may be one of the following: a potential major loss to a building or facility; an emergency that involves more than one building or facility; a situation in which a choice must be made in the assignment of relative levels of authority among emergency-response groups; a potential hazard to the surrounding community; threat; civil disturbances or alerts; natural disasters such as earthquakes, floods, and landslides; and site wide electrical power or other utility failure.

During response to such major events, if deemed necessary by management or [Company] Fire or Police may be summoned, and a pre-designated succession of management personnel would determine who would take charge. The primary responsibility person designated to be in charge is to ensure that priorities are established, that the response is appropriate and adequately implemented, and that the proper notifications are made. In most cases the direct involvement of local supervision and remedial action will be necessary.

Adequate emergency response will be made at the group, department, and building levels, with support from Fire, Medical, Protective Services, and other support organizations. As a practical matter it must be recognized that management personnel are normally on site only 40 of the 168 hours per week. Thus, there may be considerable delay before management personnel can assume on-site direction of major emergencies. This highlights the importance of local initiative, at least at the onset of an emergency.

The underlying philosophy of the emergency response plan is the recognition that each employee has a vital role and a basic responsibility in the area of safety and emergency action. The only reasonable expectation is that at the onset of an emergency the initial response will be at the individual level. Immediate and knowledgeable action is vital. The emergency plans for individual buildings and facilities set forth the responses to be taken by employees following the discovery of an emergency.

Following the immediate measures taken by the individual, the responsibility for action will normally proceed upward through normal organizational lines of authority to the Building Manager and to emergency-response groups. Involvement of individuals at a higher level of responsibility will depend on the particular situation. To reiterate, levels of responsibility proceed downward from top management while action and response levels proceed upward from the first person involved.

Please have the courage to call outside assistance like the police and firefighters. Dial 9-1-1.

When the police, firefighters or paramedics arrive, surrender command to an qualified emergency specialist. Notify management as soon as practical, which means after all immediate responses have been exercised. The operator at 911 will tell you who is the person in charge of the specialized personnel assigned to respond to the emergency. An orderly transfer of responsibility is then made from the local building or facility organization to this responding unit.

The examples listed below identify the most likely outside incident commander for the following types of emergencies:

- Injury: Ranking Fire Officer or Physician
- Fire: Ranking Fire Officer
- Bomb Threat: Ranking Police Officer
- Civil Disturbance: Ranking Police Officer
- Radioactive or Chemical Spills: Ranking Fire Officer Responsible Safety Officer Special Toxic Clean Up crew or alternate
- Power Outage: Pacific Gas and Electric or local Plant Power Engineer
- Mechanical Utility Failures: Construction and Maintenance Department Superintendent
- Structural Plant Failures: Engineering Department Head or alternate
- Landslide: Engineering Department Head or alternate

In most emergencies the person who should be in charge is obvious. However, an emergency might arise that requires the major involvement of more than one emergency-response group. In such a case the ultimate authority among those on the scene may not be obvious. In this event, management should be consulted for direction.

Building Emergency Plan

A specific emergency plan for each building or facility must be prepared under the direction of the Building Manager. A Building Manager and Deputy Manager must be appointed and oriented for each building or complex. Generally, the Building Manager is the person in charge of a building or facility. The Building Manager has specific responsibility for the preparation, updating, and implementation of the emergency plan for this area. This responsibility includes recommending personnel to attend indoctrination and training programs. Specifically, each plan must contain the following information and procedures as appropriate for each building: The names of the Building Manager, Deputy Manager, and Assistant Manager(s).

A list of people with specific duties during an emergency and a description of their duties. For example, specific people should be assigned to supervise evacuation and to carry out a rapid search of the area (assuming this can be done safely). Floor plans showing evacuation routes, the location of shutoff switches and valves for the utility systems (water, gas, electricity), and the locations of emergency equipment and supplies (including medical). Indications on the floor plans of areas where specific hazards (i.e., toxic, flammable, and/or radioactive materials) exist. Location and description of special hazards or hazardous devices should be included in the text together with shutdown procedures if applicable.

Designation of a primary assembly point for evacuees, well away from the building. An alternate site should also be designated in case the first choice cannot be used.

Reentry procedures. No one should reenter an evacuated building or area without specific instructions from the Building Manager or other person in charge. Department Head and Supervisor responsibilities regarding emergency preparedness and action procedures. Emergency plans for facilities or equipment requiring an Operational Safety Procedure (OSP).

Operational Safety Procedures

OSP's for individual facilities or pieces of equipment must include emergency plans for the facilities or equipment.

Supervisors Responsibilities

During an emergency, the supervisor must: Ensure that those under his or her supervision are familiar with the plan for the building, particularly the recommended exit routes and how to report an emergency. Render assistance to the person in charge during an emergency, as required. Maintain familiarity with the shutdown procedures for all equipment used by those under his or her supervision. Know the location and use of all safety equipment on his or her floor. Keep employees from reentering an evacuated area until reentry is safe.

No Loitering Policy

Employees not involved in the emergency must stay away from the scene and follow the instructions issued over the public address system or directly from the person in charge. The sounding of a fire bell means immediate evacuation by the nearest exit. Employees must not reenter an area that they have evacuated until notified that it is safe to return.

Employee Responsibilities

Employees, other than emergency-response groups, involved in any emergency greater than a minor incident are expected to act as follows: If there is threat of further injury or further exposure to hazardous material, remove all injured persons, if possible, and leave the immediate vicinity. If there is no threat of further injury or exposure, leave seriously injured personnel where they are. Report the emergency immediately by phone. State what happened, the specific location, whether anyone was injured, and your name and phone number. Proceed with first aid or attempt to control the incident only if you can do so safely and have been trained in first aid or the emergency response necessary to control the incident. Show the ranking emergency-response officer where the incident occurred, inform him or her of the hazards associated with the area, provide any other information that will help avoid injuries, and do as he or she requests.

Emergency Action Plan

- ☞ An emergency action plan (EAP) is a written document required by particular OSHA standards. The purpose of an EAP is to facilitate and organize employer and employee actions during workplace emergencies. The elements of the plan must include, but are not limited to:
- ☞ Evacuation procedures and emergency escape route assignments.
- ☞ Procedures to be followed by employees who remain to operate critical plant operations before they evacuate.
- ☞ Procedures to account for all employees after an emergency evacuation has been completed.
- ☞ Rescue and medical duties for those employees who are to perform them.
- ☞ Means of reporting fires and other emergencies.
- ☞ Names or job titles of persons who can be contacted for further information or explanation of duties under the plan.

At [Company], we have established specific plans of action for dealing with a variety of emergencies – please read this section carefully and commit it to memory.

Evacuation

xxx

Accounting for all employees after an emergency evacuation

xxx

Reporting Fires & Other Emergencies

Xxx

Rescue & Medical Duties

Xxx

Contacts

xxx

Employee Health Services

Medical Services

The objectives of the Medical Services Department are:

- To ensure that employees are assigned duties they are physically able to perform.
- To provide medical care and rehabilitation of the occupationally ill or injured.
- To provide emergency treatment of serious illnesses or injuries.
- To encourage employees to maintain their physical and mental health.
- To assist in maintaining a healthful and safe work environment.

Occupational Health Monitoring

Pre-placement, periodic, special, and termination examinations are conducted and emergency services are provided. Potential occupational exposures to hazardous situations or agents are investigated on a continuing basis in cooperation with the Responsible Safety Officer. Diagnosis and treatment of non-occupational illness or injury are limited to minor first aid, emergencies, and special situations for which treatment is in the best interest of [Company] and the patient. The Company offers confidential counseling for employees to aid in resolving work-related or personal problems.

Medical Services Area

The Medical Services area includes a first aid room, clerical and filing space, examination rooms, offices, x-ray and dark room, laboratories, holding ward, clinical laboratory, and an area for fitting and dispensing safety glasses, examining the eyes of laser users and performing refractions.

On Site Medical Aid

The On Site Medical Services Program is under the leadership of [Company] physicians, who are available to respond to medical emergencies. The Medical Services Department is managed by the Physician-in-Charge assisted by the Department Administrator. The clerical staff oversees scheduling and medical data filing.

Nurses are on duty from 7:30 a.m. until 5:00 p.m. on workdays.

First aid is available from the Fire Department at all other times.

The clinical laboratory is staffed by licensed medical technologists. Physical examinations are done by contract physicians and [Company] physicians. The contract physicians (internists, an ophthalmologist, and a radiologist) and an optometrist are all in private practice and are not employees of the Company.

The EAP is conducted by a specialist in human resource management who is a certified employee assistance professional. Consultants to the EAP include psychiatrists, psychologists, and other sources of aid.

Safety Examinations

A complete confidential medical examination is required of all new career employees and those temporary employees hired for periods exceeding 3 months. Periodic examinations are offered at intervals and at termination of employment. Frequency and content of examinations are established by the Responsible Safety Officer based upon OSHA guidelines.

The complete examination may include some or all of the following:

- Family and personal medical history (see Privacy Notice)
- Physical examination
- Vision tests
- Hearing tests
- Measurement of pulmonary function
- Electrocardiograms for employees 40 years of age or older, and for other employees when indicated.
- Tonometry (test for glaucoma) for employees 40 years of age or older
- Chest x-ray or tuberculin test upon request of the examining physician
- Complete blood count
- Blood chemistries
- Urinalysis
- Special procedures

An active program of follow-up on all positive findings is carried out by [Company] physicians via letters, telephone calls, or visits with employees. Results of examinations may be forwarded to an employee or his/her personal physician upon written request by the employee. The purpose of this examination is to ascertain whether the physical and mental fitness of the prospective employee is adequate for the requirements of the specific position under consideration. The examination consists of all applicable procedures listed above.

Physical Examinations

Employees are offered complete physical examinations every two years through age 44. In the interim year a complete blood count and urinalysis are done. Employees 45 years of age and older are offered complete examinations yearly. Notification is initiated by an appointment card to employees, and an attempt is made to schedule a time convenient for the employee. Upon termination of employment, adjustments are made regarding the procedures to be carried out, depending upon how recently an individual may have had a periodic examination. This policy also applies to reemployment.

A termination questionnaire regarding occupational injuries is provided. Upon return to work following non-occupational illness or injury as follows: An employee who has been ill and absent from work for five or more consecutive working days should report to the Responsible Safety Officer before returning to duty. The RSO will determine whether the employee is medically ready to return to work. In some instances a release to return to work from an employee's private physician may be required (e.g., following surgery).

Laser Users Employees using lasers are examined by an optometrist before starting such work, after a suspected exposure, and when laser use is discontinued.

Bioassay Program

All employees with significant potential for internal exposure to radioisotopes, e.g., by inhalation of ingestion, are requested to submit urine samples periodically for radiochemical analysis. Accidental releases of radioisotopes in the workplace may require employees to collect urine and/or fecal samples for analysis in order to estimate their internal radiation exposure.

Medical Records

Complete medical records are maintained for each employee from the time of the first examination. These records are protected as confidential information and remain in the custody and control of the Responsible Safety Officer. Information from an employee's health record may be disclosed only with the employee's written consent, or as required by law. These records are retained indefinitely.

Return to Work

Restrictions may be placed on an employee's work pursuant to physical examination, occupational or non-occupational illness, or injury.

Pregnancy & Workplace Hazards

As soon as an employee learns that she is pregnant, she must inform the Responsible Safety Officer of the expected date of childbirth. A physician or nurse will discuss her work environment with her and will determine whether any change in the environment should be made to ensure her good health and that of her baby.

Employee Assistance Program

The Company offers confidential assistance in resolving personal problems such as alcoholism, drug abuse, emotional disturbances, and legal, marital, or financial difficulties. Employees may seek this assistance or be referred by supervisors. Classes on topics such as stress management are offered on an as-requested basis.

Safety Glasses

Appointments with an optometrist to fit safety glasses are available. The glasses are supplied free of charge to employees needing this protection. Employees may bring a recent prescription or have a refraction done here for a nominal cost.

Immunizations

Employees needing immunizations for travel may have them at Medical Services. In special instances where a communicable disease is imminent, immunization is offered to the entire [Company] population. Tetanus toxoid is routinely administered to laborers and animal handlers.

Occupational Injury / Illness

Treatment is coordinated with outside specialists in accordance with the provisions and requirements of Workers' Compensation laws. Every injury sustained while performing [Company] assigned tasks, no matter how minor, must be reported to the employee's supervisor and to the Responsible Safety Officer. If an employee goes to a private off-site doctor about a job-incurred injury or illness, the physician consulted should be informed that the injury or illness is industrial. It is the employee's responsibility to notify the RSO and his/her supervisor of the injury or illness and the treatment received. An occupational

injury or illness is one which results from a work accident or from an exposure involving an incident in the work environment. In most cases, the employee will be referred to his/her private physician, a selected specialist, or a hospital emergency room. Standard procedures for ingestion of poisons, eye injuries, burns, cardiac arrest, coma, etc., are followed. In the event that a patient cannot be moved from the site of the injury, primary aid will be rendered by [Company] physicians, nurses, firefighters, or ambulance personnel. A physician should be notified of any major accident that occurs at any time at the workplace. When the company physician has been notified, he/she will take the responsibility for appropriate notification of family, relatives, and the President's Office.

In the event of an occupational injury or illness that requires care by a specialist, the patient is referred to his/her personal physician or a physician selected from a panel of locally practicing specialists. Medical Services is prepared to provide definitive treatment for minor occupational injuries or illnesses and rehabilitation where appropriate. Diagnosis and treatment such as suturing, splinting, dressing, and analgesia are given routinely when appropriate by the physicians and registered nurses on site. Minor injuries and illnesses not associated with work frequently are treated by the physician or nurse on duty.

Patients who present themselves with more severe or chronic health problems are consulted with and referred to their personal physician or transported, if necessary by ambulance, to nearby hospitals for emergency care. No injured or ill persons, regardless of employment status, are denied first aid or referral to medical resources in the community. [Company] personnel are advised by the Responsible Safety Officer regarding known personal exposure to radiation. The procedure and urgency of notification and subsequent action by the physician vary in detail depending on the particulars of the exposure or spill.

Usually, in the event of contamination by radioactive isotopes or possible activation by high-energy beam, the employee(s) will receive a whole-body count and bioassay of excreta, if indicated. Dose estimates are the joint responsibility of Responsible Safety Officer and Medical Services Departments. Medical Services is prepared to assist in decontamination of personnel when necessary especially of contaminated wounds. [Company] has written mutual aid agreements with local hospitals to admit and care for contaminated injured personnel. Employees who are injured severely or become seriously ill at work are transported to Medical Services in the ambulance operated by the Fire Department, except when other transportation is specifically approved by Medical Services. If necessary, the ambulance is used to transport patients to nearby hospitals or clinics.

Privacy Notice

[Company] should provide the information below to individuals who are asked to complete medical history forms or otherwise supply personal information about themselves. The information on this form is requested for purposes of maintaining a complete medical record on each [Company] employee as part of the Occupational Medical Program of the Medical Services Department. Furnishing the requested information is voluntary, but failure to provide such information on pre-employment examination may delay or even prevent medical approval for employment. Supplying information on subsequent examinations is in the best interest of the employee and is intended to protect the health of [Company] employees.

All information in employee medical records is available only to Medical Services staff. Information from medical records cannot be disseminated outside Medical Services without the written consent of the employee except as required by law; however, the information may be used as a basis for recommendations by the Responsible Safety Officer to various persons in miscellaneous personnel matters such as, but not limited to, consideration for employment, transfer, work assignment, and eligibility for benefits. Individuals have the right to review their own records in accordance with company policies. Information on these policies may be obtained from the Personnel Department or the Responsible Safety Officer.

Building Management & Construction

Introduction

[Company]'s buildings and equipment must equal or exceed existing legal standards for safety, fire prevention, sanitation, architectural barriers, health protection, and resistance to seismic forces. Safeguards must provide built-in protection against injury to personnel or damage to property and include methods for limiting the consequences of accidents. Protection systems must permit the most effective work conditions consistent with effective safeguards. Since physical plant facilities are the responsibility of the Engineering Department, the following matters related to engineering and construction must be referred to the Engineering Department: New construction or alteration of buildings, building facilities, fixed equipment, outside utilities such as cooling towers, electrical substations, underground pipes, conduits, or vaults, roadways, parking lots, walkways, landscaping, sewers, and drainage systems. Plans under consideration that will affect any structure or physical plant facility because of the size of the project, loads, vibration, temperature requirements, humidity control, radiation background, or ventilation requirements, or any code-related feature of the facility.

Engineering Responsibilities

The Engineering Department is responsible for planning, construction, and alterations involving physical plant facilities. Job control by the Engineering Department includes obtaining all required official approvals; requesting new account numbers; initiating requisitions, materials orders, and job orders; and administering all subcontracts pertaining to the project. To initiate new construction or alterations, a request is submitted to the Engineering Department. The submission must inform the Plant Engineering Department of the proposed use and any special safety requirements for the project. The Responsible Safety Officer will assist the Engineering Department in determining the need for developing specific safety criteria and facilities.

Structural Alterations

Plant alterations that are necessary for safety or to improve safety should be carried out expeditiously. Requests for such alterations or additions, and job orders for such projects, should be conspicuously marked as safety projects. The Responsible Safety Officer establishes appropriate priorities for these safety projects.

Hazardous Materials

Hazardous materials must be handled and stored in enclosures that 1) protect the worker by means appropriate to the hazard and 2) protect the casual or unwitting passerby from hazards or access to hazards. These aims are achieved by work enclosures such as hoods, glove boxes, fire safes, and fenced areas. Applicable construction criteria for such work enclosures are given below.

Standards

The standards and recommendations of the American Conference of Governmental Industrial Hygienists (ACGIH) will be followed.

Hazmat Glove Boxes

Glove boxes for use with radioisotopes or other hazardous materials will be purchased or built and installed only with the approval of the Responsible Safety Officer.

Fences

Fences of suitable type must be provided wherever unauthorized access can lead to personnel injury or property damage. Protection from such serious hazards as high level radiation, high pressure, or exposed high voltage requires special considerations. Vehicle gates must be at least 12 ft wide.

General Requirements

The following general requirements apply to all buildings: Construction should be of non-combustible or fire-rated materials as much as possible. Building Manager must ensure that the floors of traffic corridors are unobstructed and meet code requirement. All work areas should have the following: At least two unobstructed exits if total floor area is over 250 sq ft. A smooth wall finish and smooth, impermeable work surfaces.

- Automatic fire detection and suppression systems.
- Adequate ventilation.
- Additional requirements for manufacturing, industrial or production areas are as follows:
- Safety enclosures or barriers for high energy systems.
- Warning signals and safety interlocks for high energy systems or equipment.
- Adequate grounding devices for electrical systems as required by the National Electric Code and this manual.
- Proper design of pressurized gas systems in accordance with this manual.

Additional requirements for chemical handling areas are as follows:

- Process and special ventilation in accordance with the ACGIH standards and recommendations. Safety storage arrangements for chemicals.
- Emergency eye wash and shower facilities.

Contractors

In addition to the full- and part-time employees on the [Company] payroll, important work is performed by personnel through contract arrangements. These non-[Company] persons are sometimes referred to as contract or subcontract personnel. Nevertheless, the safety obligations of subcontractor personnel are the same as those of the [Company] employees. Those [Company] supervisors assigned to direct work of contractor and/or subcontractor employees must instruct and otherwise provide safety equipment and conditions equivalent to those provided to payroll employees. This is to ensure that [Company] property is protected from damage and that all employees, payroll or non-payroll, are protected from work injury and illness. [Company] is required by law to make its facilities as safe as possible for the protection of the employees of its contractors and subcontractors, as well as any other visitor.

Construction Safety

Construction safety is closely monitored by the various on-site construction supervisors, job site

coordinators, superintendents, architects, engineers, government and private inspectors, contractor's and subcontractor's safety officials and [Company]'s Responsible Safety Officer, all of whom must work closely together. Each contractor and subcontractor must supply the name of its designated safety official for that job site to [Company]'s Responsible Safety Officer before being allowed to commence work on the site. In addition, the following definitions and procedures formalize the safety responsibilities and duties of all those persons involved with construction site management.

Construction Leadership

The following definitions describe personnel referred to in these procedures. Construction Inspector. The person assigned by [Company] to monitor subcontractor activities for construction compliance with the subcontract specifications and drawings. Responsible Safety Officer. The person assigned to monitor construction safety. Architect/Engineer (A/E). The person assigned by [Company] to ensure that a construction project is built according to contract documents and design intent may also be called Project Architect, Project Engineer, or Project Manager. Subcontractor. Firm responsible for actual construction and compliance with all safety regulations.

OSHA Regulations and Building Owner

Responsible Safety Officer has been given the responsibility by [Company] and OSHA for monitoring the safety of construction site activities and enforcing all OSHA regulations. The extent of monitoring will vary depending upon the type of activity the subcontractor is engaged in. The Responsible Safety Officer role after visiting a construction site is to advise the Construction Inspector and the Architect/Engineer wherever the subcontractor is in violation of a safe practice or an unsafe condition exists. After notification by Responsible Safety Officer, the Construction Inspector and the Architect/Engineer are responsible for notifying the Subcontractor to take corrective action. The responsibility for correction of the problems rests with the Subcontractor. The Responsible Safety Officer will follow up to ensure that corrective action is being taken or had been taken by the Subcontractor. A record will be maintained by the Responsible Safety Officer giving the date, discrepancies noted, notifications given, and actions taken by the Subcontractor.

Sub-Contractor Safety

The Responsible Safety Officer is responsible for monitoring the safety performance of the Subcontractor. He/she will usually coordinate visits with the Construction Inspector, or if the Construction Inspector is not available, will carry on the monitoring activities. The Subcontractor's safety performance must be logged by the Responsible Safety Officer, and if necessary referred in writing to the Construction Inspector and the Architect/Engineer for notification to the Subcontractor and subsequent action as appropriate by the Subcontractor.

Sub-Contractor Employees

Except when responding to an emergency, personnel entering a construction site must: Identify themselves to the Construction Inspector and/or Architect/Engineer upon arrival. State the purpose of their visit and the area to be visited. Obey the on-the-job instructions, wear appropriate protective equipment, and follow any special instructions given by the Construction Inspector. Communicate with the Subcontractor only through the Construction Inspector and the Architect/Engineer. Notify the Construction Inspector when their visit is terminated. The Responsible Safety Officer visits to construction sites will normally be limited. Instructions and/or recommendations from the Responsible Safety Officer must be directed to the Subcontractor in the presence of the Construction Inspector. In cases of imminent threat to life safety or severe hazard of injury, the Responsible Safety Officer Inspector may contact the Subcontractor without the presence of the Construction Inspector. Operational problems

relating to the safety will be coordinated by the Responsible Safety Officer and discussed directly with the Construction Inspector and/or with the Architect/Engineer. The Construction Inspector and the Architect/Engineer will notify the Subcontractor of the need to fulfill his responsibilities.

Subcontractors Project Safety Program

The Subcontractor must submit a project safety program for review and acceptance before any on-site activities. The Safety Program must be acceptable to the Responsible Safety Officer, with copies of the accepted program going to the Construction Inspector, the Architect/Engineer, and the Contract Administrator. The subcontractor must comply with all rules and the construction industry safety orders by OSHA.

Pre-Job Construction Conferences

The Construction Inspector must notify the Responsible Safety Officer of the subcontractor's on-site start date and discuss any unusual safety problems with the Responsible Safety Officer and the Architect/Engineer. In addition, Responsible Safety Officer and the Architect/Engineer will discuss any unusual safety problems at a construction pre-start meeting with the Subcontractor.

Fire Permits

The Subcontractor must call the Fire Department for a burn permit and describe where and what is to be burned. A Firefighter must meet with and visit the location with the superintendent where the burning is to take place and will instruct him/her in the precautions to be taken and the placement of fire extinguishers. In case of problems, the Firefighter's first points of contact are the Construction Inspector and the Architect/Engineer. However, in case of immediate fire hazard, he/she will contact the person creating the hazard directly. Fire permits may be issued on an extended basis if appropriate.

Fire Inspections

Construction site fire safety inspections may be made at any time by any authorized representative. All discrepancies or problems observed must be in writing and addressed to the Construction Inspector and the Architect/Engineer.

Stop Work Orders

The [Company] stop work procedure applies to all construction subcontractor activities. It must be used only where life-safety or hazard of severe injury situations exist, or where significant damage to equipment or property could occur if the operation continued. The Construction Inspector or Architect/Engineer of a construction project is responsible for directing the Subcontractor to stop an operation whenever he/she has reason to believe that continuing will lead to injury or damage to [Company] or Subcontractor employees or property. The Responsible Safety Officer is authorized to request the Construction Inspector to have the Subcontractor stop any operation they believe will lead to injury of [Company] or Subcontractor personnel or damage to [Company] or Subcontractor property. All work stoppages must be in writing to the Subcontractor and must reference Safety and Health or the Subcontract's General Conditions, and, if known, the appropriate OSHA regulation. A safety memorandum must be issued by the Responsible Safety Officer after each instance of stopping work, with copies to the Construction Inspector, the Architect/Engineer, and the Contract Administrator. Work must not resume until authorized by [Company] management. An example of a work stoppage situation would be having people working next to an upper-level edge not provided with edge barriers. A stop work notice would be issued and work would not resume until [Company] management was satisfied that proper barriers were in place. When issuing a stop work order, only those areas of the construction project immediately involved in the hazardous situation are included in the order. Differences of opinion between

the Responsible Safety Officer and the Construction Inspector or Architect/Engineer concerning a stop work order must be immediately referred to their supervisors or department heads. The Responsible Safety Officer's recommendations must be followed until the supervisors/department heads make a decision. In the absence of the Construction Inspector, the Responsible Safety Officer must direct the Subcontractor to stop an operation that the Responsible Safety Officer considers perilous to personnel or property. The Responsible Safety Officer must locate the Construction Inspector, the Architect/Engineer, or the department head and notify them of the action taken.

Serious Accidents On Site

In the event of a serious accident on a construction site, the Construction Inspector, Architect/Engineer, or Responsible Safety Officer will determine if all work is to be immediately stopped. If work is stopped, all workmen in the immediate area are to be assembled by the Subcontractor until the Responsible Safety Officer has conducted an initial investigation, collected applicable information from witnesses, and determined whether work may resume. The person stopping work must initiate notification of Responsible Safety Officer and [Company]'s legal Counsel.

Radiation Exposure

Subcontract personnel who plan to work in areas where they may be exposed to ionizing radiation from [Company] operations must receive a personal dosimeter and radiation safety training from the Responsible Safety Officer before work begins. Each dosimeter issued to Subcontractor personnel must be returned at the designated periods and at the conclusions of the job. Training will be handled on a case-by-case basis for each contract. The length of this training will range from 15 minutes to 1 hour, depending on the facility in which work is to be done. The Responsible Safety Officer must be notified of the above situation before work begins so that a determination can be made as to whether dosimeters will be issued and what radiation training will be required.

Excavation and Shoring

Job orders, purchase orders, and subcontracts for excavations that are 5 or more feet deep or are in unstable earth and in which people will work, must specify that shoring is required that is in compliance with 29 CFR 1926, Subpart P, Excavation, which is available from Engineering Department or the Responsible Safety Officer. If it is necessary to deviate from the requirements, a civil engineer registered by the State must submit detailed data to the Responsible Safety Officer for alternative effective shoring and sloping systems. These data shall include soil evaluations, slope stability, and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used.

When sheet piling is to be used, full loading due to ground water table must be assumed unless prevented by weep holes and drains or other means. Additional stringers, uprights, and bracing must be provided to allow for any necessary temporary removal of individual supports. Excavated material must be located at least 2 ft back from the edge of excavations of 5-ft or greater depth and 1 ft back from the edge for excavations less than 5-ft deep. Sloping. Instead of a shoring system, the sides or walls of an excavation may be sloped, if this provides equivalent protection. The degree of sloping is dependent on the type of soil and the depth of excavation. Sloping requirements are shown in 29 CFR 1926, Subpart P, Appendix B. Supervision. Excavation work must always be under the immediate supervision of someone with authority and qualifications to modify the shoring system or work methods as necessary to provide greater safety. A ladder projecting 36 in. above ground surface must be provided for access and exit. Travel distance to the ladder must not exceed 25 ft.

Fire Safety

Introduction

Policy and planning for fire safety at [Company] takes into account the special fire hazards for specific operating areas, the protection of high-value property, and the safety of employees. These ends are met by:

- Non-combustible or fire-rated materials and construction practices suitable to the assigned uses of buildings and facilities.
- Alarm systems and automatic extinguishing systems.
- Availability of suitable hand extinguishers and local hose lines for use before firefighters arrive.
- Access to professional fire department, always staffed and trained in the control of emergencies that could occur at the Company. (The Fire Department makes the initial response to all requests for emergency aid received on the emergency telephone number, 911.)

This chapter covers the fire safety responsibilities of employees and supervisors and sets forth the fire safety rules and procedures.

Fire Department

The Community Fire Department is responsible for protecting people and property from fires, explosions, and other hazards through prevention and expeditious control of such events. In addition, the Fire Department provides first-response rescue and transportation services in medical emergencies. The Fire Department's inspection staff is responsible for ensuring company-wide compliance with fire safety and protection requirements and for reviewing all plans and procedures for compliance with these requirements; for inspecting and testing automatic fire protection and alarm systems and ensuring their maintenance and repair; for conducting fire safety and protection inspections; and for providing fire prevention recommendations. Other responsibilities include training employees in fire safety equipment, practices, and procedures. All these fire protection and response functions are performed in conformance with OSHA regulations, State law, [Company] policies, and nationally recognized standards and guidelines for fire and life safety.

The Fire Chief and the Fire Marshall have the authority to enforce applicable requirements of the Uniform Building Code; the Uniform Fire Code; National Fire Protection Association Codes (including the Life Safety Code), Standards, and Recommended Practices; and the fire protection provisions of OSHA Orders. All employees must immediately report fires, smoke, or potential fire hazards to the Fire Department (dial 911). All employees must conduct their operations in such a way as to minimize the possibility of fire. This means applying rules such as keeping combustibles separated from ignition sources, being careful about smoking, and avoiding needless accumulations of combustible materials. Supervisors are responsible for keeping their operating areas safe from fire.

The Responsible Safety Officer and the Fire Department will provide guidance and construction criteria with respect to fire and life safety as well as inspections. The provision and maintenance of fire detection systems and both automatic and manual fire extinguishing equipment is the responsibility of the Responsible Safety Officer. But the supervisor, who best knows the day-to-day nature of his/her operations, is responsible for notifying the Responsible Safety Officer of operations that change the

degree of fire risk and will therefore require a change in the planned fire protection provisions.

Supervisor Responsibilities

Supervisors must ensure that their personnel are properly instructed regarding potential fire hazards involved in their work and around their workplaces, the proper precautions to minimize fires, and the procedures in case of fire. The local Fire Department and the Responsible Safety Officer also offer formal courses and training materials on fire prevention and response:

- Fire Safety
- Fire-Extinguisher Operation
- Self-Contained Breathing Apparatus

Class A Combustibles

Class A combustibles are common materials such as wood, paper, cloth, rubber, plastics, etc. Fires in any of these fuels can be extinguished with water as well as other agents specified for Class A fires. They are the most common fuels to be found in non-specialized operating areas of the work place such as offices. Safe handling of Class A combustibles means: Disposing of waste daily. Keeping work area clean and free of fuel paths, which can spread a fire, once started. Keeping combustibles away from accidental ignition sources such as hot plates, soldering irons, or other heat or spark-producing devices. Keeping all rubbish, trash, or other waste in metal or metal-lined receptacles with tight-fitting covers when in or adjacent to buildings. (Exception: wastebaskets of metal or of other material and design approved for such use, which are emptied each day, need not be covered.) Using safe ash trays for disposal of smoking materials and making sure that the contents are extinguished and cold to the touch before emptying them into a safe receptacle. Planning the use of combustibles in any operation so that excessive amounts need not be stored. Storing paper stock in metal cabinets and rags in metal bins with automatically closing lids. Making frequent inspections and checks for noncompliance with these rules in order to catch fires in the potential stage.

Class B Combustibles

Class B combustibles are flammable and combustible liquids (including oils, greases, tars, oil-base paints, lacquers) and flammable gases. Flammable aerosols (spray cans) are treated here. Cryogenic and pressurized flammable gases are treated elsewhere in this manual. The use of water to extinguish Class B fires (by other than trained firefighters) can cause the burning liquid to spread carrying the fire with it. Flammable-liquid fires are usually best extinguished by excluding the air around the burning liquid. Generally, this is accomplished by using one of several approved types of fire-extinguishing agents, such as the following: Carbon dioxide ABC multipurpose dry chemical Halon 1301 (used in built-in, total-flood systems) Halon 1211 (used in portable extinguishers) Fires involving flammable gases are usually controlled by eliminating the source of fuel, i.e., closing a valve. Technically, flammable and combustible liquids do not burn. However, under appropriate conditions, they generate sufficient quantities of vapors to form ignitable vapor-air mixtures. As a general rule, the lower the flash point of a liquid, the greater the fire and explosion hazard. It should be noted that many flammable and combustible liquids also pose health hazards. NOTE: The flash point of a liquid is the minimum temperature at which it gives off sufficient vapor to form an ignitable mixture with the air near the surface of the liquid or within the vessel used. It is the responsibility of the user to ensure that all Class B combustibles are properly identified, labeled, handled, and stored. If assistance is required, contact the Responsible Safety Office. Safe handling of Class B combustibles means: Using only approved containers, tanks, equipment, and apparatus for the storage, handling, and use of Class B combustibles. Making sure that all containers are conspicuously and accurately labeled as to their contents. Dispensing liquids from tanks, drums, barrels,

or similar containers only through approved pumps taking suction from the top or through approved self-closing valves or faucets. Storing, handling, and using Class B combustibles only in approved locations, where vapors cannot reach any source of ignition, including heating equipment, electrical equipment, oven flame, mechanical or electrical sparks, etc. Never clean with flammable liquids within a building except in a closed machine approved for that purpose. Never storing, handling, or using Class B combustibles in or near exists, stairways, or other areas normally used for egress. In rooms or buildings, storing flammable liquids in excess of 10 gallons in approved storage cabinets or special rooms approved for the purpose. Knowing the locations of the nearest portable fire extinguishers rated for Class B fires and how to use them. Never smoking, welding, cutting, grinding, using an open flame or unsafe electrical appliances or equipment, or otherwise creating heat that could ignite vapors near any Class B combustibles.

Electrical Fires

There are many combustible materials, including electrical equipment, oxidizing chemicals, fast-reacting or explosive compounds, and flammable metals, which present specialized fire safety and extinguishing problems. Refer to other appropriate chapters of this manual for safe handling advice. If in doubt, request advice from the Responsible Safety Officer.

Welding & Other Permits

As part of the local Fire Department's program to control and reduce fire hazards, a permit system is in effect to cover welding, burning, or other operations with a high fire hazard. Typically, operations that require a permit are: Welding (arc, oxyacetylene, or heliarc) Soldering (which requires an open flame) Use of a torch (for cutting, bending, forming, etc.) Use of tar pots (for road work or roofing, etc.) Open fires for any purpose Spray painting To obtain additional information or to request a permit for these operations, call the Fire Department on its business line, not the emergency 911 number.

Portable Heaters

The use of these devices, whether privately or company owned, is allowed only where there is no chance of causing injury to personnel or of creating a fire hazard. This provision obviously requires common sense in safely locating such devices and ensuring that they do not operate when they are unattended. These devices may not be used in locations where: Flammable or explosive vapors or dusts may be present. Smoking, eating, or drinking are prohibited because toxic or radioactive materials may be present. The area has been designated as unsafe for such devices. The following practices should be carried out when operating portable heating appliances: Do not place the appliance on unstable or readily combustible materials. Maintain a clearance of at least 12 inches between the appliance and combustible materials. Ensure that the appliance is approved by either Underwriters Laboratories, Inc., or Factory Mutual Research Corporation. Connect the appliance directly to a proper electrical outlet using only the cord with which it was originally equipped. Do not use extension cords in lieu of permanent wiring. Do not operate appliances during off hours if they are unattended unless they are controlled by a timer installed by an [Company] electrician. The timer will automatically de-energize the appliance during off hours and energize it not more than 30 minutes before the arrival of personnel. If 24 hour operation is desirable, the proposed operation and arrangement must be reviewed by the local Fire Department and a permit obtained. This permit must be posted near the operating appliance for the information of off-shift personnel who may be checking the area.

Fire Fighting Equipment

This section describes the fixed and portable equipment that is provided in working areas for fire

protection. The fixed equipment includes automatic sprinklers, detectors and alarms, fire doors, etc. The portable equipment consists of fire extinguishers and hoses to be operated by employees before the arrival of the local Fire Department.

Fire Detectors

Several types of automatic fire detectors are used throughout [Company], according to particular needs and purposes. All of them will detect fire (by one of several means) and transmit an alarm to the fire station. In the many buildings equipped with evacuation alarm bells, the automatic detectors activate those alarms, as do the manual pull boxes. In some cases, automatic extinguishing systems are activated by automatic detectors. The Fire Department always dispatches firefighters and apparatus to the scene of any automatically actuated alarm.

Sprinkler Systems

Many buildings are provided with automatic sprinkler systems. The sprinkler heads contain a fusible element (most commonly fused at 212 degrees F) which, on melting, opens the head and starts a spray of water. The resulting flow of water in the piping activates an alarm at the fire station, and firefighters are dispatched. Automatic sprinkler heads can be damaged if they are subjected to mechanical abuse. A protective cage should be installed where such damage is possible. Heat inadvertently applied to the sprinkler head can also activate the sprinkler when no actual fire is present. Normal heat sources should therefore be kept away from sprinkler heads. To avoid decreasing the flow or spread of water or altering the spray pattern, do not allow material or furniture to be located too near the sprinkler head. Allow at least 18 inches of clearance around sprinkler heads. Sprinkler system control valves must be kept accessible for Fire Department use. Allow at least 3 feet of clearance (enough for a man to pass through easily) around such valves.

Alarm System

In most buildings, evacuation alarm bells are automatically activated when fire is detected. They can also be activated manually at strategically located pull boxes. The emergency actions of personnel and the evacuation procedures for each building or operating area are usually set forth in the Operational Safety Procedures for each building and posted near the main entrance or fire exit or elevator. Never use the elevator in case of a fire.

Fire Doors

Automatic fire doors and dampers are provided at strategic points to close and block the spread of smoke and fire when these are sensed by automatic detectors. Automatic fire doors must never be blocked or left in disrepair so that they cannot close and latch automatically as intended in the event of a fire. Self-closing fire doors are those doors designed and installed to close each time after being opened. They too must never be blocked, wedged, or tied open. If such doors must be kept open, the self-closers must be replaced with approved automatic smoke-activated release hold-open devices.

Fire Exits

Exit corridors must not be used for storage. The Life Safety Code, NFPA 101, requires that buildings designed for human occupancy must have continuous and unobstructed exits to permit prompt evacuation of the occupants and allow necessary access for responding emergency personnel. The intent of the Code is to keep exits free from obstructions and clear of combustible materials. Attention to housekeeping, therefore, is very important. "Temporary" storage of furniture, equipment, supplies, or anything else is

not permitted in exit ways. Combustibles, including recyclable waste paper, are not permitted in exit ways. Metal lockers with ends and tops ferried to the walls and that do not interfere with minimum exit width requirements may be installed in exit corridors when approved by the Fire Department and the Responsible Safety Officer.

The following requirements must be met for storage locker/cabinets: Cabinets will be permitted on one side of the corridor only. Cabinets must end at least 6 ft from the corridor exit door. Cabinet ends must be at least 12 in. from the edge of the doorway on the latch side and from the edge of the door leaf when fully opened into the corridor. The cabinets must not be more than 20 in. deep by 37 in. wide by 72-3/4 in. high. The cabinets must be all metal construction with positive latches to prevent spillage of contents in the event of an earthquake. All doors must return automatically to the closed position when not held open manually. A 45 degree-angle fairing must be provided from the wall to the corridor corner of the cabinet. Fairing must be provided at both ends of cabinet or bank of cabinets.

*A 45 degree-angle fairing must be provided at the top of the cabinets from the outside corridor edge of cabinet to the wall. All cabinets must be anchored to the wall firmly enough to withstand 0.5g of lateral acceleration (or a lateral load equal to 1/2 the total dead weight of the cabinet and its contents) in the event of an earthquake. Liquids and chemicals are not to be stored in corridor lockers. All cabinets must be kept locked, with one key being retained by the Building Manager. All cabinets must be labeled with the contents and the name, address, and telephone number of the assigned user. Any deviation from the above requirements must be approved by Responsible Safety Officer.

Fire Hydrants

Fire hydrants are maintained for emergency use by the Fire Department. They must be kept accessible and in good working condition. Certain temporary uses may be authorized in writing by the Chief or Assistant Chief of the Fire Department. An example of such temporary use may be connection by construction contractors. When temporary connections are authorized, the following practices must be observed: Use only valved outlets. Use only a hydrant spanner provided by the Fire Department. (Other types of wrench can damage the wrench flats on the valve stem.) Do not leave connections in place unattended, except at construction sites. Close a hydrant valve 1/8th turn after fully opening it. (This is done so that a person mistakenly turning the valve the wrong way will not cause damage by forcing it.) When replacing the outlet caps after using a hydrant, screw them on only hand-tight.

Mechanical Equipment Rooms

Mechanical equipment rooms contain boilers, blowers, compressors, filters, electrical equipment, etc. Such rooms must be separated from other areas of a building by fire-resistant walls and doors. To maintain the integrity of these separations, the fire doors must never be left open. Fan rooms house ventilation equipment which often includes automatic shut down and dampers activated by interlocking with the building smoke and fire detectors. Fire dampers and other automatic shut-down provisions must not be disabled without Fire Department approval (as for temporary maintenance procedures). Mechanical equipment rooms and fan rooms must not be used for storage of any kind.

Construction Areas

Construction areas under control of either [Company] or outside contractors must be maintained in a fire-safe condition and accessible to emergency response forces.

Life Safety Code

The Life Safety Code of the National Fire Protection Association, NFPA 101, requires that emergency

lighting be provided for means of egress in certain areas. The Code states emergency lighting is required in exit corridors in any office-type building where the building is two or more stories in height above the level of exit discharge. In industrial occupancies such as laboratories and shops, the Code requires emergency lighting in all exit aisles, corridors, and passageways. Emergency lighting may be installed in areas where not required by the Code when such areas present an egress hazard during a power failure. Although elevators are not considered a means of egress within the jurisdiction of the Life Safety Code, they do require emergency lighting. (Titles 8 and 24 require that emergency lighting be maintained in an elevator for a period of at least four hours.) Several types of emergency lights that satisfy the specifications of the Life Safety Code are: Battery Type - Only rechargeable batteries may be used. The rating of the battery must be such that it provides power for illumination for one and one-half hours in the event of a failure of normal lighting. Generator Type - When emergency lighting is provided by an electric generator, a delay of not more than 10 seconds is permitted. Exit sign lights, when burned out, should be reported to Maintenance for service.

Exit Corridors

Exit corridors must not be used for storage. The Life Safety Code, NFPA 101, requires that buildings designed for human occupancy must have continuous and unobstructed exits to permit prompt evacuation of the occupants and allow necessary access for responding emergency personnel. The intent of the Code is to keep exits free from obstructions and clear of combustible materials. Attention to housekeeping, therefore, is very important. "Temporary" storage of furniture, equipment, supplies, or anything else is not permitted in exit ways. Combustibles, including recyclable waste paper, are not permitted in exit ways. Metal lockers with ends and tops ferried to the walls and that do not interfere with minimum exit width requirements may be installed in exit corridors when approved by the Fire Department and the Responsible Safety Officer. The following requirements must be met for storage locker/cabinets: Cabinets will be permitted on one side of the corridor only. Cabinets must end at least 6 ft from the corridor exit door. Cabinet ends must be at least 12 in. from the edge of the doorway on the latch side and from the edge of the door leaf when fully opened into the corridor. The cabinets must not be more than 20 in. deep by 37 in. wide by 72-3/4 in. high. The cabinets must be all metal construction with positive latches to prevent spillage of contents in the event of an earthquake. All doors must return automatically to the closed position when not held open manually. A 45 degree-angle fairing must be provided from the wall to the corridor corner of the cabinet. Fairing must be provided at both ends of cabinet or bank of cabinets.

* A 45 degree-angle fairing must be provided at the top of the cabinets from the outside corridor edge of cabinet to the wall. All cabinets must be anchored to the wall firmly enough to withstand 0.5g of lateral acceleration (or a lateral load equal to 1/2 the total dead weight of the cabinet and its contents) in the event of an earthquake. Liquids and chemicals are not to be stored in corridor lockers. All cabinets must be kept locked, with one key being retained by the Building Manager. All cabinets must be labeled with the contents and the name, address, and telephone number of the assigned user. Any deviation from the above requirements must be approved by Responsible Safety Officer.

No Smoking

Smoking is forbidden in certain areas for fire safety reasons. Such areas include the following: Where flammable gases or liquids are stored, handled, or used. Where significant quantities of combustible materials, such as paper, wood, cardboard, or plastics are stored, handled, or used. Where liquid- or gaseous-oxygen is stored, handled, or used. Within 20 feet of a smoke detector. In tape and record storage vaults and computer equipment areas. Areas that are designated "No Smoking" areas for fire safety reasons are indicated by large rectangular signs consisting of white backgrounds with red letters stating "NO SMOKING."

Kitchen Safety

General Rules

If you can't cook, send out for a pizza. haha

What is Kitchen Safety? It's keeping your kitchen accident-free as you cut, chop, slice, dice, mince, mix and perform other kitchen-related duties. The safety rules presented in this chapter can help prevent accidents that might lead to: Pain and discomfort from cuts, bumps, bruises, burns and more serious mishaps. Disruptions in work schedules, vacation plans and social life. Financial problems due to lost wages and unexpected medical bills.

Simple Prevention

Are Kitchen Accidents really Preventable? Yes... if you're willing to follow a recipe for safety. Kitchen safety is a blend of these basic ingredients: Know-How - Smart workers learn to use equipment the right way. Common Sense - Sensible workers avoid taking dangerous shortcuts and unnecessary risks. A "Can-Do" Attitude - Positive people believe that they can prevent accidents, and they do! Learn more about how you can make safety a specialty of the house.

Use of Care

To help maintain a firm footing in the kitchen, pay special attention to: Floor Surfaces - a slip on a banana peel may create a comic television scene, but in "real life" a slip can be dangerous. To prevent slipping: Clean up any dropped food, spilled liquids and grease immediately. Wear properly fitted, slip-resistant shoes. Clean entire floor thoroughly with a degreasing agent each night. Post a "wet floor" sign when necessary, to alert others to slippery conditions. Aisles/Walkways - Anyone who works in a kitchen understands the need for unobstructed aisles and walkways. Many tripping accidents can be prevented if you: Keep passageways free of carts, boxes, trash cans, mop buckets and other obstacles. Close oven doors immediately after inserting or removing food. To avoid other possible dangers, make sure that you: Use the proper equipment (step stools, stepladders) for reaching upper shelves. Never climb on shelves, boxes or chairs. Don't run or engage in horseplay. Tell your supervisor about any condition that could cause a fall (such as a loose tile, spilled liquids, and inadequate lighting). Remember--people never plan to have accidents, but they can plan to avoid them!

Cuts & Bruises

Cuts and bruises are a common type of kitchen injury. But, you can avoid them by being extra careful with: Knives. Remember to: Keep knives sharp, since dull knives slip easier than sharp ones. Choose the proper knife for the job. Use a cutting board. Wipe knives clean by moving your cloth from the dull edge to the sharp edge. Cut away from your body, and don't hack. (Wear cut-resistant gloves, as recommended.) Let falling knives fall. (Never attempt to catch them!) Store knives in their proper places.

Dishes/Glasses. To avoid breakage: Store glasses and cups upside down. (Never stack them.) Don't pick up several glasses in one hand by inserting your fingers into the glasses. Never put glassware in a sink used for washing pots. If you break a glass item: Use a broom and dustpan, or a damp paper or cloth, (not your bare hands) to pick up the pieces. Drain water before trying to remove glass from a sink. Label some paper with the word "glass." Then wrap the glass in the paper, and discard in the proper receptacle.

Machinery. Be sure that you: Operate machines only if you're trained and authorized. Follow the

manufacturer's instructions for safe operation. Wear a hair net if you have long hair. Keep all guards on equipment. Turn off the switch, and pull the plug before you clean or adjust equipment. Use special care when operating rotating choppers and vertical cutter mixers. Use a wooden tamper when operating food choppers and meat grinders. Avoid putting your hands inside a garbage disposal. (If you must retrieve an object, make sure the power is off!)

To avoid other possible hazards, remember to: Wear gloves, and watch for nails, wires and splinters, if you must handle crates. Use a stiff brush for scrubbing. Steel wool can cause cuts. Wear cut-resistant gloves when cleaning slicers. Remove can lids completely. Pull – don't push – carts through doorways. Keep the work area clean and orderly.

Kitchen Machines

Follow the manufacturer's instructions for the proper use and care of every piece of equipment. Take special precautions with ovens, ranges, steam tables, fryers, pressure cookers, dishwashers, and cleaning agents. Here's how: Ovens: Be especially careful when lighting a gas oven. First, make sure the pilot is lit. Then, stand to one side as you light the oven. Get help when removing heavy pans from hot ovens. Use dry mitts or potholders.

Ranges:

Assume that all objects on the range (and the range itself) are hot. Use dry mitts or potholders to move pots, pans, etc. Keep utensil handles away from burners, and don't let handles stick out beyond the range's edge. Please ask for help if you must move a heavy container full of hot liquid or food. Direct steam away from you when removing the lid of a pot or pan, by raising the far edge of the lid with a mitt or potholder.

Steam Tables:

Tilt food containers away from you as you insert them into the well. Avoid reaching across steam tables when serving food. Turn off the valves when the tables aren't in use. Be sure the equipment is cool before cleaning it. Fryers: Keep grease from building up on fryer and frying area. Do not overfill. Fill to the mark, or not more than 3 inches from the top of the fryer to prevent overflows. Be especially careful when filtering fat.

Pressure Cookers:

Use these devices only if you have properly trained. Keep a close watch on gauges. Always vent the pressure cooker before opening. Dishwashers: Avoid handling very hot dishes with your bare hands. Turn off the steam, and allow the dishwasher to cool before cleaning it. (Spray cold water on the interior to speed the cooling process.) Cleaning Agents can cause burns and other hazards. To avoid possible problems, carefully follow the manufacturer's instructions for their use, and never mix cleaning agents.

Kitchen Lifting

Ease the strain of lifting and moving objects. Muscle and back injuries can be very painful. To help prevent them, follow these guidelines for lifting and carrying, handling heavy or bulky materials, using team lifting, and lifting over your head.

Lifting & Carrying:

Stand close to the object with feet spread for balance. Don't twist your body to get into position. Squat down, keeping your back straight and your knees bent. Grasp the object firmly. Breathe in to inflate your lungs. (This helps support your spine.) Lift smoothly with your legs, slowly straightening them. Then return your back to a vertical position. Hold the object firmly and close to your body as you carry it. Turn by moving your feet, not by twisting your body.

Handling Heavy, Bulky Materials:

Use dollies or hand trucks for moving materials packed in bulky burlap sacks, crates, boxes and barrels. Store heavy, bulky materials on lower shelves, or on pallets. This eliminates the need to lift heavy objects over your head and makes materials easy to reach. "Team" Lifting: Two or more people should work together any time an object must be placed high on a shelf or can't be easily handled by one person. To help ensure that the lift proceeds smoothly, one person should give the signals. Lifting over your head is usually a two-person task. One person may be able to lift a box from the floor to waist level quite easily, because this movement relies on leg muscles. But it may take two people to lift the same box to an overhead shelf, because this motion uses weaker arm and back muscles. (Avoid storing heavy or bulky items on top shelves.)

Kitchen Electric

Don't let electricity shock you! The same electricity that powers so many work-saving appliances can be deadly, unless you treat it with respect. Unplug cords properly by grasping the plug (not the cord) and pulling. Report defective plugs, as well as frayed, worn or broken cords to your supervisor. Don't overload circuits by inserting too many plugs into a single outlet. This could cause an electrical fire. Check ground connections on all electrical appliances. Equipment should be grounded with a 3-prong plug or a separate ground wire. Be sure your hands are dry and your feet aren't in contact with any water, whenever you operate electrical appliances. Clean equipment only after you've turned off the switch and pulled the plug.

Kitchen Fire Safety

Take stock of your fire safety know-how. Thousands of kitchen fires are reported each year. For safety's sake, be familiar with evacuation procedures, how to put out small fires, fire extinguisher use, and prevention techniques. Evacuation Procedures: Plan an escape route that includes at least two fire exits. Know the location of fire alarms. Don't hesitate to use them in emergencies. Post the telephone numbers of emergency response personnel where you can find them quickly.

How to Put Out Small Fires:

Extinguish cooking fires by turning off the range, covering the pan, and removing it from the burner. Smother oven fires by closing the oven door and turning off the heat.

Fire Extinguisher Use:

Know the location of fire extinguishers and know how to use them. Always leave yourself a clear escape path. Have someone call the fire department. (Fire fighting is best handled by trained professionals.) Know the correct type of fire extinguisher to use for each type of fire. Some Prevention Techniques: Clean range hoods and ducts regularly. Keep convection ovens clean. Keep the range free of spilled fats, sugar, sauces, etc. Clean broiler trays containing grease drippings immediately after use. Store combustible materials away from heat sources. Never take chances! If your safety is threatened, get out quickly!

Kitchen First Aid

Know the location of the first-aid cabinet, how to get medical help and how to give basic first aid for cuts, burns, chemicals in the eye, fractures, electrical shock, and sprains and strains.

Cuts - Control **bleeding** by applying direct pressure and elevating the injured area (if there is evidence of a fracture). **Burns** - Immerse minor burns in cold water. Then cover the area with a clean, dry dressing. Do not apply butter, ointment or any homemade remedy.

Chemicals in the Eye - Flood eye with water for 15 minutes. Then cover eye with dry dressing and get medical help immediately.

Fractures - Prevent movement of the injured part, treat for shock, and get medical help as quickly as possible.

Electrical Shock - Turn off the power by pulling the plug or flipping the switch to OFF. Never use wet hands. Then, give mouth-to-mouth resuscitation and CPR, if necessary and if you are trained to do so. Treat for shock and get medical aid.

Sprains & Strains - To reduce swelling, apply an ice pack or ice wrapped in a cloth. Bandage the area (but not too tightly), and elevate the injured part. Do not hesitate to get immediate medical assistance if an accident occurs. Promptly report all injuries to your supervisor.

Tools

Company Provided Tools

[Company] provides hand and powered portable tools that meet accepted safety standards. A damaged or malfunctioning tool must not be used; it must be turned in for servicing and a tool in good condition obtained to complete the job. Employees must use the correct tool for the work to be performed; if they are unfamiliar with the operation of the tool, they must request instruction from their supervisor before starting the job. Supervisors are responsible for ensuring that their subordinates are properly trained in the operation of any tool that they are expected to operate. An employee is not permitted to use a powder-actuated tool unless instructed and licensed by the manufacturer.

Grounding

Tools that are not double-insulated must be effectively grounded and tested. Testing must be accomplished before initial issue, after repairs, and after any incident that could cause damage, such as dropping or exposure to a wet environment. Grounded tools must always be used with an effectively grounded circuit. Any extension cord used with a grounded tool must be a three-wire, grounded type. Electric-powered hand tools used on construction sites, on temporary wired circuits, or in wet environments will be used in conjunction with an approved ground fault circuit interrupter (GFCI). The responsibility for implementing and maintaining this program rests with the individual supervisors involved. Tool testing equipment will be maintained by the Responsible Safety Officer. Documentation of tool testing will be maintained by the group owning powered hand tools. Tools maintained in a tool crib and tested prior to issue are exempted from this requirement. Repairs of defective tools will only be made by qualified electrical personnel.

Shop Rules

Any [Company] facility housing shop tools is defined by OSHA as a shop. It is the responsibility of the person in charge of each shop to ensure compliance with the following practices: Shop machines and tools are to be used only by qualified personnel. It is the responsibility of the person in charge of the shop to render a judgment as to who is qualified. The person in charge will take whatever action is deemed necessary to prevent a personal injury or damage to equipment. Equipment guards and protective devices must be used and must not be compromised. Approved eye protection (visitor's glasses) must be worn by anyone entering and/or passing through shop areas. Approved industrial safety eye protection must be worn by anyone working in a posted shop area. Shoes or boots covering the whole foot must be worn in shop areas. Persons using machine tools must not wear clothing, jewelry, or long hair in such a way as to represent a safety hazard.

Traffic & Transportation

Speed Limits

The speed limit on [Company] property is 25 miles per hour. However, conditions such as road repair, wet weather, poor visibility, and pedestrian traffic may require speeds much lower than 25 mph. All traffic laws are strictly enforced. As a result of high density traffic, limited parking, and general congestion, it is recommended that shuttle buses and transportation services be used whenever possible. These services are convenient and reduce exposure to potential motor vehicle accidents.

Official Vehicle Use

The [Company] requires that an operator hold a valid driver's license for the class of vehicle that he/she is authorized to operate. Persons intending to operate forklifts are required to successfully complete the appropriate course as outlined in this manual.

Responsibility

Each Division Director and Department Head is responsible for restricting the use of Company-furnished vehicles to official Company business only. They are also responsible for limiting use of such vehicles to properly authorized personnel. Use of an official vehicle for an employee's personal convenience or benefit constitutes misuse and is prohibited. Employees who misuse Company vehicles are subject to disciplinary action and financial responsibility for any accident. All drivers of Company vehicles are responsible for reporting any damage or deficiency to the Motor Pool. Repairs, adjustments, and maintenance can only be accomplished if the driver adequately documents and reports these items. Failure to report unsafe vehicle conditions can result in an accident.

Safety Belts

Employees operating or riding in company-furnished vehicles, or personal vehicles on official company business, are required to wear safety belts at all times. The driver should instruct the passengers to fasten their safety belts before operating the vehicle.

Accidents

Any accident involving Company vehicles (included private, rented, or leased vehicles used on official Company business) must be reported to the driver's supervisor. If the driver is unable to make a report, another employee who knows the details of the accident must make the report. It is [Company]'s policy that employees should not admit to responsibility for vehicle accidents occurring while on official business. It is important that such admissions, when appropriate, be reserved for the company and its insurance carrier. The law requires that each driver involved in a vehicle accident must show his/her license on request by the other party. Be sure to obtain adequate information on the drivers involved as well as on the owner of the vehicles. Names, addresses, driver's license numbers, vehicle descriptions, and registration information are essential. In addition, a description of damages is needed for completion of accident reports. If the accident is investigated by off-site police agencies, request that a copy of the police report be sent to [Company], or obtain the name and department of the investigating officer. A printed card titled "In Case of Accident" is kept in each official vehicle to assist in collecting required information. In case of collision with an unattended vehicle (or other property), the driver of the moving vehicle is required by law to notify the other party and to exchange information pertaining to the collision. If unable to locate the other party, leave a note in, or attached to, the vehicle (or other property) giving the

driver's name, address, and vehicle license number. The driver of any [Company] vehicle involved in an accident must also complete a Company Motor Vehicle Accident Report and submit it to his/her supervisor within one work day of the accident. The supervisor should interview the driver and complete the supervisor's portion of the report. Within two work days of the accident, the completed form and vehicle must be taken to the Administration Office so that damages may be estimated and repairs scheduled. Forms for obtaining appropriate information about an accident are carried in the vehicle or may be obtained from Administration. The Responsible Safety Officer will receive copies of all accident reports and will prepare any required OSHA reports.

Warnings & Citations

Any operator of a vehicle at [Company] who violates the State Vehicle Code may be issued a written warning or citation. A warning will include a description of the violation and cite the relevant code section, date, time, location, and the name of the officer issuing the warning. A person who receives such a warning will be called to meet with the Responsible Safety Officer. If more than one warning is issued in a six-month period, the Responsible Safety Officer will normally suspend the offender's driving and parking privileges at the Company. The first suspension will be for a period of one month. If there is a repeat violation, the period of suspension will be for six months. Serious offenses may result in revocation of privileges and may include termination of employment.

Safety Hazards Correction

The Safety Committee reviews all accidents involving Company-furnished vehicles, whether on site or off site, and makes recommendations to have safety hazards corrected. The committee meets periodically to review accidents or to review and consider other issues relating to traffic safety. The committee is also the hearing board for drivers who are involved in vehicle accidents or who have received a warning notice for a moving violation, as noted above. Such drivers may appear before this committee to explain causes of accidents or violations.

Parking

Here are the parking designations in use at [Company]:

- Red Zones: No stopping, standing, or parking.
- Yellow Zones: Stopping only for the purpose of loading or unloading passengers or freight.
- Green Zones: Limited time parking.
- Government Vehicles: Official vehicles only.
- Reserved Parking: Vehicle with designated license number only.
- Time Zone Lanes: All vehicles must be prepared to move at the time indicated.
- Compact Car: Vehicle must not extend beyond rear limit line.
- General Parking: Vehicles must be parked in designated places only and must not extend beyond the edge of road, stripes, or rear limit lines.

Violators of the above parking rules will be issued a warning notice, order-to-show cause, or citation.

Off-Site Safety

Off-Site Operations

Off-site operations are those performed away from the Company and for which [Company] personnel have responsibility in one or more of the following fields: design, test, transportation, assembly, operation, maintenance, disassembly, and storage or removal of equipment.

All off-site operations must be reviewed to determine if an Operational Safety Procedure (OSP) is required. The OSP will be reviewed by the Responsible Safety Officer. Personnel contemplating off-site operations must give written notification of the nature and scope of the project to the Responsible Safety Officer. This notification must be made as soon as possible after the project is approved. The OSP will be reviewed by the Responsible Safety Officer.

The Responsible Safety Officer may visit off-site operations in order to:

- Observe local conditions.
- Inspect facilities prior to operation. Evaluate periodically operating procedures and modifications.
- Evaluate procedures for disassembly, transportation, and storage.

When [Company] employees are injured or become ill during off-site operations, the following procedure should be used: Employees should obtain appropriate treatment by a nearby physician or hospital staff. Those rendering care should be informed that the injury is work related. The Responsible Safety Officer should be informed so the proper injury report can be prepared.

Boating & Driving

Group leaders and/or supervisors of employees planning to engage in marine boating or diving operations as part of a work assignment must contact the Responsible Safety Officer for guidelines and safety procedures relevant to their specific operation. An “Application for Vessel Use” must be filled out and reviewed by the Responsible Safety Officer for each vessel to be used for boating or diving operations.

Reference standards for safe boating and diving operations are the following:

- Rules and Regulations for Small Passenger Vessels (under 100 gross tons), U.S. Department of Transportation, Coast Guard 323, 1977.
- Navigation Rules: International-Inland, U.S. Department of Transportation, Coast Guard, Series M6672.2 (supersedes Coast Guard 169), 1982.
- Research Vessel Safety Standards, University-National Oceanographic Laboratory System, Woods Hole Oceanographic Institute, Woods Hole, MA, May 1976. Commercial Diving Operations Policy and Procedure, 29 CFR 1910, Subpart T, Vol. VI, No. 36, August 18, 1980.

Biological Hazards

Definitions

By law, an infection control plan must be prepared by every person that handles, stores, uses, processes, or disposes of infectious medical wastes. This infection control plan complies with OSHA requirement, 29 CFR 1910.1030, Blood Borne Pathogens. The plan includes requirements for personal protective equipment, housekeeping, training, and a procedure for reporting exposures. Biological Hazard. The term biological hazard or bio-hazard is taken to mean any viable infectious agent (etiologic agent) that presents a risk, or a potential risk, to the well being of humans. Each supervisor has identified the specific biological hazard associated with your job, and the supervisor will arrange for your training if necessary. Etiologic Agents.

The United States Department of Health and Human Services, Public Health Service, Classification of Etiologic Agents on the Basis of Hazard, is the classification system used at [Company] for etiologic agents. Medical Wastes/Infectious Wastes. All laboratory waste emanating from human or animal tissues, blood or blood products or fluids; all cultures of tissues or cells of human origin or cultures of etiologic agents; specimens of human or animal parts or tissues removed by surgery, autopsy, or necropsy. Universal Precautions. Refers to a system of infectious disease control that assumes that every direct contact with body fluids is infectious and requires every employee exposed to be protected as though such body fluids were infected with blood-borne pathogens. All infectious/medical material must be handled according to Universal Precautions (OSHA Instruction CPL 2-2.44A)

General Procedures

The following procedures must be followed by personnel when in medical or biological rooms or laboratories. All supervisors must ensure that their staff is trained in proper work practices, the concept of universal precautions, personal protective equipment, and in proper clean-up and disposal techniques. Resuscitation equipment, pocket masks, resuscitation bags, or other ventilation equipment must be provided to eliminate the need for direct mouth to mouth contact in groups where resuscitation is a part of their responsibilities. Eating, drinking, smoking, applying cosmetics or lip balm, and handling contact lenses are prohibited in work areas where there is a potential for exposure to any health hazard. Food and drink must not be stored in refrigerators, freezers, or cabinets where blood or other potentially infectious material is stored or in other areas of possible contamination.

In infectious disease laboratories, the following requirements apply to utility rooms and attics serving these laboratories: Only authorized employees, participating guests, students, and visitors are permitted to enter. All surplus materials and equipment must be kept out of these rooms. Drinking fountains must be the sole source of drinking water for humans. Masks and eye protection are required when contact of mucosal membranes (eyes, mouth or nose) with body fluids is likely to occur (e.g., splashes or aerosolization). According to the level of risk, wearing laboratory or protective clothing may be required for persons entering infectious disease laboratories. Likewise, showers with a germicidal soap may be required before exit. Gowns, aprons, or lab coats must be worn whenever there is a possibility that body fluids could splash on skin or clothing.

Gloves

Gloves must be made of appropriate disposable material, usually intact latex or vinyl. They must be used in the following circumstances: When the employee has cuts, abraded skin, chapped hands, dermatitis, or

similar conditions. During instrumental examination of the oropharynx, gastrointestinal (G.I.) tract, and genitourinary (G.U.) tract. When examining abraded or non-intact skin of a patient with active bleeding. While handling blood or blood products or other body secretions during routine laboratory procedures. Employees must wash their hands immediately, or as soon as possible, after removal of gloves or other personal protective equipment and after hand contact with blood or other potentially infectious materials.

All personal protective equipment must be removed immediately upon leaving the work area, and if this equipment is overtly contaminated, it must be placed in an appropriate area or container for storage, washing, decontamination, or disposal. Contaminated laboratory clothing must not be worn in clean areas or outside the building. Only disposable Luer-lok syringes and needles may be used. All procedures involving blood or other potentially infectious agents must be performed in a manner that will minimize splashing, spraying, and aerosolization. Individuals must not work alone on any hazardous operation. All employees working with radiation or radioactive materials are required to receive training.

Medical Wastes

Medical/infectious waste must be segregated from other waste at the point of origin. Medical/infectious waste, except for sharps (i.e., razor blades, broken glass, needles, etc.) capable of puncturing or cutting, must be contained in double disposable red bags conspicuously labeled with the words “INFECTIOUS WASTE” and “BIO-HAZARD.” Used needles or other sharps (razor blades, broken glass, scalpels, etc.) must not be sheared, bent, broken, recapped, or re-sheathed. Infectious sharps must be contained for disposal in leak-proof, rigid puncture-resistant containers [available from [Company]] Infectious waste contained as described above must be placed in reusable or disposable leak-proof bins or barrels that are conspicuously labeled with the words “INFECTIOUS WASTE” and “BIO-HAZARD.” These waste barrels are picked up regularly by an outside company licensed to handle infectious wastes. All infectious agents, equipment, or apparatus must be disinfected in an autoclave or otherwise disinfected before being washed or disposed of.

Each individual working with infectious bio-hazardous agents is responsible for disinfection and disposal of these agents. Mixed waste that includes biological/infectious waste and radioactive waste must be disinfected by a person trained in radioisotope safety and waste disposal procedures. After disinfection call the Responsible Safety Officer for disposal. Biological wastes that do not contain radioactive or hazardous substances may be disinfected by steam sterilization (autoclave) then disposed of in the regular trash. Liquid bio-hazardous waste may be disposed of in the sewage system following chemical decontamination.

Reusable glassware must be decontaminated in sodium hypochlorite (household bleach) solution (1:9) prior to rinsing and acid washing. The glassware must then be sterilized in an autoclave. To minimize the hazard to firefighters or emergency response personnel, at the close of each work day and before the building is closed, all infectious or toxic material must be placed in a refrigerator, placed in an incubator, or autoclaved or otherwise disinfected.

Infectious agents must not be placed in an autoclave and left overnight in anticipation of autoclaving the next day. All laboratory rooms containing infectious substances must have designated separate areas or containers labeled “INFECTIOUS – TO BE AUTOCLAVED” or “NOT INFECTIOUS – TO BE CLEANED.” All infectious disease work areas, including cabinets, must be prominently marked with the Bio-hazards Warning Symbol. Floors, laboratory benches, and other surfaces in buildings where infectious agents are handled must be disinfected with a suitable germicide, such as 1:9 sodium hypochlorite solution (household bleach) as often as necessary as determined by the supervisor. The surroundings must be disinfected after completion of operations involving planting, pipetting, centrifuging, and similar procedures with infectious agents. Floor drains throughout the building must be flooded with water or disinfectant at least once each week to fill traps and to prevent sewer gases from escaping. Floor drains in new construction must be omitted wherever possible.

Water used to mop floors must contain a disinfectant. Wet mopping or the use of vacuum cleaners equipped with high-efficiency filters is the preferred method of cleaning floors. Avoid sweeping when possible.

Stock solutions of suitable disinfectants must be maintained in each laboratory. Laboratories must be sprayed with insecticides as often as is necessary to eliminate flies and other insects. Protection against vermin must be provided at all building exterior openings. Infectious agents must not be dumped into the building drainage system without prior disinfection.

Mechanical garbage disposal units must not be used to dispose of contaminated wastes. Mechanical disposal units release considerable amounts of aerosol.

Working with Infectious Agents

All procedures using infectious agents that may generate aerosols must be performed in a ventilated safety cabinet. These procedures include opening test tubes, flasks, and bottles; using pipettes; making dilutions; inoculating; necropsying animals; grinding; blending; opening lyophile tubes; operating a sonic vibrator; and operating a standard table model centrifuge, etc. A safety box or safety shaker tray must be used to house or safeguard all containers of infectious agents placed on shaking machines. A safety centrifuge cabinet or safety centrifuge cup must be used to house or safeguard infectious agents during any centrifuging operation. When centrifuging is performed in a ventilated cabinet, the glove panel must be in place with the glove ports covered. An operating centrifuge creates reverse air currents that may permit an infectious agent to escape from an open cabinet.

A respirator must be worn when changing a glove or gloves attached to a cabinet whenever there is any possibility that an infectious aerosol may be present in the cabinet. All pipetting must be carried out with the aid of a rubber bulb or other vacuum assist device. Mouth pipetting is strictly forbidden. Infectious bio-hazardous mixtures must not be prepared by bubbling expiratory air through a liquid with a pipette. Infectious bio-hazardous agents must not be blown out of a pipette. Infectious bio-hazardous agents must not be mixed by pipetting. Contaminated pipettes must be placed horizontally in a pan containing enough suitable disinfectant to allow complete immersion. Contaminated pipettes must not be placed vertically in a cylinder. The pan and pipettes must be disinfected in an autoclave as a unit and replaced in a clean pan with fresh disinfectant.

Broth cultures must be taken in a manner that avoids wetting the plug or cap. If the plug or cap is exposed, it must be disposed of in the proper container or disinfected. Before centrifuging, the tubes must be inspected for cracks and the inside of the trunnion cup must be inspected for rough walls caused by erosion or adhering matter. Bits of glass, if any, must be removed from the rubber cushion. A germicidal solution added between the tube and trunnion cup disinfects the outer surface of both, and also provides an excellent cushion against shocks that might otherwise break the tube. Decanting centrifuge tubes should be avoided. If it must be done, wipe off the outer rim with a disinfectant to prevent the infectious fluid from spinning off as an aerosol. The tube should not be filled to the point where the rim will become wet with culture. Water baths and Warburg baths used to inactivate, incubate, or test infectious agents must contain disinfectant. For cold water baths, 70% propylene glycol is recommended. When a building vacuum line is used, suitable traps or filters must be interposed to ensure that pathogens do not enter the fixed vacuum system. Deep freeze and dry ice chests and refrigerators must be inspected and cleaned periodically to remove any broken ampules, tubes, etc., that may contain infectious agents. Rubber gloves and respiratory protection must be worn during this cleaning. All infectious or toxic agents stored in refrigerators or deep freezers must be properly labeled. All virulent fluid cultures or viable powdered infectious agents in glass vessels must be transported, incubated, and stored in easily handled, non-breakable, leak-proof containers that are large enough to contain all the fluid or powder if the glass vessel leaks or breaks. All inoculated Petri plates or other inoculated solid media must be transported and incubated in leak-proof pans or other leak-proof containers. Care must be exercised in the use of

membrane filters to obtain sterile filtrates of infectious materials. Because of the fragility of the membrane and other factors, such filtrates must not be handled as non-infectious until culture or other tests have proved their sterility.

Cuts

If an employee has a needle stick, cut, or mucous membrane exposure to body fluids he/she must report the incident immediately to the Responsible Safety Officer.

Blood Exposure

All employees exposed to human blood and blood products must report to the Responsible Safety Officer for information and possible inclusion in the Hepatitis B Immunization Program.

Experimentation

The Responsible Safety Officer provides oversight and auditing for experimentation with recombinant DNA or an infectious biological hazard. Experimentation of bio-hazardous agents involving animals must meet the strict guidelines set forth in the Animal Welfare Act of 1970. The implementing rules and regulations appear in the Code of Federal Regulations, Title 9. Any experimentation of bio-hazardous agents with animals must be approved prior to experimentation.

Infection Control Plan

The purpose of the Infection Control Plan is to protect the health and safety of the persons directly involved in handling the materials, [Company] personnel and the general public by ensuring the safe handling, storage, use, processing, and disposal of infectious medical waste. This plan complies with OSHA requirement proposed for 29 CFR 1910.1030, Blood Borne Pathogens. Medical wastes/Infectious wastes: All laboratory waste emanating from human or animal tissues, blood or blood products or fluids; all cultures of tissues or cells of human origin or cultures of etiologic agents; specimens of human or animal parts or tissues removed by surgery, autopsy, or necropsy. Universal precautions: Refers to a system of infectious disease control which assumes that every direct contact with body fluids is infectious and requires every employee exposed to be protected as though such body fluids were infected with blood-borne pathogens. All infectious/medical material must be handled according to Universal Precautions (OSHA Instruction CPL 2-2.44A).

The following universal precautions must be taken.

1. Gloves must be made of appropriate disposable material, usually intact latex or vinyl. They must be used: a. when the employee has cuts, abraded skin, chapped hands, dermatitis, or the like. b. during instrumental examination of the oropharynx, gastrointestinal (G.I.) tract, and genitourinary (G.U.) tract. c. when examining abraded or non-intact skin of a patient with active bleeding. d. while handling blood or blood products or other body secretions during routine laboratory procedures.
2. Gowns, aprons, or lab coats must be worn when splashes of body fluid on skin or clothing are possible.
3. Mask and eye protection are required when contact of mucosal membranes (eyes, mouth or nose) with body fluids is likely to occur (e.g. splashes or aerosolization).
4. Resuscitation equipment, pocket masks, resuscitation bags, or other ventilation equipment must be provided to eliminate the need for direct mouth to mouth contact. (This statement is required for groups where resuscitation is a part of their responsibility such as a Fire Department or Police or Medical Emergency Services).

5. Phlebotomy: Gloves must be available for use by phlebotomists.
6. Pipetting: All pipetting must be carried out with the aid of a rubber bulb or other vacuum assist device. Mouth pipetting is strictly forbidden.

Waste Disposal Plan

1. Medical/Infectious waste must be segregated from other waste at the point of origin.
2. Medical/Infectious waste, except for sharps (e.g. razor blades, broken glass, needles, etc.) capable of puncturing or cutting must be contained in double disposable red bags conspicuously labeled with the words, "INFECTIOUS WASTE – BIO-HAZARD."
3. Infectious sharps must be contained for disposal in leak-proof, rigid puncture resistant containers (available from [Company]).
4. Infectious waste thus contained as described in procedures 2 and 3 above must be placed in reusable or disposable leak-proof bins or barrels which must be conspicuously labeled with the words, "INFECTIOUS WASTE – BIO-HAZARD." These waste barrels are to be picked up regularly by an outside company licensed to handle infectious wastes.
5. Mixed waste that includes biological/infectious waste and radioactive waste must be disinfected by a person trained in radioisotope safety and waste disposal procedures. After disinfection call the Responsible Safety Officer for disposal.
6. Spills/Disinfectants: a solution of sodium hypochlorite (household bleach) diluted 1:9 with water must be used to disinfect, following initial clean-up of a spill with a chemical germicide approved as a hospital disinfectant. Spills must be cleaned up immediately.
7. After removing gloves, and/or after contact with body fluids, hands and other skin surfaces must be washed thoroughly and immediately with soap or other disinfectant in hot water.
8. Other biological wastes that do not contain radioactive or hazardous substances may be disinfected by steam sterilization (autoclave) and then disposed of in the regular trash.
9. Liquid bio-hazard waste may be disposed of in the sewage system following chemical decontamination.
10. Reusable glassware must be decontaminated in sodium hypochlorite (household bleach) solution (1:9) prior to rinsing and acid washing. Then the glassware must be sterilized in an autoclave. All supervisors must ensure that their staff is trained in proper work practices, the concept of universal precautions, personal protective equipment, and in proper clean-up and disposal techniques.

Carcinogens

Introduction

This section of the Safety Manual describes the recommendations and requirements established to govern the use of substances that pose a carcinogenic risk. All personnel using chemical carcinogens are expected to be familiar with these guidelines and conduct their operations accordingly.

Categories of Carcinogens

OSHA has divided this list of carcinogens into the following three categories: 1. Human Carcinogens: Those materials for which there is sufficient evidence of carcinogenicity from studies of humans to indicate a causal relationship between the agents and human cancer. 2. Human Suspect Carcinogens: Those materials with limited evidence of carcinogenicity in humans and generally substantiated evidence as animal carcinogens. 3. Animal Carcinogens: Those materials that have sufficient evidence of carcinogenicity from studies of experimental animals cancer in humans and/or animals. However, since many are not well studied, less hazardous than one designated as a human carcinogen. Below is a partial list of chemical carcinogens which may be found in use at [Company]. A complete list is available from the Responsible Safety Officer. Chemical Name/ Reference

Confirmed Human Carcinogens:

ACRYLONITRILE OSHA AMINODIPHENYL; 4- IARC, NTP, ACGIH ARSENIC AND ARSENIC COMPOUNDS IARC, NTP, OSHA ASBESTOS IARC, NTP, ACGIH BENZENE IARC, NTP BENZIDINE IARC, NTP, ACGIH BIS(CHLOROMETHYL)ETHER IARC, NTP, ACGIH CHLORAMBUCIL IARC, NTP CHLOROMETHYL METHYL ETHER IARC, NTP CHROMIUM (VI) COMPOUNDS IARC, NTP, ACGIH DIBROMO-3-CHLOROPROPANE; 1,2- OSHA NAPHTHYLAMINE; 2- IARC, NTP, ACGIH NITRODIPHENYL; 4- ACGIH VINYL CHLORIDE IARC, NTP, ACGIH

Suspected Human Carcinogens:

ACETYLAMINOFLUORENE; 2- OSHA AFLATOXINS IARC, NTP, ACGIH BENZO(A)PYRENE ACGIH, IARC BERYLLIUM AND BERYLLIUM COMPOUNDS IARC, NTP, ACGIH BUTADIENE; 1,3- ACGIH CADMIUM AND CADMIUM COMPOUNDS NTP CARBON TETRACHLORIDE ACGIH CHLOROFORM ACGIH DICHLOROBENZIDINE; 3,3'- ACGIH, OSHA DIMETHYL SULFATE ACGIH, IARC DIMETHYLAMINOAZOBENZENE; 4- OSHA

Responsibilities

The responsibilities of various groups involved with chemical safety at [Company] are described below.

Responsible Safety Officer: Determines if the use of a carcinogen creates a significant potential for occupational exposure. Evaluates operations for compliance with OSHA mandated standards. Provides technical guidance to personnel regarding the selection of appropriate laboratory practices and engineering controls. Investigates all reported incidents that result in exposure of personnel or the environment to chemical carcinogens and recommends corrective actions to reduce the potential for recurrence. Supervises cleanup operations where incidents have resulted in significant contamination of laboratory areas or personnel. Updates and transmits list of carcinogens to the Purchasing Department

Authorizes issue of carcinogens stocked at the [Company] Storeroom. Purchasing Department: Specifies special distribution procedures and purchase orders for carcinogens.

Materiels Management Department: Obtains approval from the Responsible Safety Officer before issuing carcinogens.

Receiving Department: Notifies the Responsible Safety Officer of the receipt of carcinogens designated for special distribution (Distribution Category A).

Supervisor: Employs and ensures the use of appropriate practices, engineering controls, and personal protective equipment that reduce the potential for exposure as low as reasonably achievable. Informs employees under his/her supervision of the potential hazards associated with the use of carcinogens and provides proper training and instruction in the use of laboratory practices, engineering controls, and emergency procedures. Reviews operating procedures with the Responsible Safety Officer before the initiation of an operation or when significant changes occur in an ongoing operation. Reports to the Medical Services Department any incident that involves the exposure of personnel to carcinogens. Reports to the Responsible Safety Officer any incident that results in danger of environmental contamination from carcinogens. Provides any necessary assistance during accident investigations.

Other Company Personnel: Know and comply with safety practices required for the assigned task. Wear appropriate protective clothing. Report all unsafe conditions to the laboratory supervisor. Attend appropriate training in safety procedures for handling and using carcinogenic materials. Report to the Responsible Safety Officer when pregnant to review working conditions. Report to the immediate supervisor and the Responsible Safety Officer all facts pertaining to incidents resulting in exposure to carcinogens or in environmental contamination.

Practices & Controls

The practices and engineering controls included in this section provide general safeguards that are recommended for the use of chemical carcinogens. To select the appropriate safeguards, knowledge is required of the physical and chemical properties, the proposed use, the quantity needed, the carcinogenic and other toxic hazards, and the applicable health and safety standards. Careful judgment is therefore essential in planning any activity that involves chemical carcinogens. Personnel within the Responsible Safety Officer's Department are available to assist the laboratory supervisor in selecting the appropriate safeguards. Carcinogen Safety Data Sheets provide details of chemical and physical properties, hazards, and safe operational procedures for specific carcinogens.

- Wear gloves appropriate to the task. Discard after each use and immediately after any obvious contact.
- Wear appropriate eye protection. The type of eyewear used will depend upon the hazard presented by the operation and chemical in use. Contact lenses should be removed.
- Do not eat, drink, smoke, chew gum or tobacco, apply cosmetics carcinogens are used or stored. Do not pipette by mouth -- use mechanical aids.
- Wash hands immediately after the completion of any procedure. Wash immediately after an exposure, or if appropriate, shower the affected area.
- Provide respirators for emergency use. (Personnel who will use respirators must have medical approval and be properly trained before use.)

Operational Practices: Label all primary and secondary containers and place warning signs on entrances to work or storage areas. To obtain appropriate labels and signs, call the Responsible Safety Officer. Limit entry to only personnel authorized by the supervisor for entry to work or storage areas. Women who are pregnant must consult with the Medical Services Department before the start of any activity involving chemical carcinogens.

Maintenance and Emergency Storage Areas: Cover work surfaces with stainless steel or plastic trays, absorbent paper with a moisture-proof lining, or other impervious material. Decontaminate or discard the protective covering materials after the procedure has been completed. Conduct aerosol-generating procedures or procedures involving volatile carcinogens in a chemical fume hood, a glove box, or other suitable containment equipment.

Examples of aerosol-producing operations opening of closed vessels; transfer operations; preparation of mixtures; blending; sonification; open vessel centrifugation. Capture vapors or aerosols produced by analytical instruments with local exhaust ventilation or ventilation into a chemical fume hood. Decontaminate obviously contaminated equipment. Transfer carcinogens in tightly closed containers placed within a durable outer container. Maintain an inventory of all carcinogens including the quantities acquired, dates of acquisition, and disposition. Keep working quantities to a minimum; do not exceed the amounts required for use in one week. This does not include amounts stored in a designated area or a central cabinet. Dissolve finely divided powdered carcinogens, if possible, into a liquid. This reduces the possibility of generating an aerosol. Use mixtures that are as dilute as possible.

Place contaminated materials in a closed plastic bag and sealed primary container. Place the primary container in a durable box before transporting. Label each primary container with content, amount, physical state, and percentage breakdown when dealing with a mixture. Each box must have a complete list on contents or description written on an official Hazardous Material packing list. To obtain blank packing lists, contact the Responsible Safety Officer.

Chlorinated Hydrocarbons

The chlorinated hydrocarbons as a whole have many industrial as well as laboratory uses. At [Company] they are commonly used as cleaners, degreasers, paint removers, solvents, and extractants.

Hazards

Most of these compounds have an anesthetic (narcotic) effect, causing workers to feel "drunk," become unconscious, or even die if the amount of inhaled vapor is excessive. Individuals working around moving machinery can be subject to accidents when their judgment and coordination are impaired by the anesthetic effects of inhaled solvents. Usually it is the anesthetic effect that is responsible for sudden unconsciousness of persons exposed to solvents in tanks, pits, and other confined spaces. Trichloroethylene, ethylene dichloride, and chloroform are examples of compounds that are powerful anesthetics. Some, but not all, of the chlorinated hydrocarbons are strong poisons that damage the liver, kidneys, nervous system, and/or other parts of the body. This damage may be permanent or even cause death, although recovery from lesser exposures does occur.

Single exposures to higher concentrations of vapors, as well as repeated exposure to small concentrations can produce symptoms of poisoning. These symptoms most often come on gradually, with nausea, loss of appetite, vomiting, headaches, weakness, and mental confusion most often noted. Carbon tetrachloride, tetrachloroethane, and 1,1,2-trichloroethane are examples of compounds that are strong poisons. All chlorinated hydrocarbons on repeated contact with the skin can cause rashes (dermatitis) because of their ability to remove the protective fats and oils from the skin. A few of these solvents are known to be capable of entering the body through contact with the skin.

In addition, many of these compounds are highly irritating to the membranes around the eyes and in the nose, throat, and lungs. Examples of chlorinated hydrocarbons that have irritant properties are ethylene dichloride and chloroform. Some compounds are human suspect carcinogens, such as carbon tetrachloride and chloroform. In studies on laboratory animals, several chlorinated hydrocarbons have been linked to the production of cancer. These compounds are ethylene dichloride, perchloroethylene, and trichloroethylene. At present, there is no direct evidence associating these compounds with an increased

risk of cancer in humans. When heated, these compounds can decompose, forming highly toxic fumes of phosgene, hydrochloric acid, and chlorine. Most of the chlorinated hydrocarbons are nonflammable; however, there are exceptions.

The Table below lists important characteristics of some of the common chlorinated hydrocarbon solvents.

TLV Volatility*

Common name Flammability	Chemical name (ppm)** (mm Hg)
Acetylene dichloride 1,2-dichloroethylene 200 200	
Moderate Carbon tetrachloride***	Tetrachloromethane 5 115
Nonflammable Chloroform***	Trichloromethane 10 200
Nonflammable Ethylene dichloride 1,	2-dichloroethane 10 80
Moderate Methyl chloroform 1,1,	1-trichloroethane 350 132
Nonflammable Methylene chloride	Dichloromethane 100 435
Nonflammable Perchloroethylene	Tetrachloroethylene 50 18
Nonflammable Tetrachloroethane 1,1,2,	2-tetrachloroethane 1 8
Nonflammable Trichloroethane 1,1,2,	-trichloroethane 10 25
Nonflammable Trichloroethylene	Trichloroethylene 50 76

* The threshold limit value (TLV) is expressed as parts of pure solvent vapors per million parts (ppm) of air.

** The vapor pressure at 77F (25C).

*** Designated as a carcinogen by OSHA.

Because of their inherent properties, these compounds are harmful to varying degrees. For questions concerning the hazards of a specific compound, contact the Responsible Safety Officer.

Precautions

The above table includes information on the TLV, the volatility, and the flammability of the compounds listed. These three characteristics always must be taken into careful consideration in selecting a compound in order to minimize the health hazards connected with its use. 1,1,1-trichloroethane (ethyl chloroform) is recommended for degreasing operations. If there is a possibility of skin or eye contact, wear the appropriate protection equipment. Gloves made of impervious material should be worn for hand protection. Barrier creams are in no instance as protective as impervious gloves. However, if finger dexterity is an absolute requirement, a solvent resistant ointment may be used in some instances. For high vapor concentrations, control by local exhaust ventilation or chemical fume hoods is necessary.

Chlorinated hydrocarbons should be stored in cool, dry, and well-ventilated areas. Containers should be checked for leaks because metal corrosion can occur from hydrochloric acid produced by the decomposition of the solvent. Decomposition may occur under conditions of high temperature, exposure to moisture, and exposure to ultraviolet light. Compounds, both in the original containers and in containers used by employees, should be labeled so that the potentially injurious substances are plainly identified. Labels for perchloroethylene, trichlorethylene, 1,1,1-trichloroethane, and carbon tetrachloride can be obtained at the [Company] Central Storeroom. Chlorinated hydrocarbons must be placed in an organic liquid waste can for disposal. When the waste can is full, Decontamination and Waste Disposal personnel must be called to pick it up.

Fiberglass

Fiberglass is found in many materials (such as flexible duct, Nema G-10, and electrical wire insulation) used at the Company.

Hazards

Irritation of the exposed skin, a common complaint among persons working with this material, is the result of the mechanical irritation from small glass fibers. The sensation varies from an itch to a prickling or burning sensation. Common locations involved are the arms, face, or neck. Another cause of dermatitis is contact with fiberglass binders or coating materials. Except for skin irritation, there is no other known health hazard associated with exposure to fiberglass particles. Results of medical research, including examinations of hundreds of persons who have worked in fiberglass plants for as long as 25 to 30 years, give evidence that fiberglass is inert and noninjurious to the person's overall health. It will not cause silicosis.

Precautions

Persons with skin problems should consult the Medical Services Department before working with fiberglass. Wear loose-fitting clothing and change daily. Adherent fibers on the skin should be washed off with an ample amount of lukewarm or cool water. Air hoses and brooms should not be used to clean off fibers from the body because these methods may drive the fibers deeper into the skin. Showering at the end of a work shift is advisable. Plastic binders should be fully cured before working on fiberglass laminates. Use vacuum pickup units when machining fiberglass parts. Practice good housekeeping. Some skin protective creams may be of benefit. At home, clothing should be washed separately in a tub or basin. Washing machines should not be used. Ideally, rubber gloves should be worn. The tub or basin should then be fully rinsed.

Flammable Liquids

Class B combustibles are flammable and combustible liquids (including oils, greases, tars, oil base paints, lacquers) and flammable gases. Flammable aerosols (spray cans) are also treated here. Water should not be applied to fire in a Class B combustible. The use of water may float burning liquids, causing the fire to spread more rapidly. Class B fires are usually extinguished by excluding the air around the burning liquid. This is accomplished by one of several approved types of fire extinguishing agents, e.g., carbon dioxide, ABC multipurpose dry chemical, and Halon 1301 (a vaporizing liquid that breaks the flame front). Technically, flammable and combustible liquids do not burn. However, under appropriate conditions, they generate sufficient quantities of vapors to form ignitable vapor-air mixtures. As a general rule, the lower the flash point of a liquid, the greater the fire and explosion hazard. (The flash point of a liquid is the minimum temperature at which it gives off sufficient vapor to form an ignitable mixture with the air near its surface or within its containment vessel.) Many flammable and combustible liquids also pose health hazards. It is the responsibility of the user to ensure that all Class B combustibles are properly identified, labeled, handled, and stored. If assistance is required, contact the Responsible Safety Officer Safety.

Classifications

Flammable and combustible liquids are defined and divided into classes as shown below. Flammable Liquids (Class I). Liquids having flash points below 100F (37.8C) and having vapor pressures not exceeding 40 pounds per square inch (absolute) at 100F (37.8C).

Flammable Class I liquids are subdivided as follows:

Class IA. Liquids having flash points below 73F (22.8C) and boiling points below 100F (37.8C).

Flammable aerosols (spray cans) are included in Class IA.

Class IB. Liquids having flash points below 73F (22.8C) and having boiling points at or above 100F (37.8C).

Class IC. Liquids having flash points at or above 73F (22.8C) and below 100F (37.8C). Combustible Liquids (Classes II and III). Liquids having flash points at or above 100F (37.8C).

Combustible liquids in Class II and Class III are subdivided as follows:

Class II. Liquids having flash points at or above 100F (37.8C) and below 140F (60.0C).

Class IIIA. Liquids having flash points at or above 140F (60.0C) and below 200F (93.4C).

Class IIIB. Liquids having flash points at or above 200F (93.4C).

Unstable (Reactive) Liquids.

These are liquids that in the pure state, or as commercially produced or transported, will vigorously polymerize, decompose, combine, or become self-reactive under conditions of shock, pressure, or temperature. Use of such materials must have prior approval from the Responsible Safety Officer on a case-by-case basis.

Fire Hazards

Fires involving Class B combustibles are especially dangerous because they release heat quickly, causing the fire to spread rapidly. The handling and use of these combustibles presents the most significant single source of fire hazard. Misuse or improper storage threatens not only the employee and the entire building, but all fellow employees. Liquids with flash points below room temperature (Class IA and IB liquids) continually emit sufficient quantities of vapors to be ignitable, except when chilled to temperatures below their flash points. Even when chilled, if spilled on a floor or work surface, they will heat rapidly and pose severe fire and explosion hazards. Liquids with flash points above room temperature (Class IC, II, IIIA, and IIIB liquids) can easily be heated to the point at which they will create flammable vapor-air mixtures. Flammable liquid vapors are heavier than air. They can travel for appreciable distances and accumulate in low places. Since it is the vapor of flammable liquids that burns, the fire hazard may not be confined to the immediate vicinity of actual use. Vapors can be ignited several hundred feet from the point of vapor generation. Flammable liquid vapors generally have low ignition-energy requirements and can often be ignited by small sparks from electrical motors, switches, relay contacts, etc.

Precautions

Recommended precautions are based on the properties of the liquid to be used and the intended application. The user cannot make a correct decision on necessary precautions unless the properties of the liquid are known and the intended use is reviewed from a safety standpoint. There must be sufficient ventilation to preclude the accumulation of flammable vapors. Flammable liquids should be used in a fume hood or with local exhaust ventilation. Normal room ventilation may be sufficient to permit small-scale use of flammable liquids (milliliter quantities). However, if larger quantities of liquid must be used in such facilities, it will be necessary to provide additional ventilation by opening doors and windows or providing some form of temporary exhaust ventilation. Extreme care must be exercised when using flammable liquids in closed spaces with minimal ventilation (such as glove boxes and tanks). Even milliliter quantities of flammable liquids can cause the build-up of explosive mixtures in the confined space.

Containers

The maximum allowable sizes of containers and portable tanks are identified in the table below:

Flammable liquids	Combustible liquids	Class IA	Class IB	Class IC	Class II	Class III	Glass or approved plastic	1 pt*	1 qt*	1 gal
1 gal	1 gal	1 gal	Metal (other than Department of Transportation (DOT) drums	1 gal	5 gal	5 gal	5 gal	5 gal	5 gal	5 gal
Safety cans**	2 gal	5 gal	5 gal	5 gal	5 gal	Metal drums	60 gal	60 gal	60 gal	60 gal (DOT specifications)
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal	660 gal	660 gal	660 gal	660 gal	*

Glass or approved plastic containers of no more than 1 gallon capacity may be used for Class IA or IB flammable liquids if (1) such liquid either would be rendered unfit for its intended use by contact with metal or would excessively corrode a metal container so as to create a leakage hazard or (2) the user's process either would require more than 1 pint of a Class IA liquid or more than 1 quart of a Class IB liquid, of a single assay lot, to be used at one time.

** Approved safety cans of various materials and capacities are available through [Company].

Cabinets

Storage cabinets must be designed and approved for the anticipated usage. Approved metal storage cabinets are available in various sizes from [Company] stock. Not more than 120 gallons of Class I, Class II, and Class IIIA liquids, combined, may be stored in a storage cabinet. Of this total, not more than 60 gallons may be of Class I and Class II liquids, combined, and not more than three such cabinets may be located in a single fire-separation area.

Refrigerators

Ordinary domestic refrigerators must not be used for the storage of flammable liquids because they contain certain built-in ignition sources (such as electrical contacts). These sources of ignition may initiate a fire or an explosion if flammable vapors are present. In special cases, ordinary refrigerators have been modified to specifications approved for storage of flammable liquids. Refrigerators are now available commercially that are specifically designed and approved for storage of flammable materials. Refrigerators must bear an appropriate label as supplied by the Responsible Safety Officer.

Allowable Quantities

To adequately manage the exposure hazards in each building, or fire-separation area in each building, it is necessary to consider the needs of all users, and/or of user groups in aggregate, for each building or fire-separation area. The restrictions set forth below provide guidance for lower usage levels. In general, quantities in excess of three-months usage should not be stored. If the need for larger quantities is anticipated, contact the Responsible Safety Officer for assistance. The maximum allowable quantities of Class B combustibles outside designated and approved storage rooms or facilities are listed below: Less than one gallon of Class I and Class II liquids combined, in glass or plastic containers, is the maximum allowed outside of approved storage cabinets when not actually in use. One gallon is the maximum allowable container size for general dispensing of Class I and Class II liquids unless in an approved safety can. Where more than one laboratory unit is located in a single fire-separation area, all Class I and Class II liquids must be stored in approved storage cabinets or approved safety cans. Ten gallons of Class I and Class II liquids, combined, in approved safety cans, is the maximum allowable outside of approved storage cabinets. Five gallons of Class IIIA liquids is the maximum allowable outside of approved storage cabinets or safety cans. For single fire-separation areas, 10 gallons of Class I and Class II liquids, combined, is the maximum quantity allowable outside of approved storage cabinets or approved safety cans. For single fire-separation areas, 25 gallons of Class I and Class II liquids, combined, is the maximum allowable quantity outside of approved storage cabinets. For single fire-separation areas, 60 gallons of Class IIIA liquids is the maximum allowable outside of approved storage cabinets.

Fluorocarbon Solvents

Fluorocarbon solvents are organic compounds containing fluorine. Common names for some members of this family are Freon-TF, Freon-MF, and Freon-BF.

Hazards

The vapors are four to five times heavier than air and tend to accumulate in tanks, pits, and low places. This displaces the oxygen, which can cause suffocation, or the vapors themselves may be toxic in high concentrations. Fluorocarbon solvents will dissolve and extract the natural oils present in the skin. If contact is prolonged, the skin may become dry and perhaps cracked. The vapors have little or no effect on the eyes. If the liquid is splashed in the eyes, temporary redness may be produced. Lower boiling liquids may cause freezing if splashed on the skin or in the eyes. Fluorocarbon vapors decompose when exposed to high temperatures. Toxic fumes such as hydrofluoric acid, hydrochloric acid, and phosgene may be formed. Fluorocarbon solvents are nonflammable.

Precautions

Contact the Responsible Safety Officer if fluorocarbon solvents are used in enclosed areas such as tanks and pits. Forced-air ventilation and air supplied respirators may be required. Avoid contact with hot surfaces, electric heating elements, or open flames. If toxic fumes are formed, good ventilation will be required. Wear gloves made of neoprene or equivalent when there is the possibility of prolonged or repeated skin contact with the liquid. Wear protective clothing and eye goggles if the liquid may be splashed.

Hazardous Gases

The general precautions for compressed gas cylinders must be followed. Large cylinders of hazardous gases should not be purchased if it is possible to use small cylinders. The color coding must not be used on the cylinder to identify its contents. These colors have not been standardized by the suppliers. Read the label placed on the cylinder. The Responsible Safety Officer must be notified of all hazardous gases ordered to ensure that adequate facilities are available (e.g., fume hoods, safety showers, alarms, fire extinguishers, respirators, etc.) and that the user is aware of the hazardous properties of the material. When hazardous gases are received by [Company], the Responsible Safety Officer will pick up and deliver all cylinders of J-size and smaller. Larger cylinders will be released by the Responsible Safety Officer delivery by [Company] or contractor employees. Cylinders should be returned to the vendor as soon as possible after use. It is not uncommon for gas cylinders to develop leaks during storage. Arrangements for pickup of used cylinders are made by contacting the Responsible Safety Officer. Before pickup, the cylinder valve must be closed, the regulator or needle valve must be removed, and the valve cover put back on the cylinder. Arrangements for pickup of cylinders that are leaking or have valves that are stuck open should be made by contacting the Responsible Safety Officer.

Mercury

The most widely used form of mercury at [Company] is elemental mercury. Mercury also exists as a salt and as an organic compound. From the standpoint of risk to human health, the most important forms of mercury are elemental mercury vapor and short-chain organoalkylmercurials such as methylmercury and ethylmercury.

Hazards

Mercury can enter the body through the lungs, the skin, and the digestive system. Because mercury

vaporizes at room temperature, inhalation of its vapors is the most likely route of entry. Short exposures to high levels of mercury vapor can cause acute poisoning characterized by tightness and pain in the chest, difficulty in breathing, inflammation of the mouth and gums, fever, and headaches. Acute poisoning, however, is rare. Much more common among workers is chronic poisoning caused by long-term exposure to lower levels of mercury. Steady exposure can cause a slow build-up of mercury in the body that can result in illness, personality changes, and eventual disability. Symptoms of chronic poisoning include inflammation of the mouth and gums, weakness, loss of appetite and weight, shaking (particularly in the hands), and irritability. During an ordinary laboratory spill of metallic mercury, clean-up effort need not be either hasty or heroic since a long duration of exposure to the vapors would be required before any adverse symptoms would occur. However, at elevated temperatures, the concentration of mercury vapor rises rapidly and poisoning can occur within a short period of time.

Precautions

Avoid skin contact. Keep mercury containers closed when not in use. Use plastic or metal catch cans under all mercury apparatus that is likely to break or spill; make transfers over a catch pan. Provide adequate ventilation, especially if mercury is heated above room temperature. Use a label similar to that below on all equipment and vessels containing mercury. Store in protected area in closed, labeled containers, preferably plastic. If a glass bottle is used, place in a secondary container. Dispose of mercury by placing in sealed, labeled containers. Send unused mercury to a licensed salvage company. If mercury is used, call the Responsible Safety Officer. Do not pour mercury down any drains. If Mercury is spilled at room temperature notify the Responsible Safety Officer as soon as possible to obtain clean-up equipment and a mercury vapor survey. If mercury is released at elevated temperatures, evacuate the area immediately and notify the emergency dispatcher at the Fire Department, call 911. Equipment being sent to the warehouse for storage must be drained of mercury, properly secured, and tagged with a mercury label.

Oxygen Pumping in Vacuum Systems

Oxygen in concentrations 25% by volume should not be introduced into a mechanical vacuum pump charged with hydrocarbon oil, which is a combustible fluid. During compression in the pump, the pressure of the oxygen may reach as high as 2-3 atmospheres, and at this pressure it may cause an explosion if combined with a hydrocarbon oil.

Required Solution

Pump manufacturers recommend the use of an inert fluid in place of hydrocarbon oil. Various fluids are available, such as Fomblin or HaloVac (Sargent-Welch Science Company). Modification of the pump may be required because these fluids have high molecular weights and high specific gravities and may be incompatible with seals. An inquiry to the pump manufacturer is recommended. Pumps modified for oxygen service shall be permanently identified and used only with the specified fluid.

Peroxidizable Compounds

Isopropyl ether, ethyl ether, dioxane, tetrahydrofuran, and other alkyl ethers form peroxides on exposure to air and light. Because these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have not been opened. The longer the storage period of these chemicals, the greater the amount of dangerous peroxides that may form. Experience has shown that isopropyl ether is by far the worst offender.

Hazards

These peroxides are highly unstable, explosive chemicals that may detonate if subjected to high temperature, shock, or friction. Concentration by evaporation or distillation of the ether increases the risk of detonation.

Precautions

Ethers containing an inhibitor should be purchased when possible. Ethers should be kept in cans rather than glass bottles. Ethers should be stored in as cool a location as feasible (but not stored in refrigerators unless explosion-proof). Ethers should always be tested for peroxide content before any distillation procedure and, of course, should not be used if peroxides are found to be present. Safety shields should be placed in front of reaction vessels or distillation apparatus in hoods when they involve ethers. At least 10% bottoms in distillation should be left. Any container of uncertain age or condition must not be opened, particularly when the cap or stopper is tightly stuck. Suspected containers must not be removed or disposed of. Contact the Responsible Safety Officer. Containers of isopropyl ether must have the red label shown below, indicating the date of purchase, attached to the outside surface. These labels should be applied by storeroom personnel. When the container is opened, the opening date should also be recorded on this label. These containers must be disposed of one year after purchase, or three months after opening. Call the Responsible Safety Officer for pick-up of containers for disposal.

Polychlorinated Biphenyls (PCBs)

PCBs are a broad class of nonflammable, synthetic, chlorinated hydrocarbon insulating fluids used mostly in capacitors and transformers at [Company]. Synonyms include askarel, aroclor, inerteen, pyranol, therminol, and many others.

Hazards

Prolonged skin contact with PCB oils can cause skin irritation and occasionally the formation of temporary acne-like cysts. Eye contact can cause severe irritation and inflammation. Breathing the vapor or mist from heated oil can cause respiratory irritation. PCBs are listed as suspect carcinogens. Because of their inert character and stability under extreme physical stresses, PCBs do not break down in the environment. PCBs are widely dispersed in the environment and can accumulate in foods found in the human diet.

Precautions

When working with PCB-contaminated equipment or on PCB spills, the appropriate personnel must wear protective equipment, including viton gloves, coveralls, and splash goggles. Small spills can be absorbed in vermiculite or Sorb-all. Place waste material in plastic bags and call the

Decontamination & Waste Disposal Unit.

All equipment containing PCBs must be disposed of through the Responsible Safety Officer. In case of large spills or explosion of a capacitor, evacuate all personnel from the area. Call the Fire Department, 911, for assistance. Provide or maintain ventilation in the affected area, if possible. If entry to the area is necessary, self-contained breathing apparatus must be worn. All large capacitors containing PCBs and all PCB transformers must be labeled. Banks of capacitors may be labeled as a unit. Capacitors and transformers within a confined area with limited access may be labeled at each point of entry. Labels may be obtained at the Central Storeroom or from the Responsible Safety Officer. A record of the quantity, type, movement, and disposal of PCB items must be maintained by each owner. A yearly update of the record is made. Calibration of Gas Detection Systems: This policy covers the calibration of systems to detect flammable, toxic, or pyrophoric gases being used at [Company]. Specifications of Calibration: The

specifications of the calibration technique and the frequency of calibration must be described in the Operational Safety Procedure governing the operation of apparatus with which the gas-detecting system is associated. It is recommended that calibrations of these systems be performed by an approved outside contractor or by Scientific and Technical Resources personnel. In all cases calibrations must be carried out by an independent party: calibration of these systems may not be carried out by the group operating the apparatus. When changes are required in the Operational Safety Procedure, approval of the new procedure will be coordinated by the Responsible Safety Officer.

Chemical Safety

Introduction

The objective of this chapter is to provide guidance to all [Company] employees and participating guests who use hazardous materials so that they may perform their work safely. Many of these materials are specifically explosive, corrosive, flammable, or toxic; they may have properties that combine these hazards. Many chemicals are relatively non-hazardous by themselves but become dangerous when they interact with other substances, either in planned experiments or by accidental contact. To avoid injury and/or property damage, persons who handle chemicals in any area of the Company must understand the hazardous properties of the chemicals with which they will be working. Before using a specific chemical, safe handling methods must always be reviewed. Supervisors are responsible for ensuring that the equipment needed to work safely with chemicals is provided. The cost of this equipment is borne by the Company.

Hazcom Plan

On May 25, 1986 the Occupational Safety and Health Administration (OSHA) placed in effect the requirements of a new standard called Hazard Communication (29 CFR 1910.1200). This standard establishes requirements to ensure that chemical hazards in the workplace are identified and that this information, along with information on protective measures, is transmitted to all affected employees. This section describes how [Company] employees are informed of the potential chemical hazards in their work area so they can avoid harmful exposures and safeguard their health. Components of this program include labeling, preparing a material safety data sheet (MSDS), and training.

With regard to MSDS, [Company] has limited coverage under the OSHA Hazard Communication Standard. The Company is required to maintain only those sheets that are received with incoming shipments for the following reasons: the Company commonly uses small quantities of many different hazardous materials for short periods of time; that the hazards change, often unpredictably; many materials are of unknown composition and most workers are highly trained.

Responsibilities of Supervisors/Management Identify hazards for respective work areas.

Ensure hazards are properly labeled. Obtain/maintain copies of material safety data sheets, as required, of each hazardous material used in the work area and make them accessible to employees during each work shift. Have the written Hazard Communication Program available to all employees. Provide hazard-specific training for employees. Identify hazardous materials in the hazard review section of the [Company] purchase requisition form. Employees must: Attend safety training meetings. Perform operations in safe manner. Notify management immediately of any safety hazards or injuries. When ordering materials, identify hazardous chemicals in the hazard review section of the [Company] purchase requisition form. The Responsible Safety Officer must: Develop a written Hazard Communication Program. Maintain a central file of material safety data sheets. Review and update [Company] stock safety labels. Provide generic training programs. Assist supervisors in developing hazard-specific training programs. Oversee the Hazard Communication Standard written policy and implementation plans. Alert on-site contractors to hazardous materials in work areas. Alert on-site contractors that they must provide to their employees information on hazardous materials they bring to the work site. The number of hazardous chemicals and the number of reactions between them is so large that prior knowledge of all potential hazards cannot be assumed. Therefore, when the chemical properties of a material are not fully

known, it should be assumed hazardous and used in as small quantities as possible to minimize exposure and thus reduce the magnitude of unexpected events. The following general safety precautions should be observed when working with chemicals: Keep the work area clean and orderly. Use the necessary safety equipment. Carefully label every container with the identity of its contents and appropriate hazard warnings.

Store incompatible chemicals in separate areas.

Substitute less toxic materials whenever possible. Limit the volume of volatile or flammable material to the minimum needed for short operation periods. Provide means of containing the material if equipment or containers should break or spill their contents. Follow the requirements of this manual, if systems that can generate pressure or are operated under pressure are involved. Provide a back-up method of shutting off power to a heat source if any hazard is involved. Obtain and read the Material Safety Data Sheets.

Task Evaluation

Each task that requires the use of chemicals must be evaluated to determine the potential hazards associated with the work. This hazard evaluation must include the chemical or combination of chemicals that will be used in the work, as well as other materials that will be used near the work. If a malfunction during the operation has the potential to cause serious injury or property damage, an Operational Safety Procedure (OSP) must be prepared and followed. Operations must be planned to minimize the generation of hazardous wastes. Additionally, unused chemicals should be recycled.

Supervisor Responsibility

Supervisors are responsible for establishing safe procedures and for ensuring that the protective equipment needed to work with the chemicals is available. Supervisors must instruct their workers about possible hazards, safety precautions that must be observed, possible consequences of an accident, and procedures to follow if an accident does occur. The supervisor is required to enforce the proper use of protective equipment and the established safety practices. It is the responsibility of employees and all who use [Company] facilities to understand the properties of the chemicals with which they will work and to follow all precautions that apply to each specific task. When faced with an unexpected threat of malfunction, injury, or damage, employees are expected to choose a course of action that provides the most protection to themselves and to others in the area. Every employee is expected to report to the supervisor any unsafe condition seen in the area that would not permit him/her to work safely. The Responsible Safety Officer assists employees and supervisors to work safely by providing information on the hazardous properties of materials, recommending methods for controlling the hazards of specific operations, and by monitoring the work environment. Supervisors must instruct their personnel about the potential hazards involved in the work, proper safety precautions to follow, and emergency procedures to use if an accident should occur. To supplement the supervisor's training, the Responsible Safety Officer will conduct training courses and materials on selected topics. In addition, material safety data sheets and safety information, including hazards, health effects, potential routes of exposure, proper handling precautions, and emergency procedures on specific chemicals, are available through the Responsible Safety Officer's office.

Effects on Reproduction

Both men and women may be exposed to hazardous agents that can cause infertility or result in genetic damage that is passed on to offspring. These agents include ionizing radiation, alcohol, cigarette smoke, pharmaceuticals, and some of the thousands of different chemicals that are used in the home or workplace. Although many of these have been tested to determine whether they cause acute (immediate) effects on the body, few have been studied to see if they cause cancer (carcinogens), birth defects

(teratogens), or genetic defects (mutagens). Even fewer have been studied to see if they can cause infertility, menstrual disorders, or other disorders relating to reproduction. The primary path for hazardous substances to reach an unborn child is through the placenta. Scientists now believe that most chemical substances or drugs can cross this barrier with varying degrees of ease and enter the system of the developing fetus. Thus, many chemicals and drugs that enter a pregnant woman's body (through breathing, swallowing, absorption through the skin, etc.) will eventually enter the mother's blood circulation and find their way into the unborn child. In general, the important questions of exactly how much of the toxic substance that enters the mother's body will reach the fetus or what concentration the fetus can tolerate without harmful effects are not yet answered. The fetus may be most vulnerable in the early weeks of pregnancy, but it is also at risk later in pregnancy. In light of the potential harm of workplace exposures to both a pregnant woman and her developing fetus, it is very important and required by [Company] policy for the woman to inform the Responsible Safety Officer of her pregnancy immediately.

Airborne Contaminants

Exposures by inhalation of airborne contaminants (gases, vapors, fumes, dusts, and mists) must not exceed the levels listed in the latest edition of Threshold Limit Values of Airborne Contaminants (TLV) published by the American Conference of Governmental Industrial Hygienists. These TLV levels refer to airborne concentrations of substances and represent conditions under which it is believed that workers may be repeatedly exposed without adverse effect. In all cases of potentially harmful exposure, feasible engineering or administrative controls must first be established. In cases where respiratory protective equipment, alone or with other control measures, is required to protect the employee, the protective equipment must be approved by the Responsible Safety Officer, for each specific use.

Safety Equipment

Eyewash fountains are required if the substance in use presents an eye hazard. The eyewash fountain must provide a soft stream or spray of aerated water. In areas where a corrosive chemical or rapid fire hazard exists, safety showers must be provided for immediate first aid treatment of chemical splashes and for extinguishing clothing fires. The shower must be capable of drenching the victim immediately in the event of an emergency. Eyewash fountains and safety showers should be located close to each other so that, if necessary, the eyes can be washed while the body is showered. Access to these facilities must always remain open. In case of accident, flush the affected part for at least 15 minutes. Report the accident to the Responsible Safety Officer immediately. A special first aid treatment kit for fluorine and hydrofluoric acid burns is prepared by the Medical Services Department. The kit is obtained by contacting the Responsible Safety Officer. Safety shields must be used for protection against possible explosions or splash hazards. Company equipment must be shielded on all sides so that there is no line-of-sight exposure of personnel. The sash on a chemical fume hood is a readily available partial shield. However, a portable shield must also be used, particularly with hoods that have vertical-rising sashes rather than horizontal-sliding sashes.

Labels

All containers (including glassware, safety cans, plastic squeeze bottles) must have labels that identify their chemical contents. Labels should also contain information on the hazards associated with the use of the chemical. Precautionary labels are available from [Company] stock room for most of the common chemicals.

Chemical Storage

The separation of chemicals (solids or liquids) during storage is necessary to reduce the possibility of unwanted chemical reactions caused by accidental mixing. Explosives such as picric acid should be stored separately outdoors. Use either distance or barriers (e.g., trays) to isolate chemicals into the following groups: Flammable liquids (e.g., acetone, benzene, ethers, alcohols). Place in approved fire lockers. Other liquids (e.g., chloroform, trichloroethane). Acids (e.g., nitric, sulfuric, hydrochloric, perchloric). * Treat acetic acid as a flammable liquid. Bases (e.g., sodium hydroxide, ammonium hydroxide). Lips, strips, or bars should be installed across the width of reagent shelves to restrain the chemicals in case of earthquake. Chemicals must not be stored in the same refrigerator used for food storage. Refrigerators used for storing chemicals must be appropriately identified by placing a label on the door (labels may be obtained from Responsible Safety Officer).

Emergencies

In case of an emergency, consider any of the following actions if appropriate: Evacuate people from the area. Isolate the area. If the material is flammable, turn off ignition and heat sources. Call the Fire Department or 911 for assistance. Wear appropriate personal protective equipment. Pour Sorb-all or appropriate neutralizing agent on spill. Clean up; place waste in plastic bag for disposal. Chemical spill cleanup materials are available from stores as listed below: Flammable solvent spill kit Flammable solvent absorbent Acid spill kit Acid spill absorbent Caustic (base) spill kit Caustic (base) absorbent Safety equipment kit (contains scoops, sponge, safety glasses, disposal bags, etc.) Cabinet to hold kits

Disposal of Chemicals

All [Company] employees, participating guests, and visitors using hazardous chemicals are responsible for disposing of these chemicals safely. Federal and state regulations mandate strict disposal procedures for chemicals. To comply with these regulations all persons using Company facilities must observe these procedures. Routine Disposal of Chemicals In general the disposal of hazardous chemicals to the sanitary sewer is not permitted. The Responsible Safety Officer will advise on the proper disposal of chemical wastes. In using chemical waste storage containers, certain procedures must be observed, as listed below: Incompatible chemicals must not be mixed in the same container (e.g., acids should not be mixed with bases; organic liquids should not be mixed with strong oxidizing agents). Waste oils must be collected in 55-gallon drums. Disposal solids, and explosive materials must be stored in separate containers.

The following requirements must be met as a condition for pickup and disposal of chemicals by the Responsible Safety Officer:

- Chemicals must be separated into compatible groups.
- Leaking containers of any sort will not be accepted.
- Dry materials (gloves, wipes, pipettes, etc.) must be securely contained in plastic bags and over packed in a cardboard box.
- Packages that are wet or have sharp protruding objects will not be accepted for pick up.
- Unknown chemicals will require special handling.

The responsible department must make every effort to identify the material that is to be disposed. If all the user's attempts to identify the waste chemicals have failed, the Responsible Safety Officer will accept the waste and analyze the material. For more information call the Responsible Safety Officer. Each breakable container must be properly boxed. Place all bottles in plastic bags, then place in a sturdy container and use an absorbent cushioning material that is compatible with the chemicals. Each primary

container must be labeled with content, amount, physical state, and the percentage breakdown of a mixture. Each box must have a complete list of contents or description written on an official Responsible Safety Officer hazardous materials packing list. Blank packing lists are available from the Responsible Safety Officer. For safety purposes, boxes must be of a size and weight so that one person can handle them. Boxes that exceed 45 pounds or 18 inches on a side cannot be safely handled by one person and will not be acceptable for pick up. General Housekeeping Rules: Maintain the smallest possible inventory of chemicals to meet your immediate needs. Periodically review your stock of chemicals on hand. Ensure that storage areas, or equipment containing large quantities of chemicals, are secure from accidental spills. Rinse emptied bottles that contain acids or inflammable solvents before disposal. Recycle unused laboratory chemicals wherever possible.

DO NOT:

Place hazardous chemicals in salvage or garbage receptacles. Pour chemicals onto the ground. Dispose of chemicals through the storm drain system. Dispose of highly toxic, malodorous, or lachrymatory chemicals down sinks or sewer drains.

Beryllium

Beryllium is used predominantly in three forms: beryllium metal, beryllium oxide, and beryllium-copper alloys. Beryllium-copper alloys may consist of 0.5 to 4% beryllium, although the most common alloy has about 2% beryllium. Beryllium may also be alloyed with other metals, such as nickel and cobalt, or be found as a salt, e.g., beryllium fluoride, chloride, nitrate, or sulfate, and as beryllium hydroxide. Exposure to beryllium and its compounds can damage the skin, eyes, and respiratory system. The soluble beryllium salts, especially the fluoride and sulfate, are skin sensitizers and in high concentrations are also primary skin irritants. If beryllium gets into broken skin, the cut may abscess and not heal properly until the substance is removed. Eye irritations are also common, and splash-burns can cause damage to the cornea. Breathing dust and fumes, however, is the most common cause of beryllium poisoning. The effects of inhaling high levels of beryllium can range from mild inflammation of the nose and throat, a condition that resembles a cold, to a severe pneumonia-like reaction characterized by coughing, difficulty in breathing, pain and tightness in the chest, loss of appetite, and general fatigue. The effects of inhaling low levels of beryllium over an extended period of time may be delayed from a few months to years after the last exposure.

Chronic beryllium poisoning in most cases affects the respiratory tract. The onset may be manifested by weakness, loss of weight, shortness of breath, and coughing. Beryllium dusts or powders constitute a moderate fire hazard. However, any fire involving beryllium is a serious threat to the health of nearby personnel. Avoid skin contact with beryllium salts or salt solutions, and do not allow metallic beryllium to come in contact with open wounds or abrasions. Wear gloves when handling beryllium or beryllium compounds when loose contamination (dust or chips) is present. There is no danger in ordinary skin contact with beryllium metal, alloys, or fused-ceramic material.

All operations involving the generation of airborne beryllium must be done under controlled conditions for which concurrence must be obtained from the Responsible Safety Officer. Operations such as machining, grinding, welding, cutting, drilling, sawing, and milling must be enclosed and the exhaust ventilated through high-efficiency filters. A hazardous concentration of beryllium fumes may be generated when the metal is heated above 650C (1200F), or when the oxide is heated above 1540C (2800F). Scrupulous adherence to good housekeeping practices and plant and personal cleanliness is an obvious necessity. All beryllium parts must be stored and transported in labeled containers. One of the following labels may be used. "Beryllium (Beryllium oxides)" "Contains Beryllium" All beryllium and beryllium-contaminated waste must be placed in properly marked containers and picked up by the Decontamination and Waste Disposal Section. The following work on beryllium-copper alloys may be performed without special controls: lathe cutting using a coolant, shearing, forming, hand sawing, hand

filing, hand sanding, and soft soldering in a hood.

Cadmium

The greatest exposure potential is probably from welding or burning cadmium-plated parts and brazing or silver soldering with cadmium-containing rods and wires. These brazing alloys contain 15 to 19% cadmium. Finely divided cadmium metal and cadmium oxide fumes are highly toxic and must not be inhaled or ingested. A single exposure to high levels of cadmium in the air can cause severe lung irritation, which may be fatal. Symptoms usually appear 4 to 10 hours after exposure when cough, labored breathing, and commonly a feeling of constriction or a burning sensation in the chest develop. Generalized flu-like symptoms characterized by shaky chills, sweating, aching in the extremities and back, headache, and dizziness may also develop. Continued exposure to low levels of cadmium in the air can result in chronic poisoning characterized by irreversible lung injury and kidney damage.

Cadmium is suspected of causing cancer in humans. Symptoms of the cumulative effects of cadmium may appear after exposure has terminated. Cadmium metal dust will burn with the evolution of a very hazardous brownish-yellow fume. Remove all cadmium from plated parts before welding or burning. Substitute cadmium-free silver solder whenever possible. When cadmium is melted, temperatures should be kept as low as possible, consistent with the requirement of the operation, to prevent excessive fume generation. Indoor work or continuous outdoor work that involves the generation of airborne cadmium must be enclosed to the maximum extent practical and be provided with a good exhaust system that collects and removes the fumes as they are formed. If the work is outdoor and intermittent, a properly fitted fume respirator must be used. In confined spaces where an exhaust system is not practical, a supplied-air respirator must be worn. Evaluation of exhaust systems and work situations and supply of respiratory protective equipment are available from the Responsible Safety Officer. Cadmium-containing and cadmium-plated parts should be kept separate from parts not containing cadmium and marked appropriately so that accidental exposures resulting from cutting and welding will not occur. When there is cadmium dust, cleaning must be performed by vacuum pickup or wet mopping. No dry sweeping or blowing is permitted.

Confined Spaces

Definitions

A confined space is defined as any structure that must be entered and that has or may contain dangerous concentrations of hazardous gases or vapors or an oxygen deficient atmosphere. Entry to these spaces must be rigorously controlled to prevent serious injury or death.

Hazardous Conditions

Hazardous conditions include, but are not limited, to the following: An atmosphere containing less than 19.5% oxygen (normal air contains 20.9% oxygen). This is usually the result of oxygen displacement by inert gases such as nitrogen, argon, helium, or sulfur hexafluoride. Flammable gases and vapors (e.g., methane, ethane, propane, gasoline, methyl-ethyl ketone, alcohol). Toxic gases and vapors (e.g., hydrogen sulfide, nitrogen dioxide, 1,1,1 trichloroethane, perchloroethane, methylene chloride).

Hazard Prevention

The primary objective is to prevent oxygen deficiency or other hazardous condition. This must be accomplished by accepted engineering control measures, such as general and local ventilation and substitution of materials. Only when such controls are not possible should respiratory protection be used. Written operating procedures governing the identification, testing, and entry into a confined space with a potential for oxygen deficiency must be established by the operating personnel and approved by the Responsible Safety Officer. Monitoring devices, audible alarms, warning lights, and instructional signs should be installed where there is a potentially oxygen-deficient atmosphere. These installations must be approved by the Responsible Safety Officer.

Before entering a confined space, the steps below must be followed:

- An entry permit must be issued to the worker by the responsible supervisor and reviewed by the Responsible Safety Officer.
- Air quality must be tested to determine the level of oxygen and toxic or flammable air contaminants.
- Air purging and ventilation must be provided whenever possible.
- The confined space must be isolated from supply lines capable of creating hazardous conditions.
- Lock-out procedures must be used to secure electrical systems, pressure systems, piping, machinery, or moving equipment.

If a person must enter a confined space containing hazardous gases, the procedures below must be followed:

- Protective equipment must be worn, including air supply respirator plus harness and lifeline.
- At least one person must be stationed outside the confined space, with suitable respirator.
- Communication with personnel in the confined space must always be maintained.

Cryogenic Fluids

Properties

Handling cryogenic fluids safely is largely a matter of knowing their properties and using common sense procedures based on that knowledge. This chapter describes the cryogenic fluids and containers used at [Company] and practices for handling them safely. Liquefied gases commonly used at [Company] are fluids that have boiling points below -73.3°C . There are a number of general precautions and safety practices that must be observed because of the effects of the extremely low temperature of these gases and their high gas-to-liquid volume ratios. Liquid nitrogen, for example, expands 700 times when changing from liquid to gas at normal temperature and pressure and if confined in the original volume would create very high pressures. Specific precautions must be followed where particular cryogenic fluids such as oxygen or other strong oxidizers may react chemically with contaminants. In addition, a spill that displaces the air in a closed room may present a hazard to life.

Several hazards associated with liquid hydrogen merit special attention: Its extremely low temperature (20 K) and low heat of vaporization (215 cal/g mol) make it difficult to retain in storage. As a gas, it has a very wide flammability range (4% to 75%), a low ignition temperature (585°C), and a rapid flame velocity (270 cm/sec). Additional information on hydrogen is given in the chapter on Gases, Flammable and/or Compressed. Another hazard can develop when using foam-insulated cryogenic containers or transfer lines. This hazard can occur when liquid nitrogen-filled containers or lines reach liquid nitrogen or lower temperatures and condense air as oxygen-enriched liquid air from surrounding atmospheric air. There is a probability that a potentially hazardous flammable mixture will be formed when liquid air penetrates the foam. There is a higher probability when the cryogen is liquid hydrogen (20 K) or liquid helium (4 K) because of their lower temperatures. More specifically, a cold liquid nitrogen metal transfer line surface will begin to condense air and hence oxygen at 81 K at one atmosphere.

If the condensed liquid air penetrates the cells in the foam (this phenomenon is known to occur for both open-cell and closed-cell foams) the part of the liquid air-enriched foam that is within the flammable limits can be ignited. When ignited, for example, by an open flame, the liquid air/foam mixture will burn vigorously. How vigorously the mixture burns depends upon how long the foam was exposed to liquid air, how much liquid-air/foam mixture was formed, and how close the mixture is to being stoichiometric. When ignited by a shock-inducing device, the liquid air/foam mixture will explode. The hazard disappears when the foam warms. This phenomenon has a low probability of occurring, but if it does occur the damage could be significant. This type of accident has occurred, and the user is advised to be aware of this phenomenon.

Cryogenic Fluids

All personnel working with cryogenic fluids must be thoroughly familiar with the physical, chemical, and physiological hazards involved. They must also be familiar with all emergency measures that might be required in the event of an accident. Employees who have not worked with cryogenic fluids and systems must be trained on the job by experienced employees until thorough familiarity with safe methods of operation is achieved. Supervisors are responsible for making certain that all personnel know when and how to use respiratory protective devices, safety glasses, face shields, gloves, and other protective clothing and equipment. Personnel must leave an enclosed area immediately after a spill of more than one liter of cryogenic fluid because of the large volume of gas produced and the explosion and fire hazard if

the fluid is flammable. Personnel must not reenter the area until the air has been monitored to determine that no toxic or flammable mixture is present and that oxygen content in the area has reached 19.5%. Similar precautions, including those for fire prevention, must be taken following liquid oxygen spills. Any spill of a cryogen, if large enough, may cause a local oxygen-deficient space. Procedures for entering an oxygen-deficient space are discussed in the Chapter on Confined Space. See also the chapter on Gases, Flammable and/or Compressed, for explosive limits of flammable gases. Personnel who suffer cryogenic frostbite should immediately immerse the affected part in warm water and then report to the Medical Services Department.

Safety Practices

During operation with cryogenic fluids, personnel must observe the following safety practices: Flammable cryogenic fluids may be transferred or used within buildings or near ignition sources only after a safety review. Cryogenic fluid containers (dewars) must be safety vented and protected against mechanical shock and damage. Glass dewars must be wrapped with fabric or fiber-glass tape, or otherwise protected to prevent flying glass in the event of breakage. Dewars must be moved very carefully. Do not tilt, jar, bump, or roll the dewar. Sloshing liquid into warmer regions of the container can cause sharp pressure rises. Before 150 and 175 liter industrial-type liquid-hydrogen dewars are moved, the internal pressure must be reduced to 5 psig or lower. The relief valve must be set at not more than 10 psig. Vents must be protected against icing and plugging. When all vents are closed, enough gas can boil off (vaporize) in a short time to explode the vessel.

At [Company], liquid hydrogen is supplied only in double-vent vessels. Liquid helium is supplied in both single- and double-vent vessels. The single-vent helium vessels have a special large diameter neck and are issued on special request. All helium and hydrogen dewars in use at [Company] are checked every few days to ensure safe operation. On liquid nitrogen-shielded laboratory-type hydrogen or helium dewars, the rubber tube caps are kept on the vent and fill lines of the nitrogen circuit at all times to prevent oxygen condensation and freezing. Liquid hydrogen and liquid helium may be transferred only into approved systems and only by personnel experienced in the handling of these liquids.

Operators must avoid physical contact with any liquefied gases because burns can occur. Face masks and gloves must be worn while transferring and handling cryogenic liquids. Proper transfer equipment must be used when moving cryogenic liquids from one container to another. Liquid helium must always be transferred through well insulated, vacuum-jacketed lines. Flammable cryogenic liquids may be transferred only when there is controlled ventilation. Only helium gas may be used for pressurizing liquid helium or hydrogen dewars for liquid transfer. When transferring liquid gases from laboratory type dewars, a properly purged tube must be inserted slowly. When insufficient knowledge exists regarding the potential hazards of cryogenic fluids, obtain assistance before proceeding to full-scale operations. Emergency conditions should be planned for that may occur during operations by considering (1) the consequences of a malfunction or error, (2) all methods of preventing such malfunctions and errors, and (3) methods of minimizing their effects. Cryogenic systems that require personnel and/or equipment protection must be barricaded and isolated. Glass apparatus in cryogenic systems must be shielded. Adequate personnel exits must be provided, and they must never be blocked. All cryogenic equipment must be promptly and adequately maintained. All dewars must be purged on a regular basis to limit the buildup of contaminants.

Dewars

Air or oxygen must be excluded from hydrogen-filled dewars. Ice plugs of frozen water, air, or other impurities, rarely occur in hydrogen dewars because of their closed system fill and vent circuits and the warmup procedure used before every refilling. Frozen oxygen, however, has caused explosions in liquid hydrogen. Single-neck (single-opening) laboratory-type dewars must not be filled with liquid hydrogen.

Dewars filled with liquid hydrogen must be stored outdoors in a controlled area and must be securely attached to the contact of a good electrical ground at all times to preclude build-up of a static charge that could ignite escaping gas. The hydrogen dewar cart must be electrically grounded, and the hydrogen venting system must be connected before filling or transferring takes place.

Shielded Dewars

At [Company] liquid helium is supplied to users in gas shielded 30-, 60-, 100-, 250-, and 500-liter dewars and in LN-shielded 10-, 25-, and 50-liter dewars. All of the liquid helium dewars in normal use at [Company] should have dual coaxial necks to provide redundant venting. LN-shielded dewars normally have a primary relief valve set at 0.5 psig located on the removable 5/8 inch-outside-diameter, coaxial inner neck. The LN-shielded dewar has a secondary relief valve normally set at 7 to 10 psig and a pressure gauge, both located on the coaxial outer neck. The outer neck is part of the dewar venting and safety system and is not accessible to the user. Gas-shielded liquid helium dewars have a variety of openings and neck sizes up to 2 inches. Venting on gas-shielded dewars is accomplished by multiple relief valves and safety bursting discs. Dewars containing liquid helium must be inspected by the user to ensure that they do not plug. Although modern dual-neck dewars seldom plug, users are cautioned to determine the approximate heat-leak rate and bursting pressure of any dewar they use. The greatest hazard associated with the use of liquid helium-filled dewars [caused by the extreme low temperature (4.2 K) of liquid helium] is a vent plugged with ice.

In a plugged dewar, the boil-off gas cannot escape, and pressure may build up high enough to burst the dewar. Therefore, air, water, and other impurities that can freeze solid and plug the vent must be excluded from the dewar. Ice plugs can result when air is wiped into the dewar neck as the fill tube is inserted or if air has entered because the positive-pressure relief cap was not in place. When approaching a dewar you suspect may be plugged, keep your face and body away from the top of the dewar as much as possible. The pressure in a plugged dewar depends on its heat-leak rate, how it has been handled, and how long it has been plugged. The pressure in a plugged 25-liter helium dewar in good condition rises about 3 psi per hour. The pressure in a dewar in poor condition will rise faster. Also, the pressure will rise faster when a plugged dewar is transported and the liquid helium sloshes against the warmer parts of the dewar. The pressure in a filled 25-liter helium dewar will rise less than 3 psi per hour when the dewar has a closed vent. In a second test, a filled 25-liter helium dewar was pressurized until it burst, at 400 psig. As an example based on this test data, if a 25 liter helium dewar has been plugged for 72 hours and its pressure has been rising at 3 psi/hr, the dewar pressure will be around 216 psig. A pressure of 216 psig is about half the burst pressure.

Plugged Dewars

If you suspect a dewar containing liquid helium is plugged, first determine if helium boil-off gas is coming out of the vent-cap check valve (on a laboratory-type dewar), or from the vent valve (of an industrial-type dewar). If no gas flows out of the valve, assume that the dewar is plugged and immediately notify the Responsible Safety Officer. If the Responsible Safety Officer is not available, call the local Fire Department. The Responsible Safety Officer or the Fire Department will determine the dewar's condition and clear the dewar if it is plugged, or take other appropriate action. If a liquid-helium dewar is plugged, all personnel must be evacuated from the area immediately.

Electrical Safety

Policy

It is the policy of [Company] to take every reasonable precaution in the performance of work to protect the health and safety of employees and the public and to minimize the probability of damage to property. The electrical safety requirements contained in this chapter are regulations set forth by [Company].

Employee Responsibility

All [Company] personnel are responsible for all aspects of safety within their own groups. The Responsible Safety Officer is responsible for providing information, instruction, and assistance, as appropriate, concerning [Company] electrical safety requirements and procedures. Individual employees are responsible for their own and their co-workers' safety. This means: Become acquainted with all potential hazards in the area in which they work. Learn and follow the appropriate standards, procedures, and hazard-control methods. Never undertake a potentially hazardous operation without consulting with appropriate supervision. Stop any operation you believe to be hazardous. Notify a supervisor of any condition or behavior that poses a potential hazard. Wear and use appropriate protective equipment. Immediately report any occupational injury or illness to the Responsible Safety Officer, any on site Medical Services Department and the appropriate supervisor.

Supervisors

Each employee acting in a supervisory capacity has specific safety responsibilities. These include: Developing an attitude and awareness of safety in the people supervised and seeing that individual safety responsibilities are fully carried out. Maintaining a safe work environment and taking corrective action on any potentially hazardous operation or condition. Ensuring that the personnel he/she directs are knowledgeable and trained in the tasks they are asked to perform. Ensuring that safe conditions prevail in the area and that everyone is properly informed of the area's safety regulations and procedures. Ensuring that contract personnel are properly protected by means of instructions, signs, barriers, or other appropriate resources. Ensuring that no employee assigned to potentially hazardous work appears to be fatigued, ill, emotionally disturbed, or under the influence of alcohol or drugs (prescription, over the counter medicinal or otherwise). Management at every level has the responsibility for maintaining the work environment at a minimal level of risk throughout all areas of control.

Each manager:

- Is responsible for being aware of all potentially hazardous activities within the area of responsibility.
- May assign responsibility or delegate authority for performance of any function, but –
- Remains accountable to higher management for any oversight or error that leads to injury, illness, or damage to property.

Procedures

It is the policy of [Company] to follow the fundamental principles of safety, which are described below. A clear understanding of these principles will improve the safety of working with or around electrical equipment. Practice proper housekeeping and cleanliness. Poor housekeeping is a major factor in many accidents. A cluttered area is likely to be both unsafe and inefficient. Every employee is responsible for keeping a clean area and every supervisor is responsible for ensuring that his or her areas of responsibility remain clean. Identify hazards and anticipate problems. Think through what might go wrong and what the

consequences would be. Do not hesitate to discuss any situation or question with your supervisor and coworkers. Resist “hurry-up” pressure. Program pressures should not cause you to bypass thoughtful consideration and planned procedures.

Design for safety

Consider safety to be an integral part of the design process. Protective devices, warning signs, and administrative procedures are supplements to good design but can never fully compensate for its absence. Completed designs should include provisions for safe maintenance.

Maintain for Safety

Good maintenance is essential to safe operations. Maintenance procedures and schedules for servicing and maintaining equipment and facilities, including documentation of repairs, removals, replacements, and disposals, should be established. Document your work. An up-to-date set of documentation adequate for operation, maintenance, testing, and safety should be available to anyone working on potentially hazardous equipment. Keep drawings and prints up to date. Dispose of obsolete drawings and be certain that active file drawings have the latest corrections. Have designs reviewed. All systems and modifications to systems performing a safety function or controlling a potentially hazardous operation must be reviewed and approved at the level of project engineer or above. Have designs and operation verified. All systems performing safety functions or controlling a potentially hazardous operation must be periodically validated by actual test procedures at least once a year, and both the procedures and actual tests must be documented. Test equipment safety. Tests should be made when the electrical equipment is de-energized, or, at most, energized with reduced hazard. Know emergency procedures. All persons working in areas of high hazard (with high-voltage power supplies, capacitor banks, etc.) must be trained in emergency response procedures, including cardiopulmonary resuscitation (CPR) certification.

Working with Energized Equipment

This section contains safety requirements that must be met in constructing electrical equipment and in working on energized electrical equipment. Special emphasis is placed on problems associated with personnel working on hazardous electrical equipment in an energized condition. Such work is permissible, but only after extensive effort to perform the necessary tasks with the equipment in a securely de-energized condition has proven unsuccessful, or if the equipment is so enclosed and protected that contact with hazardous voltages is essentially impossible.

Definitions: The following definitions are used in this discussion of electrical safety.

Authorized Person: An individual recognized by management as having the responsibility for and expertise to perform electrical procedures in the course of normal duties. Such individuals are normally members of electronic or electrical groups.

Backup Protection: A secondary, redundant, protective system provided to de-energize a device, system, or facility to permit safe physical contact by assigned personnel. A backup protective system must be totally independent of the first-line protection and must be capable of functioning in the event of total failure of the first-line protective system.

Companion: A co-worker who is cognizant of potential danger and occasionally checks the other worker.

Electrical Hazard: A potential source of personnel injury involving, either directly or indirectly, the use of electricity.

Direct Electrical Hazard: A potential source of personnel injury resulting from the flow of electrical energy through a person (electrical shocks and burns).

Indirect Electrical Hazard: A potential source of personnel injury resulting from electrical energy that is transformed into other forms of energy (e.g., radiant energy, such as light, heat, or energetic particles;

magnetic fields; chemical reactions, such as fire, explosions, the production of noxious gases and compounds; and involuntary muscular reactions).

First Line Protection: The primary protective system and/or operational procedure provided to prevent physical contact with energized equipment.

General Supervision: The condition that exists when an individual works under a supervisor's direction but not necessarily in the continuous presence of the supervisor.

Grounding Point: The most direct connection to the source of a potential electrical hazard such as the terminals of a capacitor. Such a point must be indicated by a yellow circular marker.

Grounds, Electrical: Any designated point with adequate capacity to carry any potential currents to earth. Designated points may be building columns or specially designed ground-network cabling, rack, or chassis ground. Cold water pipes, wire ways, and conduits must not be considered electrical grounds.

Grounds, Massive: Large areas of metal, concrete, or wet ground that make electrical isolation difficult or impossible. Implied Approval: Approval is implied when a supervisor, knowing the qualifications of an individual, assigns that individual a task, or responsibility for, a device, system, or project.

Qualified Person: An individual recognized by management as having sufficient understanding of a device, system, or facility to be able to positively control any hazards it may present. Must, Should, and May: "Must" indicates a mandatory requirement. "Should" indicates a recommended action. "May" indicates an optional or permissive action, not a requirement or recommendation.

Safety Watch: An individual whose sole task is to observe the operator and to quickly de-energize the equipment, using a crash button or circuit breaker control in case of an emergency, and to alert emergency personnel. This person should have basic CPR training.

Type of Hazards

The degree of hazard associated with electrical shock is a function of the duration, magnitude, and frequency of the current passed by the portion of the body incorporated in the circuit. The current that can flow through the human body with contacts at the extremities, such as between the hand or head and one or both feet, depends largely on the voltage. Body circuit resistance, even with liquid contacts (barring broken skin) will probably be not less than 500 ohms. The current flow at this resistance at 120 volts is 240 milliamperes. Recognition of the hazards associated with various types of electrical equipment is of paramount importance in developing and applying safety guidelines for working on energized equipment. Three classes (in order of increasing severity) of electrical hazards have evolved.

Class A Hazard

Class A electrical hazard exists when all the following conditions prevail: The primary AC potential does not exceed 130 volts rms. The available primary AC current is limited to 30 amperes rms. The stored energy available in a capacitor or inductor is less than 5 joules ($J=CV^2/2=LI^2/2$). The DC or secondary AC potentials are less than 50 volts line-to-line and/or to ground or the DC or secondary AC power is 150 volt-amperes (V-A) or less. Although the voltages and currents may be considered nominal, a "Class A" electrical hazard is potentially lethal. This class is particularly dangerous because of everyday familiarity with such sources, an assumed ability to cope with them, and their common occurrence in less guarded exposures.

Class B Hazard

A Class B electrical hazard has the same conditions as a Class A hazard except that the primary AC potential is greater than 130 volts rms, but does not exceed 300 volts rms.

Class C Hazard

Class C electrical hazard classifications prevail for all situations when one or more of the limitations set in Class B is exceeded.

Employee Attitude

The attitudes and habits of personnel and the precautions they routinely take when working on energized equipment are extremely important. There are three modes of working on electrical equipment.

Mode 1: Turn Off the Power

All operations are to be conducted with the equipment in a positively de-energized state. All external sources of electrical energy must be disconnected by some positive action (e.g., locked-out breaker) and with all internal energy sources rendered safe. "Mode 1" is a minimum hazard situation.

Mode 2: Latent Danger

All manipulative operations (such as making connections or alterations to or near normally energized components) are to be conducted with the equipment in the positively de-energized state. Measurements and observations of equipment functions may then be conducted with the equipment energized and with normal protective barriers removed. "Mode 2" is a moderate-to-severe hazard situation, depending on the operating voltages and energy capabilities of the equipment.

Mode 3: Hot Wiring

"Mode 3" exists when manipulative, measurement, and observational operations are to be conducted with the equipment fully energized and with the normal protective barriers removed. "Mode 3" is a severe hazard situation that should be permitted only when fully justified and should be conducted under the closest supervision and control. One knowledgeable person should be involved in addition to the worker(s). Written permission may be required. Work on Class B or Class C energized circuitry must only be done when it is absolutely necessary.

Safety Glasses

Either safety glasses or a face shield must be worn when working on electrical equipment.

Personal Protective Devices

For work on any energized circuitry with a Class B or Class C hazard, the use of personal protective devices (e.g., face shields, blast jackets, gloves, and insulated floor mats) is encouraged, even if not required.

Elevated Locations

Any person working on electrical equipment on a crane or other elevated location must take necessary precautions to prevent a fall from reaction to electrical shock or other causes. A second person, knowledgeable as a safety watch, must assume the best possible position to assist the worker in case of an accident.

Chain of Command

The supervisory chain must be identified for normal operation and development, servicing, or testing of hazardous equipment. An up-to-date set of instructions for operation, maintenance, testing, and safety should be provided and made readily available to anyone working on hazardous equipment. As many tests as practicable should be made on any type of electrical equipment in the un-energized condition, or at most, energized with reduced hazard. All covering, clothing, and jewelry that might cause hazardous involvement must be removed. Adequate and workable lock-out/tag-out procedures must be employed. A

person in a hazardous position who appears to be fatigued, ill, emotionally disturbed, or under the influence of alcohol and/or drugs (medicinal, or otherwise) must be replaced by a competent backup person, or the hazardous work must be terminated. Supervisors and workers must be encouraged to make the conservative choice when they are in doubt about a situation regarding safety. Training sessions and drills must be conducted periodically to help prevent accidents and to train personnel to cope with any accidents that may occur. CPR instruction must be included. An emergency-OFF switch, clearly identified and within easy reach of all high-hazard equipment, should be provided. Also, this switch may be used to initiate a call for help. Resetting an Emergency-OFF switch must not be automatic but must require an easily understandable overt act. Automatic safety interlocks must be provided for all access to high-hazard equipment. Any bypass of such an interlock should have an automatic reset, display conspicuously the condition of the interlocks, and ensure that barriers cannot be closed without enabling the interlock. All equipment should have convenient, comfortable, and dry access. Communication equipment (e.g., fire alarm box, telephone) should be provided near any hazardous equipment. Its location should be clearly marked to ensure that the person requesting assistance can direct the people responding to a call for help to the emergency site quickly. Any component that in its common use is non-hazardous, but in its actual use may be hazardous, must be distinctively colored and/or labeled. (An example might be a copper pipe carrying high voltage or high current.) Periodic tests of interlocks to ensure operability must be performed and documented at least yearly.

Protective Systems

Equipment must be designed and constructed to provide personnel protection. First-line and backup safeguards should be provided to prevent personnel access to energized circuits. Periodic tests must be established to verify that these protective systems are operative.

Safety Practices

Additional safety practices are described below.

Cable Clamping: A suitable mechanical-strain-relief device such as a cord grip, cable clamp, or plug must be used for any wire or cable penetrating an enclosure where external movement or force can exert stress on the internal connection. Grommets, adlets, or similar devices must not be used as strain relief.

Emergency Lighting: There must be an emergency lighting system that activates when normal power fails in Class C conditions.

Flammable & Toxic Material Control: The use of flammable or toxic material must be kept to a minimum. When components with such fluids are used, a catch basin or other approved method must be provided to prevent the spread of these materials should the normal component case fail.

Isolation: All sources of dangerous voltage and current must be isolated by covers and enclosures. Access to lethal circuits must be either via screw-on panels, each containing no less than four screws or bolts, or by interlocked doors. The frame or chassis of the enclosure must be connected to a good electrical ground with a conductor capable of handling any potential fault current.

Lighting: Adequate lighting must be provided for easy visual inspection. Overload Protection: Overload protection and well marked disconnects must be provided. Local “Off” controls must be provided on remote-controlled equipment. All disconnects and breakers should be clearly labeled as to which loads they control.

Power: All ac and dc power cabling to equipment not having a separate external ground but having wire-to-wire or wire-to-ground voltage of 50 volts or more must carry a ground conductor unless cabling is inside an interlocked enclosure, rack, grounded wire way, or conduit, or feeds a commercial double-insulated or UL-approved device. This requirement will ensure that loads such as portable test equipment, temporary or experimental, is grounded. UL-approved devices such as coffeepots, timers, etc., used per

the manufacturer's original intent are permissible. Rating: All conductors, switches, resistors, etc., should be operated within their design capabilities. Pulsed equipment must not exceed either the average, the RMS, or the peak rating of components. The equipment should be derated as necessary for the environment and the application of the components.

Safety Grounding: Automatic discharge devices must be used on equipment with stored energy of 5 joules or more. Suitable and visible manual grounding devices must also be provided to short-to-ground all dangerous equipment while work is being performed.

Safety Practices

The following check list must be used as a guide for circuits operating at 130 volts or more or storing more than 5 joules. An enclosure may be a room, a barricaded area, or an equipment cabinet.

Access: Easily opened doors, panels, etc., must be interlocked so that the act of opening de-energizes the circuit. Automatic discharge of stored-energy devices must be provided. Doors should be key-locked, with the same required key being also used for the locks in the control-circuit-interlock chain. This key must be removable from the door only when the door is closed and locked.

Heat: Heat-generating components, such as resistors, must be mounted so that heat is safely dissipated and does not affect adjacent components.

Isolation: The enclosure must physically prevent contact with live circuits. The enclosure can be constructed of conductive or non-conductive material. If conductive, the material must be electrically interconnected and connected to a good electrical ground. These connections must be adequate to carry all potential fault currents.

Seismic Safety: All racks, cabinets, chassis, and auxiliary equipment must be secured against movement during earthquakes.

Strength: Enclosures must be strong enough to contain flying debris due to component failure.

Temporary Enclosure: Temporary enclosures (less than 6-month duration) not conforming to the normal requirements must be considered Class C hazards.

Ventilation: Ventilation must be adequate to prevent overheating of equipment and to purge toxic fumes produced by a fault.

Visibility: Enclosures large enough to be occupied by personnel must allow exterior observation of equipment and personnel working inside the enclosure.

Warning Indicators: When systems other than conventional facilities represent Class C hazards, the systems should be provided with one of the following two safety measures:

- (1) A conspicuous visual indicator that is clearly visible from any point where a person might make hazardous contact or entry; and
- (2) A clearly visible primary circuit breaker or "OFF" control button on the front of the enclosure.

Safety Practices

Because a wide range of power supplies exist, no one set of considerations can be applied to all cases. The following classification scheme may be helpful in assessing power-supply hazards. Power supplies of 50 volts or less with high current capability too often are not considered a shock hazard, although these voltages are capable of producing fatal shocks. Since they are not "high voltage," such power sources frequently are not treated with proper respect.

In addition to the obvious shock and burn hazards, there is also the likelihood of injuries incurred in trying to get away from the source of a shock. Cuts or bruises, and even serious and sometimes fatal falls,

have resulted from otherwise insignificant shocks. Power supplies of 300 volts or more, with lethal current capability, have the same hazards to an even greater degree. Because supplies in this category are considered Class C hazards, they must be treated accordingly. High-voltage supplies that do not have dangerous current capabilities are not serious shock or burn hazards in themselves and are therefore often treated in a casual manner. However, they are frequently used adjacent to lower-voltage lethal circuits, and a minor shock could cause a rebound into such a circuit. Also, an involuntary reaction to a minor shock could cause a serious fall (for example, from a ladder or from experimental apparatus).

The following are additional safety considerations for power supplies.

Primary Disconnect. A means of positively disconnecting the input must be provided. This disconnect must be clearly marked and located where the workmen can easily lock or tag it out while servicing the power supply. If provided with a lockout device, the key must not be removable unless the switch or breaker is in the “Off” position.

Overload Protection. Overload protection must be provided on the input and should be provided on the output.

Danger with Large Capacitors

This section describes the hazards associated with capacitors capable of storing more than 5 joules of energy. Capacitors may store hazardous energy even after the equipment has been de-energized and may build up a dangerous residual charge without an external source; “grounding” capacitors in series, for example, may transfer rather than discharge the stored energy. Another capacitor hazard exists when a capacitor is subjected to high currents that may cause heating and explosion. At one time, capacitors were called condensers and older capacitors may still bear this label in diagrams and notices. Capacitors may be used to store large amounts of energy. An internal failure of one capacitor in a bank frequently results in explosion when all other capacitors in the bank discharge into the fault. Approximately 10 sup 4 joules is the threshold energy for explosive failure of metal cans. Because high-voltage cables have capacitance and thus can store energy, they should be treated as capacitors.

The liquid dielectric in many capacitors, or its combustion products, may be toxic. *Do not breath the fumes from the oil in older capacitors.* The following are safety practices for capacitors:

Automatic Discharge. Permanently connected bleeder resistors should be used when practical. Capacitors in series should have separate bleeders. Automatic shorting devices that operate when the equipment is de-energized or the enclosure is opened should be used. The time required for a capacitor to discharge to safe voltage (50 volts or less) must not be greater than the time needed for personnel to gain access to the voltage terminals – never longer than 5 minutes. In the case of Class C equipment with stored energy in excess of 5 joules, an automatic, mechanical discharging device must be provided that functions when normal access ports are opened. This device must be contained locally within protective barrier to ensure wiring integrity and should be in plain view of the person entering the protective barrier so that the individual can verify its proper functioning. Protection also must be provided against the hazard of the discharge itself.

Safety Grounding. Fully visible, manual-grounding devices must be provided to render the capacitors safe while they are being worked on. Grounding points must be clearly marked, and caution must be used to prevent transferring charges to other capacitors.

Ground Hooks. All ground hooks must: Have conductors crimped and soldered. Be connected such that impedance is less than 0.1 ohms to ground. Have the cable conductor clearly visible through its insulation. Have a cable conductor size of at least #2 extra flexible, or in special conditions a conductor capable of carrying any potential current. Be in sufficient number to ground conveniently and adequately ALL designated points. Be grounded and located at normal entry way when stored, in such a manner to ensure that they are used. In Class C equipment with stored energy in excess of 5 joules, a discharge point

with an impedance capable of limiting the current to 500 amperes or less should be provided. This discharge point must be identified with a yellow circular marker with a red slash and must be labeled “**HI Z PT**” in large readable letters. A properly installed grounding hook must first be connected to the current-limiting discharge point and then to a low-impedance discharge point (less than 0.1 ohm) that is identified by a yellow circular marker. The grounding hooks must be left on all of these low impedance points during the time of safe access. The low-impedance points must be provided, whether or not the HI-Z current-limiting points are needed. Voltage indicators that are visible from all normal entry points should also be provided.

Fusing. Capacitors used in parallel should be individually fused when possible to prevent the stored energy from dumping into a faulted capacitor. Care must be taken in placement of automatic-discharge safety devices with respect to fuses. If the discharge will flow through the fuses, a prominent warning sign must be placed at each entry indicating that each capacitor must be manually grounded before work can begin. Special knowledge is required for high-voltage and high-energy fusing.

Unused Terminal Shorting. Terminals of all unused capacitors representing a Class C hazard or capable of storing 5 joules or more must be visibly shorted.

Danger with Large Magnets

This section describes inductors and magnets that can store more than 5 joules of energy or that operate at 130 volts or more. The following are some hazards peculiar to inductors and magnets:

The ability of an inductor to release stored energy at a much higher voltage than that used to charge it. Stray magnetic fields that attract magnetic materials. Time-varying stray fields that induce eddy currents in conductive material thereby causing heating and mechanical stress. Time-varying magnetic fields that may induce unwanted voltages at inductor or magnet terminals.

The following are safety practices for inductive circuits:

Automatic Discharge. Freewheeling diodes, varistors, thyrites, or other automatic shorting devices must be used to provide a current path when excitation is interrupted.

Connections. Particular attention should be given to connections in the current path of inductive circuits. Poor connections may cause destructive arcing.

Cooling. Many inductors and magnets are liquid cooled. The unit should be protected by thermal interlocks on the outlet of each parallel coolant path, and a flow interlock should be included for each device.

Eddy Currents. Units with pulsed or varying fields should have a minimum of eddy-current circuits. If large eddy-current circuits are unavoidable, they should be mechanically secure and able to safely dissipate any heat produced.

Grounding. The frames and cores of magnets, transformers, and inductors should be grounded.

Rotating Electrical Machinery. Beware of the hazard due to residual voltages that exists until rotating electrical equipment comes to a full stop.

Safety Design

Proper philosophy is vital to the safe design of most control applications. The following check list should be used as a guide.

Checkout. Interlock chains must be checked for proper operation after installation, after any modification, and during periodic routine testing.

Fail-Safe design. All control circuits must be designed to be “fail-safe.” Starting with a breaker or fuse, the circuit should go through all the interlocks in series to momentary on-off switches that energize and

"seal in" a control relay. Any open circuit or short circuit will de-energize the control circuit and must be reset by overt act.

Interlock Bypass Safeguards. A systematic procedure for temporarily bypassing interlocks must be established. Follow-up procedures should be included to ensure removal of the bypass as soon as possible. When many control-circuit points are available at one location, the bypassing should be made through the normally open contacts of relays provided for this purpose. In an emergency, these relays can be opened from a remote control area.

Isolation. Control power must be isolated from higher power circuits by transformers, contactors, or other means. Control power should be not more than 120 volts, ac, or dc. All circuits should use the same phase or polarity so that no additive voltages (Class B or Class C hazard) are present between control circuits or in any interconnect system. Control-circuit currents should not exceed 5 amperes.

Lock-out. A keyed switch should be used in interlock chains to provide positive control of circuit use. To ensure power removal before anyone enters the enclosure, this same key should also be used to gain access to the controlled equipment.

Motor Control Circuits (Class B or Class C Hazards). All Class B or Class C motor circuits must have a positive disconnect within view of the motor or, if this is not practical, a disconnect that can be locked open by the person working on these motor circuits is acceptable.

Over-Voltage Protection. Control and instrumentation circuits used with high-voltage equipment must have provision for shorting fault-induced high voltages to ground. High-voltage fuses with a high-current, low-voltage spark gap downstream from the high-voltage source are recommended. This also applies to all circuits penetrating high-voltage enclosures.

Voltage Divider Protection. The output of voltage dividers used with high voltages must be protected from over-voltage-to-ground within the high-voltage area by spark gaps, neon bulbs, or other appropriate means.

Current Monitors. Currents should be measured with a shunt that has one side grounded or with current transformers that must be either loaded or shorted at all times. Instrument Accuracy. Instrumentation should be checked for function and calibration on a routine basis.

Radiation Hazards

This section covers radiation hazards that may be encountered in working with electrical equipment. The following information should be used as a rough guide to radiation safety. Hazardous electromagnetic radiation must be isolated in shielded enclosures. Transmission paths of microwave energy must be enclosed or barricaded and well-marked. Care must be taken to avoid reflecting energy out of this path. Suitable goggles must be worn where exposure is possible. Dose rates must not exceed those shown below.

Monitoring. When equipment capable of generating a radiation hazard is used, monitoring must be provided to detect and measure the radiation. Where personnel may be exposed, this monitoring equipment should be arranged to de-energize the generating equipment at a safe preset level. Isolation. Equipment that produces x-rays (high-voltage vacuum tubes operating at more than 15,000 volts) or any equipment that under fault conditions could produce x-rays (e.g., spectrometers) must be isolated from personnel. This isolation may be by distance or by lead shielding. For any questions, call the Responsible Safety Officer.

High-power sources of ultraviolet, infrared, and visible light must be isolated by barriers that are opaque to the radiation. When a beam of this radiation is projected out of an enclosure, the beam path must be barricaded and well marked. Care must be taken to eliminate reflective surfaces along the beam path. Suitable goggles must be worn where exposure is possible.

More than 300 Volts

To work on systems with voltages greater than 300 volts (CLASS B OR C HAZARD):

Open the feeder breaker, roll out if possible, tag out, and lock if in enclosure. If work is on circuits of 600 V or more, positive grounding cables should be attached to all three phases. Tag should contain who, why, and when information, and it is of vital importance because a person's life may depend on it. "Vital" in this case means that the presence and status of the tag are inviolate, and the tag must not be altered or removed except by the person who attached it.

Less than 300 Volts

To work on systems with voltages less than 300 volts (CLASS A HAZARD): Turn-off and tag the feeder breaker. Tag is inviolate except on projects where established circuit checkout procedure allows a qualified person to remove it and energize circuit after checkout is complete.

Motor Generator Systems

For motor or generator work, primary feeder breaker must be opened, tagged, and locked out if possible. For generator-load work, motor-start permissive key must be removed by person doing work and restored when work is complete.

High Voltage

To work on high voltage power supplies and enclosures use Class B or Class C hazard procedure specified in the safety requirements. Access should always be by permissive key that interrupts input power when key is removed from control panel. Grounding of power supply output must occur either automatically when key is removed from control panel or manually before access door can be opened.

High Current

To work on high current power supplies (normally for magnets), treat system as a high voltage power supply, if energy storage is 5 joules or more when system is off. If not, then requirements for working on magnet are as follows: If power supply is equipped with Kirk (trademark) or equivalent interlock, turn the key and remove. This locks the input breaker in "off" position until key is reinserted and turned. If power supply is not equipped with a Kirk (trademark) or equivalent interlock, turn off and tag input circuit breaker.

Working on Power Supplies

The minimum requirements for working on any power supply is to turn the power off and properly tag feeder circuit breaker external to power supply.

Electrical Lock-out/Tag-out Procedures

When you have to perform maintenance work on a machine, take these four steps to protect yourself and your co-workers from injury:

- 1) De-energize the machine if possible. Positively disconnect the machine from the power source. If there is more than one source of power, then disconnect them all.
- 2) If possible, lock out all disconnect switches. You must be given a lock and a key for each disconnect before you begin working on the machine.
- 3) Tag all disconnect switches. Use the yellow or Red safety tags which state in large letters -- "Danger...Do Not Operate," or "Danger...Do Not Energize" and which give the name of the individual who locked out the equipment, date and time. The tag must also state "DO NOT REMOVE THIS TAG". (The person who placed the tag may remove it only after the machinery maintenance has been completed.)

- 4) Test the equipment to insure it is de-energized before working on it. First, attempt to operate the equipment by turning it on normally. Next, check all electrical lines and exposed areas with test equipment or a "lamp". Finally, short to ground any exposed connections using insulated grounding sticks. This test must be done even if the electrical connection is physically broken, such as pulling out a plug, because of the chance of discharging components.

A TAG OUT ONLY PROCEDURE MAY BE USED IF THE MACHINE CANNOT BE LOCKED OUT. IF THE MACHINE IS SUPPLIED ELECTRICAL POWER FROM A SINGLE SOURCE, WHICH IS UNDER THE EXCLUSIVE CONTROL OF A TRAINED AND QUALIFIED REPAIR PERSON AT ALL TIMES AND THERE ARE NOT ANY OTHER PERSONS IN THE REPAIR AREA WHO COULD BE HARMED BY THE ACCIDENTAL ENERGIZING OF THE MACHINERY, THEN TAG OUT MAY BE USED INSTEAD OF LOCK-OUT/TAG OUT.

Be aware that many accidents occur at the moment of re-energizing. If the machinery is to be re-energized, all persons must be kept at a safe distance away from the machinery. The re-energization can be performed only by a person who either performed the lock-out/tag out, a person acting under the immediate and direct commands of the original lock-out/tag out person, or in the event of a shift change, or other unavailability of the original person, then the original shall, before leaving, appoint a surrogate original person and show him or her all steps taken to lock-out/tag out the equipment.

Gases

This chapter contains guidelines and requirements for the safe use of flammable and/or compressed gases. It covers the use of flammable-gas piping systems, high-pressure gas cylinders, manifolded cylinders, and compressed air.

Hazards

All gases must be used in a manner that will not endanger personnel or property in routine shop use or experimental operations. Hazards associated with handling and use of flammable and/or high-pressure gases include the following: Injuries caused by flying objects accelerated by an explosion or pressure release; Almost certain death if a flammable mixture is inhaled and then ignited; Asphyxiation; Secondary accidents such as falls or electrical shocks; Fire caused by ignition of flammable gases;

Relief Valves Required

All systems, system components, and piping subject to over-pressures must be equipped with relief devices.

Operational Safety Procedures

Equipment containing highly toxic gases requires an Operational Safety Procedure (OSP) and must comply with the requirements described in the chapters on chemical safety. If you are in doubt as to the hazards, toxicity, or safe operating practices for any gases, consult the Responsible Safety Officer.

Fire Risk

Fire requires three elements: fuel, oxygen, and ignition. Any experiment or routine operation that places a flammable gas in the presence of an oxidant (air, oxygen) and an ignition source (spark, flame, high temperature) is extremely dangerous. To reduce the risk of fire, eliminate two of these three elements. Thus, when using flammable gases, (1) eliminate ignition sources and (2) prevent mixing of fuel with air or oxygen. Contain or vent fuel. Pyrophoric substances, which are materials that ignite spontaneously when exposed to air, require even more care. Minimize the use of oxygen in high concentration. Materials not normally considered combustible burn violently in high-oxygen atmospheres. Therefore, special precautions must be taken when working with high-oxygen concentrations.

Equipment Design

When designing equipment for flammable gas that does not involve intentional combustion, any possibility of ignition or explosion must be prevented.

Guidelines

All personnel authorized to work with flammable gases must be familiar with the hazards and emergency measures that might be required in the event of an accident. For safe operation the following safety guidelines must be observed: A piping (schematic) diagram of the apparatus and an operating procedure that includes safety considerations and emergency instructions must be developed, and the installed piping must be inspected to ensure that it is installed as shown on the piping diagram. Only personnel authorized to work on the experiment are allowed in the operations area. Appropriate warning devices and

signs, such as "Danger-Hydrogen" and "No Smoking and Open Flames," must be posted on or near the work area and at the doors to the operating area. Flammable gas shutoff valves must be located outside flammable gas operating areas. Good housekeeping practices must be observed; unnecessary combustible material must be kept out of flammable gas operating areas. Only the flammable gas cylinders actually required for the experiment are allowed in the operating area. Extra cylinders must be stored in an approved area outside the building or work area.

When two or more cylinders containing flammable gas are used inside a room or other confined area, and are connected to a common manifold, the regulators must be modified. The existing relief valves on the regulator must be replaced with two special relief valves connected to a metal vent line that terminates outside and above the building. Likewise, when the building occupancy is rated H7, as defined in the Uniform Building Code, all flammable gas regulators must have their relief valves vented to a vent line that terminates outside and above the building. All ignition sources, e.g., welding torches, lit cigarettes, electric arcs, electrostatic charges, and pilot lights, must be kept away from flammable gases at all times. Ventilation must be provided to prevent entrapment of flammable gases in closed areas. If the gas is lighter than air, overhead ventilation is required.

Gases denser than air must be prevented from entering trenches and manholes where they can collect and form explosive mixtures with air. Cracking a hydrogen gas cylinder valve before attaching the regulator is not recommended since the gas may be ignited by static charge or friction heating. Closing the valve stops the flame immediately. Never use a flame to detect flammable gas leaks. Use soapy water or use other approved methods. If a flammable gas cylinder is discovered with a small leak and the gas has not ignited, the cylinder must be moved carefully to a safe outside area. If the leak is serious or the gas has ignited, evacuate the area and call the [Company] security department and the local Fire Department immediately.

Hydrogen

Hydrogen is a colorless, odorless, non-toxic, and highly flammable gas. It is the lightest gas, being only 0.07 times the density of air and having a rate of diffusion 3.8 times faster than air, which allows it to fill a confined space rapidly. The danger hydrogen poses is evident from its wide range of flammable mixtures: 4% to 75% in air and 4% to 94% in oxygen. Hydrogen-air mixtures can be ignited by an extremely low energy input, 0.02 millijoules, which is only 10% of the energy required to ignite a gasoline-air mixture. High pressure hydrogen leaks will usually ignite as a result of the static electricity generated by the escaping gas. The ignition temperature of hydrogen is 932 degrees F, its flame velocity is 270 cm/sec (almost 10 times the velocity of a natural-gas flame), and it burns with a virtually colorless (invisible) flame at 3713 degrees F. If ignited, unconfined hydrogen and air mixtures will burn or explode depending upon how close the mixture is to being stoichiometric. Confined mixtures may detonate (burn at sonic velocity) depending upon the mixture and the geometry of the confined space. Hydrogen is not toxic but can cause asphyxiation. See NFPA 50A, Standard for Gaseous Hydrogen Systems at Consumer Sites

Oxygen

Oxygen supports combustion but is itself nonflammable. Oxygen lowers the ignition point (in air) of flammable substances and causes them to burn more vigorously. Materials such as oil and grease burn with nearly explosive violence in oxygen, even in minute quantities. Therefore, oxygen cylinders must not be handled with greasy or oily hands or gloves and must not be stored near highly combustible materials such as oil, grease, or reserve acetylene. Oxygen must never be used to purge lines, to operate pneumatic tools, or to dust clothing - cloth, plastics, etc., saturated with oxygen burn explosively. Accordingly, oxygen cylinders must never be used as hat racks, clothes hangers, etc., since leaky fittings can result in accumulations of gas in the covering material. Insects in oxygen "pigtailed" can ignite spontaneously and may cause sufficient heat and over-pressure to burst the pigtail, valve, or manifold: don't leave pigtailed disconnected for more than a few minutes. Do not use white lead, oil, grease, or any

other non-approved joint compound for sealing oxygen-system fittings. Threaded connections in oxygen piping must be sealed with joint compounds or Teflon tape approved for oxygen service. Litharge and water is recommended for service pressures above 300 psig (2.0 MPa). Gaskets must be made of non-combustible materials. When high pressure oxygen cylinders are stored inside a building, they must be separated from flammable gas cylinders by at least 20 feet or by a fire-resistive partition.

Acetylene

Acetylene is used principally with welding and cutting torches. Commercial acetylene gas is colorless and highly flammable with a distinctive garlic-like odor. Acetylene, in its free state under pressure, may decompose violently - the higher the pressure, the smaller the initial force required to cause an explosion. Therefore, acetylene is stored in acetone, which dissolves 300 times its volume of acetylene. Acetylene cylinders are filled with a porous filler material that holds the acetone. The combination of filler and acetone allows acetylene to be contained in cylinders at moderate pressures without danger of explosive decomposition. Full cylinder pressure is 250 psig at 70 degrees F.

CAUTION: When acetylene is withdrawn from its cylinder too rapidly, the gas cannot come out of solution fast enough, the downstream pressure drops, and liquid acetone is thrown out of the cylinder and may limit the flow of the pressure-reducing regulator. The following precautions are recommended when working with acetylene: To prevent flashbacks check valves are required in welding gas lines and at the welding/cutting torch. If the acetylene pressure drops, the oxygen pressure at the torch can push oxygen back up the acetylene line, where it can mix with acetylene and cause a flashback. Copper must not be used in acetylene piping - copper forms an impact-sensitive copper acetylide. NEVER use free acetylene gas outside the cylinder at pressures over 15 psig (30 psia) -- it can decompose violently. Acetylene cylinders should be used or stored only in an upright position to avoid the possibility of acetone leaking from the cylinder. If an acetylene cylinder has been stored horizontally, the cylinder should be put upright and left in that position for about 30 minutes before being used. When cylinders are empty of acetylene, valves must be closed to prevent evaporation of the acetone. Acetylene cylinders may be filled only by the supplier.

Magic Gas

Magic Gas (magic gas II) has been used at [Company] in multi-wire proportional chambers. This particular mixture is denser than air and consists of the following: Isobutane _____ 23.52% Methylal (dimethoxy-methane) _____ 4.00% (nominal) Freon 13-B1 _____ 0.48% Argon _____ 72.00% This gas is purchased premixed in Matheson 1F (Fat Boy) cylinders pressurized to 35 psig. The flammable limits of this gas are about 1.8% to 7% in air. [Company] safety rules for high pressure cylinders and flammable gases apply to all uses of Magic Gas.

Cylinders

Only cylinders meeting Department of Transportation (DOT) regulations may be used for transporting compressed gases. Each cylinder must bear the required DOT label for the compressed gas contained, except under certain specified conditions set forth in DOT regulations. It is illegal to remove or to change the prescribed numbers or other markings on cylinders - do not deface, cover, or remove any markings, labels, decals, or tags applied or attached to the cylinder by the supplier. Each cylinder in use at [Company] must carry a legible label or stencil identifying the contents. Do not repaint cylinders unless authorized by the owner. Compressed-gas containers must not contain gases capable of combining chemically, nor should the gas service be changed without approval by Responsible Safety Officer. The cylinder-valve outlet connections on cylinders containing gas mixtures are provided by the gas supplier,

based on the physical and chemical characteristics of the gases. Gas mixtures having a flammable component must have a cylinder-valve outlet connection with left-handed threads, even though the gas mixture is nonflammable, unless Responsible Safety Officer has authorized otherwise. Regulators, gauges, hoses, and other appliances provided for use with a particular gas or group of gases must not be used on cylinders containing gases having different chemical properties unless information obtained from the supplier indicates that this is safe. Gases must not be mixed at [Company] sites in commercial DOT cylinders and must not be transferred from one DOT cylinder to another. Gases mixed at [Company] must never be put into a [Company]- or vendor-owned compressed gas cylinder. Vendor-owned cylinders must not be used for any purpose other than as a source of vendor-supplied gas. Only the vendor may pressurize these cylinders. It is illegal to transport a leaking cylinder (charged or partially charged) by common or contract carrier.

Compressed Gases

Compressed gases (over 150 psig) are usually stored in steel cylinders manufactured according to DOT specifications. When the DOT was formed in 1969, it acquired responsibility for cylinder specifications, formerly issued by ICC. DOT regulations require the following markings on all cylinders: Type of cylinder and pressure rating. Serial number. Inspection date. For example: DOT 3AA2065 973487 6/70. DOT 3AA indicates DOT specification 3AA, which is a seamless alloy-steel cylinder of definite prescribed steel, not over 1000-lb water capacity, with at least 150-psi service pressure; 2065 is the service pressure at 70 degrees F. and the maximum refill pressure; 973487 is the manufacturer's serial number; and 6/70 is the date of the initial qualifying test. Old cylinders (made before 1970) will have "ICC" in the markings, whereas cylinders manufactured after 1970 will be marked "DOT." The other identification markings are unchanged. [Company] owns cylinders for most of the common industrial gases and uses its own content identification color code. For non-Company-owned cylinders, which may, or may not, have a non-Company color code, the name of the gas painted on each cylinder, rather than the color code, should be used to identify the contents. Mixed-gas cylinders must be marked with an adhesive label placed on the shoulder of the cylinder. The label must contain a RED diamond for flammable gas or a GREEN diamond for nonflammable gas. The percentage of each gas component must be marked on the label and on a tag attached to the valve by the supplier. In addition, a circumferential white stripe must be painted near the shoulder of the cylinder to indicate mixed gas.

Inspections

All compressed gas cylinders, hoses, tubing, and manifolds must be inspected frequently to ensure that they are free of defects that could cause a failure. Cylinders must be considered defective and rejected (or removed from service) if a valve is stiff, or a fitting leaks, or if they contain dents, cuts, gouges, digs over 3 inches long, leaks (of any size), fire damage, or valve damage. All defective cylinders ([Company]- or vendor-owned) must be sent back to the manufacturer or vendor for test and repair. Hoses and fittings that appear worn must be replaced before the equipment is put to further use. All standard size single compressed gas cylinders (200 scf) that are used only at [Company], such as in fixed tube banks, must be pressure tested to 5/3 (1.67) of their DOT service pressure every 6 years.

Cylinder Handling

Compressed gases should be handled only by experienced and properly instructed personnel. When in doubt about the proper handling of a compressed gas cylinder or its contents, consult Responsible Safety Officer. Compressed gas cylinders are dangerous when handled incorrectly. Always assume that a cylinder is pressurized. Handle it carefully. Never throw, bang, tilt, drag, slide, roll, or drop a cylinder from a truck bed or other raised surface. If a cylinder must be lifted manually, at least two people must do the lifting. Because of their shape, smooth surface, and weight, gas cylinders are difficult to move by

hand. A truck or an approved cylinder handcart must always be used to move a cylinder. Cylinders must be fastened in metal cradles or skid boxes before they are raised with cranes, forklifts, or hoists. Rope or chain lifting slings alone must not be used. Cylinders, even empty ones, must never be used as rollers for moving materials, as work supports, etc.

If damaged, a cylinder can cause severe injuries, including lung damage from inhalation of toxic contents and physical trauma from explosion. A pressurized gas cylinder can become a dangerous projectile if its valve is broken off. When a cylinder is not connected to a pressure regulator or a manifold, or is otherwise not in use, it is extremely important that the cylinder valve be kept closed and the safety cap be kept in place -- the cap protects the cylinder valve (do not lift cylinders by their caps). Notify the Responsible Safety Officer, giving details and cylinder serial number, if you believe that a foreign substance may have entered the cylinder or valve. Cylinders containing compressed gases should not be subjected to a temperature above 125 degrees F. Flames, sparks, molten metal, or slag must never come in contact with any part of a compressed gas cylinder, pressure apparatus, hoses, etc. Do not place cylinders where they might become part of an electric circuit. When cylinders are used in conjunction with electric welding, ensure that the cylinders cannot be accidentally grounded and burned by the electric welding arc. Cylinders must not be subjected to artificially low temperatures. Many ferrous metals become extremely brittle at low temperatures. The loss of ductility and thermal stress at low temperature may cause a steel cylinder to rupture. Never attempt to repair, alter, or tamper with cylinders, valves, or safety relief devices.

Working With Gases

Always identify the contents of a gas cylinder before using it. If a cylinder is not clearly labeled, return it to the Responsible Safety Officer. Before using a cylinder, be sure it is properly supported with two metal chains or the equivalent to prevent it from falling. Contamination of compressed gas cylinders by feedback of process materials must always be prevented by installation of suitable traps or check valves. Suitable pressure-regulating devices and relief devices must always be used when gas is admitted to systems having pressure limitations lower than the cylinder pressure. Gas cylinder valves can be "cracked" (opened slightly) momentarily before regulators are attached to blow dirt off the valve seats, but the valve outlet should always be pointed away from people or equipment. (Cracking the valve is not recommended with hydrogen because it can be ignited by static charge or friction.) After the regulator is securely attached to the cylinder valve, fully release (turn counter-clockwise) the pressure-adjusting screw of the regulator before opening the cylinder valve.

Open gas cylinder high pressure valves slowly; this gives compression heat time to dissipate and prevents "bumping" the gauges.

Never use a wrench on any cylinder-valve hand wheel. Keep removable keys or handles on valve spindles or stems while cylinders are in service.

Never leave pressure in a system that is not being used. To shut down a system, close the cylinder valve and vent the pressure from the entire system. Equipment must not be disassembled while it is under pressure. Be aware that any valved-off portion of the system may still be under pressure; bleed the hose, line, or vessel before disassembly to ensure that there is not enough pressure energy stored in the trapped gas or in piping distortion to propel loose objects. Connections to piping, regulators, and other appliances should always be kept tight to prevent leakage. Where hose is used, it should be kept in good condition. Manifold pigtails should not be left disconnected for more than a few minutes. Certain insects are attracted to pure gases and will quickly clog these lines. Never use compressed gas to dust off clothing; this may cause serious injury or create a fire hazard. About 30 psi gauge pressure (0.2 MPa) must be left in "empty" cylinders to prevent air from entering the cylinder and contaminating it; air contamination in a hydrogen cylinder is extremely dangerous. Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator. Before returning an empty cylinder, close the

valve and replace the cylinder-valve protective cap and outlet cap or plug, if used.

Cylinder Storage

Cylinders not actively in use inside of buildings must be stored outside in areas approved by Responsible Safety Officer and must be fastened - with two metal chains or bars or in a fixture - to prevent them from falling if they are bumped or shaken, as during an earthquake. When gases of different types are stored at the same location, cylinders must be grouped by types of gas, and the groups must be arranged in accordance with the gases contained, e.g., flammable gases must not be stored near oxygen. Charged cylinders and empty cylinders should be stored separately in an arrangement that permits removal of "old stock" (cylinders in storage the longest) with minimum handling of other cylinders. Storage rooms or areas should be dry, cool, well ventilated, and, where practical, fire resistant; must have solid, level floors or storage surfaces; and must be away from traffic. Storage in sub-surface locations should be avoided. Cylinders must not be stored at temperatures above 125 degrees F. or near radiators or other sources of heat, near sparking devices, or near salt or other corrosive chemicals. If stored outside, cylinders must be protected from continuous direct sunlight, extreme weather, or moisture.

Supervisor Responsibilities

Supervisors must make periodic surveys of regulators in their areas. Damaged, unreliable, or otherwise defective regulators must be replaced immediately. All surplus regulators must be inspected, cleaned, adjusted, and repaired, as required. Immediately after its removal from a flammable, toxic, and/or radioactive system, the entire regulator must be safely vented and purged. If in doubt about the hazard call the Responsible Safety Officer. Use only regulators of the approved type and design for the specific gas-and-cylinder combination to be employed. Ensure that threads and nipples (e.g. round, flat, conical) on regulators correspond to those on the cylinder-valve outlet (never force connections).

Regulators with green-face gauges must be used only with oxygen. Regulators designed for use on gas lines must not be used on gas cylinders; single-stage regulators are for use only up to 150 psig (1.0 MPa) and must be used only for in-line installation. Two-stage regulators for inert gases are equipped with two relief valves that protect the regulator diaphragms and gauges from excessive over-pressure. Relief valves on regulators for use with flammable, toxic, and/or radioactive gases must be vented to a safe location.

The second stage of a two-stage regulator will normally be adjusted so that the low-pressure output cannot exceed 67% of the highest reading on the low-pressure output gauge; the low pressure output relief valve will be set to open at (or under) the highest reading on the low-pressure output gauge. Users are cautioned that additional pressure-relief valves may be required to protect downstream equipment. Single-stage cylinder regulators (except acetylene regulators) are equipped with a single relief device that is set to open at (or under) the highest reading on the output gauge. These regulators will be adjusted to limit the output pressure to 67% of the highest reading of the output gauge. If piping and associated apparatus connected to the regulator discharge are rated at a pressure lower than the lowest possible setting of the low-pressure output relief valve on the regulator and, therefore, a leak in the regulator valve seat could cause damage to the connected apparatus, a separate relief valve must be installed in the downstream equipment to protect it from damage caused by over-pressurization.

Diaphragm Failure

Diaphragm failure permits the cylinder gas to escape to the surrounding atmosphere through holes in the regulator body. To reduce the probability of diaphragm failure, high-pressure regulators are equipped with stainless steel diaphragms. Regulators for use with flammable and/or toxic gases can be obtained with a bonnet fitting which allows the regulator to be vented.

Regulators, Vacuum Service

If piping on the high-pressure side of a regulator is to be evacuated through the regulator, it must be modified for vacuum service to prevent damage to the diaphragms and pressure gauges. Regulators modified for vacuum service must be so labeled.

Compressed Air

Compressed air for general shop or laboratory use must be restricted to 30-psig (207-kPa) maximum pressure by restricting nozzles. Compressed air at pressures up to 100-psig (700-kPa) may be used to operate pneumatic tools, certain control instruments, and research equipment with properly designed over-pressure relief devices. Use of air-pressurized research equipment must be approved by the Responsible Safety Officer. Building compressed air (house air) may be used to dry parts and to help accomplish many other jobs in the shop or laboratory, but always ensure that no one is in line with the air stream and always wear goggles or a face shield. Compressed air must not be used for breathing unless it has been especially installed for this purpose and such use has been approved by Responsible Safety Officer.

Never apply air pressure to the body or use compressed air to clean clothing. Compressed air injected into the body openings can be fatal. Compressed air used to clean clothing drives particles into the fabric, where they can cause skin irritation and infections. Use a clothes brush. Compressed air must not be used to transfer liquids from containers of unknown safe working pressure. A pressurized commercial drum of unknown pressure rating is a hazardous device; for example, a 55-gal (200liter) drum pressurized to 14.5 psig (100 kPa) has a force on the drum head of about 3 tons. To transfer liquids use a pump or a siphon with a bulk aspirator. The transfer pressure for commercial-type liquid nitrogen dewars must be less than 14.5 psig. For most laboratory-type liquid nitrogen systems, transfer pressures of less than 5 psig are adequate. Compressed air must never be used for transferring liquid hydrogen or liquid helium. When an automatic shut-off coupling is not used on air-operated tools, a short metal chain (or its equivalent) should be attached to the hose to prevent it from whipping in case it separates from the tool. When using an air-operated tool, shut off the compressed air and vent the hose before changing nozzles or fittings.

Ladders & Scaffolds

Ladders

Ladders must be in good condition, made of suitable material, of proper length, and of the correct type for the use intended. Damaged ladders must never be used; they should be repaired or destroyed. Ladders used near electrical equipment must be made of a non-conducting material. Stored ladders must be easily accessible for inspection and service, kept out of the weather and away from excessive heat, and well supported when stored horizontally. A portable ladder must not be used in a horizontal position as a platform or runway or by more than one person at a time. A portable ladder must not be placed in front of doors that open toward the ladder or on boxes, barrels, or other unstable bases. Ladders must not be used as guys, braces, or skids. The height of a stepladder should be sufficient to reach the work station without using the top or next to the top steps. Bracing on the back legs of stepladders must not be used for climbing. The proper angle (75-1/2 degrees) for a portable straight ladder can be obtained by placing the base of the ladder a distance from the vertical wall equal to one quarter of the vertical distance from base to top of ladder's resting point. Ladders must be ascended or descended facing the ladder with both hands free to grasp the ladder. Tools must be carried in a tool belt or raised with a hand line attached to the top of the ladder. Extension ladders should be tied in place to prevent side slip.

Scaffolds

All scaffolds, whether fabricated on site, purchased, or rented must conform with the specifications found in ANSI A10.8, Safety Requirements for Scaffolding. Rolling scaffolds must maintain a 3:1 height to base ratio (use smaller dimension of base). The footing or anchorage for a scaffold must be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks must not be used to support scaffolds or planks. No scaffold may be erected, moved, dismantled, or altered unless supervised by competent persons. Scaffolds and their components must be capable of supporting at least four times the maximum intended load without failure. Guard rails and toe boards must be installed on all open sides and ends of scaffolds and platforms more than 10 ft above the ground or floor. Scaffolds 4 feet to 10 feet in height having a minimum horizontal dimension in either direction of less than 45 inches must have standard installed on all open sides and ends of the platform. Wire, synthetic, or fiber rope used for suspended scaffolds must be capable of supporting at least 6 times the rated load. No riveting, welding, burning, or open flame work may be performed on any staging suspended by means of fiber or synthetic rope. Treated fiber or approved synthetic ropes must be used for or near any work involving the use of corrosive substances. All scaffolds, bosun's chairs, and other work access platforms must conform with the requirements set forth in the Federal Occupational Safety and Health Regulations for Construction, 29 CFR 1926.451, except where the specifications in ANSI A10.8 are more rigorous.

Floors

Workroom floors must be in a clean and, as much as possible, dry condition. Drainage mats, platforms, or false floors should be used where wet processes are performed. Floors must be free from protruding nails, splinters, holes, and loose boards or tiles. Permanent aisles or passageways must be marked. Floor holes must be protected by covers that leave no openings more than one inch wide. Floor openings into which persons can accidentally walk must be guarded by standard railings and toe boards. Open-sided floors, platforms, and runways higher than four feet must be guarded by standard railings. Toe boards must be

used wherever people can pass below or hazardous equipment or materials are below.

Fall Arrester Systems Required

When workers are required to work from surfaces that are in excess of 7-1/2 ft above an adjacent safe work place and are unprotected by railings, the following procedures and guidelines must be applied: Before selecting personnel for work at elevated work stations, supervisors must consider the workers' physical condition, such as medical problems, fear of heights, and coordination. The Medical Services Department should be contacted for information in this regard. Approved fall-arrester systems are required for all work at heights of 10 or more feet. A recommended fall-arrester system consists of a full body-harness, a lanyard consisting of 1/2inch nylon rope or equivalent with a breaking strength of 5400 lb and a maximum length to provide for a fall no greater than 6 feet, Sala-type fall-arrester block (optional), and an anchored hook-up location Alternate equipment must be approved by the Responsible Safety Officer. Fall-arrester systems are recommended for light work at heights between 7-1/2 and 10 feet. Fall-arrester systems are not required when work is being done while standing on a ladder. Ladders should be tied off. Use of a controlled descent device is not necessary unless it is impossible to reach a stranded person by another means. The Responsible Safety Officer will advise, on request, regarding usage and procedures. It is the responsibility of the supervisor to plan the intended work sufficiently to ensure that job planning and proper precautions have been taken. The Responsible Safety Officer is available for consultation.

Personnel Platforms

Work may be performed from a crane-suspended platform where another procedure is not possible because of structure design or work site conditions. Personnel platforms must be designed by a qualified engineer and reviewed by the Responsible Safety Officer. The suspension system must minimize tipping. The platform must be designed with a minimum safety factor of 5 based on the ultimate strength of the members, and the design must conform to 29 CFR 1926.550(g).

Materials Handling

Introduction

[Company] requires that safety planning and practices for commonplace tasks be as thorough as for operations with unusual hazards. Commonplace tasks make up the greater part of the daily activities of most employees and, not unexpectedly, offer more potential sources of accidents with injuries and property damage. Every operation or work assignment begins and ends with handling of materials. Whether the material is a sheet of paper (paper cuts are painful) or a cylinder of toxic gas, accident risks can be reduced with thorough planning. Identifying obvious and hidden hazards should be the first step in planning work methods and job practices. Thorough planning should include all the steps associated with good management from job conception through crew and equipment decommissioning. Most of the material presented in this chapter is related to the commonplace and obvious. Nevertheless, a majority of the incidents leading to injury, occupational illness, and property damage stem from failure to observe the principles associated with safe materials handling and storage. A less obvious hazard is potential failure of used or excessive motorized handling or lifting equipment. The Responsible Safety Officer must be notified whenever it is desired to acquire a crane, forklift, truck, or other motorized handling or lifting equipment from outside sources.

Lifting & Moving

Lifting and moving of objects must be done by mechanical devices rather than by manual effort whenever this is practical. The equipment used must be appropriate for the lifting or moving task. Lifting and moving devices must be operated only by personnel trained and authorized to operate them. Employees must not be required to lift heavy or bulky objects that overtax their physical condition or capability.

Rigging

Planning for safe rigging and lifting must begin at the design stage, and lifting procedures must be developed for assembly and installation. The lifting procedure should be developed and discussed with the rigging crew fore person. Responsibility for all rigging jobs is shared between the rigging crew and the customer. The customer is responsible for defining and requesting the move, for providing technical information on relevant characteristics of the apparatus, including special lifting fixtures when required, for providing suggestions on rigging and moving, and for assigning someone to represent them both in planning and while the job is being carried out. The riggers are responsible for final rigging and for carrying out whatever moves have been designated.

Before any movement takes place, however, each representative must approve the rigging and other procedures associated with the intended move. Each must respect the responsibility and authority of the other to prevent or terminate any action he or she judges to be unsafe or otherwise improper. The supervisor must make certain that personnel know how to move objects safely by hand or with mechanical devices in the operations normal to the area and must permit only those employees who are formally qualified by training and certification to operate a fork truck, crane, or hoist. The supervisor must enforce the use of safe lifting techniques and maintain lifting equipment in good mechanical condition. Employees are required to observe all established safety regulations relating to safe lifting techniques. The Responsible Safety Officer provides training programs followed by certification for employees who have demonstrated the ability to operate fork trucks of up to 4-ton capacity and for incidental crane operations that require no special rigging.

Manual Lifting Rules

Manual lifting and handling of material must be done by methods that ensure the safety of both the employee and the material. It is [Company] policy that employees whose work assignments require heavy lifting be properly trained and physically qualified, by medical examination if deemed necessary. The following are rules for manual lifting: Inspect the load to be lifted for sharp edges, splinters, and wet or greasy spots. Wear gloves when lifting or handling objects with sharp or splintered edges. These gloves must be free of oil, grease, or other agents that may cause a poor grip. Inspect the route over which the load is to be carried. It should be in plain view and free of obstructions or spillage that could cause tripping or slipping. Consider the distance the load is to be carried. Recognize the fact your gripping power may weaken over long distances. Size up the load and make a preliminary “heft” to be sure the load is easily within your lifting capacity. If it is not, get help. If team lifting is required, personnel should be similar in size and physique. One person should act as leader and give the commands to lift, lower, etc. Two persons carrying a long piece of pipe or lumber should carry it on the same shoulder and walk in step. Shoulder pads should be used to prevent cutting shoulders and help reduce fatigue.

To lift an object off the ground, the following are manual lifting steps:

Make sure of good footing and set your feet about 10 to 15 inches apart. It may help to set one foot forward of the other. Assume a knee-bend or squatting position, keeping your back straight and upright. Get a firm grip and lift the object by straightening your knees - not your back. Carry the load close to your body (not on extended arms). To turn or change your position, shift your feet – do not twist your back. The steps for setting an object on the ground are the same as above, but in reverse.

Mechanical Lifting

Mechanical devices must be used for lifting and moving objects that are too heavy or bulky for safe manual handling by employees. Employees who have not been trained must not operate power-driven mechanical devices to lift or move objects of any weight. Heavy objects that require special handling or rigging must be moved only by riggers or under the guidance of employees specifically trained and certified to move heavy objects.

Inspections

Each mechanical lifting or moving device must be inspected periodically. Each lifting device must also be inspected before lifting a load near its rated capacity. Defective equipment must be repaired before it is used. The rated load capacity of lifting equipment must not be exceeded. Material moving equipment must be driven forward going up a ramp and driven backward going down a ramp. Traffic must not be allowed to pass under a raised load. The floor-loading limit must be checked before mobile lifting equipment enters an area. Passengers must not be carried on lifting equipment unless it is specifically equipped to carry passengers.

Load Path Safety

Loads moved with any material handling equipment must not pass over any personnel. The load path must be selected and controlled to eliminate the possibility of injury to employees should the material handling equipment fail. Equipment worked on while supported by material handling equipment must have a redundant supporting system capable of supporting all loads that could be imposed by failure of the mechanical handling equipment. A suspended load must never be left unattended but must be lowered to the working surface and the material handling equipment secured before leaving the load unattended.

Off Site Shipping

Material being shipped off site must be packed or crated by competent shipping personnel. Boxes, wooden crates, and other packing materials must be safely consigned to waste or salvage as soon as practicable following unpacking.

Truck Loading

All objects loaded on trucks must be secured to the truck to prevent any shifting of the load in transit. The wheels of trucks being loaded or unloaded at a loading dock must be chocked to prevent movement.

Clean Work Areas

All areas controlled by [Company] must be kept in orderly and clean condition and used only for activities or operations for which they have been approved. The following specific rules must also be followed: Keep stairs, corridors, and aisles clear. Traffic lanes and loading areas must be kept clear and marked appropriately. Store materials in work rooms or designated storage areas only. Do not use hallways, fan lofts, or boiler and equipment rooms as storage areas. Do not allow exits, passageways, or access to equipment to become obstructed by either stored materials or materials and equipment that is being used. Arrange stored materials safely to prevent tipping, falling, collapsing, rolling, or spreading - that is, any undesired and unsafe motion. Do not exceed the rated floor capacity of stored material for the area. The load limit and the maximum height to which material may be stacked must be posted. Place materials such as cartons, boxes, drums, lumber, pipe, and bar stock in racks or in stable piles as appropriate for the type of material.

Store materials that are radioactive, fissile, flammable, explosive, oxidizing, corrosive, or pyrophoric only under conditions approved for the specific use by the Responsible Safety Officer. Segregate and store incompatible materials in separate locations. Remove items that will not be required for extended periods from work areas and put them in warehouse storage. Call for assistance. Temporary equipment required for special projects or support activities must be installed so that it will not constitute a hazard. A minimum clearance of 36 inches must be maintained around electrical power panels. Wiring and cables must be installed in a safe and orderly manner, preferably in cable trays. Machinery and possible contact points with electrical power must have appropriate guarding.

The controls for temporary equipment must be located to prevent inadvertent actuation or awkward manipulation. When heat-producing equipment must be installed, avoid accidental ignition of combustible materials or touching of surfaces above 60 degrees C (140 F). Every work location must be provided with illumination that meets OSHA requirements. Evaluation of illumination quality and requirements is made by the Responsible Safety Officer, but the supervisor of an area is responsible for obtaining and maintaining suitable illumination. Areas without natural lighting and areas where hazardous operations are conducted must be provided with enough automatically activated emergency lighting to permit exit or entry of personnel if the primary lighting fails.

Cranes

There are two types of heavy duty cranes at [Company]. Bridge cranes are classified as cab-operated or pendant-operated. Mobile cranes consist of a boom and controls mounted on a truck chassis. Bridge and mobile cranes must be operated only by trained operators designated by the supervisor in charge of the facility. The supervisor is also responsible for ensuring that operators are trained, carrying out the inspections and following the safe operating rules explained in the Operator/Rigger Training Program. The Operator/Rigger Training Program is administered by the Responsible Safety Officer. The training staff consists of a qualified crane consultant, professional riggers, and the Responsible Safety Officer. There are two levels of required training and performance: Professional Operator/Rigger: Person whose

principal assignment includes crane operation and rigging functions. The chief operator/rigger must ensure that those professional operator/riggers under his/her supervision maintain the necessary qualifications. Incidental Operator/Rigger: Person who performs operating/rigging functions as an incidental part of his/her normal work assignment. Persons in this category are restricted to lower load limits and rigging of specific types of hardware. Incidental operator/riggers must be reexamined at least once every three years. Designated operator/riggers must have Government identification cards (Federal Form 46), endorsed appropriately. Before an employee may operate any of these cranes, the supervisor must arrange for the employee to receive incidental crane-operator training on the appropriate crane. Successful completion of the training must include an oral or written examination on the safety aspects of crane operation and a satisfactory demonstration of operational skills. The supervisor must determine that the applicant does not have any disqualifying medical or physical disabilities based on established requirements.

Loading the Crane

The crane must not be loaded beyond its rated load except for test purposes. Hoist chain or hoist rope must be free of kinks or twists and must not be wrapped around the load. Crane operators and floor persons must follow the OSHA requirements relating to moving the load.

Design Parameters

The Engineering Department is responsible for establishing design parameters relating to general requirements, cabs, foot walks and ladders, stops, bumpers and rail sweeps, brakes, electric equipment, hoisting equipment, warning devices, and other appurtenances to cranes as required in Occupational Safety and Health Standards, 29 CFR 1910.179. In addition the Responsible Safety Officer shall establish design parameters for bridge cranes and to incorporate provisions for maintenance work stations (platforms, railings, ladders, tie-off points, etc.) that permit maintenance personnel to safely perform their operations. Cranes must have the load capacity marked on each side of the bridge or on the rail in the case of a monorail and jib crane. Mobile cranes must have the load capacity marked in a convenient location. The Responsible Safety Officer must review specifications developed by the Engineering Department.

Crane Inspections Required

All crane functional operating mechanisms for maladjustment interfering with proper operation and for excessive wear of components. On days used inspection is required by a crane operator. Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic systems. On days used inspection is required by a crane operator. Hooks. On days used visual inspection by a crane operator is required. Annual inspections must have signed reports by [Company] or an outside Engineer. Hooks with cracks or having deformation more than 15% in excess of normal throat opening or more than 10 degrees twist from the plane of the unbent hook must be discarded. Wire-rope slings, including end connections, for excessive wear, broken wires, stretch, kinking, or twisting. Visual inspection by crane operator on days used. The Responsible Safety Officer, the primary user or the Building Manager must ensure that an annual inspection with a signed report is made. [Company] or an outside Engineer must inspect rope reeving for non-compliance with manufacturer's recommendations before first use and annually thereafter.

Six Month Crane Inspections

According to OSHA requirements a crane that has been idle for a period of over six months must be inspected before being placed in service.

Crane Maintenance

All crane hooks and lifting fixtures must be magnafluxed at least every four years. This will normally coincide with the certification load testing and inspection. The person in charge of a crane may request testing of hooks and/or lifting fixtures more frequently than every four years. The person in charge must give the Responsible Safety Officer a schedule of the desired frequency for testing the hook so that disassembly of the hook block can be included in their schedule for preventive maintenance of a particular crane.

Running Ropes Inspections

Running ropes must be thoroughly inspected at least once a year during the structural inspection of the crane, and a full, written, dated, and signed report of rope conditions must be kept on file.

OSHA Crane Standards

Routine maintenance, adjustments, and repairs must be performed by a qualified mechanic and reported to the Responsible Safety Officer according to each machine's established schedule and according to OSHA requirements.

Forklift Operators

The Responsible Safety Officer must be notified whenever it is desired to acquire a crane from excess sources.

OSHA Standards for Forklifts

Forklift users must familiarize themselves with and comply with OSHA Standard 29 CFR 1910.178 and ANSI B56.1. Modifications and additions must not be performed by the customer or user without manufacturer's prior authorization or qualified engineering analysis. Where such authorization is granted, capacity, operation and maintenance instruction plates, tags, or decals must be changed accordingly. If the forklift truck is equipped with front end attachments other than factory installed attachments, the user must ensure that the truck is marked with a card or plate that identifies the current attachments, shows the approximate weight of the truck with current attachments and shows the lifting capacity of the truck with current attachments at maximum lift elevation with load laterally centered. The user must see that all nameplates and caution and instruction markings are in place and legible. The user must consider that changes in load dimension may affect truck capacities.

Forklift Maintenance

Because forklift trucks may become hazardous if maintenance is neglected or incomplete, procedures for maintenance must comply with ANSI B56.1 Section 7 and OSHA Standard 29 CFR 1919.178 g.

Forklift Extension

Maximum efficiency, reliability, and safety require that the use of fork extensions be guided by principles of proper application, design, fabrication, use, inspection, and maintenance. The user must notify the Responsible Safety Officer before purchasing extensions or having them fabricated. Fork extensions are only appropriate for occasional use. When longer forks are needed on a regular basis, the truck should be equipped with standard forks of a longer length. Routine on-the-job inspections of the fork extension must be made by the fork lift operator before each use unless, in the judgment of the supervisor, less frequent inspections are reasonable because of his or her knowledge of its use since the last inspection.

Extensions must be inspected for evidence of bending, overload, excess corrosion, cracks, and any other deterioration likely to affect their safe use.

All fork extensions must be proof load tested to establish or verify their rated capacities, whether they were supplied commercially or fabricated at [Company]. A load equal to the rated capacity of the pair at a particular load center multiplied by 1.15, must be placed on each fork extension pair and fork assembly and supported for a period of five minutes without any significant deformation. Rated capacity must be determined at significant load centers, including the midpoint of the extension and at the tip. Once determined, the rated capacity and load center information must be shown by stamping or tagging the extensions in a protected location of low stress. The proof load test must be witnessed by a mechanical engineer or designer. Whenever evidence of deterioration is detected or whenever the extensions have been overloaded, magnetic particle inspection must be performed.

Safety Inspection, Responsibility

Each operator is responsible for the safety and safety inspection of his or her lifting devices (such as screw pin shackles, hoist rings, commercial equipment, etc.) and for its lifting fixtures (such as spreader bars, special slings, [Company]-designed equipment, etc.). All lifting fixtures designed at [Company] must be proof tested to twice their maximum rated loads before they are placed in service. A magnetic particle inspection or other appropriate crack detection inspection is required after the proof test. The capacity must be marked on the lifting fixture so that it is clearly visible to the equipment operator. All lifting device pins of 2-inch diameter or larger must have a magnetic particle inspection before they are placed in service. All lifting fixtures must be inspected at least once every four years (or upon request), using magnetic particle detection or other appropriate methods. The Responsible Safety Officer must ensure that proof testing is performed on all lifting fixtures designed at [Company] before they are placed in service; that adequate test records are kept; and that the lifting devices and fixtures are used and maintained correctly. Upon request, the Responsible Safety Officer will provide a current test report to the user. For equipment designed at [Company], the Responsible Safety Officer must provide the user with the information required to operate the lifting device or fixture safely.

Design Stress

The Responsible Safety Officer is responsible for the design, fabrication, and testing of lifting fixtures. The design stress for lifting fixtures must not exceed one-fifth ($1/5$) the ultimate strength of the material at the operating temperature. If welded fabrication is used, the design stress must take into consideration any weakening effects of welding, such as those that occur in aluminum alloys. If practical, avoid welding in the fabrication of lifting fixtures; however, if welding is used, design and fabrication must conform to the latest standards of the American Welding Society (AWS). Careful, thoughtful design and follow-up are required. The following rules apply when designing welded units: There must be no possibility of subjecting welds to tearing loads. Stresses in welds must be substantially uniform.

Where possible, design lifting fixtures so that the main loads are carried only by structural members, plates, or shear pins rather than by welds. Examine this possibility carefully. Welded fabrications must be proof tested to twice the maximum rated load followed by a magnetic particle inspection or other appropriate crack inspection method. Primary load carrying welds and welds in tension must be x-rayed. The screw-thread engagement required for conservative development of the full strength of a screw fastener depends upon the screw fastener material and the material of the threaded member. If the fastener is made of the same material as the female threaded member, e.g., a low-carbon steel bolt and a hole threaded into low-carbon steel, an engagement of at least 1-1/2 diameters is required. A hardened steel screw (Allen screw) in mild steel requires at least 2-diameters engagement. A low-carbon screw fastener, threaded into a tapped hole in aluminum alloy, copper, or cast iron must have a threaded engagement of 1-1/2 diameters. Other material combinations must be approved by the Responsible Safety Officer.

Safety hoist rings may be used to make lifts up to their rated load when screwed 2 hoist ring bolt diameters into materials such as aluminum alloy, copper, or cast iron. When special high strength bolts are required, consider the use of nonstandard pitch threads to avoid the possibility of using the wrong bolt in the lifting device. Any bolt used as part of [Company]-designed lifting fixtures or pickup devices must be tested to two (2) times its rated load. A crack detection inspection must be performed after the load test to ensure soundness. It is desirable to maintain a supply of tested bolts in the event that one is lost. Once a lifting device or fixture is in the hands of the user, it is the user's responsibility to ensure that the proper bolt is inserted to the proper depth and correctly torqued.

Crane Loads

When equipment is designed to be crane lifted at a single point with a single-bolt pickup device, the vertical lifting load through the screw thread of the bolt must be in line with the axis of the bolt so that the load will remain level when it is lifted. With this bolt alignment the lift will be through the center of gravity and will be safer since the load will not tilt or kick out when it is lifted. A single-bolt pickup device, such as a Safety Hoist Ring or equivalent carefully designed and maintained in-house device, must be used. When a load is to be crane-lifted by slings from a crane hook through 2, 3, or 4 single-load pickup points located at the corners of the load, and without the use of a spreader bar, the forces at the lift points will be non-vertical. In this case a single bolt pickup device, such as a safety hoist ring or equivalent carefully designed and maintained in-house device, must be used at each pickup point. The use of eye bolts with shoulders is permitted for lifting light incidental loads after receiving approval from the crane certified operator or supervisor and when the following conditions are met: The load is in line with the axis of the eye bolt and side loads are minimal (a spreader bar may be required). The average stress at the root area of the thread does not exceed 5000 psi. The thread engagement is at least two bolt diameters.

Mechanical Guarding

Introduction & Standards

Mechanical guarding must encompass both the power transmission parts of all mechanical equipment and the points of operation on production machines. Guards must be provided where rotational motion, nip points, and cutting, shearing, punching, and forming mechanisms can cause injury to personnel or damage to tools and equipment. Mechanical guards must be designed or otherwise procured to meet the following specifications: The guard must provide positive protection equal to that specified in ANSI B15.1. The guard must be considered a permanent part of the machine or equipment, capable of being easily or quickly removed or replaced. The guard must not interfere with efficient operation or maintenance of the machine or give discomfort to the operator. The guard must not weaken the machine structure. The guard must be designed for a specific job and a specific machine. The guard must be durable, resistant to fire and corrosion, and easily repaired. The guard must not present hazards, such as rough edges, splinters, pinch points, shear points, or sharp corners. Methods of guarding that must be considered include the following: Enclosing the operation (preferred) Interlocking devices Moving barriers Removal devices Remote control Two-handed tripping devices Electronic safety devices Machines designed for fixed locations must be securely anchored to the floor or bench to prevent walking or tipping. Employees may operate machinery only when properly trained and authorized to do so. Proper clothing and protective devices must be worn when specified by the supervisor or shop foreman.

Electrical Tag Out Procedure

When you have to do maintenance work on a machine, take these four steps to protect yourself and your co-workers from injury:

- 1) De-energize the machine if possible. Positively disconnect the machine from the power source. If there is more than one source of power, then disconnect them all.
- 2) If possible, lock out all disconnect switches. You must be given a lock and a key for each disconnect before you begin working on the machine.
- 3) Tag all disconnect switches. Use the yellow or Red safety tags which state in large letters – **“Danger... Do No Operate,”** or **“Danger--Do Not Energize”** and gives the name of the individual who locked out the equipment, date and time. The tag must also state **"DO NOT REMOVE THIS TAG"** (except the person who placed the tag may remove it only after the machinery maintenance has been completed).
- 4) Test the equipment to insure it is de-energized before working on it. First, attempt to operate the equipment by turning on normally. Next check all electrical lines and exposed areas with test equipment or a "lamp". Finally, short to ground any exposed connections using insulated grounding sticks. This test must be done even if the electrical connection is physically broken, such as pulling out a plug, because of the chance of discharging components.

A TAG OUT ONLY PROCEDURE MAY BE USED IF THE MACHINE CAN NOT BE LOCKED OUT. IF THE MACHINE IS SUPPLIED ELECTRICAL POWER FROM A SINGLE SOURCE, WHICH IS UNDER THE EXCLUSIVE CONTROL OF A TRAINED AND QUALIFIED REPAIR PERSON AT ALL TIMES AND THERE ARE NOT ANY OTHER PERSONS IN THE REPAIR AREA WHO COULD BE HARMED BY THE ACCIDENTAL ENERGIZING OF THE MACHINERY, THEN

TAG OUT MAY BE USED INSTEAD OF LOCK OUT/TAG OUT.

Re-Energizing

Many accidents occur at the moment of re-energizing. If the machinery is to be re-energized, all persons must be kept at a safe distance away from the machinery. The re-energization can be performed only by a person who either performed the lock-out/tag out, a person acting under the immediate and direct commands of the original lock-out/tag out person, or, in the event of a shift change, or other unavailability of the original person, then the original shall, before leaving, appoint a surrogate original person and show him or her all steps taken to lock-out/tag out the equipment.

Noise!

Introduction

This chapter contains information on the effects, evaluation, and control of noise. For assistance in evaluating a noise problem, contact the Responsible Safety Officer.

Danger of Noise

Exposing the ear to high levels of noise may cause hearing loss. This loss can be temporary or permanent. Temporary hearing loss or auditory fatigue occurs after a few minutes exposure to an intense noise but is recoverable following a period of time away from the noise. If the noise exposure is repeated, there may be only a partial hearing recovery and the loss becomes permanent. Typically, significant hearing losses occur first in the frequency range of 3,000 to 6,000 hertz (Hz). Losses in this frequency range are not critical to speech perception, and the individual usually is completely unaware of this initial symptom. With longer exposures, the hearing loss spreads to lower frequencies, which will affect speech perception. Workers' Compensation laws regard hearing losses in the speech frequency range of 500 to 3,000 Hz as being compensable. The evaluation of hearing loss due to noise is complicated by the fact that hearing acuity normally decreases with increasing age. Further, the losses associated with age are quite similar to those caused by excessive noise since the hearing for high frequency sounds is most affected in both instances. Hearing impairment may also result from infections, tumors, and degenerative diseases.

ACGIH Standards

OSHA has prescribed the limits established by the American Conference of Governmental Industrial Hygienists as a standard for occupational noise exposure. Both the sound pressure level of the noise and the total duration of the noise exposure are considered to determine if these limits are exceeded. The sound pressure levels are expressed as dBA or decibels A-weighted. A-weighting filters are used when measuring sound levels to more accurately predict the response of the human ear to different frequencies. When the daily noise exposure is composed of two or more periods of noise of different levels, their combined effect must be considered rather than the individual effect of each. Exposure to continuous noise above 115 dBA is not permitted without ear protection. Personnel must not be exposed to impact noises exceeding 140 dBA. Impact noises occur at intervals of greater than one per second. For example, the noise made by a metal shear.

Reducing Noise Exposure

Noise exposure can be reduced by using engineering controls, administrative procedures, or personal protective devices. Engineering Controls Reduction of noise production at the source: Proper design of new machines Modification of present machines Proper repair and upkeep of equipment Use of appropriate mufflers Use of vibration dampeners on machines Reduction of noise transmission: Increase distance between noise and personnel exposed Construction of barriers between noise source and personnel Sound treatment of ceilings and walls Administrative Procedures: Job schedule changes Personnel rotation Personnel Protective Devices: Ear plugs Earmuffs Federal and state occupational safety and health regulations require that whenever employees are exposed to excessive noise levels, feasible engineering or administrative controls must be used to reduce these levels. When these control measures cannot be completely accomplished and/or while such controls are being initiated, personnel must be protected from the effects of excessive noise levels. Such protection can, in most cases, be

provided by wearing suitable protective hearing devices. The appropriate Medical Services provider and/or the supervisor of the Department will supply ear plugs for employees upon request or before going into a high noise area. There is a need for medical supervision when ear plugs are used because their effectiveness depends on proper fitting. Only approved plugs should be used. Ear plugs should be cleaned daily to prevent ear infections. Protection greater than that provided by a single device can be obtained by wearing ear plugs under an earmuff. While the reduction provided by wearing both devices simultaneously is considerably less than the sum of the individual attenuations, it is still greater than when either device is worn separately.

Measurement

The measurement of hearing is called audiometry. Audiometric tests are used to determine whether or not the hearing of workers is adversely affected by noise. The appropriate Medical Services provider will give a pre-employment audiometric test to every employee who will regularly work in a high noise area. Thereafter, an audiometric test is given to all such employees at the time of their periodic physical examination. In addition, all employees whose noise exposures equal or exceed an eight-hour, time-weighted average of 85 dBA will be given an initial baseline audiometric test that must be preceded by at least 14 hours without exposure to workplace noise. Thereafter, the test will be repeated annually. To reduce unwanted noise, the audiometric test is administered by placing each individual in a sound insulated booth. Earphones are placed on the individual's head and a microprocessor audiometer presents a series of fixed frequency pure tones between 500 and 8000 Hz in each ear. These frequencies include the most useful range of hearing, as well as those frequencies most likely to show changes as a result of exposure to damaging levels of noise. By comparing tests taken at successive intervals, it can be determined how an employee's hearing ability is affected by a noisy environment.

Other Noises

Nuisance noises are noises that are not intense enough to cause hearing loss but that do disturb or interfere with normal activities, such as: Speech communication Telephone communication Listening to TV or radio broadcasts Concentration during mental activities Relaxation Sleep The amount of interference is dependent upon the intensity of the noise and its characteristics, such as steady versus intermittent noise, high or low pitch. The amount of interference may also depend upon the person's personality, attitude toward the source, familiarity with the noise, and the intrusiveness of the noise. What is music to one ear may be noise to another!

Pesticides

Pesticide Usage

Each person performing pest control shall:

- Use only pest control equipment which is in good repair and safe to operate. Perform all pest control in a careful and effective manner.
- Use only methods and equipment suitable to insure proper application of pesticides.
- Perform all pest control under climatic conditions suitable to insure proper application of pesticides.
- Exercise reasonable precautions to avoid contamination of the environment. A copy of the registered labeling that allows the manner in which the pesticide is being used shall be available at each use site.
- Concentrate pesticides shall be weighed or measured accurately using devices which are calibrated to the smallest unit in which the pesticide is being weighed or measured. A uniform mixture shall be maintained in both application and service rigs.
- Pest control equipment shall be thoroughly cleaned when necessary to prevent illness or damage to persons, plants or animals from residues of pesticides previously used in the equipment.
- Each service rig and piece of application equipment that handles pesticides and draws water from an outside source shall be equipped with an air-gas separations, reduced pressure principle backflow prevention device or double check valve assembly.
- Backflow protection must be acceptable to both the water purveyor and the local health department.

Age of Operator

Minors under 18 years of age shall not be permitted to mix or load a pesticide which, in any use situation, requires either air supplied respiratory protection; closed systems; or full body chemical resistant protective clothing.

Protection From Pesticides

An applicator prior to and while applying a pesticide shall evaluate the equipment to be used, meteorological conditions, the property to be treated, and surrounding properties to determine the likelihood of harm or damage. No pesticide application shall be made or continued when there is a reasonable possibility of either: Contamination of the bodies or clothing of persons not involved in the application process; Damage to nontarget crops, animals, or other public or private property; or, Contamination of nontarget public or private property, including the creation of a health hazard, preventing normal use of such property.

Notice of Pesticide Application

Each person performing pest control must give notice to the owner or operator of the property to be treated before any pesticide is applied. The operator of the property shall give notice to all persons known to be on such property or likely to enter. Such notice shall be adequate to advise of the nature of the pesticide and the precautions to be observed as printed on the registered label or included in applicable

laws or regulations.

Operator Identification Numbers

Prior to the purchase and use of pesticide(s) for the production of an agricultural commodity, the operator of the property (or the operator's authorized representative) shall obtain an operator identification number from the commissioner of each county where pest control work will be performed. The operator shall provide each pest control business applying pesticides to such property with his or her operation identification number. This also applies to the following pesticides, when they are not used for the production of an agricultural commodity (e.g., post-harvest agricultural commodities and certain nonagricultural sites): (1) Any pesticide for agricultural use, excluding those for use only on livestock, and (2) any pesticide for industrial use as a post-harvest commodity treatment.

Pest Control Business Operations

Each person engaged for hire in the business of pest control shall keep each ground rig, service rig, and similar equipment used for mixing or applying pesticides conspicuously and legibly marked with either the business' name, or with "Licensed Pest Control Operator," "Fumigation Division," "Licensed Fumigator" or substantially similar wording and the pest control operator license number of the person or firm. The markings shall be large enough to be readable at a distance of 25 feet. Each person engaged for hire in the business of pest control shall have available a copy of both the written recommendation and the use permit covering each agricultural use application of a pesticide that requires a permit. Each person engaged for hire in the business of pest control shall report to the commissioner as soon as practicable, by the most expedient method, any forced landing, or emergency or accidental release of pesticides. Such report shall include the location, the pesticide and estimated amount. Each person engaged for hire in the business of pest control shall maintain records of and report on each pesticide use, in the manner prescribed in the Food and Agriculture Code and shall identify the qualified person who made or supervised the application.

Delivery / Storage of Containers

Each person who controls the use of any property or premises is responsible for all containers or equipment on the property which hold or have held a pesticide. That person or a person responsible to him shall maintain such control over the containers at all times, or store all such containers in a locked enclosure, or in the case of liquid pesticides in a container larger than 55 gallons capacity, the container shall have a locked closure. No person shall deliver a container which holds or has held a pesticide to a property unless he stores it in such an enclosure or delivers it to a person in charge of the property or his agent, or to a pest control operator or his employee.

Posting of Storage Areas

Signs visible from any direction of probable approach shall be posted around all storage areas where containers which hold or have held pesticides required to be labeled with the signal words "warning" or "danger" are stored. Each sign shall be of such size that it is readable at a distance of 25 feet and be substantially as follows:

DANGER: Poison storage area all unauthorized persons keep out! KEEP DOOR LOCKED WHEN NOT IN USE

The notice shall be repeated in an appropriate language other than English when it may reasonably be anticipated that persons who do not understand the English language will come to the enclosure.

Container Requirements

Except as provided in the Food and Agricultural Code pertaining to service containers, any container which holds or has held any pesticide, when stored or transported, shall carry the registrant's label. All lids or closures shall be securely tightened except for measuring devices that are not used to store or transport a pesticide. In no case shall a pesticide be placed or kept in any container of a type commonly used for food, drink, or household products.

Service Container Labeling

Service containers, other than those used by a person engaged in the business of farming when the containers are used on the property that the person is farming, shall be labeled with: The name and address of the person or firm responsible for the container, The identity of the poison in the container, and, The word "Danger," "Warning," or "Caution" in accordance with the label on the original container.

Transportation of Pesticides

Pesticides shall not be transported in the same compartment with food or feed. Pesticide containers shall be secured to vehicles during transportation in a manner that will prevent spillage onto the vehicle or off the vehicle. Paper, cardboard, and similar containers shall be covered when necessary to protect them from moisture.

Container Rinse/Drain Procedures

Each emptied container which has held less than 28 gallons of a liquid pesticide that is diluted for use shall be rinsed and drained by the user at time of use by either of the following methods:

METHOD A:

(1) Use the following amount of water or other designated spray carried for each rinse. If the size of container is less than 5 gallons, then the amount of rinse medium should be 5 gallons. If the size of container is over 5 gallons, then the amount of rinse medium is 1/5 the container volume. (2) Place required minimum amount of rinse medium in the container, replace closure securely, and agitate.

(3) Drain rinse solution from container into tank mix. Allow container to drain 30 seconds after normal emptying.

(4) Repeat (2) and (3) above a minimum of two times so as to provide a total of three rinses; or

METHOD B:

(1) Invert the emptied container over a nozzle located in the opening of the mix tank which is capable of rinsing all inner surfaces of the container.

(2) Activate the rinse nozzle allowing the rinse solution to drain into the tank. The rinse shall continue until the rinse solution appears clear and a minimum of one-half of the container volume of rinse medium has been used. A minimum of 15 pounds pressure per square inch shall be used for rinsing.

Worker Safety Responsibilities

Both the employer and each employee shall comply with each pesticide regulation which is applicable to his own action and conduct. The employer is responsible for knowing about the applicable safe use requirements specified in state and federal regulations and on the pesticide label, and the employer shall inform the employee in the language he/she understands of the specific pesticide being used and the protective clothing, equipment and work procedures to be followed. The employer shall supervise

employees so that safe work practices including all applicable regulations and label requirements are complied with, and the Employer requires employees to follow safe work practices. The Employer shall inform employees of pesticide safety hazards and pesticide safety regulations applicable to all activities they may perform, and employees must handle and use pesticides in accordance with the requirements of law, regulations, and label requirements.

Employee Pesticide Training

The employer shall have a written training program for employees who handle minimal exposure pesticides. The written program describes the materials (e.g., study guides, pamphlets, pesticide labels, Pesticide Safety Information Series leaflets, slides, video tapes) and information that will be provided and used to train his or her employees. The written program shall address each of the subjects specified in subsection (b) The employer shall maintain a copy of the training program for two years at the location where employee training records are kept. The employer provides training for each employee who handles any pesticide as to each of the following subjects: The immediate and long term hazards involved as identified in laboratory animals (e.g., tumors, cancer and other effects due to repeated or continuous exposure, birth defects, or an effect on parental reproductive performance); The safety procedures to be followed; The clothing and protective equipment to be used; The common symptoms of pesticide poisoning and the ways poisoning or injury from pesticides can occur; Where to obtain emergency medical treatment; The purposes and requirements of medical supervision; Applicable laws, regulations and label requirements; The need for immediate decontamination of skin and eyes when exposure occurs; and The contents of the Pesticide Safety Information Series leaflets.

The employer shall post copies of the appropriate Pesticide Safety Information Series leaflets in a prominent location at the workplace where the employee begins the workday. If there is no designated workplace, the employer shall provide copies of the leaflets to each employee. Training shall be completed before the employee is allowed to handle pesticides and at least annually thereafter. Initial training may be waived if the employee is a certified commercial applicator or submits a record that training was received within the last year and a letter from the previous employer documenting satisfactory work practices. The employer shall record the date and extent of initial and annually required training given to the employee and the job to be assigned. This record shall be verified by the employee's, employer's and trainer's signature and retained by the employer for two years at the employee's permanent assigned work location.

Emergency Medical Care

Employees shall be informed of the name and location of a facility where emergency medical care is available for employees who will be handling pesticides. The employer shall post in a prominent place at the work site, or work vehicle if there is no designated work site, the name, address and telephone number of a facility able to provide emergency medical care whenever employees will be handling pesticides and, if the identified facility is not reasonably accessible from that work location, procedures to be followed to obtain emergency medical care. When there is reasonable grounds to suspect that an employee has a pesticide illness or when an exposure to a pesticide has occurred that might reasonably be expected to lead to an employee's illness, the employee shall be taken to a physician immediately.

Medical Supervision

Whenever an employee handles a pesticide in toxicity category one or two that contains an organophosphate or carbamate, for the purpose of producing an agricultural commodity, the employer shall maintain use records that identify the employee, name of the pesticide and the date. An employee that regularly handles pesticides shall have a written agreement signed by a physician, that includes the names and addresses of both the physician providing the medical supervision and the employer

responsible for the employees, stating that the physician has agreed to provide medical supervision and that the physician possesses a copy of, and is aware of the contents of the document "Medical Supervision of Pesticide Workers-Guidelines for Physicians" (available from the Department of Health Services) . A copy of this agreement shall be given to the commissioner by the employer no later than when an employee begins to regularly handle pesticides. All covered employees shall have baseline red cell and plasma cholinesterase determinations. Baseline values shall be verified every two years. For new employees, the medical supervisor may accept previously established baseline values if they are obtained in accordance with these regulations by the same laboratory methodology and are acceptable to the laboratory which will analyze the new employee's blood samples.

Each employee, not previously under medical supervision associated with the employer, must have his red cell and plasma cholinesterase determinations within three working days after the conclusion of each 30-day period in which pesticides are regularly handled. After three tests at 30-day intervals, further periodic monitoring shall be at intervals specified in writing by the medical supervisor except for verification of baseline as specified above. Where the medical supervisor has made no written recommendation for continued periodic monitoring, the testing interval shall be 60 days. Records of the agreement to provide medical supervision, use records, all recommendations received from the medical supervisor, and all results of cholinesterase tests required to be made, shall be maintained for three years. The name, address, and telephone number of the medical supervisor shall be posted in a prominent place at the locale where the employee usually starts the workday or, if there is no locale where the employee usually starts the workday, at each work site or in each work vehicle.

There shall be an investigation of the work practices of any employee whose red cell or plasma cholinesterase levels fall below 80% of the baseline. The investigation of work practices shall include a review of the safety equipment used and its condition; and the employee's work practices which included employee sanitation, pesticide handling procedures, and equipment usage. The employer shall maintain a written record of the findings, any changes in equipment or procedures and any recommendations made to the employee. The employer shall remove an employee from exposure to organophosphate or carbamate pesticides if the employee's plasma cholinesterase level falls to 60% or less of baseline, or if red cell cholinesterase falls to 70% or less of baseline. The employee shall be removed from further exposure until cholinesterase values return to 80% or more of their respective baseline values.

The employer shall maintain written records of the dates of removal and the dates when employees are returned to exposure. Red cell and plasma cholinesterase tests ordered by a medical supervisor for occupational health surveillance shall be performed by a clinical laboratory currently approved by the State Department of Health Services to perform these tests.

Working Alone With Pesticides

An employee mixing, loading or applying a pesticide in toxicity category one for production of an agricultural commodity may not work alone during daylight hours unless personal, radio, or telephone contact is made to a responsible adult at intervals not exceeding two hours. An employee mixing, loading or applying pesticide in toxicity category one for production of an agricultural commodity may not work alone during nighttime hours unless personal, radio, or telephone contact is made to a responsible adult at intervals not exceeding one hour. A pilot, mixer-loader, and/or flagger team is considered as working together. In the case of two ground applicators working in the safe field, no additional person is necessary if they can see each other or each other's application vehicles.

Facilities / Equipment For Use

Change Area: For any employee who regularly handles pesticides in toxicity categories one or two, that there shall be, at the place where employees complete their workday, an area where employees may change clothes and wash themselves. Clean towels, soap, and adequate water shall be available to allow

for thorough washing. Employees are instructed to thoroughly shower with warm water and soap as soon as possible after the end of each work shift. The employer shall provide a clean, pesticide-free place where employees may store any personal clothing not in use while at work handling pesticides.

Washing Facilities:

Clean water, soap and towel(s) for routine washing of hands and face, and for emergency washing of the entire body shall be available for all employees at the work site where they mix or load pesticides in toxicity categories one or two. A minimum of ten gallons of water shall be present at the beginning of each workday for one employee and a minimum of 20 gallons for two or more employees. This water shall be stored separate from that used for mixing with pesticides unless the tank holding water for mixing with pesticides is equipped with appropriate valves to prevent back flow of pesticides into the water. Any other easily available supply of clean water within 100 feet of the mixing and loading site is satisfactory for the purposes of this section.

Work Clothing:

The employer shall provide clean work clothing for each employee who handles any pesticide in toxicity category one or two.

Employees shall:

- Start each work day wearing clean work clothing whenever then handle pesticides in toxicity categories one or two;
- Change out of their work clothing and wash at the end of the work day;
- Not take home potentially contaminated work clothing;
- Remove and store contaminated work clothing in a sealable container outside of their own living quarters for later return to the employer,

The employer shall:

- provide for cleaning of work clothing and
- inform the person or firm doing the laundry that they will receive pesticide-contaminated clothing which should be laundered separately.
- provide at the mixing and loading site at least one change of clean work clothing.

Safety Equipment:

The employer shall provide all necessary safety equipment and provide for its cleaning, repair and replacement when necessary. The employer shall require that all personal protective equipment be maintained and kept in a clean, specially designated place or locker when not in use. This clothing and equipment shall remain the property of the employer. Safety equipment shall be provided and maintained in accordance with the regulations of the Food and Agriculture Code.

Safe Equipment:

Equipment used for mixing, loading, or applying pesticides shall be kept in good repair and shall be safe to operate. Equipment with any safety defect shall be repaired or altered to remove the hazard before further use.

All openings on tanks used for mixing or applying pesticides shall be equipped with covers that will prevent splashes and spills. Fixable hoses carrying liquid pesticides in toxicity categories one or two under pressure shall not pass unshielded through the cockpit of an airplane or helicopter. Shut-off devices

shall be installed on the exit end of all hoses carrying liquid pesticides in toxicity categories one or two form mixing tanks that are adequate to prevent splashes onto the employee doing the loading when filling operations are stopped and the filler hose is removed from the inlet to the tank of the application vehicle. As an alternative, a reversing action pump or a similar system may be used that will empty the hose and will eliminate dripping of liquid from the end of the hose when the filling operation is stopped. Each tank with capacity of more than 49 gallons that is used to mix or apply any liquid mixture derived from a pesticide in toxicity categories one or two, shall have either, A properly functioning means to indicate externally the internal liquid level in the tank such as a sign gauge; or The tank or the filler hose nozzle shall have a device that will automatically stop the filling operation before the pesticide liquid mixture spills over the top.

Equipment Maintenance:

Persons who own or operate pesticide mixing, loading, or application equipment shall inform each employee under their control who may be involved in the cleaning, servicing or repair of that equipment of the hazards of the pesticides that person may encounter and the methods of protecting against personal injury. If such cleaning, servicing or repairing is to be performed by persons not under the control of the owner or operator of the equipment, he shall so notify the person in charge of performing these services. Employees who clean, service, or repair mixing and application equipment shall be provided and must use, with any necessary protective equipment or clothing, and shall be instructed and supervised in the maintenance operation in a manner that will reduce work hazards.

Closed Systems:

Closed systems shall be provided for employees that mix or load liquid pesticides in toxicity category one, or load diluted liquid mixes derived from dry pesticides in toxicity category one, for the production of an agricultural commodity. No employee shall transfer, mix, or load these pesticides except through a closed system. These requirements do not apply to employees who handle a total of one gallon or less of pesticides in toxicity category one per day exclusively in original containers of one gallon or less.

Field Worker Safety

No person shall apply any pesticide in such manner that it contaminates the body or clothing any employee during the application process, except for employees who are involved in the application process and who are wearing the appropriate protective clothing and/or equipment. Field work supervisors shall be informed of what posting means, the activities prohibited during a reentry interval, where to go for emergency medical care and the usual symptoms of organophosphate and carbamate poisoning. Emergency medical care for employees that enter fields that have been treated with pesticides shall be planned for in advance.

The employer shall locate a facility where emergency care is available for employees who will be working in treated fields. The employees or their supervisor in the field shall be informed of the name and location of a physician or medical facility where emergency medical care is available and if the identified facility is not reasonably accessible from that work location, the procedures to be followed to obtain emergency medical care. When there are reasonable grounds to suspect that an employee has a pesticide illness or when an exposure to a pesticide has occurred that might reasonably be expected to lead to an employee's illness, the employee is taken to a physician immediately. Hand washing facilities shall be available.

Field Reentry After Application

Employees shall not be permitted to enter any field treated with a pesticide until the pesticide spray has dried or the pesticide dust has settled except in case of emergency. Production or harvesting operations do

not constitute an emergency. The waiting period for the drying or settling to occur need not exceed 24 hours. A treated field may be entered by an employee without restriction after the pesticide has dried or the pesticide dust has settled, except: (1) when the labeling of the pesticide specifies a longer reentry interval or, (2) when a longer reentry interval is specified in the regulations of the Food & Agriculture Code.

When a pesticide in toxicity category one, or a minimal exposure pesticide is being applied through an irrigation system, but before the application starts, signs shall be posted that state in English and Spanish, "Danger, Pesticides are applied in water through the irrigation system. Do not drink water from the irrigation system." These signs shall be readable at 25 feet, shall be posted at all the usual points of field entry and shall be placed at intervals not exceeding 600 feet around the field. The use of an additional third language is permissible. Unless treatment occurs weekly or at more frequent intervals, signs shall be removed no later than five days after application. As an alternative there shall be on site a sufficient number of persons to prevent unauthorized employees from entering and any employee from drinking from the irrigation system.

Pesticide Warnings

Employees who might reasonably be anticipated to enter an area being treated or which has been treated with a pesticide for which the reentry interval has not expired shall be orally warned by the employer. Oral warnings shall be given in a language understood by employees. Posting of signs is required when any pesticide in toxicity category one, with a reentry interval of two days or more, is applied to the foliage of the following crops: broccoli, cauliflower, celery, flowers, lettuce, ornamentals, strawberries, or tomatoes.

Posting of signs is required when any pesticide in toxicity category one, with a reentry interval of two days or more, is applied during the period April 15 through harvest to the following crops: grapes, nectarines, peaches, plums, or prunes. When any pesticide is applied and the application results in a reentry interval greater than seven days, the posting of warning signs, is also required. Whenever warning signs are required: The operator of the property or agent with written authorization shall post warning signs at the usual point or points of entry.

When treated fields requiring posting are adjacent to a public right-of-way and are unfenced, warning signs shall be posted at each corner and at intervals not exceeding 600 feet in addition to the normal points of entry. Posted warning signs shall be of such durability and construction that they will remain clearly legible for the duration of the reentry interval, will be of such size so that the word "DANGER" is readable and two skull and cross-bone symbols are clearly visible at a distance of 25 feet and will read in English and Spanish languages substantially as follows: When posting is required the following sign shall be used:

DANGER: (Place skull and cross-bone symbol here) (Name of Pesticide)

DO NOT ENTER DATE: (Grower's Name) (Field Identification, if any)

When posting is required without field identification, the following sign may be used in lieu of the above:

DANGER: (Place skull and cross-bone symbol here)

PESTICIDE... DO NOT ENTER

The signs shall be posted before an application begins. The signs shall not be posted unless a pesticide application is scheduled within the next 24 hours. The signs shall not be removed during the reentry interval. Warning signs shall be removed by the operator of the property or the agent with written authorization within 5 days after the end of reentry interval and before employees are allowed to enter.

Fumigation

Safe-Use Requirements:

When fumigant concentrations cannot be controlled and an employee's exposure exceeds the Permissible Exposure Limit (PEL) as specified by state agency for Airborne Contaminants, or more stringent requirements by product labeling, the employer shall provide and require the employee to wear approved respiratory protective equipment. Whenever an employee may be exposed above an exposure standard to methyl bromide, sulfuryl fluoride, or any other fumigant for which only air-supplied respirator equipment is approved, the employer shall either: Require the use of air-supplied respirator equipment, or Employ continuous monitoring to warn employees before the PEL is reached. The employer shall have an accident responses plan at the work site. The plan shall provide instructions to protect employees during situations such as spills, fire, and leaks. Employees shall be trained in accident management procedures based on the plan.

Fumigation of Enclosed Spaces:

Enclosed spaces include, but not limited to vaults, chambers greenhouses, vans boxcars, ships, planes, vehicles, and tarpaulin-covered structures and commodities. When fumigating tarpaulin-covered commodities inside of buildings are areas or things inside enclosed greenhouses this section applies to the entire structure. Whenever a pesticide is used for fumigation inside of enclosed spaces, at least two trained employees shall be present at all times during introduction of the fumigant, and entry into the enclosed space for purposes of facilitating aeration or determining the concentration of fumigants. Prior to the commencement of fumigation, warning signs shall be posted in plainly visible locations on or in the immediate vicinity of all entrances to the space under fumigation and shall not be removed until fumigation and ventilation has been completed, and the premises is safe for reentering.

Warning signs shall be printed in red on white background and shall contain, in English and Spanish, the following statement in letters not less than two inches in height: "DANGER-FUMIGATION." They shall also depict a skull and crossbones not less than one inch in height and shall state in letters not less than one-half inch in height the name of the fumigant, the date and time the fumigant was injected, and the name, address and telephone number of the applicator performing the fumigations. Employees shall not be allowed to enter fumigated enclosed areas, except to determine the fumigant concentration or facilitate aeration unless the concentration in the area is known to be at or below the maximum PEL. The fumigant shall not be released into an occupied work area. After completion of the fumigation, the treated area or products shall be managed so that employees entering the area or working with the treated products are not exposed to a concentration in excess of the maximum PEL.

Field Fumigation:

Whenever methyl bromide or chloropicrin is used for field fumigation at least two trained employees shall be present during introduction of the fumigant and removal of tarps, if used. Pesticide warning signs shall be posted and shall remain in place until aeration is complete.

Protective Equipment

Introduction

[Company] will provide suitable equipment to protect employees from hazards in the workplace. The Responsible Safety Officer will advise on what protective equipment is required for the task, but the supervisor of the operation must obtain this equipment and see that it is used. Protective clothing is not a substitute for adequate engineering controls.

Protection Issued

Protective clothing will be issued to employees who work with hazardous material for the purpose of protecting their health and safety. The Responsible Safety Officer is available for consultation as needed.

Radiation Monitoring

Protective clothing must be monitored for radioactive contamination before being sent to the laundry.

Protective Shoes

[Company] encourages the wearing of safety shoes by making them available to any employee at cost from a manufacturer. For certain types of work the wearing of safety shoes is required by Company policy or by federal regulations. Examples are when employees are exposed to foot injuries from hot, corrosive, or poisonous substances; in shops, in equipment handling, or in construction jobs where there is a danger of falling objects; or in abnormally wet locations.

Protective Gloves

[Company] provides proper hand protection to employees exposed to known hand hazards. The supervisor must obtain the suitable hand protection and ensure that it is used. The individual department must maintain a supply of special or infrequently used hand protection. Assistance in selecting the proper hand protection may be obtained by consulting the Responsible Safety Officer.

Head Protection

[Company] provides appropriate head protection devices for employees to protect them from head or other injuries that could result from their working environment. Some head protection devices are available from stock. The supervisor must also maintain sufficient supply of head protection devices for visitors in the area.

Eye Protection

[Company] provides appropriate eye protection devices for employees assigned to tasks in which an eye-injury hazard exists. The supervisor of the operation is responsible for determining the need for suitable eye-protection devices and for ensuring that the employees use them. The Responsible Safety Officer and appropriate Medical Services agency will assist the supervisor in defining eye-hazard operations and in selecting appropriate eye protection. An optometrist is available to issue, repair, adjust, and fit personal safety glasses and also for consultation regarding occupational eye protection.

The standard sign: CAUTION, EYE HAZARD AREA, DO NOT ENTER WITHOUT EYE PROTECTION, must be posted in every area where eye protection is mandatory. All employees who work in such an area must wear the eye protection issued to them. Every visitor to the area must also be provided with suitable eye protection.

Eye Protection Devices

Eye-protection devices are classified in four categories: Personal safety glasses. Goggles, face shields, etc. Temporary safety glasses provided to visitors in eye-hazard areas Laser safety eye wear.

Respiratory Protection

Any operation that generates harmful airborne levels of dusts, fumes, sprays, mists, fogs, smokes, vapors, or gases or that may involve oxygen-deficient atmospheres requires the use of effective safety controls. This must be accomplished, as much as feasible, by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respiratory protection must be used in accordance with [Company] requirements as prescribed by OSHA in ANSI 288.2-1980, Standard Practices for Respiratory Protection.

Responsibilities

To ensure that the respiratory protection program is conducted in accordance with ANSI 288.2-1980, certain responsibilities are required of each employee, supervisor, Responsible Safety Officer, and the Medical Services Department.

Employees are responsible for:

- Wearing the respirator in accordance with the instructions and training received.
- Maintaining and storing the respirator in good condition.
- Returning the respirator at the end of the required use for overhaul, cleaning, and disinfection.

Supervisors are responsible for:

- Identifying those employees who may need to use respiratory protection (Responsible Safety Officer will provide assistance upon request in this determination).
- Ensuring that their employees have been properly trained and fitted.
- Ensuring that their employees use the respirators as required.

The Responsible Safety Officer is responsible for:

- Providing respiratory equipment.
- Maintaining the equipment in good condition.
- Fitting employees with proper respirators and providing training for their use.
- Evaluating employee exposures and work conditions, including inspection of respirator use.

The Medical Services Department is responsible for:

- Granting medical approval for each respirator user.

Respiratory Equipment

The Responsible Safety Officer has selected the types of respiratory protective equipment to be used at

[Company]. Any changes to protective equipment, its application, or the substitution of alternative protective equipment must be approved by the Responsible Safety Officer before its use. [Company] has a wide variety of respiratory protective equipment available. Each respirator has certain capabilities and limitations that are taken into account when issued. The types of respiratory protective devices provided by [Company] are described below. Disposable dust masks are approved for protection against low (non-hazardous) levels of nuisance dusts. They provide no protection against vapors or gases, and they cannot be used in oxygen-deficient areas.

There are no applicable training or fitting restrictions. Air-purifying, half- and full-face masks are approved for protection against low concentration of toxic particulates, organic vapors, acid gases, and ammonia. Specific cartridges must be selected for protection against each material. They must never be used in atmospheres deficient in oxygen, when carbon monoxide or oxides of nitrogen are suspected, or when conditions prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skullcap that projects under the face-piece or temple pieces on eyeglasses. Users must be trained, fitted, and medically approved before they can be issued a respirator. Supplied-air, half- and full-face masks may be used in atmospheres unsuitable for air-purifying respirators but cannot be used in areas which are immediately dangerous to life or health. Compressors are normally used to supply breathing air, but compressed air cylinders may also be used. The user must be medically approved, trained, and fitted before using this equipment.

Personnel will not be fitted or issued a respirator if there is any condition that may prevent a good face seal, such as a beard, sideburns, skullcap, or temple pieces on eyeglasses. Supplied-air hoods are approved for respiratory protection in any atmosphere not immediately dangerous to life or health, and from which the wearer can escape without the aid of a respirator. The user must be medically approved and trained in its proper use. The presence of a beard, sideburns, skullcap, or eyeglasses will not affect the performance of this type of respirator.

Pressure Safety

Definitions

The following definitions apply in this chapter:

Low Pressure:

Gas Pressure less than 1 MPa gauge (150 psig) or liquid pressure less than 10 MPa (1500 psig).

Intermediate Pressure:

Gas pressure from 1 to 20 MPa gauge (150 to 3000 psig) and liquid pressure from 10 to 35 MPa gauge (1,500 to 5,000 psig).

High Pressure:

Gas pressure greater than 20 MPa gauge (3,000 psig) and liquid pressure greater than 35 MPa gauge (5000 psig).

Pressure Equipment:

Any equipment, e.g., vessels, manifolds, piping, or other components, that operates above or below (in the case of vacuum equipment) atmospheric pressure.

Pressure System:

Any mechanical system comprising pressure equipment.

Pressure Vessel:

A relatively high-volume pressure component (such as a spherical or cylindrical container) with a cross section larger than the associated piping.

Ductile Vessel:

A pressure vessel fabricated from materials that yield extensively before failure when over stressed at any temperature within the vessel's operating range (generally, materials that exhibit greater than 5% plastic strain to rupture).

Brittle Vessel:

A pressure vessel fabricated from materials that do not yield extensively before failure when over stressed at any temperature within the vessel's operating range (generally, materials that exhibit less than 5% plastic strain to rupture).

Research Pressure Equipment:

Pressure equipment used for research, development, or for some other unique activity (such as special test equipment for shop use).

Plant-Facility Pressure Equipment:

Pressure vessels and pressurized utility equipment that is part of [Company] buildings or physical-plant facilities.

Operational Safety Procedure:

The OSP is the document used to describe the controls necessary to ensure that the risks associated with a potentially hazardous research project or unique activity are at an acceptable level.

Safety Note (SN):

A Safety Note is generally used to document engineering calculations or tests of specific equipment or activities when there is a safety concern but the potential hazard is not high enough to require an OSP.

Maximum Allowable Working Pressure (MAWP):

The maximum differential pressure (at the specified operating temperature) at which equipment is designed to operate safely. The relief device must not be set higher than the MAWP.

Operating Pressure (OP):

The pressure at which equipment is normally operated - always less than the MAWP (also called working pressure).

Pressure Test:

A test to ensure that equipment will not fail or permanently deform - i.e., will operate reliably at the MAWP.

Proof Test:

A test in which equipment prototypes are pressurized to determine the actual yield or failure (burst) pressure (used to calculate the MAWP).

Safety Factor (SF):

The ratio of the ultimate (i.e., burst or failure) pressure (measured or calculated) to the MAWP. A SF related to something other than the failure pressure should be identified with an appropriate subscript, e.g., SF sub y (based on yield pressure) or SF sub u (based on ultimate strength).

Leak Test:

A pressure or vacuum test to determine the existence, rate, and/or location of a leak.

Standard Operating Procedures

Any [Company] division involved in the construction and/or use of pressure equipment must ensure that such equipment is designed, installed, tested, and operated in accordance with the requirements of this chapter. The Responsible Safety Officer must make an evaluation to determine whether the potential hazard of the pressure equipment is high enough to require an OPS.

Pressure Installer

The Pressure Installer is a technician or mechanic certified to fabricate, assemble, install, and operate pressure equipment within a specified pressure range. Upon being assigned by his or her supervisor, the Pressure Installer is authorized to work directly for a supervisor or the Responsible Safety Officer.

Low & High Hazards

For convenience in describing the required controls, pressure equipment has been divided into two hazard categories: Low-Hazard pressure equipment - equipment with a low hazard level involving routine risks that are accepted without question by most users or equipment that is covered by existing industrial standards. High-Hazard pressure equipment - equipment for which operational risk is high enough to require a SN and may be high enough to require an OSP. Review and approval are required.

Low Hazards

The following systems are low hazard and do not normally require an SN or OSP. Air and inert-gas systems for working pressures up to 1 MPa gauge (150 psig) and inert-liquid systems for working pressures up to 10 MPa gauge (1500 psig), provided that the stored energy does not exceed 100 kJ(75,000 ft-lb). Utility systems for MAWPs up to 2.0 MPa gauge (300 psig), including cold-water, hot-water, low-conductivity-water, compressed-gas, natural-gas, butane and propane (LPG), and steam systems that strictly comply with applicable Engineering standards. Compressed-gas-cylinder manifolds assembled with compound-thread fittings in compliance with the chapter on GASES of this Manual. Manifolds on tubebanks and tubetrailers that consist of components rated at 20.7 MPa gauge (3000 psig) or higher and that are periodically retested. Unmodified pressure vessels designed in accordance with Refs. 1-3, ASME Boiler and Pressure Vessel Codes and ASME-code stamped. Refrigeration systems that comply with the ASME Boiler and Pressure Vessel Codes (Refs. 1 and 2) and applicable Air-Conditioning and Refrigeration Institute (ARI) standards (Ref. 4).

Pressure vessels, stamped with a Department of Transportation (DOT) rating, used to supply and transport fluids. These vessels are subject to the retesting requirements of Ref. 5, Code of Federal Regulations, CFR 49, Transportation, Parts 100-199 (current issue).

Air-pressure tanks, liquefied-petroleum-gas tanks, anhydrous-ammonia tanks, and fired-steam boilers inspected periodically in accordance with Ref. 6, "Unfired Pressure Vessel Safety Orders," or Ref. 7, "Boiler and Fired Pressure Vessel Safety Orders" of the State of California or other similar state requirements.

The Responsible Designer must notify the Technicians Supervisor whenever such a vessel is to be installed. Unmodified, commercially manufactured hydraulic systems with a safety factor of 4 or higher for working pressures to 35 MPa (5075 psi) on hydraulic presses, motorized vehicles, and machine tools that are periodically inspected and maintained by the using organization.

High Hazards

The systems listed below are high-hazard (containing hazardous materials or employing pressures that involve high hazard) and must be evaluated by the Responsible Safety Officer to determine if an OSP is required. A Safety Note is required, and the vessel must be approved by a Certified Pressure Inspector or by outside safety engineer. Responsible Safety Officer approval is required for systems containing flammable, irritant, toxic, infectious, and/or radioactive fluids. Fire Department approval is also required for systems containing oxygen or flammable and/or toxic fluids. All vessels and systems that contain irritant, toxic, infectious, and/or radioactive fluids at any pressure. All oxygen or flammable-fluid vessels and systems. All pressurized equipment and ASME-coded vessels that have been structurally modified and that operate at gas pressures over 1 MPa gauge (150 psig) or liquid pressures over 10 MPa gauge (1500 psig) or that contain over 100 kJ (75,000 ft-lb) of stored energy.

ASME

Pressure equipment must be designed, or specified, and reviewed by the Responsible Safety Officer. Pressure vessels within the scope of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels (over 6 in. in diameter and 15 to 3000 psi for unfired pressure vessels), must comply with this Code except for Pressure Vessels controlled- and low-use ancillary vessels, such as: Vacuum vessels subject to over pressure only during an emergency, Vessels designed for specific one-time or low-activity use, such as an external pressure test of a vacuum vessel, or Vessels used for vacuum impregnating magnet coils. Pressure vessels and systems made of commercial pipe or pipe fittings, or both, must not be used above their rated American National Standards

Institute (ANSI) working pressures and must comply with all the rules of this Manual.

Protective Containments

This section covers protective containment designed, specified, or used by [Company] personnel to enclose gas-pressurized vessels (including those that contain toxic, radioactive, and/or flammable materials) to protect personnel from the pressure-vessel-failure hazards of blast pressure and flying fragments and to prevent release to the atmosphere of any hazardous materials leaked from the pressure vessel. Containment vessels may be required to enclose research equipment during its development or to enclose vessels used to transport highly toxic and/or radioactive substances.

Transportation

Only containers approved by the Department of Transportation (DOT) or by OSHA may be used for off-site shipment of pressure vessels containing radioactive materials. Contact the Responsible Safety Officer for approval for transporting radioactive material on or off site.

Ductile Vessels

When the contained vessel is made of ductile material, the containment vessel must be designed with an ultimate (burst) safety factor of at least 4. When the contained vessel is made of brittle material, the containment vessel must be designed with an ultimate (burst) safety factor of at least 8.

Design Curtain

The following requirements apply to all gas-pressure containment vessels. Design the containment vessel using the appropriate safety factor specified in the above paragraph. Base the design upon the maximum equilibration pressure expected if the contained vessel fails and its contents enter the containment vessel heated to the highest temperature expected within the containment vessel or to 55 degrees C (130 degrees F), whichever is higher. Containment-vessel materials must have satisfactory fracture toughness at an operating temperature of -40 degrees C (-40 degrees F), unless a lower temperature is required and specified. If off-site transportation is to be permitted, design the containment vessel to withstand the normal conditions of transport, including heat, cold, pressure, vibration, water spray, free drop, corner drop, penetration, and compression. The contained vessel must be mounted securely inside the containment vessel. Include a compound pressure/vacuum gauge to allow monitoring of the internal pressure of the containment vessel. This gauge must be graduated to at least 120%, but not over 200%, of the highest credible equilibration pressure. Include two separate valves and gas lines for safely introducing, exhausting, and monitoring flushing gases. Include suitable covers and shields to protect all valves and gauges from damage. Cap or plug all terminal valve ports. Provide accommodations for locking or wiring valve handles closed, or have valve handles removed during shipment to prevent unauthorized operation or tampering.

Pressure Testing

Pressure test the containment vessel to at least 1.5 times the maximum possible equilibration pressure as defined above. No detectable plastic strain is permitted, as determined before and after testing by measurements made to within 0.025 mm (0.001 in.). After successful pressure testing, leak check the containment vessel at its maximum possible equilibration pressure with a leak detector capable of detecting leakage of 1×10^{-8} atm cm³/sec. No detectable leakage is permitted. The Responsible Safety Officer should specify contained-vessel rupture testing of the containment vessel if she or he deems it advisable. After a successful test, label the containment vessel with the working pressure that was the basis for the design calculations and for an operating-temperature range of -29 to +55 degrees C

(-20 to +131 degrees F), unless a wider temperature range is required and specified.

MAWP Statements

The MAWP must be stated on all pressure-system (and pressure-vessel) assembly drawings.

Relief Valves Required

The following requirements (Relief Devices) apply in addition to all other sections of this manual. When evacuated vacuum vessels are raised to atmospheric pressure with a pressurized-gas source, a relief device must be installed between the gas source and vacuum vessel. Use ASME code-approved or [Company]-stocked relief devices whenever possible. The use of any other non-ASME pressure-relief device on high-hazard pressure equipment must be specifically approved by the Responsible Safety Officer. [Company] personnel are not permitted to set, seal, or stamp relief devices on utility water boilers, steam boilers, and compressed-air receivers that are under the jurisdiction of the State. Only authorized Plant Maintenance Technicians, and other specifically authorized persons, are permitted to set and seal relief devices on non-coded pressure vessels and systems.

Piping Standards

The following requirements apply in addition to other sections of this manual on Pressurized Flammable-Fluid Piping, and Instruments. Use flexible nonmetallic hose only when it is impractical to use metal pipe or tubing. Any use of nonmetallic hose in pressure systems must be approved by the Responsible Safety Officer. Keep hose lengths as short as possible, protect them from mechanical damage, and anchor the ends to prevent whipping in case of a hose or hose-fitting failure. Avoid sharp hose bends, and do not bend hoses more sharply than recommended by the manufacturer. Replace or repair any hose showing leaks, burns, wear, or other defects. Do not use nonmetallic hose on flammable, toxic, and/or radioactive gas systems. (Gases tend to permeate nonmetallic hose.)

On liquefied-gas systems, ensure that all terminal-block (liquid-withdrawal) valves are rated above the vapor pressure of the liquefied gas at 38 degrees C (100 degrees F) or that a properly set relief valve is permanently installed on the outlet side of each terminal-block valve. All work on pressure equipment requiring an SN must be performed by trained personnel under the direction of an engineer or the Responsible Safety Officer. All systems must be securely fastened to resist seismic forces as specified in the chapter on Seismic Safety. For gas systems use gauges graduated to about twice the MAWP of the system; for liquid systems use gauges graduated to at least the test pressure. Calibrate pressure gauges, switches, and other devices through 120% of their maximum operating points. These devices must be capable of withstanding the operational, and emergency, temperatures of the system, and their material must be compatible with the system fluid. Use safety-type gauges (with shatterproof faces, solid fronts, and blow-out backs) or protect operators with a tested, [Company]-approved gauge-safety shield. This applies to all gas-pressure gauges over 100 mm in diameter graduated to over 1.4 MPa (200 psi) and to all liquid-pressure gauges over 100 mm in diameter graduated to over 140 MPa (20,000 psi).

Safety-type gauges may be required for other combinations of diameter and pressure. Protect a gauge subject to pressure surges or cyclic pulses by installing a throttling device. Ensure that there is no oil in gauges used on gas systems. This is important on oxygen systems since hydrocarbons and oxygen can combine explosively. Clean all gauges to be used on high-purity gas systems. Equip every flammable-gas drop or regulator/hose connection with a flash arrester or a check valve, a pressure gauge, and a shut-off valve. If the flammable gas is to be (or could be) cross connected with oxygen or compressed air, a flash arrester must be installed in the flammable-gas line and a check valve in the oxygen or compressed air line. Equip all oxygen drops with a check valve. This applies to all single- and multiple-station installations and portable equipment.

Designer Responsibilities

The person who designs a pressure vessel for use by [Company] must review the inspection report for all completed pressure vessels to ensure that they are free from manufacturing defects that might affect their use.

Signs

All pressurized gas equipment operating at pressures greater than 500 psig must be painted yellow, must have the operating pressure clearly marked thereon, and must bear a sign, "DANGER, HIGH-PRESSURE EQUIPMENT."

Operator Qualifications

[Company] will authorize only trained persons to operate pressure equipment. Use of personnel or equipment shields may be required when there is a probability of damage from blast and to protect personnel or equipment from blast.

The User must ensure that the following safety precautions are taken:

- Flammable, radioactive, irritant, and/or toxic gases or liquids or oxygen must not be used in systems that are not specifically designed for their use.
- Flammable gas must not be used in combination with oxygen or compressed air unless there is a flash arrestor in the flammable-gas line and a check valve in the oxygen or air line.
- Oxygen and air, because of its oxygen content, can combine explosively with organic materials and flammable gases.
- Acetylene-gas pressure must not exceed 15 psig since acetylene is unstable and will explode spontaneously around 30 psig at room temperature.
- Work may not be performed on pressurized components unless the method has been approved by means of an SN or is specifically authorized by the User or designee.

Depressurized Vessels

Whenever practical, a system or vessel not in use must be depressurized. When a vessel or system is stored under pressure, the pressure, fluid, and date pressurized must be clearly indicated on the vessel. The Shutdown Procedures apply.

Safety Orders

State and federal Safety Orders establish minimum standards for the following: The design and construction of all unfired pressure vessels for Plant-Facility Pressure Systems. The installation, operation (including issuance of permits), inspection, and repair of air-pressure tanks and liquefied-petroleum-gas (LPG) tanks. The design, construction, repair, or alteration of storage tanks for liquefied-natural gas (LNG) at 15 psi or less. The installation, use, and repair of anhydrous ammonia tanks. The design and construction of pressure vessels for storing and dispensing natural gas for motor fuel and of motor-fuel tanks installed on vehicles not licensed to travel on highways. The installation, use, and repair of natural-gas vessels and systems that are not a part of hazardous research equipment.

State Safety Orders are not applicable to the following:

Pressure vessels that are under the jurisdiction and inspection of the United States Government and that are specifically exempted by the State. Pressure vessels, except for LNG tanks, subject to an internal or external pressure of not more than 15 psi, with no limitation on size, and vessels having an inside diameter less than 6 in., with no limitation on pressure. (However, such vessels must be designed and constructed in accordance with recognized standards, when applicable, or in accordance with good engineering practices concerning pressure-vessel design, with a factor of safety of at least 4, and must be fitted with controls and safety devices necessary for safe operation.)

Natural-gas vessels and installations subject to the jurisdiction and inspection of the State Public Utilities Commission, Department of Transportation, or Highway Patrol; air-brake tanks installed on units of transportation, including trucks, buses, trains, and streetcars, that are operated by any person, firm, or corporation subject to the jurisdiction and inspection of the Public Utilities Commission, the Department of Transportation, or the Highway Patrol.

The following vessels must be constructed, inspected, and stamped in accordance with the appropriate ASME Boiler and Pressure Vessel Code:

- Air-pressure tanks LPG tanks Anhydrous-ammonia tanks
- All Plant-Facility pressure vessels LNG tanks for low-temperature storage at 15 psi or less must be designed, constructed, inspected, and certified in accordance with API (American Petroleum Institute) Standard 620.
- LPG vaporizers having a volume greater than one U.S. gallon must be constructed in accordance with the California State Boiler and Fired Pressure Vessel Safety Orders, Title 8, Subchapter 2.
- Permits to Operate are required for LPG tanks and air tanks larger than 1.5 ft sup 3 with relief valves set to open above 150 psi.

OSHA Standards

State Safety Orders establish minimum standards for the design, construction, installation, inspection, operation, and repair of all (1) power boilers, including nuclear, (2) all low-pressure boilers and high-temperature-water boilers, and (3) any other fired pressure vessels in California not specifically exempted from these Orders. State Safety Orders are not applicable to (1) boilers and fired pressure vessels under the jurisdiction of, and inspected by, the United States Government, (2) boilers and fired pressure vessels used in household service, and (3) boilers used exclusively to operate highway vehicles, including automobiles.

Power Boilers

All new power boilers, high-temperature water boilers, and low-pressure boilers must be constructed, inspected, and stamped in full compliance with the ASME Boiler and Pressure Vessel Codes (Refs. 11 and 12) unless the design and construction of the boiler are accepted by the [Company] Engineering Division as equivalent to Code. Vessels not included in the scope of the ASME Codes must be designed and constructed in accordance with good engineering practice regarding pressure-vessel design for the pressure and temperature to be expected in service, with a factor of safety of at least 4. Good engineering practice (as used in this Manual) must be construed to require details of design and construction at least as safe as required by the rules in the ASME Codes, including shop inspection. State Permits to Operate are required on all boilers and fired pressure vessels except for: Low-pressure boilers Miniature boilers High-temperature water boilers Boilers, including forced-circulation boilers, in which none of the following is exceeded: 100 ft sup 2 of heating surface, 16-in. steam-drum inside diameter, 100-psi MAWP, 35-gal.

normal water capacity, and 400,000-Btu/hr burner power input.

ASME Standards

Code: The ASME Boiler and Pressure Vessel Codes and the ANSI Standards. Low-pressure boiler - a boiler that does not operate at steam pressure or with steam-safety valve settings exceeding 15 psi (low-pressure boiler) or (2) operate at water pressures exceeding 160 psi or water temperatures exceeding 250 degrees F (hot-water-heating boiler). [This definition is not intended to include domestic-type water heaters, provided the heater does not have a water capacity of more than 120 gal and is used only for heating service water.] Miniature boiler - a boiler that has (1) an inside shell diameter of 16 in. or less and (2) a gross volume of 5 ft sup 3 or less, exclusive of casing and insulation. (This volume includes the total volume of the steam- and water-containing parts of the boiler plus the volume of the combustion space and gas passages up to the point of attachment of the smokestack or chimney breaching.) High-Temperature Water Boiler - a fired or unfired pressure vessel used to heat water to temperatures above 212 degrees F at pressures exceeding 160 psi or to temperatures exceeding 250 degrees F regardless of pressure. Power boiler - a steam boiler operated at pressures exceeding 15 psi.

Pressure Testing Standards

Whenever practical, pressure vessels and systems should be sent to an Assembly Shop or the Plant Maintenance Technician Shops for pressure testing. When this is not practical, the vessel or system must be tested in accordance with the In-Place Pressure Testing procedures described in this manual. Pressure tests performed at [Company] must be conducted by a Plant Maintenance Technician, a Physical Plant Mechanic, or an Assembly Shop Machinist and must be observed (or conducted) and certified by the Responsible Safety Officer (or designee) or an outside independent Pressure Inspector. Pressure-test and pressure-inspection records must be maintained for the life of the vessel by the organization that certifies the test or inspection.

Pressure Testing

Pressure vessels must be tested in accordance with the rules in this Section, using an inert fluid. Pressure vessels for low-hazard inert systems for operation with nonflammable, nontoxic, and non-radioactive fluids must be hydrostatically tested to at least 1.5 times the MAWP or pneumatically tested to at least 1.25 times the MAWP (only when safety considerations or research requirements do not permit a hydrostatic test). Any special temperature conditions or temperature cycles to which the vessel will be subjected in use must be reproduced as closely as possible during the test. Pressure vessels for high-hazard reactive systems for operation with oxygen or flammable, toxic, and/or radioactive fluids must be tested to at least 2.0 times the MAWP with an inert liquid (preferred) or gas. Any special temperature conditions or temperature cycles to which the vessel will be subjected in use must be reproduced as closely as possible during the test. In addition, consider the need to inspect any vessel ultrasonically or to check the vessel surface for cracks using the magnetic-particle test or (for nonmagnetic vessels) the fluorescent-penetrant test. During tests of pressure vessels in which the yield strengths of their construction materials is approached, strain-gauge measurements must be made at high-stress locations. Diameter measurements accurate to within plus or minus 0.025 mm (0.001 in.) must also be taken both before and after testing to determine whether detectable plastic yielding has occurred during pressurization. When the strength of the vessel is questionable (old or unknown design), strain-gauge measurements must be made during testing, and diameter measurements must be taken before and after testing. The MAWP for ASME Code pressure vessels made of the acceptable ductile materials listed in the code, must not exceed 0.4 times the test pressure and must comply with a Proof Test to establish MAWP.

Pressure Testing Procedures

Inert-substance (low-hazard) pressure systems that will operate with non-hazardous liquids, inert gases, or compressed air must be tested hydrostatically (preferred) at least 1.5 times the MAWP or pneumatically to at least 1.25 times the MAWP using an inert fluid. Reactive-substance (high-hazard) pressure systems that will operate with oxygen or with flammable, toxic, and/or radioactive fluids must be tested to at least 2.0 times the MAWP using an inert liquid (preferred) or gas.

Standards for Low Pressure Vessels

Pressure vessels and systems must be leak tested at their MAWP after successful pressure testing: Open flames must not be used for leak-testing. Leak testing of non pressure-tested or undocumented pressure vessels or systems must be limited to a maximum of 20% of the test pressure (or proposed test pressure).

Leak Testing Required

If a leak is detected during pressure testing of a vessel or system, and it is decided to locate the leak before completing the test, the pressure must be reduced to not over one-half the immediately preceding test pressure while the leak is being located. A system or vessel must not be repaired while it is pressurized unless this is specifically authorized.

Leak Repairs

Any modification to a pressure vessel or system, other than repair or replacement (with an exact duplicate) of existing components, must be approved by the Responsible Safety Officer and recorded in a revision to the applicable engineering drawing, to the SN, and to the OSP (if applicable). The initial pressure test must be repeated before any further use of the modified vessel or system. If an ASME-Code vessel is modified, the Code stamping must be obliterated, and the Responsible Safety Officer must be so notified. When pressure equipment has been modified for use at a pressure below the original design pressure, all modifications (e.g., use of fewer bolts in flanged joints) must be approved by the Responsible Designer. All safety requirements for the lower pressure must be met, and the reduced working pressure and the number of bolts or other supports required must be clearly marked on the equipment. If high-strength or other special bolts are required, this must also be clearly marked on the equipment near the bolt holes. Instructions on the precautions to be taken when the modified equipment is operated must be sent to all personnel concerned, and one copy must be filed in the SN file.

Inspections & Re-Testing

All high-hazard equipment that is not a part of Plant Facilities and/or under the jurisdiction of the State must be re-inspected at least every three years and retested at the MAWP at least every six years, unless otherwise specified in the SN or OSP. Low-hazard pressure equipment that is not a part of Plant Facilities and/or under the jurisdiction of the State need not be periodically re-inspected and retested, unless otherwise specified in an SN or OSP. Pressure re-inspection is performed by a Pressure Inspector or by the Responsible Safety Officer and is recorded on a "Pressure Inspection Record" form. The completed form must be signed by the User and sent to Responsible Safety Officer to be kept for the life of the vessel. The result of the retest must be certified and a label must be fixed on the vessel or system as described earlier.

Inspections & Testing

If it is impractical to pressure test a vessel or system at the Mechanical Shop or some other approved location, pressure test it in place, in accordance with the provisions of this Section. The supervisor or user

must ensure that in-place retesting of pressure equipment for which he or she is responsible is performed. Although other individuals may be designated to observe and direct testing or retesting, responsibility for safe conduct of the test and safe functioning of tested pressure equipment cannot be delegated. The user and the Responsible Safety Officer must prepare the required test procedure, direct the test personnel, and witness in-place pressure testing of vessels and systems for which he or she is responsible.

Pressure Testing On Site

A written test procedure must be prepared for every high-hazard pressure test conducted in the field. When testing will be conducted in place, the test procedure must be included in (or appended to) the SN or OSP (if applicable). Procedures for in-place testing of high-hazard vessels and systems must be approved. The Building Manager or Area Supervisor must be advised of pressure tests planned to occur in his or her facility, and Responsible Safety Officer must be notified if toxic and/or radioactive material is involved. All pressure tests must be conducted by a person designated by the Responsible Safety Officer or conducted by a Plant Maintenance Technician, a Physical Plant Mechanic, or a Machinist in the Assembly Shop and must be observed (or conducted) and certified by a member of the Responsible Safety Officer (or designee) or a Pressure Inspector.

Pressure Testing with Liquids

Pressure testing with a gas is more dangerous than testing with a liquid. Therefore, tests must be conducted with liquids, whenever practical. Barricade the equipment being tested, shield the controls and operators, and evacuate all unauthorized personnel from the test area. Signs reading "**Danger - High-Pressure Test in Progress - Keep Out**" must be posted at all approaches to the test area. For in-place testing with liquids, all air must be removed from both the testing system and the equipment to be tested. Compressed air will expand violently in case of vessel failure. Spongy action of pumping equipment usually indicates the presence of trapped air.

Pressure Testing with Gas

For correct standards, refer to the following: ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1, American Society of Mechanical Engineers, New York (latest version). ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 2, American Society of Mechanical Engineers, New York (latest version). ASME Boiler and Pressure Vessel Code, Section X, "Fiberglass-Reinforced Plastic Pressure Vessels," American Society of Mechanical Engineers, New York (latest version). ARI Standards, Air-Conditioning and Refrigeration Institute, Arlington, VA (latest version). Code of Federal Regulations 49, Transportation, Parts 100-199, General Services Administration (latest version). Unfired Pressure Vessel Safety Orders, State of California Administration Code, Title 8, Industrial Relations, Part 1, Department of Industrial Relations, Chapter 4, Division of Industrial Relations, Subchapter 1 (latest version). Boiler and Fired Pressure Vessel Safety Orders, State of California Administration Code, Title 8, Industrial Relations, Part 1, Department of Industrial Relations, Chapter 4, Division of Industrial Relations, Subchapter 2 (latest version). OSHA Order 6430.1, General Design Criteria (latest version). American Petroleum Institute, Standard 620 (latest version). ASME Boiler and Pressure Vessel Code, Section I, Power Boilers, American Society of Mechanical Engineers, New York (latest version). ASME Boiler and Pressure Vessel Code, Section IV, Heating Boilers, American Society of Mechanical Engineers, New York (latest version). American National Standard Code, ANSI-B31.1, Power Piping (latest version). American National Standard Code, ANSI-B31.3, Chemical Plant and Refinery Piping (latest version).

Sanitation

Drinking Water

The Responsible Safety Officer periodically takes samples from the potable water system throughout the Company and has them checked for biological contaminants. This is a check to ensure a high-quality water supply for drinking purposes. The drinking water supply must not contain impurities in concentrations that may be hazardous to the health of the employees or that would be offensive to the senses of sight, taste, or smell. The drinking water supply system must be installed according to the National Plumbing Code and must be maintained in good condition. The drinking water system must be protected against backflow with approved connections and plumbing devices.

New Water Sources

New additions or alterations to existing domestic water lines must be disinfected with chlorine solution and biologically tested prior to being put into service. Procedures must be those spelled out in the American Water Works Association publication AWWA C601, latest edition.

Anti-Vermin Policy

Every enclosed work place and personal service room must be constructed, equipped, and maintained in such a manner as to prevent the entrance or harborage of rodents, insects, and vermin.

Food Preparation

All readily perishable foods or beverages, capable of supporting rapid and progressive growth of micro-organisms, must be stored below 7 degrees C (45 degrees F). Food that is served hot must be heated over 60 degrees C (140 degrees F) and kept that hot during the serving period to prevent growth of bacteria. Food served cold should be maintained below 10 degrees C (50 degrees F). All food and beverages must be prepared, stored, displayed, dispensed, placed, or served so they are protected from dust, flies, vermin, pollution by rodents, unnecessary handling, airborne droplets, infection, overhead leakage, or other contamination. Food that is transported from a cafeteria where it has been prepared to another cafeteria must be protected from contamination in transit. All suspected or alleged cases of food poisoning must be reported to the Responsible Safety Officer for immediate investigation. Food must not be stored or eaten in areas where toxic materials are handled.

Sanitary Facilities

Adequate toilets, washrooms, lockers, and other essential sanitary facilities must be readily accessible for employees near their work areas. These facilities must be maintained in a clean and sanitary condition. Soap in a dispenser and apparatus for drying of hands must be provided at each wash place.

Potable Water Standards

This standard is intended to safeguard [Company] drinking water supplies by:

- Protecting potable water supplies against actual or potential cross connection.

- Eliminating any existing cross-connection hazards between potable water systems and non-potable water systems. Preventing the making of cross-connections in the future.
- Requiring the exclusive use of potable water for drinking, personal, eyewash, safety shower, and culinary purposed.

Quality Control:

No piping shall be installed so that used, unclean, polluted, or contaminated substances can enter any portion of the potable water supplies by back siphonage, suction, back pressure, or any other cause. Protection shall be guaranteed during normal use and operation and when any tank, receptacle, equipment, or plumbing fixture is flooded, or subject to pressure in excess of the operating pressure in the water piping. Unless an approved air gap or backflow prevention device is provided, no plumbing fixture, device, or equipment shall be connected to any potable water supply when such connection may pollute water supplies or may provide a cross-connection with non-potable water. Appropriate corrective action shall be taken immediately where any cross-connection hazard exists and is not properly protected. All water lines and outlets shall be appropriately marked to indicate whether the water is safe or unsafe for drinking. All backflow preventers shall be listed by the University of Southern California Foundation of Cross-Connection Control or similar agency. All fire protection backflow preventers shall be listed by Factory Mutual and the University of Southern California Foundation of Cross-Connection Control or comparable agency.

Approvals:

Before any device is installed for the prevention of backflow or back siphonage, removed from use, relocated or substituted, or an existing potable water line extended, work shall be approved by the [Company] Engineering Department. All issues of this Standard shall first be reviewed by the Responsible Safety Officer. Compliance with this Standard shall be monitored by the Health and Safety Department.

TESTING & MAINTENANCE: All devices installed in the potable water supply system for protection against backflow shall be tested annually and maintained in good working condition by designated maintenance personnel, in accordance with the procedures outlines in the latest edition of “Cross-Connection Manual” by the University of Southern California Foundation of Control and Hydraulic Research, or comparable publication. Defective or inoperative devices shall be repaired or immediately. Records of such tests, repairs, and overhauling shall be the Construction and Maintenance Department and made available to Engineering Department and Responsible Safety Officers upon request.

Revisions to This Standard:

The Engineering Department shall be responsible for maintaining this Standard. The approved devices shall be reviewed periodically to ensure that all approvals are current, and to delete or add to the approved devices as deemed necessary.

General

The Responsible Safety Officer and Engineering Department shall be kept informed of the identity of the [Company] representative responsible for the water piping concerned with this Standard. In the event of contamination or pollution of the drinking water system due to a cross-connection, the Responsible Safety Officer and Engineering Department shall be promptly advised by the [Company] representative responsible for the water system so that appropriate measures may be taken to overcome the contamination.

Definitions:

Atmospheric Vacuum Breaker (Also known as the non-pressure type vacuum breaker):

A device containing a shut-off valve followed by a valve body containing a float-check, a check seat and an air inlet port. When the shut-off valve is open the flow of water causes the float to inlet port. When the shut-off valve is closed, the float falls check valve against back-siphonage and at the same time, opens inlet port.

Backflow:

The undesirable reversal of the flow of water or mixtures of water and other liquids, gases, or other substances into the pipes of the potable supply of water from any source or sources.

Backflow Preventer (approved):

A device that has been approved by [Company] for the prevention of backflow into potable water systems.

Back Pressure:

A pressure increase in the downstream piping system (by pump, elevation of piping, or steam and/or air pressure) above pressure at the point of consideration which allows reversal of direction of flow through the backflow prevention assembly.

Back Siphonage:

A form of backflow due to a reduction in system which causes a reverse flow to exist in the water system.

Contamination:

Any change in water quality which creates a threat to the public health through poisoning or through the spread of disease by sewage, industrial fluids or waste.

Cross-connection:

Any unprotected, actual, or potential connection or structural arrangement between a potable water system and any other source or system through which it is possible to introduce into any potable water system any used water, industrial fluid, gas, or liquid other than the intended potable water. This includes bypass arrangements, jumper connections, removable sections, changeover devices and other temporary or permanent devices because of which can cause "backflow."

Double Check:

An assembly composed of two single, independently acting, approved check valves, including tight-closing shut-off valves at each end of the assembly and fitted with properly located test cocks.

Industrial Water:

non-potable water intended for industrial use.

Non-Toxic Substances:

Any substance of a non-poisonous nature that may create a moderate or minor hazard to the potable water system.

Potable Water:

Water from any source which has been approved for human consumption.

Pressure Vacuum Breaker:

A device containing one or two independently operating loaded check valves and an independently operating air inlet valve located on the discharge side of the check or device; to be equipped with properly located test cocks and closing shut-off valves located at each end of the assembly.

Reduced Pressure Principle Device:

A device containing two independently acting approved check valves together with a hydraulically and mechanically independent pressure relief valve located between the check valves and at the same time below the first check valve. The device includes properly located test cocks and tightly closing shut-off valve at each end of the assembly.

Toxic Substance:

Any substance (liquid, solid, or gaseous), such as sewage and lethal substances which, when introduced into the system, creates or may create a danger to the health and well consumer. (Defined as a contaminant or health hazard).

REFERENCES:

American Water Works Association: AWWA No. M14. Backflow Prevention and Cross-Connection AWWA C506-78 Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types. State of California Administrative Codes: Title 17: Drinking Water Supplies. Title 24: Basic Plumbing Regulations. Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California: Manual of Control

AIR GAP SEPARATION:

An air gap is the only absolute means of eliminating a physical link or cross-connection, and positively preventing backflow. Air gaps used wherever practicable and where used must not be bypassed. The supply inlet to a tank or fixture must be terminated above level rim of the tank or fixture by a distance equal to at least the effective opening of the supply inlet pipe. There should be provision for extending the supply pipe beyond the flood level Minimum 2D or 1 inch, whichever is greater; D = nominal diameter of fill pipe.

Atmospheric (Non-Pressure) Vacuum Installation:

Devices shall be:

- a. Accessible for maintenance, repair, and testing.
- b. Located outside any enclosure or hooded areas containing toxic or poisonous fumes.
- c. Installed with the air inlet in the level position.
- d. Installed a minimum of six inches above the flood level rim of the fixture, tank, highest outlet, highest sprinkler, highest downstream piping, or similar device.
- e. Installed downstream of the last shut-off valve. (example: 160F hot water).

TYPICAL APPLICATIONS

- Lawn sprinklers.
- Laboratory and janitors sinks.
- Low inlets to tanks, vats, sumps, and other receptors.

- Hose-bibs or outlets with hose attachment means.
- Aspirators.
- Water closet or urinal flushometer valves.
- Cooling towers.

Pressure Vacuum Breaker (PVB) Installation:

Devices shall be:

- a. Accessible for maintenance, repair, and testing.
- b. Installed 12 inches above the floor level rim of the highest outlet, highest sprinkler, highest downstream piping, or similar device.
- c. Installed with the air inlet in the level position.
- d. Approved to operate at the temperature of the water being used (example: 160F Hot Water).

2. Devices shall not be:

- a. Installed in pits or similar potentially submerged locations.
- b. Installed where, if slight spillage should occur, it would be objectionable.

TYPICAL APPLICATIONS:

- Lawn sprinklers.
- Cooling towers.
- Laboratories.
- Low inlets to tanks, vats, sumps, and other receptors.
- Floor drains with trap primers or flushing connections.
- Chlorinators on the suction side of the pump.
- Water cooled equipment.
- Industrial water systems.

DOUBLE CHECK VALVE ASSEMBLY (DC) INSTALLATION:

Devices shall be:

- a. Accessible for maintenance, repair, and testing.
- b. Installed level to the horizontal position.
- c. Approved to operate at the temperature of the water being used (example: 160F Hot Water). Devices shall not be:
 - a. Installed in pits or similar potentially submerged locations.

TYPICAL APPLICATIONS:

- 1) Steam boilers.

- 2) Closed heat water systems.
- 3) Heat exchangers.
- 4) Vending machines.
- 5) Fire sprinkler systems.
- 6) Chilled water systems.

REDUCED PRESSURE PRINCIPLE DEVICE INSTALLATION:

Devices shall be:

- a. Accessible for maintenance, repair, and testing.
- b. Installed in an open area to protect against flooding around the discharge from the differential relief valve assembly.
- c. Installed in the horizontal position.
- d. Be provided with funneled discharge piping and required air gap when installed indoors.
- e. Installed at least 12 inches above the floor or grade.

Devices shall not be installed in pits or similar potentially submerged locations.

TYPICAL INSTALLATIONS:

- Company building water service.
- Steam boilers.
- Closed heating water systems.
- Closed chilled water systems.
- Heat exchangers.
- Autoclave, sterilizer, and steam tables.
- Degreasing equipment.
- Hydraulic elevators.
- Etching tanks.
- Processing tanks.
- Fire sprinkler systems.
- Priming water to pumps moving toxic fluids.
- Lawn sprinklers.

Seismic Safety

Intent

It is [Company]'s policy to design and construct its physical plant and program facilities to prevent the loss of life and to minimize the risk of personal injury, program interruption, and property damage due to earthquakes.

Responsibility of RSO

The Responsible Safety Officer is responsible for: Establishing [Company] seismic safety policy, Being aware of state-of-the-art developments in the seismic response of structures and using this knowledge in the performance of its functions, Reviewing the criteria and guidance for the design of structures and special [Company] equipment involving state-of-the-art seismic design issues, for those cases where appropriate code or institutional criteria may not apply directly or may not exist, or where specified in this chapter, Determining whether dynamic structural analyses is required based on the Uniform Building Code, and Conducting Seismic Design Review Meetings to disseminate earthquake preparedness information.

Responsibility Physical Plant

[Company] has retained an outside engineering firm to evaluate the seismic safety of its existing facilities. The Responsible Safety Officer is responsible for ensuring the continued seismic safety of physical plant facilities at [Company], by insuring all additions and structural changes in the plant are designed to comply with existing building codes and regulations. The Responsible Safety Officer shall be consulted on the design of equipment and implementing exit drills for seismic safety.

Employee Responsibility

Each worker is responsible for the seismic safety of any equipment he or she brings in to the work area. Such things as book cases and heavy items must be securely fastened to the building. Also, shelves should be guarded to prevent falling objects. A bar or chain is recommended across all open shelving.

Supervisor Responsibility

Each supervisor is responsible for his or her department's operational seismic-safety program. The Responsible Safety Officer performs routine operational seismic inspections to ensure that these programs are carried out.

Radioactive Containment Facility

There must be an emergency plan for the containment of Radioactive, Infectious, Toxic, and/or Pyrophoric Materials during and after an earthquake. All tanks must be strapped and supported. The Responsible Safety Officer is responsible for the review of the seismic design and installation criteria of containment facilities for radioactive, infectious, toxic, and/or pyrophoric dispersible materials.

Periodic Inspections

An Earthquake Safety Inspection Program is carried out periodically by the Responsible Safety Officer to

ensure that industrial and research material, equipment, and hardware are restrained in place to avoid damaging motion resulting from seismic ground motion.

Minimum Standards - Earthquakes

The intent of these guidelines is to ensure that all buildings, structures, program equipment, and heavy shielding are designed to resist a magnitude-7 earthquake on a local fault or a magnitude-8.3 earthquake on a distant fault without collapse (the occurrence of some structural and nonstructural damage is accepted). In some cases the program is based upon the recommendations of an outside consultant, and the company makes no guarantees. Critical emergency facilities must be designed to remain functional during and after the design earthquakes specified above.

Enclosures and systems containing radioactive and/or other hazardous dispersible materials (e.g., toxic, flammable, or infectious) must be designed to ensure confinement during and following the design earthquake specified above and to ensure that the acceptable risk, established during the OSP determination is not exceeded. These enclosures must be inspected by the Responsible Safety Officer before any use. All structural and nonstructural elements of normally unoccupied structures must be designed to prevent damage to building structures and enclosures containing radioactive and/or other hazardous dispersible materials. All structural and nonstructural elements of normally occupied structures must be designed for life safety. All buildings must be structurally designed by, or under the supervision of, a structural engineer registered by the State.

All roads, parking lots, foundations, earth-retaining structures, and other earthworks must be designed in accordance with the recommendations of a competent engineering geologist and/or geotechnical engineer. All building projects must be designed on the basis of a geological and soils investigation used to establish foundation design values and to assess hazards from fault movement, e.g., landslides, and ground motion. No building may be constructed over an active fault, and the proposed location of a building, relative to an active fault, must be reviewed and approved by the Responsible Safety Officer. Calculations, drawings, and specifications for buildings must be submitted to the Plant Engineering Department for review before construction, and drawings must be signed and stamped with a licensed Engineer's seal.

All submissions must contain a clear statement of the seismic design criteria used and a clear description of the lateral force-resisting system used. Structural design details must be emphasized to ensure a formal and complete lateral-force-resisting system, including soil-foundation interaction and ductile inelastic behavior. All drawings and calculations for buildings must be formally reviewed by an independent licensed structural engineer before construction of the building is begun. Calculations, drawings, and specifications for programmatic equipment and structures must be approved by a licensed professional engineer. Drawings and specifications for massive structures, such as concrete shielding and their supports, that affect building elements must be reviewed. [Company] must provide continuous field inspections during construction with appropriate special inspection. The Engineer will formally approve final acceptance of the completed structure.

Minimum Standards - Lateral Force

All structures and nonstructural elements of buildings at [Company] must be designed and constructed to withstand all lateral forces (such as wind and seismic) in accordance with the 1988 edition of the "Uniform Building Code (UBC)," hereinafter referred to as UBC, and with OSHA's design criteria. Seismic analysis of buildings and structures must conform with the static lateral force procedures described in UBC Section 2312 (e), unless a dynamic lateral force analysis conforming to UBC Section 2312 (f) is required by the Engineering Department.

In addition, all buildings must be designed for at least a minimum base shear of $0.2 W$, where W is the total dead load of the structure as defined in UBC Section 2312 (e) 1. This base shear must be distributed over the height of the structure in accordance with UBC Section 2312 (e) 4 (Ref. 23-2). The Occupancy Importance Factor (I) must be assumed to equal 1.0 unless specifically designated otherwise by the Engineering Department Head.

In cases where the value of I is designated as 1.25 for Essential and Hazardous Facilities, the minimum base shear must be $0.28 W$. The bracing and anchorage for all nonstructural elements (such as mechanical, plumbing, electrical equipment and machinery and other equipment, ceilings, light fixtures, partitions, ducting, etc.) must be designed and constructed to withstand a minimum lateral force of $0.5 W$, except that when dynamic analysis is required in accordance with paragraph 2 above of this Section, the use of roof and/or floor spectra may also be required for the design of the equipment and/or the nonstructural-element bracing and anchorage. The assumed dead load resisting overturning must not exceed $0.75 W$. All suspended ceiling systems must be braced for a minimum $C_{sp} = 0.5$ and must be braced and anchored.

Bracing & Anchorage Non-Structural

Bracing and Anchorage for Nonstructural Elements Involving Toxic and/or Pyrophoric Materials. These requirements apply to the seismic restraint of nonstructural elements involving dispersible toxic and/or pyrophoric materials such as arsine, phosphine, or bromine pentafluoride. The bracing and anchorage of these nonstructural elements and toxic material must conform to the requirements set forth below.

Rigid Mounting

When moving into or rearranging work areas each division is responsible for providing anchorage for seismic resistance of nonstructural building elements (such as research equipment and systems and related vents, plumbing, ducting, electrical wiring and equipment, fixtures, furnishings, and material-storage facilities). The seismic restraint must conform to the requirements of this chapter and with the Uniform Building Code. Seismic protection must be provided to research equipment and shielding as soon as possible after its installation, and this protection must be maintained as much as possible during major maintenance or reassembly. The Responsible Safety Officer determines when a dynamic-structural analysis based on the Design Basis Earthquake is required or whether an equivalent static structural analysis is sufficient. When the use of the Design Basis-Earthquake is required, the natural frequency of the structure must be computed and the maximum stresses must be shown. The analysis procedure used must be approved by the Responsible Safety Officer.

The location of heavy objects that are to be placed close to building structural members (columns, bracing, etc.) must be reviewed and approved by a licensed Structural Engineer. In certain instances, it may be undesirable to fasten heavy objects securely to a floor because normal settlement may cause unacceptable warpage or misalignment of sensitive elements. It is acceptable to supply the requisite restraint without initial hard contact by allowing a small movement before “motionstops” become effective. In other instances, when the floor under a heavy object cannot withstand the horizontal earthquake force, it may be desirable to decouple the heavy object from the floor and allow an acceptable, but limited, horizontal motion. This decision may be made by the Engineer. The motion must be limited to a few inches and must not permit the heavy object to cause personnel injury or obstruct an escape route. In all cases, upset must be prevented.

Lateral Restraints

Rigid Mounting. If personnel can be exposed to a life-threatening injury by being struck or trapped by the lateral movement or upset (toppling, overturning) of any object from any cause (such as a seismic

disturbance, wind gusts, impact by a moving vehicle, self-excitation of machinery with an eccentric load, etc.), the movement (relative to the footing) or upset of the object must be prevented, without reliance on friction, when the object is subjected to a horizontal acceleration of 0.7 g. If the object is provided with adjustments, it must resist 0.7 g when the adjustments are in the most unfavorable positions. In this context “stationary object” means any object (such as a large detector, magnet, laboratory equipment, work bench, machine tool, surface plate, platform, or cabinet) that if put in motion cannot be easily restrained by one person. Electronic racks and other portable equipment, on wheels or casters, must conform to the lateral restraint requirements of this section once the equipment is in operating position and when it is expected to remain there for 4 weeks or more. The maximum allowable stress and displacement in seismic restraining systems for stationary objects must be established, and these criteria must be such that life-threatening lateral movement (relative to the support) or upset will not occur during a horizontal acceleration of 0.7 g. The maximum allowable design stresses for non-ductile and ductile systems are given below.

Resilient Mounting.

For equipment or other objects mounted on resilient stands or on floors of resilient buildings, the dynamic load during an earthquake may, due to amplification, greatly exceed the maximum ground acceleration. The Engineer must ensure that such stands have sufficient strength and ductility to withstand dynamic loads. Spectral analyses, using the [Company] Design Basis Earthquake, must be used to determine the seismic horizontal acceleration. The maximum allowable design stresses are given below.

Concrete Shielding

These requirements apply to the seismic restraint of systems containing toxic and/or pyrophoric materials such as arsine, phosphine, or bromine pentafluoride. The bracing and anchorage of program research equipment must be designed and fastened to resist a lateral force of 2.0 W or the force determined by the use of spectral analysis based on the floor or surface on which the equipment is mounted. These seismic restraints must also comply with the allowable design stresses in the manufacturer's proprietary recommended working loads for proprietary anchor bolts or expansion anchors using the base shear defined in this paragraph.

Shielding Requirements

The following requirements and guidelines apply to all [Company] concrete-shielding blockhouses, particle-beam shielding, or other structures consisting of large blocks. In view of the developing nature of seismic-design philosophy for concrete shielding structures and as a result of seismic-shake-table experiments, each concrete-shielding structure to be constructed, modified, or relocated must be reviewed. The review committee must consist of the Responsible Safety Officer and at least the following: An independent licensed structural engineer or an Engineer from the [Company] Engineering Department; A professional member of the project's staff; A non-[Company] seismic-engineering consultant. The Company must inform the committee of all possible uses of the structure, especially if hazardous or radiological activity is anticipated.

Whenever dispersible residual radiation or other hazard must be contained, more stringent safeguards are necessary, and the Responsible Safety Officer must be consulted regarding the appropriate requirements, including the seismic stability of shielding. All shielding structures must be designed to resist static lateral loads applied to the center of gravity from any horizontal direction. The shielding structure must be designed to resist the horizontal acceleration specified below. The intended system of restraint must be described in an Engineering Note containing the supporting calculations. Elements of a shielding structure must be prevented from moving in any lateral direction with respect to one another by a positive physical interference, such as integral keys, metal plates with end stops, or their equivalent. This requirement does not include the shielding-to-floor interface. The best seismic defense for shielding is to unify an

assemblage into a single integral structure by use of keys, strap plates, chain, etc. These requirements establish minimum criteria. In many cases restraint can be significantly increased at very small increase (1-2%) or very small loss in functional flexibility. Increasing strength of restraints is encouraged; the decision, however, is technical judgment of the designer.

Radioisotope Control

The shielding structure and components in the seismic restraining system must comply with the following design requirements. When sliding can occur, friction forces between unsecured structures must not be used in these seismic calculations. The maximum allowable stress in columns or compression struts made of rolled structural-steel sections or built-up sections having thin webs or flanges must not exceed the lower of the compressive yield stress or the critical buckling stress when simultaneously acted upon by the total dead load, W , and a $0.5 W$ lateral load. Non-ductile Shielding Structures. Structures constructed of components or materials that fail in a brittle manner [i.e., are susceptible to sudden failure resulting from elastic (nonlinear) behavior] and that do not exhibit ample reserve strain-energy capacity are considered non-ductile structures, e.g., a structure made of non-ductile-reinforced concrete blocks held together with ductile metal attachments that are not configured, or do not have enough mass, to safely absorb the seismic strain energy in the structure.

For non-ductile structures and bracing systems, the design must be based on the following: Base shear must not be less than $0.7 W$, where W equals the total dead load of the structure and equipment. The dead load assumed for calculation of the resisting moment about the center of gravity must not exceed $0.65 W$. Maximum allowable stress in ductile structural elements must not exceed: a. 75% of the ultimate compressive strength for concrete in bearing or compression, or the stresses permitted by the Building Code Requirements for Reinforced Concrete for concrete in shear, torsion, or flexure b. 50% of the ultimate strength for welds c. 75% of the manufacturer's recommended ultimate load values for proprietary anchor bolts or expansion anchors that depend on the concrete for their ultimate load capacities d. 75% of the ultimate strength for other structural elements. Ductile Shielding Structures. Structures and their attachments and bracing constructed of materials that exhibit ductile inelastic (non-linear) behavior at stresses beyond their yield points and that have ample reserve strain-energy capacity beyond their yield points are considered ductile structures, e.g., a structure and its attachments made of structural steel having a configuration and mass of ductile metal sufficient to safely absorb the seismic strain energy in the structure. For ductile bracing systems, the design must be based on the following: Base shear must not be less than $0.5 W$, where W equals the total dead load of the structure and equipment. The dead load assumed for calculating the resisting moment about the center of gravity must not exceed $0.75 W$. Maximum allowable stress in ductile structural elements must not exceed their yield strengths at $0.5 W$. (The lateral restraint of a ductile system designed to yield at $0.5 W$ will resist more than $0.7 W$ before failing at its ultimate strength.)

Personnel Protection

Radioisotope control policies at [Company] have been developed to protect both the personnel and the environment at this site from unwarranted exposure to radioisotope hazards. It is imperative that seismic design criteria be incorporated into normal radioisotope control policies to ensure complete protection of life and the environment.

Miscellaneous Hazards

Earthquake safety measures have been developed at [Company] to protect personnel in the event of a seismic disturbance. Sufficient protection is required to allow time for personnel to exit an endangered area without injury. All equipment, hardware, and objects inside and outside of buildings must be adequately restrained and/or anchored to ensure that they do not block escape routes during seismic

ground motion. The anchoring system must be analyzed to ensure that the primary support (floor, wall, etc.) is strong enough to support the restrained hardware and equipment during seismic motion.

Agriculture

Power Lawnmowers

Blade tip circle

The path described by the outermost point of the blade as it is rotated about its shaft axis.

Guards

A part or an assembly provided for shielding a hazardous area of a machine. Catcher assemblies. Parts or combinations of parts which provide a means for collecting grass clippings or debris.

Walk-behind mower

A mower either pushed or self-propelled and normally guided by the operator walking behind the unit. Operator area, walk-behind mowers. For discharge interference purposes, that area confined within a circle no smaller than 30 inches in diameter, the center of which is located to the rear of the mower on its longitudinal centerline 30 inches behind the nearest blade tip circle.

Power reel mower

A lawn-cutting machine utilizing a power source to rotate one or more helically formed blades about a horizontal axis to provide a shearing action with a stationary cutter bar or bed knife.

Power rotary mower

A lawn-cutting machine utilizing a power source to rotate one or more cutting blades about a vertical axis.

Lowest blade position

The lowest blade position under static conditions.

Riding mower

A powered, self-propelled lawn-cutting vehicle on which the operator rides and controls the machine.

Sulky type mower

Normally, a walk-behind mower which has been converted to a riding mower by the addition of a sulky.

Deadman control

A control designed so that it will automatically interrupt power to a drive when the operator's actuating force is removed.

General Requirements

Power lawn mowers of the walk-behind, riding-rotary types, and reel power lawn mowers designed for use by employees shall meet the design specifications in "American National Standard Safety Specifications for Power Lawn mowers" ANSI B71.1-1968. These specifications do not apply to sulky-type mowers, flail mowers, sickle-bar mowers, or mowers designed for commercial use. All power-driven chains, belts, and gears shall be so positioned or otherwise guarded to prevent the operator's accidental contact therewith, during normal starting, mounting, and operation of the machine. A shutoff device shall be provided to stop operation of the motor or engine. This device shall require manual and intentional

reactivation to restart the motor or engine. All positions of the operating controls shall be clearly identified. The words, "Caution. Be sure the operating control is in neutral before starting the engine," or similar wording shall be clearly visible at an engine starting control point on self-propelled mowers. Walk-behind and riding rotary mowers: The mower blade shall be enclosed except on the bottom and the enclosure shall extend to or below the lowest cutting point of the blade in the lowest blade position. Guards which must be removed to install a catcher assembly shall comply with the following: Warning instructions shall be affixed to the mower near the opening stating that the mower shall not be used without either the catcher assembly or the guard in place. The catcher assembly or the guard shall be shipped and sold as part of the mower. The instruction manual shall state that the mower shall not be used without either the catcher assembly or the guard in place. The catcher assembly, when properly and completely installed, shall not create a condition which violates the limits given for the guarded opening.

Openings in the blade enclosure, intended for the discharge of grass, shall be limited to a maximum vertical angle of the opening of 30°. Measurements shall be taken from the lowest blade position. The total effective opening area of the grass discharge opening shall not exceed 1,000 square degrees on units having a width of cut less than 27 1/2 inches, or 2,000 square degrees on units having a width of cut 27 1/2 inches or over. The word "caution" or stronger wording, shall be placed on the mower at or near each discharge opening. Blade shall stop rotating from the manufacturer's specified maximum speed within 15 seconds after declutching, or shutting off power. In a multi piece blade, the means of fastening the cutting members to the body of the blade or disc shall be so designed that they will not become worn to a hazardous condition before the cutting members themselves are worn beyond use. The maximum tip speed of any blade shall be 19,000 feet per minute. Walk-behind rotary mowers: The horizontal angle of the opening in the blade enclosure, intended for the discharge of grass, shall not contact the operator area.

There shall be one of the following at all openings in the blade enclosure intended for the discharge of grass: A minimum unobstructed horizontal distance of 3 inches from the end of the discharge chute to the blade tip circle. A rigid bar fastened across the discharge opening, secured to prevent removal without the use of tools. The bottom of the bar shall be no higher than the bottom edge of the blade enclosure. The highest point on the front of the blade enclosure, except discharge openings, shall be such that any line extending a maximum of 15° downward from the horizontal toward the blade shaft axis (axes) shall not intersect the horizontal plane within the blade tip circle. The highest point on the blade enclosure front, except discharge-openings, shall not exceed 1 and 1/4 inches above the lowest cutting point of the blade in the lowest blade position. Mowers with a swing over handle are to be considered as having no front in the blade enclosure. The mower handle shall be fastened to the mower so as to prevent loss of control by unintentional uncoupling while in operation. A positive up stop or latch shall be provided for the mower handle in the normal operating position. The up stop shall not be subject to unintentional disengagement during normal operation of the mower. The up stop or latch shall not allow the center or the handle grips to come closer than 17 inches horizontally behind the closest path of the mower blade unless manually disengaged. A swing-over handle, which complies with the above requirements, will be permitted. Wheel drive disengaging controls, except dead man controls, shall move opposite to the direction of the vehicle motion in order to disengage the drive. Dead man controls may operate in any direction to disengage the drive.

Riding Rotary Mowers

The highest point of all openings in the blade enclosure, front shall be limited by a vertical angle of opening of 15° and a maximum distance of 1 1/4 inches above the lowest cutting point of the blade in the lowest blade position. Opening shall be placed so that grass or debris will not discharge directly toward any part of an operator seated in a normal operator position. There shall be one of the following at all openings in the blade enclosure intended for the discharge of grass: A minimum unobstructed horizontal distance of 6 inches from the end of the discharge chute to the blade tip circle. A rigid bar fastened across the discharge opening, secured to prevent removal without the use of tools. The bottom of

the bar shall be no higher than the bottom edge of the blade enclosure. Mowers shall be provided with stops to prevent jackknifing or locking of the steering mechanism. Vehicle stopping means shall be provided. Hand-operated wheel drive disengaging controls shall move opposite to the direction of vehicle motion in order to disengage the drive. Foot-operated wheel drive disengaging controls shall be depressed to disengage the drive. Dead man controls, both hand and foot operated, may operate in any direction to disengage the drive.

Potable Water

Potable water shall be provided in all places of employment, for drinking, washing of the person, cooking, washing of foods, washing of cooking or eating utensils, washing of food preparation or processing premises, and personal service rooms. Portable drinking water dispensers shall be designed, constructed, and serviced so that sanitary conditions are maintained, shall be capable of being closed, and shall be equipped with a tap. Open containers such as barrels, pails, or tanks for drinking water from which the water must be dipped or poured, whether or not they are fitted with a cover, are prohibited. A common drinking cup and other common utensils are prohibited.

Non-Potable Water

Outlets for non potable water, such as water for industrial or fire fighting purposes shall be posted or otherwise marked in a manner that will indicate clearly that the water is unsafe and is not to be used for drinking, washing of the person, cooking, washing of food, washing of cooking or eating utensils, washing of food preparation or processing premises, or personal service rooms, or for washing clothes. Construction of non potable water systems or systems carrying any other non potable substance shall be such as to prevent back flow or back siphonage into a potable water system. Non potable water shall not be used for washing any portion of the person, cooking or eating utensils, or clothing. Non potable water may be used for cleaning work premises, other than food processing and preparation premises and personal service rooms: Provided, That this non potable water does not contain concentrations of chemicals, fecal coliform, or other substances which could create unsanitary conditions or be harmful to employees.

Toilet Facilities

Except as otherwise indicated in this section, toilet facilities, in toilet rooms separate for each sex, are provided in all places of employment. The number of facilities to be provided for each sex shall be based on the number of employees of that sex for whom the facilities are furnished. Where toilet rooms will be occupied by no more than one person at a time, can be locked from the inside, and contain at least one water closet, separate toilet rooms for each sex need not be provided. Where toilet facilities will not be used by women, urinals may be provided instead of water closets. This requirement does not apply to mobile crews or to normally unattended work locations so long as employees working at these locations have transportation immediately available to nearby toilet facilities which meet the other requirements of this section. The sewage disposal method shall not endanger the health of employees. Toilet paper with holder shall be provided for every water closet. The requirements of this subsection do not apply to mobile crews or to normally unattended work locations.

Showers

Showers are mandatory on exit from the job site when residual chemicals allowed to remain on the skin between work shifts could cause a serious occupational illness. The employer is responsible for identifying such potential hazards and for insisting that the employee shower at the end of the shift. Whenever showers are required the showers shall be provided, as follows: One shower shall be provided

for each 10 employees of each sex, or numerical fraction thereof, who are required to shower during the same shift. Body soap or other appropriate cleansing agents convenient to the showers shall be provided as specified in this section. Showers shall be provided with hot and cold water feeding a common discharge line. Employees who use showers shall be provided with individual clean towels. Change rooms equipped with storage facilities for street clothes and separate storage facilities for the protective clothing shall be provided, if employees are subject to contamination with toxic materials.

Food & Beverages on Premises

This section shall apply only where employees are permitted to consume food or beverages, or both, on the premises. Eating and drinking areas. No employee shall be allowed to consume food or beverages in a toilet room nor in any area exposed to a toxic material. Waste disposal containers. Receptacles, constructed of smooth, corrosion resistant, easily cleanable, or disposable materials, shall be provided and used for the disposal of waste food. The number, size, and location of such receptacles shall encourage their use and not result in overfilling. They shall be emptied not less frequently than once each working day, unless unused, and shall be maintained in a clean and sanitary condition. Receptacles shall be provided with a solid tight-fitting cover unless sanitary conditions can be maintained without use of a cover.

Sanitary storage

No food or beverages shall be stored in toilet rooms or in an area exposed to a toxic material.

Food handling

All employee food service facilities and operations shall be carried out in accordance with sound hygienic principles. In all places of employment where all or part of the food service is provided, the food dispensed shall be wholesome, free from spoilage, and shall be processed, prepared, handled, and stored in such a manner as to be protected against contamination.

Temporary Labor Camps

All sites used for camps shall be adequately drained. They shall not be subject to periodic flooding, nor located within 200 feet of swamps, pools, sink holes, or other surface collections of water unless such quiescent water surfaces can be subjected to mosquito control measures. The camp shall be located so the drainage from and through the camp will not endanger any domestic or public water supply. All sites shall be graded, ditched, and rendered free from depressions in which water may become a nuisance. All sites shall be adequate in size to prevent overcrowding of necessary structures. The principal camp area in which food is prepared and served and where sleeping quarters are located shall be at least 500 feet from any area in which livestock is kept. The grounds and open areas surrounding the shelters shall be maintained in a clean and sanitary condition free from rubbish, debris, waste paper, garbage, or other refuse.

Whenever the camp is closed for the season or permanently, all garbage, manure, and other refuse shall be collected and so disposed of as to prevent nuisance. All abandoned privy pits shall be filled with earth and the grounds and buildings left in a clean and sanitary condition. If privy buildings remain, they shall be locked or otherwise secured to prevent entrance. The camp shall be constructed in a manner which will provide protection against the elements. Each room used for sleeping purposes shall contain at least 50 square feet of floor space for each occupant. At least a 7-foot ceiling shall be provided. Beds, cots, or bunks, and suitable storage facilities such as wall lockers for clothing and personal articles shall be provided in every room used for sleeping purposes. Such beds or similar facilities shall be spaced not closer than 36 inches both laterally and end to end, and shall be elevated at least 12 inches from the floor. If double-deck bunks are used, they shall be spaced not less than 48 inches both laterally and end to end.

The minimum clear space between the lower and upper bunk shall be not less than 27 inches. Triple-deck bunks are prohibited.

The floors of each shelter shall be constructed of wood, asphalt, or concrete. Wooden floors shall be of smooth and tight construction. The floors shall be kept in good repair. All wooden floors shall be elevated not less than 1 foot above the ground level at all points to permit free circulation of air beneath. Nothing in this section shall be construed to prohibit "banking" with earth or other suitable material around the outside walls in areas subject to extreme low temperatures. All living quarters shall be provided with windows the total of which shall be not less than one-tenth of the floor area. At least one-half of each window shall be so constructed that it can be opened for purposes of ventilation.

All exterior openings shall be effectively screened with 16-mesh material. All screen doors shall be equipped with self-closing devices. Each dwelling unit shall have at least 70 square feet of floor space for the first occupant and at least 50 square feet of floor space for each additional occupant. A separate sleeping area shall be provided for the husband and wife in all family units in which one or more children over six years of age are housed. In camps where cooking facilities are used in common, stoves (in ratio of one stove to 10 persons or one stove to two families) shall be provided in an enclosed and screened shelter. Sanitary facilities shall be provided for storing and preparing food. If a camp is used during cold weather, adequate heating equipment shall be provided. All heating, cooking, and water heating equipment shall be installed in accordance with state and local ordinances, codes, and regulations governing such installation.

Blasting Operations

Application

This standard applies to all operations where an abrasive is forcibly applied to a surface by pneumatic or hydraulic pressure or by centrifugal force. It does not apply to steam blasting, or steam cleaning, or hydraulic cleaning methods where this work is done without the aid of abrasives.

Selection of Abrasives & Equipment

Each type of abrasive and each type of equipment has its particular advantages in producing the quality of work desired, and the selection will depend on the specific requirements of the user. Therefore, no rule or suggestion can be given in this standard for the selection of a particular abrasive or of particular equipment. With properly designed equipment and proper operation and maintenance all types of abrasives and equipment can be used safely. However, abrasives which create the minimum hazard should be used wherever feasible.

Abrasive Blasting Operations

Abrasive.

A solid substance used in an abrasive blasting operation.

Abrasive blasting.

The forcible application of an abrasive to a surface by pneumatic pressure, hydraulic pressure, or centrifugal force.

Abrasive-blasting respirator.

A continuous flow airline respirator constructed so that it will cover the wearer's head, neck, and shoulders to protect him from rebounding abrasive.

Air-line respirator.

A device consisting of a face-piece, helmet, or hood to which clean air is supplied to the wearer through a small-diameter hose from a source not on the wearer's body.

Blast cleaning barrel.

A complete enclosure which rotates on an axis, or which has an internal moving tread to tumble the parts, in order to expose various surfaces of the parts to the action of an automatic blast spray.

Blast cleaning room.

A complete enclosure in which blasting operations are performed and where the operator works inside of the room to operate the blasting nozzle and direct the flow of the abrasive material. Blasting cabinet.

An enclosure where the operator stands outside and operates the blasting nozzle through an opening or openings in the enclosure.

Clean air.

Air of such purity that it will not cause harm or discomfort to an individual if it is inhaled for extended

periods of time.

Dust collector.

A device or combination of devices for separating dust from the air handled by an exhaust ventilation system.

Exhaust ventilation system.

A system for removing contaminated air from a space, comprising two or more of the elements; enclosure or hood, duct work, dust collecting equipment, exhaust, and discharge stack. Dust hazards from abrasive blasting: Dust sources. Abrasives and the surface coatings on the materials blasted are shattered and pulverized during blasting operations and the dust formed will contain particles of respirable size. The composition and toxicity of the dust from these sources shall be considered in making an evaluation of the potential health hazards. Types of abrasives. A large variety of solid materials may be used as abrasives, with qualities varying from hard deep-cutting to soft polishing. These include; mineral grains, either synthetic or natural, metallic shot or grit, generally of steel or chilled cast iron, and organic abrasives, such as ground corncobs or walnut shells. Silica sand is the most hazardous mineral abrasive commonly used and its use should be limited wherever possible. The potential hazard from steel or iron dust is considered to be minimal. Readily combustible organic abrasives may be pulverized fine enough to be capable of forming explosive mixtures with air.

Types of coatings.

A surface coating formed during the fabrication of a part, or a protective coating applied after fabrication, will be removed and dispersed as a dust by abrasive blasting. The type of coating should be known to make a proper evaluation of the potential hazard. Silica sand is frequently embedded in the surface of castings and may be pulverized by blast cleaning. Coatings containing toxic metals will add to the potential seriousness of the dust exposures. Examples of such coatings are anti-fouling paints containing mercury, lead paints on structural steel, cadmium plating, and lead deposits on pistons of internal combustion engines. Plastic or resin coatings may be decomposed by the action of the abrasives to form irritating by-products.

Wet abrasive blasting.

Wet methods will tend to keep dust exposures minimal, but droplets dispersed and dried residues which become airborne may create potential exposures.

Concentrations of contaminants.

The concentration of respirable dust or fumes in the breathing zone of the abrasive-blasting operator or any other worker shall be kept below the recommended levels.

Use of combustible abrasives.

Organic abrasives which are combustible shall be used only in automatic systems because the fine dust produced presents a potential fire and explosion hazard. Where flammable or explosive dust mixtures may be present, the construction of the equipment, including the exhaust system and all electric wiring shall conform to the requirements of American National Standard Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying, Z 33.1- 1961 (NFPA 91-1961; NBFU 91-1961), and chapter 296-24 Part L. The blast nozzle shall be bonded and grounded to prevent the buildup of static charges. Where flammable or explosive dust mixtures may be present, the abrasive blasting enclosure, the ducts, and the dust collector shall be constructed with loose panels or explosion venting areas, located on sides away from any occupied area, to provide for pressure relief in case of explosion, following the principles set forth in the National Fire Protection Association Explosion Venting Guide, NFPA 68-1954.

Possession & Handling of Explosives

Basic Legal Obligations

It is unlawful for any person to manufacture, purchase, sell, use, or store any explosive without having a validly issued license. Upon notice, any law enforcement agency having jurisdiction, a person manufacturing, purchasing, selling, using, or storing any explosives without a license shall immediately surrender any and all such explosives to the respective law enforcement agency.

Portable Storage Facilities

A Class 2 storage facility shall be a box, a trailer, a semi-trailer or other mobile facility. It shall be bullet-resistant, fire-resistant, weather-resistant, theft-resistant, and well ventilated. Portable magazines shall be at least one cubic yard in size. They are to be supported to prevent direct contact with the ground. The ground around magazines shall slope away for drainage or other adequate drainage provided. When unattended, vehicular magazines shall have wheels removed or otherwise effectively immobilized by kingpin locking devices or other methods approved by the department. The exterior and doors shall be constructed of not less than 1/4-inch steel and lined with at least two inches of hardwood.

Magazines with top openings shall have lids with water-resistant seals or shall overlap the sides by at least one inch when in a closed position. Hinges and hasps shall be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps shall be installed so that they cannot be removed when the doors are closed and locked. Each door shall be equipped with two mortise locks; or with two padlocks fastened in separate hasps and staples; or with a combination of mortise lock and a padlock, or with a mortise lock that requires two keys to open; or a three-point lock. Padlocks shall have at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter. Padlocks shall be protected with not less than 1/4-inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples.

These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside. Except at doorways, a 2-inch air space shall be left around ceilings and the perimeter of floors. Foundation ventilators shall be not less than 4 by 6 inches. Vents in the foundation, roof, or gables shall be screened and offset. No sparking metal construction shall be exposed below the top of walls in the interior of storage facilities and all nails therein shall be blind-nailed, countersunk, or non sparking.

Construction of detonator (blasting cap) indoor storage facilities. Class 3 storage facility for detonators (blasting caps) in quantities of 1,000 or less shall be fire-resistant and theft-resistant. They need not be bullet-resistant and weather-resistant if the locked uninhabited building in which they are stored provide protection from the weather and from bullet penetration. Sides, bottoms and covers shall be constructed of not less than number 12-gauge metal and lined with a non sparking material. Hinges and hasps shall be attached so they cannot be removed from the outside. One steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter is sufficient for locking purposes.

Blasting Agent Storage

A Class 4 storage facility may be a building, an igloo, or army-type structure, a tunnel, a dugout, a box, a trailer, or a semi-trailer or other mobile facility. They shall be fire-resistant, weather-resistant and theft-

resistant. The ground around such storage facilities shall slope away for drainage. When unattended, vehicular storage facilities shall have wheels removed or otherwise effectively immobilized by kingpin locking devices or other methods approved by the department. As a result of tests with electric blasting caps, it has been determined that these blasting caps are not subject to sympathetic detonation. Therefore, a Class 4 storage facility meets the necessary requirements for storage of electric blasting caps. These magazines shall be constructed of masonry, metal-covered wood, fabricated metal, or a combination of these materials.

Foundations are to be constructed of brick, concrete, cement block, stone, or metal or wood posts. If piers or posts are used, in lieu of a continuous foundation, the space under the building shall be enclosed with fire-resistant material. The walls and floors are to be constructed of, or covered with, a non sparking material or lattice work. The doors shall be metal or solid wood covered with metal. Hinges and hasps shall be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps shall be installed so that they cannot be removed when the doors are closed and locked. Each door shall be equipped with two mortise locks; or with two padlocks fastened in separate hasps and staples; or with a combination of mortise lock and a padlock, or with a mortise lock that requires two keys to open; or a three-point lock.

Padlocks shall have at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter. Padlocks shall be protected with not less than 1/4-inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps and staples. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

A Class 5 storage facility may be a building, igloo or army-type structure, tunnel, dugout, bin, box, trailer, or a semi-trailer or other mobile facility. They shall be weather-resistant and theft-resistant. The ground around such storage facilities shall slope away for drainage. When unattended, vehicular storage facilities shall have wheels removed or otherwise effectively immobilized by kingpin locking devices or other methods approved by the department. The doors shall be constructed of solid wood or metal. Hinges and hasps shall be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps shall be installed so that they cannot be removed when the doors are closed and locked.

Each door shall be equipped with two mortise locks; or with two padlocks fastened in separate hasps and staples; or with a combination of mortise lock and a padlock, or with a mortise lock that requires two keys to open; or a three-point lock. Padlocks shall have at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter. Padlocks shall be protected with not less than 1/4-inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. Trailers, semi-trailers, and similar vehicular magazines may, for each door, be locked with one steel padlock (which need not be protected by a steel hood) having at least 3/8-inch diameter, if the door hinges and lock hasp are securely fastened to the magazine and to the door frame. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

Explosives Day Box Storage

A temporary storage facility shall be a day box. It must be fire-resistant, weather-resistant and theft-resistant. The ground around such storage facilities shall slope away for drainage. A day box shall be constructed of not less than number 12-gauge (.1046 inches) steel, lined with at least either 1/2-inch plywood or 1/2-inch Masonite-type hardboard. Doors shall overlap sides by at least one inch. Hinges and hasps are to be attached by welding, riveting or bolting (nuts on inside). One steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter is sufficient for locking purposes. No explosive materials shall be left in a day box if unattended. The explosive materials contained therein shall be removed to licensed storage facilities for unattended storage.

Detonators Day Box Storage

Temporary storage facilities for blasting caps in quantities of 100 or less shall be constructed as follows. Sides, bottoms and covers shall be constructed of number 12-gauge metal and lined with a non sparking material. Hinges and hasps shall be attached thereto by welding. A single five-tumbler proof lock shall be sufficient for locking purposes. No explosive materials shall be left in such facilities if unattended. The explosive materials contained therein shall be removed to licensed storage facilities for unattended storage.

Magazine Heating Systems

Magazines requiring heat shall be heated by either hot water radiant heating within the magazine building; or air directed into the magazine building over either hot water or low pressure steam (15 psig) coils located outside the magazine building. The magazine heating systems shall meet the following requirements: the radiant heating coils within the building shall be installed in such a manner that the explosive materials or their containers cannot contact the coils and air is free to circulate between the coils and the explosive materials or their containers; and the heating ducts shall be installed in such a manner that the hot air discharge from the duct is not directed against the explosive materials or their containers. The heating device used in connection with a magazine shall have controls which prevent the ambient building temperature from exceeding 130 degrees F. The electric fan or pump used in the heating system for a magazine shall be mounted outside and separate from the wall of the magazine and shall be grounded. The electric fan motor and the controls for electrical heating devices used in heating water or steam shall have overloads and disconnects, which comply with the National Electrical Code, (National Fire Protection Association, NFPA No. 70-1984).

All electrical switch gear shall be located a minimum distance of 25 feet from the magazine. The heating source for water or steam shall be separated from the magazine by a distance of not less than 25 feet when electrical and 50 feet when fuel-fired. The area between the heating unit and the magazine shall be cleared of all combustible materials. The storage of explosive materials and their containers in the magazine shall allow uniform air circulation so temperature uniformity can be maintained throughout the explosive materials.

Lighting

Battery-activated safety lights or battery-activated safety lanterns may be used in explosives storage magazines. Electric lighting used in any explosives storage magazine shall meet the standards prescribed by the "National Electrical Code," (National Fire Protection Association, NFPA 70-84), for the conditions present in the magazine at any time. All electrical switches shall be located outside of the magazine and also meet the standards prescribed by the National Electrical Code.

Explosives Storage

The storage of caps with other explosives is prohibited. No blasting caps, or other detonating or fulminating caps, or detonators, or flame-producing devices shall be kept or stored in any magazine in which other explosives are kept or stored. All Class A, Class B, Class C explosives, and special industrial explosives, and any newly developed and unclassified explosives, shall be kept in proper magazines unless they are in the process of manufacture, being physically handled in the operating process, being used or being transported to a place of storage or use. No explosives and no detonators (blasting caps) in quantities of 1,001 or more shall be stored in any building or structure except a Class 1, permanent, magazine that has been approved and licensed. There shall be separate storage of components capable of detonation when mixed. Any two components which, when mixed, become capable of detonation by a number 6 cap must be stored in separate locked containers or in a licensed, approved magazine. Blasting

operations or storage of electrical detonators shall be prohibited in vicinity of operating radio frequency transmitter stations except where the clearances can be observed. Blasting caps, electric blasting caps, detonating primers and primed cartridges shall not be stored in the same magazine with other explosives.

Quantity Restrictions

Explosive materials in excess of 300,000 pounds or blasting caps in excess of 20,000,000 shall not be stored in one storage magazine. Magazines shall be in the charge of a competent person at all times who shall be at least twenty-one years of age, and who shall be held responsible for the enforcement of all safety precautions. All explosives shall be accounted for at all times. Explosives not being used shall be kept in a locked magazine, unavailable to persons not authorized to handle them. The employer shall maintain an inventory and use record of all explosives. Appropriate authorities shall be notified of any loss, theft, or unauthorized entry into a magazine. Firearms (except firearms carried by guards) shall not be permitted inside of or within 50 feet of magazines.

The land surrounding a magazine shall be kept clear of all combustible materials, brush, dried grass, leaves and other materials for a distance of at least 25 feet. Combustible materials shall not be stored within 50 feet of magazines. Smoking, matches, open flames, and spark-producing devices are not permitted in any magazine or within 50 feet of any outdoor magazine; or within any room containing an indoor magazine. The premises on which a magazine is located shall be conspicuously marked with signs containing the words "EXPLOSIVES KEEP OFF" in letters at least three inches high. Such signs shall warn any person approaching the magazine of the presence of explosives, but shall be so located that a bullet passing directly through the face of the sign will not strike the magazine.

Temporary storage at a site for blasting operations shall be located away from neighboring inhabited buildings, railways, highways, and other magazines. A distance of at least one hundred and fifty feet shall be maintained between magazines and the work in progress when the quantity of explosives kept therein is in excess of 25 pounds, and at least 50 feet when the quantity of explosives is 25 pounds or less.

Explosives recovered from blasting misfires shall be placed in a separate magazine until competent personnel has determined from the manufacturer the method of disposal. Caps recovered from blasting misfires shall not be reused. Such explosives and caps shall then be disposed of in the manner recommended by the manufacturer.

Storage Within Magazines

Packages of explosives shall be laid flat with top side up. Black powder when stored in magazines with other explosives shall be stored separately. Black powder stored in kegs shall be stored on ends, bungs down, or on side, seams down. Corresponding grades and brands shall be stored together in such a manner that brands and grade marks show. All stocks shall be stored so as to be easily counted and checked. Packages of explosives shall be piled in a stable manner. When any kind of explosive is removed from a magazine for use, the oldest explosive of that particular kind shall always be taken first. Packages of explosives shall not be unpacked or repacked in a magazine nor within 50 feet of a magazine or in close proximity to other explosives. Tools used for opening packages of explosives shall be constructed of non sparking materials, except that non sparking metallic slitters may be used for opening fiberboard boxes. A wood wedge and a fiber, rubber, or wood mallet shall be used for opening or closing wood packages of explosives. Opened packages of explosives shall be securely closed before being returned to a magazine. Magazines shall not be used for the storage of any metal tools nor any commodity except explosives, but this restriction shall not apply to the storage of blasting agents and blasting supplies. Magazine floors shall be regularly swept, kept clean, dry, free of grit, paper, empty used packages, and rubbish. Brooms and other cleaning utensils shall not have any spark-producing metal parts. Sweepings from floors of magazines shall be properly disposed of. Magazine floors stained with nitroglycerin shall be cleaned according to instructions by the manufacturer. When any explosive has

deteriorated to an extent that it is in an unstable or dangerous condition, or if nitroglycerin leaks from any explosives, then the person in possession of such explosive shall immediately proceed to destroy such explosive in accordance with the instructions of the manufacturer. Only experienced persons shall be allowed to do the work of destroying explosives. When magazines need inside repairs, all explosives shall be removed therefrom and the floors cleaned. In making outside repairs, if there is a possibility of causing sparks or fire the explosives shall be removed from the magazine. Explosives removed from a magazine under repair shall either be placed in another magazine or placed a safe distance from the magazine where they shall be properly guarded and protected until repairs have been completed, when they shall be returned to the magazine.

Underground Storage

Explosives and related materials shall be stored in approved facilities. No explosives or blasting agents shall be permanently stored in any underground operation until the operation has been developed to the point where at least two modes of exit have been developed. Permanent underground storage magazines shall be at least 300 feet from any shaft, adit, or active underground working area. Permanent underground magazines containing detonators shall not be located closer than 50 feet to any magazine containing other explosives or blasting agents. Upon the approach of an electrical storm, unless a greater hazard would be created thereby, explosives at the adit or the top of any shaft leading to where persons are working shall be moved away from such location a distance equal to that required for inhabited buildings, as listed in the American table of distances for storage of explosive materials. All explosive manufacturing buildings and magazines in which explosives or blasting agents, except small arms ammunition and smokeless powder are had, kept, or stored, must be located at distances from inhabited buildings, railroads, highways, and public utility transmission systems in conformity with the following quantity and distance tables, and these tables shall be the basis on which applications for license for storage shall be made and license for storage issued. Blasting and electric blasting caps in strength through number 8 should be rated as one and one-half pounds of explosives per one thousand caps. Blasting and electric blasting caps of strength higher than number 8 should be computed on the combined weight of explosives.

Multiple Magazines

When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways, and highways, and in addition, they should be separated from each other by not less than the distances shown for "separation of magazines", except that the quantity of explosives contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosives. If any two or more magazines are separated from each other by less than the specified "separation of magazines" distances, then such two or more magazines, as a group, must be considered as one magazine, and the total quantity of explosives stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group, and must comply with the minimum of distances specified from other magazines, inhabited buildings, railways and highways.

Ammonium Nitrate Storage

This subsection applies to the storage of ammonium nitrate in the form of crystals, flakes, grains, or prills including fertilizer grade, dynamite grade, nitrous oxide grade, technical grade, and other mixtures containing 60 percent or more ammonium nitrate by weight but does not apply to blasting agents. This section does not apply to the transportation of ammonium nitrate. This section does not apply to storage under the jurisdiction of and in compliance with the regulations of the United States Coast Guard (see 46 CFR Parts 146-149). The storage of ammonium nitrate and ammonium nitrate mixtures that are more

sensitive than allowed by the "definition of test procedures for ammonium nitrate fertilizer" is prohibited.

Bulk Ammonium Nitrate Storage

Warehouses shall have adequate ventilation or be capable of adequate ventilation in case of fire. Unless constructed of non-combustible material or unless adequate facilities for fighting a roof fire are available, bulk storage structures shall not exceed a height of 40 feet. Bins shall be clean and free of materials which may contaminate ammonium nitrate. Due to the corrosive and reactive properties of ammonium nitrate, and to avoid contamination, galvanized iron, copper, lead, and zinc shall not be used in a bin construction unless suitably protected. Aluminum bins and wooden bins protected against impregnation by ammonium nitrate are permissible. The partitions dividing the ammonium nitrate storage from other products which would contaminate the ammonium nitrate shall be of tight construction. The ammonium nitrate storage bins or piles shall be clearly identified by signs reading "ammonium nitrate" with letters at least 2 inches high. Piles or bins shall be so sized and arranged that all material in the pile is moved out periodically in order to minimize possible caking of the stored ammonium nitrate. Height or depth of piles shall be limited by the pressure-setting tendency of the product. However, in no case shall the ammonium nitrate be piled higher at any point than 36 inches below the roof or supporting and spreader beams overhead. Ammonium nitrate shall not be accepted for storage when the temperature of the product exceeds 130°F. Dynamite, other explosives, and blasting agents shall not be used to break up or loosen caked ammonium nitrate.

Contaminants

Ammonium nitrate shall be in a separate building or shall be separated by approved type firewalls of not less than 1 hour fire-resistance rating from storage or organic chemicals, acids, or other corrosive materials, materials that may require blasting during processing or handling, compressed flammable gases, flammable and combustible materials or other contaminating substances, including but not limited to animal fats, baled cotton, baled rags, baled scrap paper, bleaching powder, burlap or cotton bags, caustic soda, coal, coke, charcoal, cork, camphor, excelsior, fibers of any kind, fish oils, fish meal, foam rubber, hay, lubricating oil, linseed oil, or other oxidizable or drying oils, naphthalene, oakum, oiled clothing, oiled paper, oiled textiles, paint, straw, sawdust, wood shavings, or vegetable oils. Walls referred to in this subsection need extend only to the underside of the roof. In lieu of separation walls, ammonium nitrate may be separated from the materials referred to above by a space of at least 30 feet. Flammable liquids such as gasoline, kerosene, solvents, and light fuel oils shall not be stored on the premises. LP-Gas shall not be stored on the premises. Sulfur and finely divided metals shall not be stored in the same building with ammonium nitrate. Explosives and blasting agents shall not be stored in the same building with ammonium nitrate except on the premises of makers, distributors, and user-compounders of explosives or blasting agents. Where explosives or blasting agents are stored in separate buildings, other than on the premises of makers, distributors, and user-compounders of explosives or blasting agents, they shall be separated from the ammonium nitrate.

Explosives Transportation

The transportation of explosives by vehicle on public highways shall be administered by the United States Department of Transportation, CFR 49-1978, Parts 100 through 199, and any state regulations. The following sections cover the transportation of explosives on the job site. No employee shall be allowed to smoke, carry matches or any other flame-producing device, or carry any firearms or loaded cartridges while in or near a motor vehicle transporting explosives; or drive, load, or unload such vehicle in a careless or reckless manner. Explosives shall not be carried on any vehicle while vehicle is being used to transport workers other than driver and two persons. Explosives shall be transferred from the disabled vehicle to another, only when proper and qualified supervision is provided. Other materials or supplies

shall not be placed on or in the cargo space of a conveyance containing explosives, detonation cord or detonators, except carrying safety fuse, and properly secured, non-sparking equipment used expressly in the handling of such explosives will be permissible.

Vehicles used for transporting explosives shall be strong enough to carry the load without difficulty and be in good mechanical condition. If vehicles do not have a closed body, the body shall be covered with a flameproof and moisture-proof tarpaulin or other effective protection against moisture and sparks. All vehicles used for the transportation of explosives shall have tight floors and any exposed spark-producing metal on the inside of the body shall be covered with wood or other non sparking materials to prevent contact with packages of explosives. Packages of explosives shall not be loaded above the sides of an open-body vehicle. Vehicles shall be placarded and displayed as specified by the United States Department of Transportation, CFR 49-1981, Parts 100 through 199. Each motor vehicle used for transporting explosives shall be equipped with a minimum of two extinguishers, each having a rating of at least 10-BC. Only extinguishers listed or approved by a nationally recognized testing laboratory shall be deemed suitable for use on explosives-carrying vehicles. Extinguishers shall be filled and ready for immediate use and readily available. Extinguishers shall be examined periodically by a competent person. A motor vehicle used for transporting explosives shall be inspected to determine that it is in proper condition for safe transportation of explosives.

Use of Explosives

While explosives are being handled or used, smoking, matches, or any other source of fire or flame shall not be allowed within 100 feet of the blast site. No person shall be allowed to handle explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs. This rule does not apply to persons taking prescription drugs and/or narcotics as directed by a physician providing such use shall not endanger the worker or others. Original containers or day box magazines shall be used for taking detonators and other explosives from storage magazines to the blast site. When blasting is done in congested areas or in close proximity to a structure, railway, or highway or any other installation that may be damaged, the blast shall be covered before firing with a mat or material that is capable of preventing fragments from being thrown.

Persons authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution, including but not limited to warning signals, flags and barricades or woven wire mats to insure the safety of the general public and workers. Blasting operations shall be conducted during daylight hours whenever possible. Whenever blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, telegraph, and steam utilities, the user (blaster) shall notify the appropriate representatives of such utilities at least twenty-four hours in advance of blasting, specifying the location and intended time of such blasting. Verbal notice shall be confirmed with written notice. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity. These precautions shall include the suspension of all blasting operations and removal of persons from the blast site during the approach and progress of an electric storm and the posting of signs, warning against the use of mobile radio transmitters, on all roads shall be in accordance with the applicable provisions of the American National Standards Institute D6.1-1971, Manual on Uniform Traffic Control Devices for Streets and Highways, as amended by Washington State Department of Highways Manual M24-01, (February 22, 1972). Ensuring that mobile radio transmitters which are less than 100 feet away from electric blasting caps, when the caps are in other than original containers, shall be de-energized and effectively locked. Compliance with the recommendations of The Institute of the Makers of Explosives (IME) with regard to blasting in the vicinity of radio transmitters as stipulated in Radio Frequency Energy--A Potential Hazard in the Use of Electric Blasting Caps, IME Publication No. 20, September 1971. When electric blasting caps are being used in blasting operations in the proximity of fixed radio transmitters, the following table of distances must be observed, unless it is determined by designated test

procedures that there is not sufficient radio frequency energy present to create a hazard. The test procedure shall be to attach a No. 47 radio pilot lamp in place of the cap in the blasting circuit progressively as the circuit is connected, starting with the initial hole. In the event the lamp glows, the length of the wires connecting the circuit shall be altered by adding or cutting off wire until the lamp does not glow. A radio frequency field strength meter may be used in lieu of the test lamp.

Blasting operations or storage of electrical detonators shall be prohibited in vicinity of operating radio frequency transmitter stations except where the clearances given below can be observed.

Transmitter Power Minimum Except FM Mobile (Watts)	Distance (Feet)
5 - 25	100
25 - 50	150
50 - 100	220
100 - 250	350
250 - 500	450
500 - 1,000	650
1,000 - 2,500	1,000
2,500 - 5,000	1,500
5,000 - 10,000	2,200
10,000 - 25,000	3,500
25,000 - 50,000	5,000
50,000 - 100,000	7000

Transmitter Power Minimum FM Mobile (Watts)	Distance (Feet)
1 - 10	5
10 - 30	10
30 - 60	15
60 - 250	30 .f

No fire shall be fought where the fire is in imminent danger of contact with explosives. All employees shall be removed to a safe area and the fire area guarded against intruders. Electric detonators shall be shunted until wired into the blasting circuit. Explosives shall not be handled near open flames, uncontrolled sparks or open electric circuits. Delivery and issue of explosives shall only be made by and to authorized persons and into authorized magazines or approved temporary storage or handling area. All loading and firing shall be directed and supervised by licensed persons thoroughly experienced in this field.

Storage at Use Sites

Empty boxes and paper and fiber packing materials which have previously contained high explosives shall not be used again for any purpose, but shall be destroyed by burning at an approved isolated location

out of doors, and no person shall be nearer than 100 feet after the burning has started. When opening kegs or wooden cases, no sparking metal tools shall be used; wooden wedges and either wood, fiber or rubber mallets shall be used. Non sparking metallic slitters may be used for opening fiberboard cases. Should cartridges or packages of explosives show signs of discoloration or deterioration, the manufacturer or the department shall be notified. Such explosives must be carefully set aside and properly disposed of.

Loading of explosives or blasting agents in blast holes.

Procedures that permit safe and efficient loading shall be established before loading is started. All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives. Tamping shall be done only with wood rods or with approved plastic tamping poles without exposed metal parts, but non sparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. The primer shall never be tamped. No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives and detonators shall be immediately returned to an authorized magazine. Drilling shall not be started until all remaining butts of old holes are examined for unexploded charges, and if any are found, they shall be refired before work proceeds. When a charge of explosives has been exploded in a bore hole to enlarge or “spring” it, an interval of at least two hours must be allowed to pass before an additional charge of explosives can be loaded into the hole. There may be an exception made to this rule provided the sprung hole is thoroughly wet down with water before it is loaded. No person shall be allowed to deepen drill holes which have contained explosives or blasting agents.

No explosives or blasting agents shall be left unattended unless stored in a licensed magazine. Users (blasters) shall not load, store or use explosives closer than the length of the steel being used for drilling and in no event nearer than fifty feet of drilling operations. Machines and all tools not used for loading explosives into bore holes shall be removed from the immediate location of holes being loaded with explosives. Equipment shall not be operated within 50 feet of loaded holes except when equipment is needed to add burden, mats or tracking of drills out of the loading area. Power lines and portable electric cables for equipment being used shall be kept a safe distance from explosives or blasting agents being loaded into drill holes. Cables in the proximity of the blast area shall be deenergized and locked out by the blaster. Holes shall not be drilled where there is danger of intersecting a charged or misfired hole. All blast holes in open work shall be stemmed to the collar or to a point which will confine the charge. No explosives for underground operations other than those in Fume Class 1, as set forth by the Institute of Makers of Explosives, shall be used; however, explosives complying with the requirements of Fume Class 2 and Fume Class 3 may be used if adequate ventilation has been provided. Warning signs, indicating a blast area, shall be maintained at all approaches to the blast area. The warning sign lettering shall not be less than 4 inches in height on a contrasting background. All loaded stumps must be marked for identification on logging sites. A bore hole shall never be sprung when it is adjacent to or near a hole which has been loaded. Flashlight batteries shall not be used for springing holes. No loaded holes shall be left unattended or unprotected. The user (blaster) shall keep an accurate record of explosives, blasting agents, and blasting supplies used in a blast and shall keep an accurate running inventory of all explosives and blasting agents stored on the operation. When loading blasting agents pneumatically over electric blasting caps, semi conductive delivery hose shall be used and the equipment shall be bonded and grounded.

Electric Blasting

Only electric blasting caps shall be used for blasting operations in congested districts, or on highways, or adjacent to highways open to traffic, except where sources of extraneous electricity make such use dangerous. Blasting cap leg wires shall be kept short-circuited (shunted) until they are connected into the circuit for firing. Before adopting any system of electrical firing, the user (blaster) shall conduct a thorough survey for extraneous currents, and all dangerous currents shall be eliminated before any holes

are loaded. In any single blast using electric blasting caps, all caps shall be of the same style or function and be of the same manufacture. Electric blasting shall be carried out by using blasting circuits or power circuits in accordance with the electric blasting cap manufacturer's recommendations. The firing line shall be checked with an approved testing device at the terminals before being connected to the blasting machine or other power source. The circuit including all caps shall be tested with an approved testing device before being connected to the firing line.

When firing a circuit of electric blasting caps, care shall be exercised to ensure that an adequate quantity of delivered current is available, in accordance with the manufacturer's recommendations. Connecting wires and lead wires shall be insulated single solid wires of sufficient current-carrying capacity, and shall not be less than twenty gauge (American wire gauge) solid core insulated wire. Firing line or leading wires shall be solid single wires of sufficient current-carrying capacity, and shall be not less than fourteen gauge (American wire gauge) solid core insulated wire. Bus wires - depends on the size of the blast, fourteen gauge (American wire gauge) copper is recommended. The ends of lead wires which are to be connected to a firing device shall be shorted by twisting them together or otherwise connecting them before they are connected to the leg wires or connecting wires, and they shall be kept in the possession of the person who is doing the loading until loading is completed and the leg wires attached. Lead wires shall not be attached to the firing device until the blaster is ready to fire the shot and must be attached by the user (blaster) themselves.

The ends of the leg wires on electric detonators shall be shorted in a similar manner and not separated until all holes are loaded and the loader is ready to connect the leg wires to the connecting wires or lead wires. When firing electrically, the insulation on all firing lines shall be adequate and in good condition. A power circuit used for firing electric blasting caps shall not be grounded. In underground operations when firing from a power circuit, a safety switch shall be placed at intervals in the permanent firing line. This switch shall be made so it can be locked only in the "off" position and shall be provided with a short-circuiting arrangement of the firing lines to the cap circuit. In underground operations there shall be a "lightning" gap of at least 5 feet in the firing system ahead of the main firing switch; that is, between this switch and the source of power. This gap shall be bridged by a flexible jumper cord just before firing the blast.

When firing from a power circuit, the firing switch shall be locked in the open or "off" position at all times, except when firing. It shall be so designed that the firing lines to the cap circuit are automatically short-circuited when the switch is in the "off" position. Keys to this switch shall be entrusted only to the user (blaster). Blasting machines shall be in good condition and the efficiency of the machine shall be tested periodically to make certain that it can deliver power at its rated capacity. When firing with blasting machines, the connections shall be made as recommended by the manufacturer of the electric blasting caps used. The number of electric blasting caps connected to a blasting machine shall not be in excess of its rated capacity. Furthermore, in primary blasting, a series circuit shall contain no more caps than the limits recommended by the manufacturer of the electric blasting caps in use. The user (blaster) shall be in charge of the blasting machines, and no other person shall connect the leading wires to the machine. Users (blasters), when testing circuits to charged holes, shall use only blasting testers especially designed for this purpose. Whenever the possibility exists that a leading line or blasting wire might be thrown over a live power line by the force of an explosion, care shall be taken to see that the total length of wires are kept too short to hit the lines, or that the wires are securely anchored to the ground. If neither of these requirements can be satisfied, a non-electric system shall be used. In electrical firing, only the person making leading wire connections shall fire the shot. All connections shall be made from the bore hole back to the source of firing current, and the leading wires shall remain shorted and not be connected to the blasting machine or other source of current until the charge is to be fired. After firing an electric blast from a blasting machine, the leading wires shall be immediately disconnected from the machine and short-circuited. When electric blasting caps have been used, workers shall not return to misfired holes for at least thirty minutes.

Use of Safety Fuse

A fuse that is deteriorated or damaged in any way shall not be used. The hanging of fuse on nails or other projections which will cause a sharp bend to be formed in the fuse is prohibited. Before capping safety fuse, a short length shall be cut from the end of the supply reel so as to assure a fresh cut end in each blasting cap. Only a cap crimper of approved design shall be used for attaching blasting caps to safety fuse. Crimpers shall be kept in good repair and accessible for use. No unused cap or short capped fuse shall be placed in any hole to be blasted; such unused detonators shall be removed from the working place and disposed of or stored in licensed magazine. No fuse shall be capped, or primers made up, in any magazine or near any possible source of ignition. Capping of fuse and making of primers shall only be done in a place selected for this purpose and at least one hundred feet distant from any storage magazine. Fuses must be cut long enough to reach beyond the collar of the bore hole and in no case less than three feet. When shooting choker holes, not less than three feet of fuse shall be used.

At least two persons shall be present when multiple cap and fuse blasting is done by hand lighting methods. Not more than 12 fuses shall be lighted by each blaster when hand lighting devices are used. However, when two or more safety fuses in a group are lighted as one by means of igniter cord, or other similar fuse-lighting devices, they may be considered as one fuse. The so-called "drop fuse" method of dropping or pushing a primer or any explosive with a lighted fuse attached is prohibited. Cap and fuse shall not be used for firing mud cap charges unless charges are separated sufficiently to prevent one charge from dislodging other shots in the blast. When blasting with safety fuses, consideration shall be given to the length and burning rate of the fuse. Sufficient time, with a margin of safety, shall always be provided for the blaster to reach a place of safety. The burning rate of the safety fuse in use at any time shall be measured, posted in conspicuous locations, and brought to the attention of all workers concerned with blasting. No fuse shall be used that burns faster than one foot in forty seconds or slower than one foot in fifty-five seconds. For use in wet places the joint between the cap and fuse shall be waterproofed with a compound prepared for this purpose. In making up primers only non sparking skewers shall be used for punching the hole in the cartridge to insert the capped fuse. No blasting cap shall be inserted in the explosives without first making a hole in the cartridge of proper size or using a standard cap crimper. Only sufficient primers for one day's use shall be made up at one time. They shall be stored in a box type magazine in which no other explosives are stored. Any loose cartridges of explosives, detonators, primers and capped fuse unused at the end of the shift shall be returned to their respective magazines and locked up.

Use of Detonating Cord

Care shall be taken to select a detonating cord consistent with the type and physical condition of the bore hole and stemming and the type of explosives used. Detonating cord shall be handled and used with the same respect and care given other explosives. For quantity and distance purposes detonating fuse up to 60 grains per foot should be calculated as equivalent to 9 lbs. of high explosives per 1,000 feet. Heavier cord loads should be rated proportionately. If using a detonating type cord for blasting the double-trunk- line or loop systems shall be used. Trunk lines in multiple-row blasts shall make one or more complete loops, with cross ties between loops at intervals of not over two hundred feet. All detonating cord knots shall be tight and all connections shall be kept at right angles to the trunk lines. The line of detonating cord extending out of a bore hole or from a charge shall be cut from the supply spool before loading the remainder of the bore hole or placing additional charges.

Detonating cord shall be handled and used with care to avoid damaging or severing the cord during and after loading and hooking-up. Detonating cord connections shall be competent and positive in accordance with approved and recommended methods. Knot-type or other cord connections shall be made only with detonating cord in which the explosive core is dry. All detonating cord trunk lines and branch lines shall be free of loops, sharp kinks, or angles that direct the cord back toward the oncoming line of detonation.

All detonating cord connections shall be inspected before firing the blast. When detonating cord millisecond-delay connectors or short- interval-delay electric blasting caps are used with detonating cord, the practice shall conform strictly to the manufacturer's recommendations. When connecting a blasting cap or an electric blasting cap to detonating cord, the cap shall be taped or otherwise attached securely along the side or the end of the detonating cord, with the end of the cap containing the explosive charge pointed in the direction in which the detonation is to proceed. Detonators for firing the trunk line shall not be brought to the loading area nor attached to the detonating cord until everything else is in readiness for the blast.

Firing the Blast

A code of blasting signals equivalent to Table T-1 shall be posted on one or more conspicuous places at the operation, and all employees shall be required to familiarize themselves with the code and conform to it. Danger signs shall be placed at suitable locations. All charges shall be covered with blasting mats before firing, where blasting may cause injury or damage by flying rock or debris. Before a blast is fired, a loud warning signal shall be given by the blaster in charge, who has made certain that all surplus explosives are in a safe place and all employees, vehicles, and equipment are at a safe distance, or under sufficient cover. Flagmen shall be safely stationed on highways which pass through the danger zone so as to stop traffic during blasting operations. It shall be the duty of the blaster to fix the time of blasting. The blaster shall conduct all blasting operations and no shot shall be fired without the blaster's approval. Before firing an underground blast, warning shall be given, and all possible entries into the blasting area, and any entrances to any working place where a drift, raise, or other opening is about to be made, shall be carefully guarded. The blaster shall make sure that all employees are out of the blast area before firing a blast.

WARNING SIGNAL - A 1-minute series of long blasts 5 minutes prior to blast signal.

BLAST SIGNAL - A series of short blasts 1 minute prior to the shot.

ALL CLEAR SIGNAL - A prolonged blast following the inspection of blast area.

Inspection After Blasting

Immediately after the blast has been fired, the firing line shall be disconnected from the blasting machine, or where power switches are used, they shall be locked open or in the off position. Sufficient time shall be allowed, not less than fifteen minutes in tunnels, for the smoke and fumes to leave the blasted area before returning to the shot. An inspection of the area and the surrounding rubble shall be made by the user (blaster) to determine if all charges have been exploded before employees are allowed to return to the operation, and in tunnels, after the muck pile has been wetted down.

Misfires

If a misfire is found, the user (blaster) shall provide proper safeguards for excluding all employees from the danger zone. No other work shall be done except that necessary to remove the hazard of the misfire and only those employees necessary to do the work shall remain in the danger zone. No attempt shall be made to extract explosives from any charged or misfired hole; a new primer shall be put in and the hole reblasted. If refiring of the misfired hole presents a hazard, the explosives may be removed by washing out with water or, where the misfire is under water, blown out with air. If there are any misfires while using cap and fuse, all employees shall remain away from the charge for at least one hour. Misfires shall be handled under the direction of the person in charge of the blasting. All wires shall be carefully traced and a search made for unexploded charges. When electric blasting caps have been used, workers shall not return to misfired holes for at least thirty minutes. All wires shall be carefully traced and a search made for unexploded charges. If explosives are suspected of burning in a hole, all persons in the endangered

area shall move to a safe location and no one shall return to the hole until the danger has passed, but in no case within one hour. No drilling, digging, or picking shall be permitted until all missed holes have been detonated or the authorized representative has approved that work can proceed.

Underwater Blasting

A user (blaster) shall conduct all blasting operations, and no shot shall be fired without the blaster's approval. Loading tubes and casings of dissimilar metals shall not be used because of possible electric transient currents from galvanic action of the metals and water. Only water-resistant blasting caps and detonating cords shall be used for all underwater blasting. Loading shall be done through a non sparking metal loading tube when tube is necessary. No blast shall be fired while any vessel under way is closer than 1,500 feet to the blasting area. Those on board vessels or craft moored or anchored within 1,500 feet shall be notified before a blast is fired. No blast shall be fired while any swimming or diving operations are in progress in the vicinity of the blasting area. If such operations are in progress, signals and arrangements shall be agreed upon to assure that no blast shall be fired while any persons are in the water.

Display of Blasting Flags

The storage and handling of explosives aboard vessels used in underwater blasting operations shall be according to provisions outlined herein on handling and storing explosives. When more than one charge is placed under water, a float device shall be attached to an element of each charge in such manner that it will be released by the firing.

Blasting in Excavation Work

Detonators and explosives shall not be stored or kept in tunnels, shafts, or caissons. Detonators and explosives for each round shall be taken directly from the magazines to the blasting zone and immediately loaded. Detonators and explosives left over after loading a round shall be removed from the working chamber before the connecting wires are connected up. When detonators or explosives are brought into an air lock, no employee except the powder man, user (blaster), lock tender and the employees necessary for carrying, shall be permitted to enter the air lock. No material, supplies, or equipment shall be brought through with the explosives. Primers, detonators and explosives shall be taken separately into pressure working chambers. The user (blaster) or powder man shall be responsible for the receipt, unloading, storage, and on-site transportation of explosives and detonators. All metal pipes, rails, air locks, and steel tunnel lining shall be electrically bonded together and grounded at or near the portal or shaft, and such pipes and rails shall be cross-bonded together at not less than 1,000-foot intervals throughout the length of the tunnel. In addition, each air supply pipe shall be grounded at its delivery end. The explosives suitable for use in wet holes shall be water-resistant and shall be Fume Class 1, or other approved explosives. When tunnel excavation in rock face is approaching mixed face, and when tunnel excavation is in mixed face, blasting shall be performed with light charges and with light burden on each hole. Advance drilling shall be performed as tunnel excavation in rock face approaches mixed face, to determine the general nature and extent of rock cover and the remaining distance ahead to soft ground as excavation advances.

Vibration & Damage Control

Blasting operations in or adjacent to coffer dams, piers, underwater structures, buildings, structures, or other facilities shall be carefully planned with full consideration for all forces and conditions involved. Black blasting powder shall not be used for blasting except when a desired result cannot be obtained with another type of explosive such as in quarrying certain types of dimension stone. In the use of black blasting powder: Containers shall not be opened in, or within fifty feet of any magazine; within any building in which a fuel-fired or exposed- element electric heater is in operation; where electrical or

incandescent-particle sparks could result in powder ignition; or within fifty feet of any open flame. Granular powder shall be transferred from containers only by pouring. Spills of granular powder shall be cleaned up promptly with non sparking equipment, contaminated powder shall be put into a container of water and its content disposed of promptly after the granules have disintegrated, or the spill area shall be flushed with a copious amount of water to completely disintegrate the granules. Containers of powder shall be kept securely closed at all times other than when the powder is being transferred from or into a container. Containers of powder transported by vehicles shall be in a wholly enclosed cargo space. Misfires shall be disposed of by washing the stemming and powder charge from the bore hole, and removal and disposal of the initiator as a damaged explosive. Bore holes of shots that fire but fail to break, or fail to break promptly, shall not be recharged for at least twelve hours. No person shall store, handle, or transport explosives or blasting agents when such storage, handling, and transportation of explosives or blasting agents constitutes an undue hazard to life. Do not abandon explosives or explosive substances.

Fixed Location Mixing

Buildings or other facilities used for mixing blasting agents shall be located appropriate distances away from inhabited buildings, passenger railroads, and public highways. In determining the distance separating highways, railroads, and inhabited buildings from potential explosions the sum of all masses which may propagate from either individual or combined donor masses are included. However, when the ammonium nitrate must be included, only fifty percent of its weight shall be used because of its reduced blast effects. Buildings used for the mixing of blasting agents shall conform to the requirements of this section. Buildings shall be of noncombustible construction or sheet metal on wood studs. Floors in a mixing plant shall be of concrete or of other nonabsorbent materials. All fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building. The building shall be well ventilated. Heating units which do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be located outside the mixing building.

All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant. Equipment used for mixing blasting agents shall conform to the requirements of this subsection. The design of the mixer shall minimize the possibility of frictional heating, compaction, and especially confinement. All bearings and drive assemblies shall be mounted outside the mixer and protected against the accumulation of dust. All surfaces shall be accessible for cleaning. Suitable means shall be provided to prevent the flow of fuel oil to the mixer in case of fire.

In gravity flow systems an automatic spring-loaded shutoff valve with fusible link shall be installed. The provisions of this subsection shall be considered when determining blasting agent compositions. The sensitivity of the blasting agent shall be determined by means of a No. 8 test blasting cap at regular intervals and after every change in formulation. Oxidizers of small particle size, such as crushed ammonium nitrate prills or fines, may be more sensitive than coarser products and shall, therefore, be handled with greater care.

No hydrocarbon liquid fuel with flash point lower than that of No. 2 diesel fuel oil 125°F. minimum shall be used. Crude oil and crankcase oil shall not be used. Metal powders such as aluminum shall be kept dry and shall be stored in containers or bins which are moisture-resistant or weather tight. Solid fuels shall be used in such manner as to minimize dust explosion hazards. Peroxides and chlorates shall not be used.

All electrical switches, controls, motors, and lights located in the mixing room shall conform to the requirements in; otherwise they shall be located outside the mixing room. The frame of the mixer and all

other equipment that may be used shall be electrically bonded and be provided with a continuous path to the ground. Safety precautions at mixing plants shall include the requirements of this subsection.

Floors shall be constructed so as to eliminate floor drains and piping into which molten materials could flow and be confined in case of fire. The floors and equipment of the mixing and packaging room shall be cleaned regularly and thoroughly to prevent accumulation of oxidizers or fuels and other sensitizers. The entire mixing and packaging plant shall be cleaned regularly and thoroughly to prevent excessive accumulation of dust. Smoking, matches, open flames, spark-producing devices, and firearms (except firearms carried by guards) shall not be permitted inside of or within 50 feet of any building or facility used for the mixing of blasting agents.

The land surrounding the mixing plant shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 25 feet. Empty ammonium nitrate bags shall be disposed of daily in a safe manner. No welding shall be permitted or open flames used in or around the mixing or storage area of the plant unless the equipment or area has been completely washed down and all oxidizer material removed. Before welding or repairs to hollow shafts, all oxidizer material shall be removed from the outside and inside of the shaft and the shaft vented with a minimum one-half inch diameter opening. Explosives shall not be permitted inside of or within 50 feet of any building or facility used for the mixing of blasting agents.

Bulk Delivery & Mixing Vehicles

The provisions of this subsection shall apply to off-highway private operations as well as to all public highway movements. A bulk vehicle body for delivering and mixing blasting agents shall conform with the requirements of this subsection. The body shall be constructed of noncombustible materials. Vehicles used to transport bulk premixed blasting agents on public highways shall have closed bodies. All moving parts of the mixing system shall be designed as to prevent a heat buildup. Shafts or axles which contact the product shall have outboard bearings with 1-inch minimum clearance between the bearings and the outside of the product container. Particular attention shall be given to the clearances on all moving parts. A bulk delivery vehicle shall be strong enough to carry the load without difficulty and be in good mechanical condition. Operation of bulk delivery vehicles shall conform to the requirements of federal regulations for interstate transportation of dangerous substances. These include the placarding requirements as specified by department of transportation. The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment. The employer shall assure that the operator is familiar with the commodities being delivered and the general procedure for handling emergency situations.

The hauling of either blasting caps or other explosives but not both, shall be permitted on bulk trucks provided that a special wood or non-ferrous-lined container is installed for the explosives. Such blasting caps or other explosives shall be in DOT-specified shipping containers.

No person shall smoke, carry matches or any flame-producing device, or carry any firearms while in or about bulk vehicles effecting the mixing transfer or down-the-hole loading of blasting agents at or near the blasting site. Caution shall be exercised in the movement of the vehicle in the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, cap wires, or explosive materials. The employer shall assure that the driver, in moving the vehicle, has assistance of a second person to guide the driver's movements. No in transit mixing of materials shall be performed. Pneumatic loading from bulk delivery vehicles into blast holes primed with electric blasting caps or other static-sensitive systems shall conform to the requirements of this subsection. A positive grounding device shall be used to prevent the accumulation of static electricity. A discharge hose shall be used that has a resistance range that will prevent conducting stray currents, but that is conductive enough to bleed off static buildup. A qualified person shall evaluate all systems to determine if they will adequately dissipate static under potential field conditions. Repairs to bulk delivery vehicles shall conform to the requirements of this section. No

welding or open flames shall be used on or around any part of the delivery equipment unless it has been completely washed down and all oxidizer material removed. Before welding or making repairs to hollow shafts, the shaft shall be thoroughly cleaned inside and out and vented with a minimum one-half-inch diameter opening.

Bulk Storage Bins

The bin, including supports, shall be constructed of compatible materials, waterproof, and adequately supported and braced to withstand the combination of all loads including impact forces arising from product movement within the bin and accidental vehicle contact with the support legs. The bin discharge gate shall be designed to provide a closure tight enough to prevent leakage of the stored product. Provision shall also be made so that the gate can be locked. Bin loading manways or access hatches shall be hinged or otherwise attached to the bin and be designed to permit locking. Any electrically driven conveyors for loading or unloading bins shall conform to the requirements of through . They shall be designed to minimize damage from corrosion. Bins containing blasting agent shall be located, with respect to inhabited buildings, passenger railroads, and public highways and separated from other blasting agent storage and explosives storage. Bins containing ammonium nitrate shall be separated from blasting agent storage and explosives storage.

Transporting Packaged Blasting Agents

Vehicles transporting blasting agents shall only be driven by and in charge of a driver at least twenty-one years of age who is capable, careful, reliable, and in possession of a valid motor vehicle operator's license. Such a person shall also be familiar with the states vehicle and traffic laws. No matches, firearms, acids, or other corrosive liquids shall be carried in the bed or body of any vehicle containing blasting agents. No person shall be permitted to ride upon, drive, load, or unload a vehicle containing blasting agents while smoking or under the influence of intoxicants, narcotics, or other dangerous drugs. It is prohibited for any person to transport or carry any blasting agents upon any public vehicle carrying passengers for hire. Vehicles transporting blasting agents shall be in safe operating condition at all times. When offering blasting agents for transportation on public highways the packaging, marking, and labeling of containers of blasting agents shall comply with the requirements of DOT. Vehicles used for transporting blasting agents on public highways shall be placarded in accordance with DOT regulations. Use of blasting agents.

Water Gel Explosives & Agents

Unless otherwise set forth in this section, water gels shall be transported, stored and used in the same manner as explosives or blasting agents in accordance with the classification of the product. Water gels containing a substance in itself classified as an explosive shall be classified as an explosive and manufactured, transported, stored, and used as specified for "explosives" in this manual. Water gels containing no substance in itself classified as an explosive and which are cap-sensitive as defined in under blasting agent shall be classified as an explosive and manufactured, transported, stored and used as specified for "explosives" in this section. Water gels containing no substance in itself classified as an explosive and which are not cap-sensitive as defined in under blasting agent shall be classified as blasting agents and manufactured, transported, stored, and used as specified for "blasting agents" in this section. When tests on specific formulations of water gels result in department of transportation classification as a Class B explosive, bullet-resistant magazines are not required.

Fixed Location Mixing

Buildings or other facilities used for mixing water gels shall be located with respect to inhabited buildings, passenger railroads and public highways. In determining the distances separating highways,

railroads, and inhabited buildings from potential explosions, the sum of all masses that may propagate from either individual or combined donor masses are included. However, when the ammonium nitrate must be included, only fifty percent of its weight shall be used because of its reduced blast effects. Buildings used for the mixing of water gels shall conform to the requirements of this subsection. Buildings shall be of non-combustible construction or sheet metal on wood studs. Floors in a mixing plant shall be of concrete or of other nonabsorbent materials. Where fuel oil is used all fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building. The building shall be well ventilated. Heating units that do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be provided exclusively from units located outside of the mixing building. All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.

Construction of Magazines

Construction of all explosive storage magazines must comply with state and Bureau of Alcohol, Tobacco, and Firearms regulations. A Class 1 storage facility shall be a permanent structure; a building, an igloo or army-type structure, a tunnel, or a dugout. It shall be bullet-resistant, fire-resistant, weather-resistant, theft-resistant, and well ventilated. All building type storage facilities shall be constructed of masonry, wood, metal, or a combination of these materials and shall have no openings except for entrances and ventilation. Ground around such storage facilities shall slope away for drainage. Masonry wall construction shall consist of brick, concrete, tile, cement block, or cinder block and shall be not less than 6 inches in thickness. Hollow masonry units used in construction shall have all hollow spaces filled with well tamped coarse dry sand or weak concrete (a mixture of one part cement and eight parts of sand with enough water to dampen the mixture while tamping in place). Interior wall shall be covered with a non-sparking material.

Metal wall construction shall consist of sectional sheets of steel or aluminum not less than number 14 gauge, securely fastened to a metal framework. Such metal wall construction shall be either lined inside with brick, solid cement blocks, hardwood not less than 4 inches in thickness or material of equivalent strength, or shall have at least a 6 inch sand fill between interior and exterior walls. Interior walls shall be constructed of or covered with a non-sparking material. Wood frame wall construction. The exterior of outer wood walls shall be covered with iron or aluminum not less than number 26 gauge. An inner wall of non-sparking materials shall be constructed so as to provide a space of not less than 6 inches between the outer and inner walls, which space shall be filled with coarse dry sand or weak concrete. Floors shall be constructed of a non-sparking material and shall be strong enough to bear the weight of the maximum quantity to be stored. Foundations shall be constructed of brick, concrete, cement block, stone, or wood posts. If piers or posts are used, in lieu of a continuous foundation, the space under the buildings shall be enclosed with metal. Except for buildings with fabricated metal roofs, the outer roof shall be covered with not less than number 26-gauge iron or aluminum fastened to a 7/8-inch sheathing.

Where it is possible for a bullet to be fired directly through the roof and into the storage facility at such an angle that the bullet would strike a point below the top of inner walls, storage facilities shall be protected by one of the following methods a sand tray shall be located at the tops of inner walls covering the entire ceiling area, except that necessary for ventilation, lined with a layer of building paper, and filled with not less than 4 inches of coarse dry sand. A fabricated metal roof shall be constructed of 3/16-inch plate steel lined with 4 inches of hardwood or material of equivalent strength (for each additional 1/16-inch of plate steel, the hardwood or material of equivalent strength lining may be decreased one inch). All doors shall be constructed of 1/4-inch plate steel and lined with 2 inches of hardwood or material of equivalent strength. Hinges and hasps shall be attached to the doors by welding, riveting or bolting (nuts on inside of

door). They shall be installed in such a manner that the hinges and hasps cannot be removed when the doors are closed and locked. Each door shall be equipped with two mortise locks; or with two padlocks fastened in separate hasps and staples; or with a combination of mortise lock and a padlock, or with a mortise lock that requires two keys to open; or a three-point lock. Padlocks shall have at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter. Padlocks shall be protected with not less than 1/4-inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside. Except at doorways, a 2-inch air space shall be left around ceilings and the perimeter of floors. Foundation ventilators shall be not less than 4 by 6 inches. Vents in the foundation, roof, or gables shall be screened and offset. No sparking metal construction shall be exposed below the top of walls in the interior of storage facilities, and all nails therein shall be blind-nailed, countersunk or non sparking. Storage facilities shall be constructed of reinforced concrete, masonry, metal or a combination of these materials. They shall have an earth mound covering of not less than 24 inches on the top, sides and rear. Interior walls and floors shall be covered with a non sparking material.

Grain Handling Facilities

Grate Openings

Receiving-pit feed openings, such as truck or rail car receiving-pits, shall be covered by grates. The width of openings in the grates shall be a maximum of two and one-half inches (6.35 cm).

Filter Collectors

All fabric dust filter collectors which are a part of a pneumatic dust collection system shall be equipped with a monitoring device that will indicate a pressure drop across the surface of the filter. Filter collectors installed after March 30, 1988, shall be located outside the facility; or located in an area inside the facility protected by an explosion suppression system; or located in an area inside the facility that is separated from other areas of the facility by construction having at least a one hour fire-resistance rating, and which is adjacent to an exterior wall and vented to the outside. The vent and ductwork shall be designed to resist rupture due to deflagration.

Grain Stream Processing Equipment

All grain stream processing equipment (such as hammer mills, grinders, and pulverizers) are equipment with an effective means of removing ferrous material from the incoming grain stream.

Emergency Escape

There should be at least two means of emergency escape from galleries (bin decks). There is at least one means of emergency escape in tunnels of existing grain elevators. Tunnels in grain elevators constructed after the effective date of this standard shall be provided with at least two means of emergency escape.

Grain Dryers

Not later than April 1, 1991, all direct-heat grain dryers shall be equipped with automatic controls that will shut-off the fuel supply in case of power or flame failure or interruption of air movement through the exhaust fan; and will stop the grain from being fed into the dryer if excessive temperature occurs in the exhaust of the drying section. Direct-heat grain dryers installed after March 30, 1988, shall be located outside the grain elevator; or located in an area inside the grain elevator protected by a fire or explosion suppression system; or located in an area inside the grain elevator which is separated from other areas of the facility by construction having at least a one hour fire-resistance rating.

Inside Bucket Elevators

Bucket elevators shall not be joggled to free a choked leg. All belts and lagging purchased after March 30, 1988, shall be conductive. Such belts shall have a surface electrical resistance not to exceed 300 megohms. Not later than April 1, 1991, all bucket elevators shall be equipped with a means of access to the head pulley section to allow inspection of the head pulley, lagging, belt, and discharge throat of the elevator head. The boot section shall also be provided with a means of access for clean-out of the boot and for inspection of the boot, pulley, and belt. Not later than April 1, 1991, the employer shall mount bearings externally to the leg casing; or provide vibration monitoring, temperature monitoring, or other

means to monitor the condition of those bearings mounted inside or partially-inside the leg casing. Not later than April 1, 1991, the employer shall equip bucket elevators with a motion detection device which will shut-down the bucket elevator when the belt speed is reduced by no more than twenty percent of the normal operating speed. Not later than April 1, 1991, the employer shall equip bucket elevators with a belt alignment monitoring device which will initiate an alarm to employees when the belt is not tracking properly; or provide a means to keep the belt tracking properly, such as a system that provides constant alignment adjustment of belts.

Dust Emissions

Employers should analyze the entire stock handling system to determine the location of dust emissions and effective methods to control or to eliminate them. The employer should make sure that holes in spouting, casings of bucket elevators, pneumatic conveying pipes, screw augers, or drag conveyor casings, are patched or otherwise properly repaired to prevent leakage. Minimizing free falls of grain or grain products by using choke feeding techniques, and utilization of dust-tight enclosures at transfer points, can be effective in reducing dust emissions. Each housekeeping program should specify the schedules and control measures which will be used to control dust emitted from the stock handling system. The housekeeping program should address the schedules to be used for cleaning dust accumulations from motors, critical bearings and other potential ignition sources in the working areas. Also, the areas around bucket elevator legs, milling machinery and similar equipment should be given priority in the cleaning schedule. The method of disposal of the dust which is swept or vacuumed should also be planned. Dust may accumulate in somewhat inaccessible areas, such as those areas where ladders or scaffolds might be necessary to reach them.

The employer may want to consider the use of compressed air and long lances to blow down these areas frequently. The employer may also want to consider the periodic use of water and hose lines to wash down these areas. If these methods are used, they are to be specified in the housekeeping program along with the appropriate safety precautions, including the use of personal protective equipment such as eye wear and dust respirators. Several methods have been effective in controlling dust emissions. A frequently used method of controlling dust emissions is a pneumatic dust collection system. However, the installation of a poorly designed pneumatic dust collection system has fostered a false sense of security and has often led to an inappropriate reduction in manual housekeeping. Therefore, it is imperative that the system be designed properly and installed by a competent contractor.

Those employers who have a pneumatic dust control system that is not working according to expectations should request the engineering design firm, or the manufacturer of the filter and related equipment, to conduct an evaluation of the system to determine the corrections necessary for proper operation of the system. If the design firm or manufacturer of the equipment is not known, employers should contact their trade association for recommendations of competent designers of pneumatic dust control systems who could provide assistance. When installing a new or upgraded pneumatic control system, the employer should insist on an acceptance test period of thirty to forty-five days of operation to ensure that the system is operating as intended and designed.

The employer should also obtain maintenance, testing, and inspection information from the manufacturer to ensure that the system will continue to operate as designed. Aspiration of the leg, as part of a pneumatic dust collection system, is another active method of controlling dust emissions. Aspiration of the leg consists of a flow of air across the entire boot, which entrains the liberated dust and carries it up the up-leg to take-off points. With proper aspiration, dust concentrations in the leg can be lowered below the lower explosive limit. Where a prototype leg installation has been instrumented and shown to be effective in keeping the dust level twenty-five percent below the lower explosive limit during normal operations for the various products handled, then other legs of similar size, capacity and products being handled which have the same design criteria for the air aspiration would be acceptable to OSHA,

provided the prototype test report is available on site. Another method of controlling dust emissions is enclosing the conveying system, pressurizing the general work area, and providing a lower pressure inside the enclosed conveying system. Although this method is effective in controlling dust emissions from the conveying system, adequate access to the inside of the enclosure is necessary to facilitate frequent removal of dust accumulations. This is also necessary for those systems called "self-cleaning." The use of edible oil sprayed on or into a moving stream of grain is another method which has been used to control dust emissions. Tests performed using this method have shown that the oil treatment can reduce dust emissions. Repeated handling of the grain may necessitate additional oil treatment to prevent liberation of dust. However, before using this method, operators of grain handling facilities should be aware that the Food and Drug Administration must approve the specific oil treatment used on products for food and feed.

As a part of the housekeeping program, grain elevators are required to address accumulations of dust at priority areas using the action level. The standard specifies a maximum accumulation of one-eighth inch dust, measurable by a ruler or other measuring device, anywhere within a priority area as the upper limit at which time employers must initiate action to remove the accumulations using designated means or methods. Any accumulation in excess of this amount and where no action has been initiated to implement cleaning would constitute a violation of the standard, unless the employer can demonstrate equivalent protection. Employers should make every effort to minimize dust accumulations on exposed surfaces since dust is the fuel for a fire or explosion, and it is recognized that a one-eighth inch dust accumulation is more than enough to fuel such occurrences.

Filter Collectors

Proper sizing of filter collectors for the pneumatic dust control system they serve is very important for the overall effectiveness of the system. The air to cloth ratio of the system should be in accordance with the manufacturer's recommendations. If higher ratios are used, they can result in more maintenance on the filter, shorter bag or sock life, increased differential pressure resulting in higher energy costs, and an increase in operational problems. A photohelic gauge, magnehelic gauge, or manometer, may be used to indicate the pressure rise across the inlet and outlet of the filter. When the pressure exceeds the design value for the filter, the air volume will start to drop, and maintenance will be required. Any of these three monitoring devices is acceptable.

The employer should establish a level or target reading on the instrument which is consistent with the manufacturer's recommendations that will indicate when the filter should be serviced. This target reading on the instrument and the accompanying procedures should be in the preventive maintenance program. These efforts would minimize the blinding of the filter and the subsequent failure of the pneumatic dust control system. There are other instruments that the employer may want to consider using to monitor the operation of the filter. One instrument is a zero motion switch for detecting a failure of motion by the rotary discharge valve on the hopper. If the rotary discharge valve stops turning, the dust released by the bag or sock will accumulate in the filter hopper until the filter becomes clogged. Another instrument is a level indicator which is installed in the hopper of the filter to detect the buildup of dust that would otherwise cause the filter hopper to be plugged. The installation of these instruments should be in accordance with manufacturer's recommendations. All of these monitoring devices and instruments are to be capable of being read at an accessible location and checked as frequently as specified in the preventive maintenance program. Filter collectors on portable vacuum cleaners, and those used where fans are not part of the storage capacity of less than one million bushels, provided that daily visual inspection is made of bucket movement and tracking of the belt.

Hydrogen Furnaces

Applicable Rules

Before the purchase or construction of a hydrogen furnace the responsible user must submit the furnace specifications to the Responsible Safety Officer for review. The following general flammable gas safety rules in other chapters of this manual are applicable to hydrogen furnaces: Chapters on Gases, Flammable and/or Compressed The provisions of NFPA 50A, Gaseous Hydrogen Systems at Consumer Sites are also applicable. In addition to the above requirements, the following special guidelines for hydrogen furnaces must be observed.

Construction Requirements

All hydrogen furnaces must be constructed of material resistant to impact and heat shock and not subject to hydrogen embrittlement. The furnace and associated equipment must be vacuum tight at 40 Pa (0.3 torr) at all operating temperatures. Personnel shields must be placed around all hot outside surfaces of the furnace to prevent injuries. If the hydrogen furnace is to be operated in a location where the hydrogen content of the space surrounding the furnace can exceed 10% of the Lower Explosive Limit (LEL), then all electrical equipment and wiring attached to the furnace and to the system must be explosion proof, i.e., Class I, group B, Division 2 [NFPA 70-NEC] or intrinsically safe, i.e., NFPA 493. In lieu of explosion-proof equipment, all electrical devices (switches, relays, etc.) on the furnace or system must be totally enclosed, and the enclosure must be purged with nitrogen at a positive pressure of not less than 0.1 inch of water when power is on. Other requirements regarding purge-gas flow rate, alarms, and other items, are stated in NFPA 496, (Ref. 29-4).

Installation & Operation Requirements

Hydrogen furnaces must be installed and operated only in rooms having automatic-sprinkler protection, and the room may only be heated by steam, hot water, or any other indirect means. A forced-air ventilation system, with the room exhaust duct located near the ceiling, must be installed and operated in rooms containing operating hydrogen furnaces. The capacity (ft³/min) of the exhaust blower must be sufficient to ensure that the maximum concentration of H₂ does not exceed 10% of the LEL based on the maximum expected leak rate of H₂ over a period of 8 hours. In most cases the blower capacity may be calculated through the following formula: $\log_{10} (1 - (QC/G)) = -(Qt/2.3V)$ where: C = concentration of H₂ expressed as a fraction at any time t (min), V = room volume (ft³), G = rate of generation of H₂ (ft³/min), and Q = ventilation rate (ft³/min).

Consideration must be given to deviations from the ideal conditions for the location of air inlets and outlets, room baffling, hoods, and to any other factors affecting exhaust efficiency. The exhaust fan must be explosion proof or use a three-phase motor without internal sparking devices such as brushes, contacts, etc. Hydrogen supply cylinders must be located at least 10 feet away from the furnace. An orifice that limits the hydrogen flow to less than 10% of the LEL when the room exhaust system is operating must be located in the high-pressure hydrogen-gas supply line at the hydrogen cylinder. A solenoid valve must be installed in the high-pressure section of the hydrogen-supply line at the hydrogen cylinder and must be interlocked with the room combustible-gas detectors to shut off the hydrogen flow when an alarm is activated, a loss of blower air occurs, or power fails. After a power failure, both the solenoid valve in the hydrogen supply line and the furnace must be manually reactivated. A solenoid valve must be located in the inert-gas supply line and must be interlocked with the combustible-gas detectors to purge the furnace

with helium, argon, or nitrogen gas when the hydrogen alarm is activated. Preferably, the inert-gas supply should be located outside the furnace room. Installation of a check valve in the inert-gas supply line is recommended to prevent hydrogen gas from backing into the inert gas. Tubing used for supplying hydrogen to the furnace must be authentic stainless steel and must be protected from physical damage. The furnace and associated equipment must be electrically grounded and bonded (all non-current-carrying metal parts connected by a solid electrical conductor) to minimize voltage-, capacitive-, and electrostatic-spark hazards. Flammable-gas detectors must be mounted above the furnace and above the hydrogen-supply cylinder if the cylinder is located inside the building. Gas detectors must be set to give an alarm at 10% of the LEL for hydrogen. Approved fire extinguishers must be installed as directed by the [Company] and the local Fire Department.

Approval & Operation

An OSP must be prepared by the responsible user in charge of the furnace operation. The hydrogen-furnace system, and its piping diagram, must be approved by a member of the Mechanical Safety Subcommittee and Responsible Safety Officer before furnace operation can begin. The piping diagram must be posted at the furnace. Only trained personnel thoroughly familiar with the hydrogen furnace may be authorized to operate it, and a list of authorized operators and their phone numbers must be posted at the hydrogen furnace.

The furnace must be pressure tested for leaks with inert gas at about 5 psig at room temperature before each use. The furnace must be evacuated to less than 0.3 torr and purged with an inert gas to remove air before the introduction of hydrogen. During operation a positive hydrogen pressure must be maintained in the furnace to exclude air from the system (the auto-ignition temperature for hydrogen in air is 585 degrees C).

Other flammable gases located in the furnace room must be confined while the furnace is in operation since the hot surface of the furnace may ignite these gases. At the end of each brazing cycle the furnace heater must be turned off, the hydrogen flow shut off, and the furnace flushed with inert gas.

Reference Standards

1. National Fire Protection Association, National Fire Codes, NFPA 50A, Gaseous Hydrogen Systems, at Consumer Sites.
2. National Fire Protection Association, National Fire Codes, NFPA 70, National Electrical Code.
3. National Fire Protection Association, National Fire Code, NFPA 493, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Locations.
4. National Fire Protection Association Technical Committee Report, NFPA No. 496, Purged and Pressurized Enclosures for Electrical Equipment.
5. "Protection of Laboratories and Buildings from Hydrogen Explosion," Hazards-Control Progress Report No. 26, UCRL 50007-66-2.

Laser Safety

Introduction

This chapter provides guidance for the safe use of lasers and laser systems. It is derived from ANSI Z136.1, Standard for the Safe Use of Lasers, prescribed by the Department of Energy and OSHA regulations. The ANSI Standard establishes a hazard classification scheme based on the ability of the laser beam to cause biological damage to the eye or skin. This scheme is used to place each laser into one of four classes; each laser must meet the laser safety requirements specified for its class.

Laser Safety Duties of RSO

The Responsible Safety Officer: Provides consulting services on laser hazards, safety controls, and training programs. Suspends, restricts, or terminates the operation of a laser or laser system if he/she considers that the laser hazard controls are inadequate. Maintains the necessary records required by applicable government regulations. Approves all protective equipment used for the control of laser hazards. Provides an adequate stock of eye protective equipment. Inspects all laser areas as frequently as considered necessary. Accompanies OSHA inspectors and documents any discrepancies noted. Ensures that corrective action is taken where required. Reviews new installations (and modifications to installations that may increase the hazard to personnel) to ensure that the hazard control measures are adequate. Investigates any known or suspected accident resulting from a laser operation and initiates appropriate action. Provides an adequate stock of warning signs. Assists supervisors in developing training programs.

Additional Duties for RSO

The Responsible Safety Officer also: Knows all applicable procedures pertaining to laser safety including training requirements, hazards, and control measures. Issues appropriate instructions and training materials on laser hazards and their control to all personnel prior to their work with lasers. Suspends the operation of a laser when there is inadequate control of laser hazards. Prepares an Operational Safety Procedure for Class 3 and Class 4 lasers and laser systems and ensures that they are provided to users of such lasers. Ensures that personnel using Class 3 and Class 4 lasers undergo a laser eye examination at the following times: (a) prior to participation in laser work and (b) immediately after a suspected eye injury. Performs all scheduling of personnel for the laser eye examination. Notifies the appropriate Medical Services provider immediately of any known or suspected accident resulting from the operation of a laser. Assists in obtaining the appropriate medical attention for any employee involved in a laser accident. Ensures that all plans for laser installations or modifications of installations are reviewed for safety prior to implementation.

Employee Responsibilities

Employees who work near a laser: Must not energize or work with or near a laser unless authorized by the Responsible Safety Officer or a supervisor. Must receive appropriate training and comply with the safety regulations prescribed by the supervisor and the Responsible Safety Officer. Must notify the supervisor immediately of any known or suspected accident involving a laser. (If the supervisor is not available, the employee must immediately notify the applicable Medical Services provider, or dial 911 for

emergencies.)

User Responsibilities

It is the responsibility of the user to notify the [Company] Responsible Safety Officer whenever the decision is made to fabricate, purchase or otherwise acquire a laser. This will facilitate the proper functioning of the Company's laser safety program and afford the user the opportunity to be informed about the safety considerations appropriate to the laser he is acquiring, prior to its actual use. To help ensure that oversights do not occur, the Purchasing Department has been asked to refer each requisition for a laser to the Responsible Safety Officer to initial before an order is placed.

OSPs for Class 3 and 4 Lasers

Each Class 3 or Class 4 laser or laser system must have an Operational Safety Procedure (OSP) located near the unit. It must contain at least the following information: Name of the laser system supervisor List of authorized users General description of the laser or laser system Specific safety control measures used Specific alignment procedures used, if applicable Eye protection required, if applicable Emergency instructions The Operational Safety Procedure will be prepared from the latest OSP preparation guide. The OSP is prepared initially by the Laser System Supervisor with the Assistance of the Responsible Safety Officer.

Injury Potential Evaluation

Injury potential from exposure to a laser beam is the basis of the following hazard classification scheme: A Class 1 laser is one that is considered to be incapable of producing damaging radiation levels and is, therefore, exempt from any control measures. As a matter of good practice, any needless direct exposure of the eye to a Class 1 laser should be avoided. A Class 2 laser emits accessible, visible radiation at levels where damage from chronic exposure is possible. Class 2 lasers must have a caution label affixed to the external surface of the device. A Class 3 laser requires control measures to prevent viewing of the direct beam since biological damage to human tissue is possible from acute exposure. Class 3 lasers are subdivided into two classes, Class 3a and Class 3b. A Class 4 laser requires the use of controls that prevent exposure of the eye and skin to the direct and diffusely reflected beams. Whenever possible, the entire beam should be controlled. Lasers or laser systems certified for a specific class by a manufacturer in accordance with the Federal Laser Product Performance Standard may be considered as fulfilling all classification requirements of this regulation. In cases where the laser or laser system classification is not provided, or where the class level may change because of a change from the use intended by the manufacturer, or because of the addition or deletion of engineering control measures, the laser or laser system may be classified by the Responsible Safety Officer. Summary levels of power emissions for continuous-wave laser and laser system classification. Terms: Wavelength range, MPE limiting aperture, Emission duration, Ultraviolet, Visible, Near infrared, Far infrared, Sub-millimeter. Summary of levels (energy and radiant exposure emissions) for single-pulsed laser and laser system classification. Terms: Wavelength range, MPE limiting aperture, Emission duration, Ultraviolet, Visible, Near infrared, Far infrared, Sub-millimeter.

Control Measures

Control measures are applied after the laser has been properly classified. Control measures are divided into four categories:

1. Physical (enclosures, interlocks, beam stops, etc.)
2. Protective equipment (goggles, clothing, etc.)

3. Warning devices (signs, lights, labels, etc.)

4. Procedures Physical measures are almost always the preferred method for controlling access to laser radiation.

Class 1: There are no control measures or warning labels required, but needless exposures of the eye should be avoided as a matter of good practice.

Class 2: An appropriate warning label must be affixed to the laser housing or control panel and have a protective housing.

Class 3: Class 3 lasers are divided into two groups, Class 3a and Class 3b. Class 3a lasers are those which have an accessible output power between 1 and 5 times the lowest appropriate Class 3 exposure level and which do not exceed the appropriate maximum permissible exposure limit. For Class 3 visible lasers, the output range is 1 - 5 mW laser beam with optical instruments.

Class 3b lasers require the following additional control measures:

Training:

All persons must be duly informed about the hazards of their particular laser operation.

Engineering Controls:

Priority must be given to the appropriate safety mechanisms (i.e., shutters, interlocks, stops, beam enlarging systems, etc.) as an integral part of the system.

Control Area: Only authorized personnel are allowed to operate laser systems. Spectators are not permitted into the area unless appropriate supervisory approval has been obtained and protective measures taken. If the laser beam is not enclosed, special emphasis must be placed on control of the path of the laser beam. The area must be posted with the appropriate warning sign(s).

Alignment Procedures:

Must be performed in such a manner that primary beam or a specularly reflected beam does not expose the level in excess of the maximum permissible exposure limit. Equipment Labeling: Warning labels with the appropriate statement must be affixed to a conspicuous place on the laser.

Eye Protection:

Eye protective equipment specifically designed to protect against radiation from the particular kind of laser must be used when engineering and procedural controls are inadequate.

Class 4:

High-power lasers require more rigid control measures because there is a greater risk of injury from hazardous diffuse reflections. The entire beam path capable of producing reflections must be controlled. Controls must rely primarily on positive engineering safeguards and secondarily on procedural controls.

In addition to the control measures outlined under Class 3 lasers, the following Class 4 control measures must be applied.

Key-switch:

All lasers must be provided with an operative, keyed, master interlock or switching device. The key must be removable, and the laser must not be operable when the key is removed.

Control Area:

Operations must be optically isolated in an area designated for laser(s), and access to the area must

require appropriate authorization. The area must be posted with the appropriate warning sign(s). Interlocks: Safety latches or interlocks will usually be required to deactivate the laser in the event of an unexpected entry into laser- controlled areas. The design of interlocks must be such as to allow both rapid egress by the laser personnel and admittance under emergency conditions. For such emergency conditions a control-disconnect switch (panic button) must be available for deactivating the laser. Interlocks must not allow automatic re-energizing of the power supply, but be designed so that the power supply or shutter must be reset manually. The person in charge of the laser-controlled area is permitted to momentarily override the room access interlocks when continuous operation is necessary, but specification for the override must have the approval of the Responsible Safety Officer.

Laser Housing

The protective housing on any Class 2, Class 3, or Class 4 laser system must limit the maximum accessible laser radiation to that level which defines the classification desired. The control measures appropriate to the classification apply when the laser is in normal operation. Each enclosed laser system must be provided with a minimum of two operative safety interlocks for any portion of the protective housing, which, by design, can be removed or displaced during normal operation. In this manner, failure of any single mechanical or electrical component in the redundant interlock system will not prevent the total interlock system from functioning. Viewing windows incorporated into an enclosed laser must be of a suitable filter material which attenuates the laser radiation to levels below the maximum permissible exposure limit.

Additional Controls

Since infrared and ultraviolet radiations are invisible, particular care must be taken when using these laser systems. Thus, in addition to the control measures that apply to the laser hazard classification, the following controls also apply: Infrared lasers ($>0.7 \mu\text{m}$): The beam from a Class 3 laser should be terminated by a highly absorbent, non-specular backstop. Class 4 laser beams should be terminated by a fire resistant material. (Note: Many surfaces which appear dull visually can act as reflectors of infrared radiation.) Ultraviolet lasers ($<0.4 \mu\text{m}$): Exposure to ultraviolet radiation must be minimized by using shield material which attenuates the radiation to levels below the maximum permissible limit for the specific UV wavelength. Special attention must be given to the possibility of producing hazardous byproducts, such as ozone, and the formation of skin-sensitizing agents. For both infrared and ultraviolet lasers, a warning sign and light should be displayed in a conspicuous location, warning those in the area when the laser is being operated.

Protective Eyewear

Laser protective eye wear must be worn whenever operational conditions may result in a potential eye hazard. All protective eye wear must be clearly labeled with the optical density at the appropriate laser wavelength(s). Adequate optical density must be weighted with the need for adequate visible light transmission. Periodic inspection must be made to ensure that pitting, cracking, etc., will not endanger the wearer. The frame of the protective eye wear should also be inspected for mechanical integrity and light leaks. Contact the Responsible Safety Officer to select the appropriate laser eye wear.

Signs

All signs must be conspicuously displayed at entrances to controlled laser areas. In the space above the tail on the sunburst, place any pertinent precautionary instructions or protective actions which are required, such as:

For Class 3a: "Laser Radiation - Do Not Stare into Beam or View Directly with Optical Instruments."

For Class 3b: “Laser Radiation - Avoid Direct Exposure to Beam.”

For Class 4: “Laser Radiation - Avoid Eye or Skin Exposure to Direct or Scattered Radiation.”

Additional precautionary instructions or protective actions that may also be provided are: Invisible, Knock Before Entering, Do Not Enter When Light Is On, Restricted Area, etc. In the space below the tail on the sunburst, place the type of laser or laser system and its classification.

Medical Exams

The basic reasons for performing medical surveillance of personnel working in laser environments are to establish a baseline against which damage can be measured and to identify certain workers who might be at special risk from chronic exposures. Medical exams are given for personnel using Class 3 and Class 4 lasers. The exams are required prior to laser use and following suspected injury. Names of employees needing the special laser eye examination are submitted to the appropriate Medical Services agency or by the Responsible Safety Officer. [Company] schedules each regular laser user for a medical examination.

The elements of the examination include:

- medical history
- visual acuity
- external ocular examination
- examination by slit lamp ophthalmoscopy
- manifest refraction,
- when indicated fundus photographs with dilation for preassignment exams and
- exams following a suspected injury

The examinations are performed by an optometrist under the supervision of a qualified physician. Any employee with a suspected eye injury is referred to an ophthalmologist directly. In addition, all fundus photographs are reviewed by an ophthalmologist. Employees with skin injuries are also seen by a physician. The Responsible Safety Officer is notified by the physician or optometrist when an examination has been completed. If an eye injury is found, the Responsible Safety Officer will be notified immediately.

Related Hazards

The operation of lasers and laser systems, like any industrial or technological process, involves possible related hazards. Potential hazards related to laser use include: electrical, explosion, fire, compressed gases, cryogenic liquids, toxic materials, noise, ultraviolet light, and ionizing radiation. It is beyond the scope of this chapter to expand on these hazards. Additional information and/or referrals can be obtained from other chapters in this manual or from the Responsible Safety Officer.

Logging

General

This section applies to pulpwood logging operations including, but not limited to the operations of felling, limbing, marking, bucking, loading, skidding, prehauling and other operations associated with the preparation and movement of pulpwood timber from the stump to the point of delivery. The provisions of this section do not apply to logging operations relating to sawlogs, veneer bolts, poles, piling and other forest products.

Clothing Protective Devices/First Aid

Gloves shall be provided for use when working with wire rope in any form. The employer shall ensure that employees exposed to the danger of foot injury due to falling or rolling pulpwood shall wear foot protection which equals or exceeds the crushing and impact specifications of ANSI Z41.1-1967. Safety helmets of approved design in accordance with American National Standard for Safety Requirements for Industrial Head Protection, Z89.1- 1969 shall be provided and worn. Eye or face protection in accordance with American National Standard for Practice for Occupational and Educational Eye and Face Protection, Z87.1-1968 shall be provided and used where chips and sawdust or flying particles are present. Dust masks in accordance with American National Standard Practices for Respiratory Protection, Z88.2-1969 shall be provided and used where exposure requires. Protection against the effects of noise exposure shall be provided and used when the sound levels exceed acceptable levels when measured on the A scale of a standard sound level meter at slow response. First-aid kits shall be provided at the work site and on all transport vehicles. In all areas where poisonous snakes may exist, snake bite kits shall be a part of the regular first-aid equipment. First-aid kits shall be regularly inspected and replenished.

Handtools

The employer shall be responsible for the condition of tools when furnished by him and the user shall inspect any tool prior to using it to determine that it is in proper operating condition. Defective tools shall be removed from service. Handles shall be sound, straight and tight fitting. Driven tools shall be dressed to remove any mushrooming. Cutting tools shall be kept sharp and properly shaped. Wood hooks and pickaroons of good grade steel shall be used. Tools shall be used for purposes for which they were designed. Hand tools shall be sheathed or boxed if transported in a vehicle with personnel. If not contained in a box, the sheathed tools shall be fastened to the vehicle. Proper storage facilities shall be provided for hand tools. Tools shall be stored in the provided location at all times when not in use.

Environmental Conditions

All work shall terminate and employees moved to a place of safety during electrical storms and periods of high winds or when other unusual weather conditions are dangerous to personnel. Dead, broken, or rotted limbs or trees that are a hazard (widow makers) shall be felled or otherwise removed before commencing logging operations, building roads, trails or landing, in their vicinity. All persons shall work within the vocal range of other workers unless a procedure has been established for periodically checking their location and welfare. All persons shall be accounted for at the end of each work day.

Chain Saw Operations

Chain saw operators shall inspect saws daily to assure that all handles and guards are in place and tight, that all controls function properly and that the muffler is operative. Defective equipment shall not be used. Chain saw operators shall follow manufacturer's instructions as to operation and adjustment. Chain saw operators shall fuel the saw only in safe areas and not under conditions conducive to fire such as near persons smoking, hot engine, etc. Chain saw operators shall hold the saw with both hands during operation. Chain saw operators shall start the saw at least 10 feet away from fueling area. Chain saw operators shall start the saw only on the ground or when otherwise firmly supported. Chain saw operators shall be certain of footing and to clear away brush which might interfere before starting to cut. Chain saw operators shall not use engine fuel for starting fires or as a cleaning solvent. Chain saw operators shall shut off the saw when carrying it for a distance greater than from tree to tree or in hazardous conditions such as slippery surfaces or heavy underbrush. If the operator is carrying a running saw, the saw shall be at idle speed. Chain saw operators shall carry the saw in a manner to prevent contact with the chain and muffler. Chain saw operators shall be instructed not to use the saw to cut directly overhead or at a distance that would require the operator to relinquish a safe grip on the saw. Supervision shall be adequately maintained to assure that the instructions required by this chapter are followed.

Stationary & Mobile Equip Operation

Equipment operators shall follow the manufacturers' recommendations for equipment operation, maintenance, safe practices, and site operating procedures. Equipment shall be kept free of flammable material. Equipment shall be kept free of any material which might contribute to slipping and falling. Engines of equipment shall be shut down during fueling, servicing, and repairs except where operation is required for adjustment. The operator shall inspect the equipment he will be operating at the start of each shift for evidence of failure or incipient failure. Equipment found to have defects which might affect the operating safety shall not be used. The equipment operator shall walk completely around machine and assure that no obstacles or personnel are in the area before startup. The equipment operator shall start and operate equipment only from the operator's station or from safe area recommended by the manufacturer. A seat belt shall be provided on mobile equipment. The equipment operator shall check all controls for proper function and response before starting working cycle. The equipment operator shall ground or secure all movable elements when not in use.

The foreman shall advise the equipment operator of the load capacity, operating speed and stability limitations of the equipment. The equipment operator shall maintain adequate distance from other equipment and personnel. Where signalmen are used, the equipment operator shall operate the equipment only on signal from the designated signalman and only when signal is distinct and clearly understood. The equipment operator shall not operate movable elements (boom, grapple, load, etc.) close to or over personnel. The equipment operator shall signal his intention before operation when personnel are in or near the working area. The equipment operator shall dismount and stand clear for all loading and unloading of his mobile vehicle by other mobile equipment. The dismounted operator shall be visible to loader operator. The equipment operator shall operate equipment in a manner that will not place undue shock loads on wire rope. The equipment operator shall not permit riders or observers on the machine unless approved seating and protection is provided. The equipment operator shall shut down the engine when the equipment is stopped, apply brake locks and ground moving elements before he dismounts. The equipment operator shall when any equipment is transported from one job location to another, transport it on a vehicle of sufficient rated capacity and the equipment shall be properly secured during transit. When any equipment is being moved or operated in the vicinity of an electric distribution line a minimum clearance of ten feet shall be maintained between the electric distribution line and all elements of the machine. Only trained and experienced personnel shall handle or use explosives.

Equipment Protective Devices

There shall be an operator's manual or operating instructions with each machine. It will describe operation, maintenance, and safe practices. On all mobile equipment rollover protective structures (ROPS) shall be installed and maintained. Equipment on which ROPS are not required shall be equipped with the following operator protective devices: Protective canopy. A protective canopy shall be provided for the operator of mobile equipment. It shall be so constructed as to protect the operator from injury due to falling trees or limbs, saplings or branches which might enter the compartment side areas, and snapping winch lines or other objects. The canopy shall be of adequate size so as not to impair the operator's movements. The canopy framework shall consist of at least two arches, either transverse or longitudinal. If transverse, one arch shall be installed behind the operator and one immediately in front of the operator. They shall be joined at the top by at least two longitudinal braces.

There shall be two braces which shall act as deflecting guards extending from the leading edge of the forward arch to the front part of the frame of the tractor. If longitudinal arches are used, they shall be extended from behind the operator to the front part of the frame and each arch shall have an intermediate support located immediately ahead of the operator so that ingress or egress is not impeded. Regardless of the type of construction used, the fabrication and method of connecting to the tractor shall be of such design as to develop a strength equivalent to the upright members. Guards. Guards shall be provided for exposed moving elements such as shafts, pulleys, belts, conveyors and gears in accordance with American National Standard Safety Code for Conveyors, Cable ways, and Related Equipment, B20.1-1957. Guards shall be in place at all times machine is in operation. Mufflers. Mufflers provided by the manufacturer or their equivalent shall be in place at all times the machine is in operation. Guy lines. Guy lines shall be arranged in such manner that stresses will be imposed on not less than two guy lines. Stumps used for anchoring guy lines shall be carefully chosen as to position and strength. They shall be tied back if necessary. Standing trees shall not be used for this purpose.

Harvesting and Felling

Work areas shall be assigned such that a tree cannot fall into an adjacent work area. The recommended distance between workers is twice the height of trees being felled. When trees may fall into public roads a flagman shall be assigned to direct traffic. Workers shall not approach a feller closer than twice the height of trees being felled until the feller has acknowledged the signal of approach. Lodged trees shall be pulled to the ground at first opportunity with mechanical equipment or animal. Workers shall not work under a lodged tree. Special precautions shall be taken to prevent felling trees into power lines. If a tree does make contact with a power line the power company shall be notified immediately and all personnel shall remain clear of the area until power company personnel advises that conditions are safe.

Manual Felling

The feller shall plan a retreat path and clear the path as necessary before cut is started. The feller shall appraise situation for dead limbs, the lean of tree to be cut, wind conditions, location of other trees and other hazards and exercise proper precautions before cut is started. Undercuts shall be about one-third the diameter of the tree to guide tree and reduce possibility of splitting. (Local practice where small diameter trees are felled without being undercut is acceptable if the direction of fall is controlled by the practice.) Back or felling cut shall be parallel to the inner edge of the undercut and approximately two inches higher than the undercut. The saw shall be shut off before feller starts his retreat. On terrain where trees are likely to slide or roll fellers shall fell trees from the uphill side and arrange to keep uphill from previously felled trees.

Bucking

Bucking on slopes shall be from the uphill side unless the log has been securely blocked to prevent rolling or swinging. Spring poles and trees under stress shall be cut so that employee is clear when the tension is released. (This is accomplished by cutting under the bend.) Trees piled for bucking shall be piled in an orderly parallel manner that minimizes hazard to employees. Spring poles and limbs under stress shall be cut in such a manner that the employee is clear when tension is released. Mechanical debarking and delimbing. Guarding shall be provided so as to protect employees from flying chunks, logs, chips, bark, limbs, and other material and to prevent the worker from contacting moving parts.

Skidding & Pre-Hauling

Only a designated, trained operator shall operate a skid or pre-haul machine. Choker setters shall work on uphill side of log. No passenger personnel shall ride on a pre-haul vehicle, logs, pallets, skid pans or other load unless adequate seating and protection is provided except on animal powered wagons. Chokers shall be positioned near the end of the log or tree length to allow turning of the pre-haul vehicle, to prevent the penetration of the operator station and to reduce possibility of striking the wheel or track. During winching, the equipment shall be positioned so that the winch line is in alignment with the long axis of the pre-haul machine. A stuck or inoperative vehicle shall be towed. A loaded pallet shall not be pushed. Stakes shall not be added to permit a load beyond the rated capacity of pallets and trailers. The operator shall be observant and cautious of height of load and vehicle when traveling under trees, limbs, and other overhead obstructions.

Skidding Equipment Requirements

Arches, fair leads, draw bars, hitches and bumpers or fenders shall be designed and constructed to allow a minimum radius vehicle turn without the load contacting a rear tire or the rear of a track assembly. Towed equipment such as skid pans, pallets and trailers shall be attached in such a manner as to allow a full 90 degree turn, prevent overrunning of the towed vehicle, and assure control of the towed equipment. Animal towed equipment shall be equipped with a hand brake within reach of the driver. Prehaulers shall have a means for securely retaining pallets or pulpwood. Prehaulers shall have a means of securely retaining loader for transport when so equipped. Provision shall be made to securely fasten and to protect all tools and material on the carrier.

Personnel Transport

The driver shall be licensed as required by the state department of motor vehicles. Explosives or flammable liquids shall not be transported on crew vehicles. Seats shall be securely fastened. Truck drivers shall stop their vehicles, dismount, check and tighten loose load binders, either just before or immediately after leaving a private road to enter a public road.

Truck Roads

Truck road grades. Truck road grades shall not be too steep for safe operation of logging or work trucks which operate over them and shall not exceed twenty percent in any case unless a positive means of lowering trucks is provided. Truck roads shall be of sufficient width and evenness to insure the safe operation of equipment. Hazards such as broken planking, deep holes, large rocks, logs, etc., which prevent the safe operation of equipment, shall be immediately corrected. On blind curves, truck roads shall be of sufficient width for two trucks to pass, or some type of signal system shall be maintained or speed limited to such that the vehicle can be stopped in one-half the visible distance. All danger trees shall be felled a safe distance back from the roadway. Rocks, which present a hazard, shall be cleared from banks. Brush and other materials that obstruct the view at intersections or on sharp curves shall be

cleared. (This subsection is applicable only to those portions of roads under direct control of the employer.) All structures shall be adequate to support the maximum imposed loads without exceeding the maximum safe working unit stresses. All bridges shall have an adequate number of reflectors to clearly define the entrance to the bridge. All structures shall be maintained in good condition and repair and shall be inspected at least annually by a qualified authorized person and a record maintained of each inspection. Shear rails shall be installed on both outside edges of bridges. The shear rails must be securely fastened and made of material capable of withstanding the impact generated by contact with the wheels of a loaded vehicle. The top of shear rails shall be not less than fifteen inches above the bridge surface. Bridges in use prior to the effective date of these regulations with outside shear rails of a minimum of ten inches high or center type shear rails of not less than five inches high are permissible until such time repairs are needed.

Dust on Logging Roads

Measures shall be instituted which will minimize dust to such degree that visibility will not be reduced beyond the point where an operator can safely operate a vehicle. Vehicle operators shall govern the speed of vehicles by road conditions. Pneumatic-tired equipment shall be equipped with fenders as described in the Society of Automotive Engineers Technical Report J321a. Before starting to fall or buck any tree or snag, the cutter shall survey the area for possible hazards and proceed according to safe practices. Snags which are unsafe to cut shall be blown down with explosives or felled by other safe methods. Workers shall not approach a faller within reach of the trees being felled unless a signal has been given and acknowledged by the faller that it is safe to approach. Before falling or bucking any tree, sufficient work area shall be swamped and an adequate escape path shall be made. An escape path shall be used as soon as the tree or snag is committed to fall, roll or slide.

Warning to be given.

Fallers shall give timely and adequate warning prior to falling each tree; such warning shall be given with the saw motor at idle or shut off. Persons in the area shall give response to the faller and shall also notify him when they are in the clear. A competent person, properly experienced in this type of work, shall be placed in charge of falling and bucking operations. Inexperienced workers shall not be allowed to fall timber or buck logs unless working under the direct supervision of an experienced worker. Snags that have loose bark in the area of the proposed cut shall have the bark removed before being felled. When a snag has elevated loose bark which cannot be removed, the buddy system shall be used to watch for and give warning of falling bark or other hazards. Tools of fallers and buckers, such as axes, sledges, wedges, saws, spring boards, etc., must be maintained in safe condition. Case hardened or battered sledges and wedges shall not be used. All tools shall be used for their intended purposes.

Trees shall not be felled if the falling tree can endanger any worker or strike any line or any unit in the operation. When practical, strips shall be laid out so cutters face out into opening when starting strip, and all trees shall be felled into the open whenever conditions permit. Cutters shall not fall into another strip; leaners on the line shall be traded. When there is danger from kickback of a sapling, the same must be either undercut or felled. Cutters shall place an adequate undercut and leave sufficient holding wood to insure the tree will fall in the intended direction. When required, mechanical means shall be used to accomplish this objective. Cutters shall be careful their chopping range is unobstructed. Cutters shall confer with their supervisor regarding a safe manner of performing the work and in unusually hazardous situations shall not proceed with the work until their method has been approved by their supervisor.

The person in charge of cutting crews shall regularly inspect the work of the cutting crews and shall be responsible for seeing the work is performed in a proper and safe manner. Common sense and good judgment must of necessity govern the safety of cutters as affected by weather conditions. At no time shall they work if wind is strong enough to prevent the falling of trees in the desired direction or when vision is impaired by dense fog or darkness. All fallers and buckers shall have a current first-aid card. All fallers and buckers shall carry or have with them in near proximity at all times, an axe, a minimum of two

wedges, a whistle and a first-aid kit. The whistle shall be carried on their person. Special precautions shall be taken to prevent trees from falling into power lines. If it appears that a tree will hit a power line, the power company shall be notified before it is attempted to fall the tree. If an unsuspected tree does contact a power line, the power company shall be notified immediately and all persons shall remain clear of the area until the power company personnel advise that conditions have been made safe to resume operations.

Wedges shall be of soft metal, hardwood or plastic. Wedges shall be driven with a hammer or other suitable tool. Double-bitted axes or pulaskies shall not be used for this purpose. While wedging, fallers shall watch for falling limbs or other material that might be jarred loose. Cutting of holding wood in lieu of using wedges is prohibited. Undercuts are required except in match cutting, and shall be large enough to safely guide trees and eliminate the possibility of splitting. Trees with no perceptible lean having undercuts to a depth of one-fourth of the diameter of the tree with a face opening equal to one-fifth of the diameter of the tree, will be assumed to be within reasonable compliance with this rule. Swing cuts are prohibited except by an experienced person. Undercuts shall be completely removed except when a dutchman is required on either side of the cut. Back cuts shall be as level as possible and shall be approximately two inches higher than the undercut, except in tree pulling. Trees with face cuts or back cuts shall not be left standing.

When a tree is not completely felled, the faller shall clearly mark the tree, shall discontinue work in the hazardous area and notify his immediate supervisor. The supervisor shall be responsible for notifying all workers who might be endangered and shall take appropriate measures to ensure that the tree is safely felled before other work is undertaken in the hazardous area. To avoid use of wedges, which might dislodge loose bark or other material, snags shall be felled in the direction of lean unless other means (mechanical or dynamite) are used. Lodged trees shall be clearly marked and identified by a predetermined method and all persons in the area shall be instructed not to pass or work within two tree lengths of such trees except to ground them. Work areas shall be assigned so that a tree cannot fall into an adjacent occupied work area. The distance between work areas shall be at least twice the height of the trees being felled. A greater distance may be required on downhill slopes depending on the degree of the slope and on the type of trees and other considerations.

Where felled trees are likely to roll and endanger workers, cutting shall proceed from the bottom toward the top of the slope, and performed uphill from previously felled timber. Cutters shall not be placed on a hillside immediately below each other or below other operations where there is probable danger. Fallers shall be informed of the movement and location of buckers or other cutters placed, passing or approaching the vicinity of trees being felled. A flag person shall be assigned on roads where hazardous conditions are created from falling trees. Where there is no through traffic, such as on a dead end road, warning signs or barricades shall be used. No tree or danger tree shall be felled by one cutter where and when the assistance of a fellow cutter is necessary to minimize the dangers or hazards involved. Cutters shall be in the clear as the tree falls. Undercuts and back cuts shall be made at a height above the highest ground level to enable the cutter to safely begin the cut, control the tree, and have freedom of movement for a quick escape to be in the clear from a falling tree. When falling, a positive means, method or procedure that will prevent accidental cutting of necessary holding wood shall be established and followed. Particular care shall be taken to hold enough wood to guide the tree or snag and prevent it prematurely slipping or twisting from the stump. The undercut shall not be made while buckers or other workers are in an area into which the tree could fall. Match cutting should not be permitted and shall be prohibited for trees larger than six inches in diameter breast high. The tree (and root wad if applicable) shall be carefully examined to determine which way the logs (and root wad) will roll, drop, or swing when the cut is completed. No worker shall be allowed in this danger zone during cutting. Logs shall be completely bucked through whenever possible. If it becomes hazardous to complete a cut, then the log shall be marked and identified by a predetermined method. Rigging crews shall recognize such marks and when possible, cutters shall warn the rigging crew of locations where such unfinished cuts remain. Cutters shall give timely warning to all persons within range of any log which may have a tendency to roll after

being cut off. Propping of logs or trees as a means to protect workers down slope from the logs or trees, shall be prohibited. Logs shall not be jackstrawed when being bucked in piles or decks at a landing.

Falling & Bucking

Springboards shall be of clear, straight-grained sound stock of sufficient length, width and strength and shall be replaced when they will no longer safely support the expected load at the extreme end. Springboard irons shall be well lipped and firmly attached with bolts or a means of attachment furnishing equivalent strength. Two workers shall be present when falling any tree or snag when springboards are used. Power saw chains shall be stopped while shifting springboards. Jack plates shall be used with hydraulic tree jacks and the base plate shall be seated on solid wood inside the bark ring as close to level as possible. Two workers shall be present at all times during the use of tree jacks. Wedges shall be used as a follow-up method while using tree jacks. The wedges shall be continuously moved in as the tree is jacked. All hydraulic tree jacks shall be equipped with an operable velocity fuse (check valve) and the pump shall be equipped with an operable pressure gauge. When tree jacking, the face cut shall be nominally one-fourth the diameter of the tree. The vertical height of the face cut shall be not less than one-fifth of the diameter of the tree when tree jacking.

Spar, Tail & Intermediate Trees

Douglas fir or spruce shall be used as spar, tail, or intermediate support trees when they are available. If other species must be used, additional guy lines, tree plates, or other precautions shall be taken to insure the tree will withstand the strains to be imposed. Spar, tail and intermediate support trees shall be examined carefully for defects before being selected. They shall be sound, straight, green and of sufficient diameter to withstand the strains to be imposed. Trees having defects that impair their strength shall not be used for spar, tail or intermediate support trees. Raised trees shall be identified and marked as such. Before raising spar trees, dummy trees shall be topped and guyed with three guy lines equivalent in taking strength to the mainline.

Anchoring

Stump anchors used for fastening guy lines and skylines shall be carefully chosen as to position, height and strength. When necessary, stump anchors shall be tied back in a manner that will distribute the load. Stump anchors shall be barked where attachments are to be made, or devices designed to accomplish the same purpose shall be used. Stump anchors shall be notched to a depth not greater than one and one-half times the diameter of the line to be attached. Dead man anchors may be used if properly installed. Guy lines shall not be directly attached to dead man anchors. Suitable straps or equally effective means shall be used for this purpose. Rock bolts and other types of embedded anchors may be used if properly designed and installed. Stumps, trees and embedded type guy line anchors shall be regularly inspected while the operation is in progress. Insecure or hazardous anchors shall be immediately corrected. Workers shall not stand close to the stump, or in the bight of lines as the guy line or wraps are being tightened.

Blocks

All blocks shall: Not be used for heavier strains or lines than those for which they are constructed; be fitted with line guards and shall be designed and used in a manner that prevents fouling, with the exception of special line blocks not designed with line guards; be kept in proper alignment when in use; have bearing and yoke pins of a material that will safely withstand the strains imposed and shall be securely fastened; have sheaves of a size designed for the size of the wire rope used. Blocks with cracked or excessively worn sheaves shall not be used. Lead blocks used for yarding, swinging, loading and unloading used in wood spars shall: be of the type and construction designed for this purpose; be bolted

with not less than two bolts through the shells below the sheaves in a manner that will retain the sheave and line in case of bearing pin failure (this does not apply to haul back lead blocks); and mainline blocks shall have a sheave diameter of not less than twenty times the diameter of the mainline. Block bearing shall be kept well lubricated. All blocks must be of steel construction or of material of equal or greater strength and so hung that they will not strike or interfere with other blocks or rigging. All pins in blocks shall be properly secured by "Molle Hogans" or keys of the largest size the pin hole will accommodate. When blocks are hung in trees, threaded pins and nuts shall be used. Sufficient corner or tail blocks to distribute the stress on anchors and attachments shall be used on all logging systems. Blocks used to lead lines directly to yarding, loading or unloading machines other than pass line or straw line blocks shall be hung by the following method: In both eyes or "D"s of straps; threading eye through eye is prohibited. Tail, side or corner blocks used in yarding shall be hung in both eyes of straps.

Wire Rope

Wire rope shall be of the same or better grade as originally recommended by the equipment manufacturer. Wire rope shall be removed from service when any of the following conditions exist: In running ropes, six randomly distributed broken wires in one lay or three broken wires in one strand in one lay; Wear of one-third the original diameter of outside individual wires. Kinking, crushing, bird-caging, or any other damage resulting in distortion of the rope structure; Evidence of any heat damage from any cause; Reductions from nominal diameter of more than 3/64-inch for diameters to and including 3/4-inch, 1/16-inch for diameters 7/8-inch to 1-1/8-inch, inclusive, 3/32-inch for diameters 1-1/4-inches to 1-1/2-inches inclusive; in standing ropes, more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection; In standing ropes, when twelve and one-half percent of the wires are broken within a distance of one wrap (lay); and corroded, damaged or improperly applied end connections. Wire rope shall be kept lubricated as conditions of use require. Marlin spikes or needles in good condition and large enough for the size of the line being spliced, shall be used for splicing. When available, and practical to use, a patented wire cutter shall be used. If using a wire axe to cut cable, the hammer used to strike the axe shall be made of soft non-spalling type material. Eye and face protection must be worn. Short splices, eye to eye splices, cat's paws, knots, molles and rolled eyes are prohibited except for use in the moving of slack lines. Knots will be permitted for use on single drum tractors and grapple pick-up lines when properly tied. Wire rope 1/2-inch or less in diameter may be tucked two times provided the rope is used only as straw line. Splices other than eye splices in lang lay lines are prohibited. Eye splices in lang lay lines shall be tucked at least four times. Long splices shall be used for permanently joining "regular lay" running lines. When U-bolt wire rope clips (clamps) are used to form eyes on high strength wire rope, an additional clip (clamp) for each grade of line above improved plow steel shall be used.

Lines, Straps & Guy Lines

When in use, steel tower guy line safety straps shall have a minimum amount of slack. A safety strap shall be installed on steel towers at the bight of the guy lines to prevent the guy lines from falling in the case of failure of guy line attachments, guy line lug rings or collar plates, where such exist. Such devices shall have a breaking strength at least equivalent to that of the guy lines. The use of cable clips or clamps for joining the ends of steel tower guy lines safety straps is prohibited, unless used to secure end of rolled eye.

Logging Type Machines

A minimum distance of thirty-six inch clearance shall be maintained between the counterweight of a loading machine and trees, logs, banks, trucks, etc., while the machine is in operation. If this clearance cannot be maintained, suitable barricades with warning signs attached, similar to a standard guardrail,

shall be installed to isolate the hazardous area. "DANGER--36 inch clearance" shall be marked in contrasting colors on sides and face of counterweight on shovels, loaders and other swing-type logging equipment. This requirement shall not apply when: The distance from the highest point of the undercarriage to the lowest point of the rotating superstructure is greater than 18- inches. This applies only to that portion of the rotating superstructure that swings directly over the undercarriage; The distance from the ground to the lowest point of the rotating superstructure is greater than five feet six inches. This applies only to that portion of the rotating superstructure that swings directly over the undercarriage; or On crawler-type track-mounted logging machines only, the rotating superstructure is positioned at a right angle to the tracks, and the distance from the side of the cab to the extreme end of the track is four feet or less. This exemption shall apply to side barricades only; barricades between the tracks at both ends of any crawler-type logging machine are required regardless of the right angle dimension.

Logging machines shall not be operated until all guards have been installed, safety devices activated and maintenance equipment removed. Stationary logging machines shall be securely anchored to prevent movement of the machine while yarding or skidding. Ends of drum lines shall be securely fastened to the drum and at least three wraps shall be maintained on the drum at all times. (This rule does not apply to tractor winch lines.) Such units shall not be tied to any part of the towing unit, when they are being moved on truck and trailer units. Logs shall not be moved, swung or held over any persons. Brow logs in the loading or unloading area shall be blocked or secured to prevent movement. Log decks shall be maintained in a safe condition and shall not present a hazard of logs rolling or sliding on workers. Brakes shall be set and brake locking devices engaged on logging machines when the operator leaves his normal operating position. Guy line drum controls and outrigger controls shall be separated, color coded or marked in a manner that will prevent engaging of the wrong control.

Exhaust pipes shall be located or insulated to protect workers from accidental contact with the pipes or muffler and shall direct exhaust gases away from the operator and other persons. Glass on logging machines shall be safety glass or equivalent and shall be free of deposits of oil, mud, or defects that could endanger the operator or other persons. Broken or defective glass shall be removed and replaced. Where safety glass or equivalent, does not provide adequate operator protection from flying chokers, chunks, saplings, limbs, etc., an additional metal screen and/or barrier shall be provided over the safety glass. The operator's vision shall not be impaired. Barriers shall consist of 1/4-inch diameter woven wire material with maximum two inch openings, 3/4-inch diameter steel rod with eight inch maximum openings in any direction or barriers so designed and constructed to provide equivalent operator protection. Such barriers shall be installed no closer than four inches to the glass to enable keeping the glass clean.

Except for hydraulic drums, brakes shall be installed on all logging machines and maintained in effective working condition. Brake levers shall be provided with a ratchet or other effective means for securely holding drums. Brakes shall be tested prior to putting the machine in operation. If defective, they shall be repaired immediately. A stable base shall be provided under outriggers or leveling pads and a means shall be provided to hold outriggers in both the retracted and extended position. Abrasive contact with hydraulic hose, tubing or fittings shall be eliminated before further use and defective hydraulic hoses, lines and fittings shall be replaced. When moving logging machines, the driver or operator shall have a clear and unobstructed view of the direction of travel. When this is not possible, a signal person with a clear and unobstructed view of the direction of travel shall be designated and used to direct movement of the machine. Where a signal person is used, the equipment operator shall move the equipment only on signal from the designated signal person and only when the signal is distinct and clearly understood. When moving power units, persons other than the operator and the person in charge shall not be permitted to ride thereon. All obstructions which may reach the operator while moving machines, shall be removed. Only shackles with threaded pins shall be used for connecting moving rigging. Anchors used for moving power units shall be carefully chosen and must be stable. When snubbing a machine down a steep slope, use the mainline for snubbing and pull with the haul back whenever possible.

Self-powered mobile logging machines of the type where towers or spars can be raised, shall not travel on

steep road grades unless they are securely snubbed or towed. When moving, all persons working on the landing shall stay in the clear of the machine and shall inform the operator of their intention to approach or be near the machine. Service brakes shall be provided on crawler crane-type logging machines that will bring the machine to a complete stop from normal travel speeds. A traction lock or brake or an equivalent locking and braking system shall be provided on crawler crane-type machines that is capable of holding the machine stationary under normal working conditions, and on any grade the machine is capable of negotiating.

No modifications or additions which affect the capacity or safe operation of the equipment shall be made by the employer without written approval of the manufacturer or a qualified engineer. If such modifications or changes are made, the capacity, operation and maintenance instruction plates, tags, or decals, shall be changed accordingly. In no case shall the original safety factor of the equipment be reduced. Equipment shall be classed and used according to the manufacturer's rating. Where low gear ratios or other devices are installed to increase the line pull in accordance with subsection of this section, the size of the rigging shall be increased accordingly so that it will safely withstand the increased strains. Every tractor, skidder, front-end loader, scraper, grader and dozer shall be equipped with a roll-over protective structure. Such structures shall be installed, tested and maintained in accordance with the society of automotive engineers SAE 1040a- 1975, "performance criteria for roll-over protective structures (ROPS) for earth moving, construction, logging and industrial vehicles". The ROPS shall be of sufficient height and width so that it will not impair the movements of the operator or prevent his immediate escape from the vehicle in emergencies and shall allow as much visibility as possible. Clearance above the deck and the ROPS of the vehicle at points of egress shall not be less than fifty-two inches. Certified roll-over protective systems shall be identified by a metal tag permanently attached to the ROPS in a position where it may be easily read from the ground. The tag shall be permanently and clearly stamped, etched or embossed indicating the name and address of the certifying manufacturer or registered professional engineer, the ROPS model number (if any) and the vehicle make, model or serial number the ROPS is designed to fit. Roll-over protective structure systems shall be maintained in a manner that will preserve their original strength.

Welding shall be performed by qualified welders only. (A qualified welder is defined under "welder qualification" in American Welding Society A.W.S. A3.0-69.) Every tractor, skidder, front-end loader, log stacker, forklift truck, scraper, grader and dozer shall be equipped with a FOPS. Such structures shall be installed, tested and maintained in accordance with the society of automotive engineers SAE J231-1971, "minimum performance criteria for falling object protective structures (F.O.S.)." Vehicles equipped with ROPS or FOPS as required in subsections and of this section, shall comply with the society of automotive engineers SAE J397a-1972, "deflection limiting volume for laboratory evaluation of roll-over protective structures (ROPS) and falling object protective structures (FOPS) of construction and industrial vehicles." The opening in the rear of the ROPS on the crawler or rubber- tired tractors (skidders) shall be covered with 1/4-inch diameter woven wire having not less than 1-1/2-inches or more than 2-inch mesh, or material which will afford equivalent protection for the operator. The covering shall be affixed to the structural members so that ample clearance is provided between the screen and the back of the operator. Structural members shall be free from projections which would tend to puncture or tear flesh or clothing.

Suitable safeguards or barricades shall be installed, in addition to the screen, to protect the operator when there is a possibility of being struck by any material that could enter from the rear. Crawler and rubber-tired tractors (skidders) working in areas where limbs or brush may endanger the operator shall be guarded. Shear or deflector guards shall be installed on each side of the vehicle at an angle leading forward and down from the top front edge of the canopy of the vehicle, which will tend to slide the brush or limbs up and over the top of the canopy. Open mesh material with openings of a size that will reject the entrance of an object larger than 1-3/4-inches in diameter, shall be extended forward as far as possible from the rear corners of the cab sides to give the maximum protection against obstacles, branches, etc. entering the cab area. Deflectors shall also be installed ahead of the operator to deflect whipping saplings

and branches. These shall be located so as not to impede ingress or egress from the compartment area. The floor and lower portion of the cab shall be completely enclosed with solid material, except at entrances, to prevent the operator from being injured by obstacles which otherwise could enter the cab compartment.

Yarding Requirements

Workers shall be alert and be positioned in the clear where they will not be exposed to the hazards of moving logs, saplings, root wads, chunks, rigging, or any other material which might be put in motion by the rigging or turn, before the "go ahead" signal is given. They shall remain in the clear at all times while the rigging is moving. No person shall be near rigging which is stopped at a hangup, until the rigging has been slacked to reduce the hazard. No person shall stand or remain within the bight of any running line, nor in a position where he could be struck by a line were it to break or come loose. Whenever possible, chokers shall be set from the uphill side of a log. Persons shall not be on the lower side of a log which appears to be unstable or likely to roll. Wire rope used for chokers shall not exceed seventy-five percent of the breaking strength of the mainline. Chokers shall be placed near the end of the log whenever possible. When pulling lines, do not stand close to fair leads or blocks. Lines shall not be guided on drums with hands or feet. The use of a bar or equivalent means is recommended.

Yarding with more than one unit on any one head spar is prohibited. The angle between the power unit, the high lead block, and the mainline road shall not exceed a square lead on rigged spars. When using portable spars or towers, the location of the machine or position of the operator shall be such that the operator shall not be endangered by incoming logs. When there is danger of tail block straps slipping up or off the stump or tree, the stump or tree shall be adequately notched or the line properly wrapped and secured. When the tail tree or stump is not secure, it shall be tied back. When yarding is being done during the hours of darkness, the area shall be provided with illumination which will allow persons to safely perform their duties. The source of illumination shall be located and directed creating a minimum of shadows and glare. If using a portable tail-hold, lights shall be directed on the equipment to allow the person to visually ascertain that the tail-hold equipment remains stabilized. No person shall be required or allowed to ride on a turn of logs or rigging excepting the pass line. The practice of holding on to moving rigging or chokers to assist a person by being pulled uphill shall be prohibited. Wire rope shall be wound evenly on the drum and not be allowed to lap one layer on another in an irregular manner. Sheaves shall be smooth and free from defects that could cause rope damage. Chaser shall be sure that turns are safely landed before approaching to remove the chokers. Signaling machine operator at landings by throwing bark, chips or other material in the air is prohibited. Whistle or hand signals shall be used at all times. Logs shall not be landed while loaders or chasers are working in the chutes. Logs shall not be removed from yarder tree by the loader or tractors while the chaser is unhooking a turn from the yarder.

Landings shall be as level as possible and of sufficient size to safely accommodate the majority of type turns to be yarded. At least two-thirds of the log shall rest on the ground or other substantial material when landed. Logs shall be set on the ground or deck and not dropped when being landed. Long sticks shall be safely removed before additional logs are landed. Chokers shall not be used on a grapple system when the yarder operator cannot clearly see the persons setting the choker, unless conventional whistle signals are used. Landings shall be free of root wads, limbs, tops, etc., that constitute a safety hazard. When shorter logs are yarded in the same turn with long sticks, the shorter logs shall be landed and chokers released before the long stick choker is released. Operators shall ensure that all persons are safely in the clear before initiating or continuing the movement of any mobile equipment. No person shall ride on any mobile equipment, except where adequate and protected seats, or other safe facilities have been provided. While in use, tractors and skidders shall be maintained in a safe operable condition, with all guards in proper places. No person shall be under a tractor or other mobile equipment, or be placed in a

hazardous position around the equipment without first making certain it cannot move or be moved by another person. Prior to working on tractor or skidder blades, arches, or other equipment, the equipment must be blocked up lowered to the ground or otherwise secured against slipping or falling.

Prior to working on hydraulic equipment, the pressure shall be relieved. When making repairs to tractor or skidder equipment, such as blades, arches, etc., the engine shall be stopped. The engine may be run when necessary for making adjustments to the engine or equipment. Operators shall operate and control their machines in a safe manner and avoid operations in areas where machine stability may not be maintained.

The following safe work procedures shall be adhered to:

When hobo logs are picked up with a log turn, the turn shall be dropped to free the hobo.

No line shall be allowed to trail behind the tractor or skidder where it may hang up and snap forward.

Winching at a severe angle, which could cause a hang-up to upset the machine, shall be avoided. Grapple skidded log turns shall be evenly bunched with squared butt ends, securely grappled and safely positioned before travel commences.

Before climbing or descending grades, the proper gear shall be selected to allow the engine to govern the tractor speed.

On side hills, an abrupt turn uphill shall be avoided.

The tractor or skidder shall be backed downhill first then turned uphill. The turn may be slacked off as necessary to permit this maneuver.

The operator shall, before leaving a tractor or skidder, lower the blade to the ground and apply the parking brake.

Tractor or skidder speed shall be adjusted to the circumstances prevailing.

Excessive or uncontrolled speed shall be avoided. Winch lines on logging tractors or skidders shall be attached to the drum with a break-away device. Hand signals are required for giving instructions to the tractor or skidder operator. Tractor and skidder brakes shall stop and hold the machine on any grade over which the machine is being operated. They shall be effective whether or not the engine is running and regardless of the direction of travel. Tractors and skidders shall be provided with a brake locking device that will hold the machine indefinitely on any grade on which it is being operated. Operating a tractor or skidder with defective steering or braking devices is prohibited. Arches shall be equipped with line guards. Where tractor and skidder operators or helpers, because of the nature or their work duties, are required to wear calk soled footwear, the decks and operating foot controls shall be covered with a suitable non slip material. Glass used in windshields or in cabs shall be of "safety glass." Broken or cracked glass shall be replaced as soon as practical. Barriers shall provided, as needed, to protect the glass from being broken by using screen, bars or other material. The protective material shall be a type that will not create a hazard by undue impairment of the operators' vision. Barriers shall be constructed of at least 1/4-inch diameter woven wire with two inch maximum openings or other material providing equivalent protection. The barrier shall be installed at least four inches from the glass to provide space to clean the glass. Enclosed-type cabs installed on mobile equipment shall have two means of exit. One may be deemed as an emergency exit and be available for use at all times, regardless of the position of the side arms or other movable parts of the machine. (An easily removable window will be acceptable as the emergency exit if it is of adequate size for a person to readily exit through.) Seat belts shall be installed on tractors and other mobile equipment equipped with a roll-over protective system and shall be worn by the operator and passenger at all times the vehicle is in motion. The seat belts and assemblies shall be designed, constructed and maintained to conform to the requirements specified in the society of automotive engineers technical report J386 or J333a. Seat belts need not be provided for equipment which is designed for stand-up operations. If the equipment operator and person in charge of the job site agree

that life safety of the operator is jeopardized by wearing a seat belt, the seat belt need not be worn. Seat belts required by subsection of this section, shall have buckles of the quick release type, designed to minimize the possibility of accidental release. Before a tractor or skidder is started or moved, the operator shall be certain nothing is in the way that could be set in motion by the movement of the machine thereby endangering persons. A log or turn shall not be moved until all persons are in the clear (behind the turn and on the uphill side on sloping ground).

Before the engine is shut-down, the brake locks shall be applied and all elements such as blades, buckets, grapples and shears shall be lowered to the ground. Tractors or skidders shall not be operated within a radius of two tree heights of trees being felled unless called upon by the cutter or faller to ground lodged trees. All cutters shall be notified of the tractor or skidder entrance into the area and all felling within two tree lengths of the tractor or skidder shall be stopped. Except where electrical distribution and transmission lines have been de-energized and visibly grounded at point of work or where insulating barriers, not a part of or an attachment to the equipment or machinery, have been erected to prevent physical contact with the lines, equipment or machines shall be operated proximate to power lines only in accordance with the following: For lines rated 50 kV or below, minimum clearance between the lines and any part of the equipment or machine shall be ten feet; For lines rated over 50 kV, minimum clearance between the lines and any part of the equipment or machine shall be ten feet plus 0.4 inch for each 1 kV over 50 kV, or twice the length of the line insulator, but never less than ten feet; In transit with no load and boom or extended equipment lowered, the equipment clearance shall be a minimum of four feet for voltages less than 50 kV, and ten feet for voltages over 50 kV up to and including 345 kV, and sixteen feet for voltages up to and including 750 kV; A person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means; Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate it is not an energized line and it has been visibly grounded. Log piles and decks shall be located and constructed to provide working areas around them that will accommodate the safe movement of personnel and machinery. Braking systems required by subsection of this section, shall be capable of stopping the equipment fully loaded. All rubber-tired tractors or other types of mobile equipment listed below, manufactured after the effective date of these standards, shall have braking systems and requirements specified in the applicable technical reports of the society of automotive engineers as follows: Brake systems for off-highway, rubber-tired, self-propelled scrapers shall meet or exceed the requirements outlined in SAE technical report J319b. Brake systems for off-highway, rubber-tired, front-end loaders, log stackers and dozers (skidders) shall meet or exceed the requirements outlined in SAE technical report J237. Brake systems for rubber-tired, self-propelled graders shall meet or exceed the requirements outlined in SAE technical report J236. Brake systems for off-highway trucks and wagons shall meet or exceed the requirements outlined in SAE technical report J166. Helicopters and helicopter cranes shall comply with any applicable regulations of the Federal Aviation Administration. Prior to each day's operation, a briefing shall be conducted. This briefing shall set forth the plan of operation for the pilot and ground personnel. A take-off path from the log pickup point shall be established, and shall be made known to all workers in that area before the first turn of logs is moved. The helicopter flight path to and from the drop zone shall be designated and no equipment or personnel (other than flight personnel necessary to assist landing and take-off) will occupy these areas during helicopter arrival or departure. The approach to the landing shall be clear and long enough to prevent tree tops from being pulled into the landing. The helicopter shall not pass over an area in which cutters are working at a height which would cause the rotor wash to inhibit a cutter's ability to safely control a tree or dislodge limbs. Drop zones shall be twice the nominal length of logs to be landed. The drop zone shall be no less than one hundred twenty- five feet from the loading or decking area. Separate areas shall be designated for landing logs and fueling the helicopter. The yarding helicopter shall be equipped with a siren to warn workers of any hazardous situation. Workers shall remain in the clear as chokers are being delivered, and under no circumstances will workers move under the helicopter that is delivering the chokers or take hold of the chokers before they have been released by the helicopter. Log

pickup shall be arranged in a manner that the hook up crew will not work on slopes below felled and bucked timber. If the load must be lightened, the hook shall be placed on the ground on the uphill side of the turn before the hooker approaches to release the excess logs. Landing crew shall be in the clear before logs are dropped. One end of all the logs in the turn shall be touching the ground and lowered to an angle of not more than 45 degrees from the horizontal before the chokers are released. Logs shall be laid on the ground and the helicopter will be completely free of the choker before workers approach the logs. If the load will not release from the hook, the load and the hook shall be on the ground before workers approach to release the hook manually. Loads shall be properly slung. Tag lines shall be of a length that will not permit their being drawn up into rotors. Pressed sleeve, swagged eyes, or equivalent means shall be used for all freely suspended loads to prevent hand splices from spinning open or cable clamps from loosening. All electrically operated cargo hooks shall have the electrical activating device so designed and installed as to prevent inadvertent operation. In addition, these cargo hooks shall be equipped with an emergency mechanical control for releasing the load. The hooks shall be tested prior to each day's operation to determine that the release functions properly, both electrically and mechanically. Personal protective equipment for employees receiving the load shall consist of complete eye protection and hard hats secured by chin straps, and high visibility vests or outer garments. Loose-fitting clothing likely to flap in the down wash, and thus be snagged on hoist line, shall not be worn. Every practical precaution shall be taken to provide for the protection of employees from flying objects in the rotor down wash. All loose gear within one hundred feet of the place of lifting of the load, depositing the load, and all other areas susceptible to rotor down wash shall be secured or removed. Good housekeeping shall be maintained in all helicopter loading and unloading areas. The helicopter operator shall be responsible for size, weight, and manner in which loads are connected to the helicopter. If, for any reason, the helicopter operator believes the lift cannot be made safely, the lift shall not be made. Employees shall not perform work under hovering craft except for that limited period of time necessary to guide, secure, hook and unhook loads. Regardless of whether the hooking or unhooking of a load takes place on the ground or other location in an elevated work position in structural members, a safe means of access and egress, to include an unprogrammed emergency escape route or routes, shall be provided for the employees hooking or unhooking loads. Static charge on the suspended load shall be dissipated with a grounding device before ground personnel touch the suspended load, or protective rubber gloves shall be worn by all ground personnel touching the suspended load. The weight of an external load shall not exceed the manufacturer's rating. Hoist wires or other gear, except for pulling lines or conductors that are allowed to "pay out" from a container or roll off a reel, shall not be attached to any fixed ground structure, or allowed to foul on any fixed structure. When visibility is reduced by dust or other conditions, ground personnel shall exercise special caution to keep clear of main and stabilizing rotors. Precautions shall also be taken by the employer to eliminate as far as practical reduced visibility. Signal systems between air crew and ground personnel shall be understood and checked in advance of hoisting the load. This applies to either radio or hand signal systems. No unauthorized person shall be allowed to approach within fifty feet of the helicopter when the rotor blades are turning. Whenever approaching or leaving a helicopter with blades rotating, all employees shall remain in full view of the pilot and keep in a crouched position. Employees shall avoid the area from the cockpit or cabin rearward unless authorized by the helicopter operator to work there. Sufficient ground personnel shall be provided, when required, for safe helicopter loading and unloading operations. There shall be constant reliable communication between the pilot, and a designated employee of the ground crew who acts as a signal person during the period of loading and unloading. This signal person shall be distinctly recognizable from other ground personnel. Open fires shall not be permitted in an area that could result in such fires being spread by the rotor down wash. Under no circumstances shall the refueling of any type helicopter with either aviation gasoline or Jet B (Turbine) type fuel be permitted while the engines are running. Helicopters using Jet A (Turbine-Kerosene) type fuel may be refueled with engines running provided the following criteria is met: No unauthorized persons shall be allowed within fifty feet of the refueling operation or fueling equipment. A minimum of one thirty-pound fire extinguisher, or a combination of same, good for class A, B and C fires, shall be provided within one hundred feet on the upwind side of the refueling operation. All fueling personnel

shall be thoroughly trained in the refueling operation and in the use of the available fire extinguishing equipment they may be expected to utilize. There shall be no smoking, open flames, exposed flame heaters, flare pots or open flame lights within fifty feet of the refueling area or fueling equipment. All entrances to the refueling area shall be posted with "no smoking" signs.

Static Electricity

Due to the numerous causes of static electricity, it shall be considered present at all times. Prior to starting refueling operations, the fueling equipment and the helicopter shall be grounded and the fueling nozzle shall be electrically bonded to the helicopter. The use of conductive hose shall not be accepted to accomplish this bonding. All grounding and bonding connections shall be electrically and mechanically firm, to clean unpainted metal parts. To control spills, fuel shall be pumped either by hand or power. Pouring or gravity flow shall not be permitted. Self-closing nozzles or dead man controls shall be used and shall not be blocked open. Nozzles shall not be dragged along the ground. In case of a spill, the fueling operation shall be immediately stopped until such time as the person determines that it is safe to resume the refueling operation. When ambient temperatures have been in the 100 degree F. range for an extended period of time, all refueling of helicopters with the engines running shall be suspended until such time as conditions become suitable to resume refueling with the engines running. Helicopters with their engines stopped being refueled with aviation gasoline or Jet B (Turbine) type fuel, shall also comply with subsection through of this section. Hook on persons in logging operations shall wear contrasting colored hard hats, with chins traps, and high visibility vests or outer garments to enable the helicopter operator to readily identify their location. Riding the load or hook of a helicopter is prohibited except in the case of an emergency with the proper safety gear.

Oil & Gas Wells

Blowout Equipment

Blowout prevention equipment (hereinafter referred to as "BOP") in all drilling operations shall be in accordance with recognized safe practices, reasonably adequate to keep the well under control at all times, as well as inclusive of blowout preventers, choke and kill lines, as necessary, and maintained in good working condition at all times. All blowout preventers, choke lines and manifold shall be installed above ground level. Casing heads and optional spools may be installed below ground level provided they are visible and accessible. All pipe fittings and valves placed on, or connected with a blowout preventer, well casing, casing head, or the drill pipe or tubing, shall be of a type suitable for the purpose for which they are to be used and adequate to withstand the pressure which may be encountered. All ram type blowout preventers and related equipment, including casing, shall be tested to the full working pressure rating of said equipment upon installation, provided that components need not be tested to levels higher than the lowest working pressure rated component. Annular type blowout preventers shall be tested in conformance with the manufacturer's published recommendations.

If, for any reason, a pressure seal in the assembly is disassembled, a test to a full working pressure rating of that seal shall be conducted prior to the resumption of any drilling operation. In addition to the initial pressure tests, ram type preventers shall be checked for physical operation each trip and all components, again with exception of the annular type blowout preventer, tested monthly to at least fifty percent (50%) of the rated pressure of the blowout preventer equipment and/or to the maximum anticipated pressure of the blowout preventer equipment and/or to the maximum anticipated pressure to be contained at the surface, whichever is greater. The working pressure rating of all blowout preventers and related equipment shall equal or exceed the maximum anticipated pressure to be contained at the surface. Studs on all well head and blowout preventer flanges shall be checked weekly for tightness. Where locking screws are provided on blowout preventers, hand wheels shall be kept installed and operational, and readily accessible.

The entire blowout preventer and well head assembly shall be kept reasonably clean of mud and ice. A drill stem safety valve shall be available on the rig floor at all times. While a well is being drilled, tested, completed or reconditioned, the appropriate blowout equipment shall be mechanically tested periodically, and the blind rams shall be mechanically tested daily (provided that this requirement does not necessitate a special trip of the tools from the hole). If found defective, any such equipment or rams shall be made serviceable before operations are resumed.

All tests shall be reported with full particulars on the daily drilling log book, and in the case of a pressure test, the pressure applied and the duration shall be recorded. One or more employees employed on the rig shall have an adequate understanding of, and be able to operate, the blowout preventer system. At least one person who is trained in blowout prevention and well control procedures shall be on the well site. Blowout preventer controls shall be readily accessible on the floor and/or at least twenty feet (20') from the well bore and outside the substructure. BOP equipment installed on wells in which formation pressures to be encountered are abnormal or unknown shall consist of a double-gate, hydraulically operated preventer with pipe and blind rams or two single-ram type preventers, one equipped with pipe rams, the other with blind rams and an annular type preventer. In addition, upper and lower kelly cocks, pit level indicators with alarms and/or flow sensors with alarms, and surface facilities to handle pressure kicks shall be installed prior to drilling any formation with known abnormal pressure. Accumulators shall maintain a pressure capacity reserve at all times to provide for operation of the hydraulic preventer and

valves with no outside source.

Areas in which abnormal pressures are likely to be encountered are those as defined by the Oil and Gas Conservation Commission's staff and posted on a map to be available in the State Oil and Gas Supervisor's office. This map, to be updated as information becomes available, will also segregate, vertically, formations where abnormal pressures are likely to be encountered. In all other drilling operations, BOP equipment shall consist of at least one double-gate preventer with pipe and blind rams or two single-ram type preventers, one equipped with pipe rams, the other with blind rams, and sufficient valving to permit fluid circulation at the surface, or shall be as approved by the State Oil and Gas Supervisor's Office and/or the U.S. Geological Survey District Engineer's office, as filed on the drilling permit. Blowout preventer equipment and related casing heads and spools shall have a vertical bore no smaller than the inside diameter of the casing to which they are attached.

Operational Specifics

Spudding shall not commence until all guards are in place on all equipment to be operated; all platforms, stairways and handrails are secured in position; the escape line with buggy is installed; and A-leg pins are instead in their proper A-leg holes and secured by safety pins to prevent their displacement. An escape line shall be a wire rope of suitable diameter and type. It shall be kept free of obstructions. An approved safety buggy with an adequate braking device shall be installed on the escape line and kept at the derrickman's working platform. The safety buggy and escape (geronimo) line shall be checked by the derrickman each trip. Tension on the escape line shall be such that a 180 pound worker sitting in the safety buggy will touch the ground at least twenty feet (20') from the anchor. The minimum length of the escape line, which shall be securely anchored both at the ground and to the rig, shall be adequate to assure no less than 45 degree descent from the vertical plane.

Every person, when engaged in work at ten feet (10') or more above the derrick floor or other working surfaces, shall wear a safety belt with an attached safety line secured to the derrick except during rig up and rig down. Where these regulations prescribe the use of safety belts, the employee shall use an approved safety belt suitable for the particular job and in good condition, which safety belt and life line is to be provided by the employer. The safety belt shall be attached by means of a tail rope or lanyard to a fixed anchor and adjusted to allow the minimum of drop in case of fall. A separate life line shall be provided for each employee requiring a life line, and safety belts and life lines shall be checked before each use and maintained in good condition. Every automatic cat head shall have a separate control. Where dual-purpose controls are used, a positive locking device shall be installed to prevent one automatic cat head from accidentally engaging while the other is in operation.

Wherever practical, every draw works master control shall be effectively locked out when not in use. Guards shall be installed so that controls may not be accidentally engaged through contact by cat lines or other equipment. The engine room, pump house, derrick floor and fourble board shall be enclosed to a sufficient height to provide protection against inclement weather. Exits shall be provided to the outside on at least three sides of the derrick floor. The pump house shall have two doors leading in different directions to the outside. No exit door of a derrick, including all doors of the dog house, shall be held closed with a lock or outside latch while anyone is on the derrick floor. The suction pit or tanks used for the circulation of flammable materials shall not be located inside the pump house. No employee shall handle a traveling hoisting line unless he uses a suitable hand guard, which shall be secured to the derrick. No employee shall slide down any pipe, kelly hose, cable or rope line except in the event of an extreme emergency. No employee shall ride a traveling block with which pipe is being moved at any time. When riding a traveling block or elevators, a safety belt with lanyard shall be worn and the lanyard shall be attached to the block above the hook.

No employee shall use the cat line as a means of ascending to or descending from any point in the derrick except in an emergency. Even then the rotary table shall be locked out and qualified employees shall

operate the cat head and controls. When working on hydraulic tong heads, the input pressure line shall be disconnected. High pressure lines (hydraulic or air) shall have a safety pressure relief valve which shall never be set higher than manufacturer's specifications for the working pressure of the lines or valve. Hydraulic tongs shall be backed up with a safety device able to withstand the full torque of the power tool. Auxiliary power tong units which employ internal combustion engines shall have the power unit placed seventy-five feet (75') upwind of the well bore, considering the normal prevailing wind at the rig location, where location and terrain permit. The rotary table shall not be used for the final making up or initial breaking out of a pipe connection.

All pipe and drill collars racked in a derrick shall be secured with rope or otherwise adequately secured to prevent them from falling across the derrick. Safety clamps, used on drill collars, flush joint pipe, or similar equipment for the purpose of preventing its falling in the well when not held by the elevator, shall be removed from the drill collars, pipe, or similar equipment before being hoisted up into the derrick. Racking foundations shall be designed to withstand the load of racked pipe and drill collars and be secured to prevent turnover.

Mud Pits & Tanks

Portable tanks shall be located where it is not possible for employees or equipment to come into contact with overhead power lines. All discharge lines shall be properly secured. No employee shall jump from one tank top to another. All fixed mud guns used for jetting shall be pinned or hobbled when unattended. Hoses used for jetting operations shall be manned and an employee stationed at the pump control to shut down the pressure in the event of an emergency. Standard railings shall be provided on the inside of all mud tank walkways. Where such walkways are four feet or more above ground level, both sides shall be provided with standard railings.

General Drilling Rules

Surface casing shall be run to reach a depth to prevent blowouts or uncontrolled wells. In areas where pressures and formations are unknown, surface casing shall be of sufficient size to permit the use of an intermediate string or strings of casing. Surface casing shall be set in or through an impervious formation and shall be cemented by the pump and plug or displacement or other approved method with sufficient cement to fill annulus to the top of the hole. If cement is not circulated to the surface during the primary operation, supplemental cemented operations shall be performed to assure that the annular space from the casing shoe to the surface is filled with cement. The cemented casing string shall stand under pressure until the cement has reached a compressive strength of 300 pounds per square inch; providing, however, that no further operation shall be commenced until the cement has been in place for at least eight (8) hours. The term "under pressure" as used herein shall be complied with if one float valve is used or if pressure is otherwise held. Setting depths of all casing strings shall be determined by taking into account formation fracture gradients and the maximum anticipated pressure to be maintained within the well bore. If and when it becomes necessary to run a production string, such string shall be cemented by the pump and plug method and shall be properly tested by the pressure method before cement plugs are drilled. Natural gas which may be encountered in a substantial quantity in any section of a cable tool drilled hole above the ultimate objective shall be shut off with reasonable diligence either by mudding or casing, or other approved method and confined to its original source.

Any gas escaping from the well during drilling operations shall be, as far as practicable, conducted to a safe distance from the well site and burned. An approved safety belt suitable for the particular job or hazard exposure, which shall be attached by means of a tail-rope or lanyard to a fixed anchor and adjusted to allow the minimum of drop in case of a fall, shall be provided and worn. Every person, when engaged in work at ten feet (10') or more above the derrick floor or other working surfaces, shall wear a safety belt with an attached safety line secured to a fixed point, or be supported from the tugger line by a safety

harness or tree trimmer-type belt. The tugger line shall not be free wheeling. Special protective wearing apparel shall be provided and worn as deemed necessary because of unusually hazardous situations not normal to the job.

Emergency Equipment

The well operator shall advise the special services organization of any area which has or may contain insufficient oxygen or has been or may be contaminated by flammable or toxic gases, vapors or dusts. The employer shall insure that servicing is not permitted until sufficient tests have been made with appropriate instruments or equipment to determine the extent of the hazard. If a hazard exists the area must be purged to reduce the hazard to an allowable concentration, or all employees shall be provided with proper protective equipment. In the event of the presence of Hydrogen Sulfide (H₂S), the following limits of exposure shall apply [in parts per million (ppm): A. Ceiling value = 20 ppm B. Time weighted average (TWA) = 10 ppm C. Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift = 50 ppm (10 minutes once only if no other measurable exposure occurs.) Where two (2) or more special services employees are on site, a minimum of two (2) approved positive-pressure or pressure-demand-type breathing equipment for use in H₂S shall be available on location when working in a known or suspected H₂S zone or area. An approved escape breathing apparatus shall be provided for each special services person on the work site. Blowers used for emergency purging or ventilation shall be of a non-sparking type.

All employees shall have been fit tested and trained in the use and operation of the employer-provided breathing equipment available on the job site within the past 12 months, and shall be retained at least annually thereafter. Employees with facial contours, physical impairments, or hair or beard styles that would interfere with the face-to-mask seal necessary for proper respiratory protection shall not enter into areas in which such protection may be necessary. Each special services crew of two or more employees shall have one or more employees with a valid certificate in first aid who will always be present at the work site. C.P.R. (Cardio Pulmonary Resuscitation) training should be received by first aid trained employees at least every three (3) years. Natural or liquefied petroleum gas (LPG) shall not be used to operate spray guns or other pneumatic equipment.

No smoking shall be allowed within twenty-five feet (25') of any flammable material storage area, or within twenty-five feet (25') of the handling of flammable liquids. Any engine being refueled with flammable fuels shall be shut off during refueling. No open flames or smoking shall be permitted within 120 feet of the well bore or well if flammable substances are in the well. Each Special Services Derrick (hereinafter "SSD") shall display the name of the manufacturer, safe load capacity, wind load capacity of miles per hour and capacity rating of the derrick or mast. No SSD shall be subjected to a compression load greater than the safe load limit shown on the manufacturer's plate. SSD shall be set up and guyed according to the manufacturer's recommendations and chocked or otherwise immobilized. SSD shall be equipped with guards which shall prevent the rig-up lines from being displaced from the sheaves during operations or when being raised to, or lowered from, the operating position. A visual inspection of the SSD shall be made by a qualified person before the SSD is raised or lowered.

Pulp Paper & Paperboard Mills

Special Machinery

Conveyors.

Hazardous areas of conveyors shall be adequately safeguarded or workers shall be protected from hazard by other effective means.

Broke shredders.

Cutting heads shall be completely enclosed except for opening at feed side sufficient only to permit entry of stock. The enclosure shall be bolted or locked in place and shall be of solid material or with mesh or other openings not exceeding 1/2 inch.

Sharp edged slitter knives.

Sharp edged slitter knives subject to accidental contact shall be effectively guarded. Carriers shall be provided and used when transporting or carrying sharp edged slitter knives.

Wheels of traveling sections of conveyors.

Traveling sections of conveyors and other equipment with wheels which run on rails or guides, other than railroad equipment, shall be provided with wheel sweep guards installed in front of the traveling wheels in all areas where persons may be exposed to contact. Sweep guards shall have not greater than 1/4 inch clearance above the rail or guide.

Stitching or sewing machine.

Carton or bag stitching machines shall be properly safeguarded to prevent persons from coming in contact with the stitching head and other pinch or nip points.

Beaters & pulpers.

Where the top edge of vessels or tubs is less than standard height guardrails above the floor or operator's platform, a guardrail of standard height shall be installed. If necessary for the protection of the person feeding equipment, an intermediate guardrail or other suitable protection shall be installed. Beater rolls shall be provided with covers.

First dryer.

A permanent guard or apron guard, or both, shall be installed to protect workers from any exposed ingoing nip of the first dryer drum in each section if the area is accessible to workers while the dryer is in operation. Floor and drain openings. Floor and drain openings in walkways and general work areas shall be covered with material or gratings with openings no larger than 2" in the narrow dimension.

Mechanical devices to dump chip cars, trucks or trailers.

When using mechanical equipment to elevate the front end of the chip containers for dumping into a hopper, the shear area between the floor and the elevated section shall be safeguarded. The pit area shall be adequately safeguarded or barricaded. Safeguards shall be installed around the exposed sides of a chip hopper.

Replacing guards.

All permanent guards must be replaced or adequate temporary safeguards provided before a machine is put into operation.

Protection from moving materials.

When material, such as chunks, slivers, cants, or logs could be thrown or flipped by a saw, barker, or other machines, adequate barricades, screens, netting, or other safeguards shall be provided and maintained.

Circular saws (not slasher saws).

Saws shall be provided with standard guards, in accordance with American National Standard 01.1-1954 (reaffirmed 1961). Protection for areas where guards are impractical. Where normal guarding is impractical the hazard shall be reduced to a minimum by use of safety chains, lifelines, signs or other reasonable means. Areas which present a major physical hazard which cannot be reasonably safeguarded shall be identified by use of paint or other materials.

Transporting knives.

Knives used for chip or hog fuel machines, or guillotine cutters, shall be secured in properly constructed containers during transportation. Hand knife or scissors. Workers shall be furnished properly designed and constructed sheaths for safely carrying knives and scissors used for cutting or trimming pulp and paper.

Safe storage for knives and scissors.

Tables where paper is being cut shall be equipped with sheaths or shelves for safe storage of knives and scissors. Safeguard for foot operated treadle switch used to activate power driven equipment. Foot operated treadle switches used for activation of power driven equipment shall be protected by a stirrup type guard or equivalent protection shall be provided to prevent accidental activation.

Automatic pressure actuated stopping devices.

Hand fed machines and other moving equipment which create shear or pinch points which cannot be reasonably guarded may be safeguarded by the installation of pressure activated bars or sensing devices which, when contacted, will automatically stop the machine or equipment.

Gas Masks on Elevators

Elevators located in areas where exposure to potentially harmful concentrations of toxic substances may occur shall be equipped with an adequate supply of gas masks to protect the maximum number of passengers.

Handling Pulp Chips & Hog Fuel

Elevating platform-type or cable-lift type unloading devices shall have adequate back bumper stops. Side rails or other positive means to prevent the trailer from falling shall be used while unloading single trailer units. The truck or tractor shall be secured when elevating platform lifts are used to elevate both the tractor and trailer or single unit trucks. All personnel shall be clear of all hoisting or elevating mechanisms before dumping commences. No person shall remain in any truck while the truck is being elevated.

Taking Chip Samples

A safe area and suitable device shall be provided for the chip tester to use while taking chip samples.

Derail required while unloading hazardous materials. To protect tank cars from being moved while loading or unloading hazardous materials by use of pipes or hoses, a derail and blue flag shall be set between the spotted tank cars and any moving railroad equipment.

Handling Pulpwood from Railway Cars

When rail cars are moved by a tugger or powered drums with cables, a means should be provided or the area barricaded in such a manner that moving cables do not endanger the workers. Railroad flat cars for the conveyance of pulpwood loaded parallel to the length of the car shall be equipped with safety- stake pockets. Where pulpwood is loaded crosswise on a flat car sufficient stakes of sizes not smaller than 4 by 4 inches shall be used to prevent the load from shifting. When it is necessary to cut stakes, those on the unloading side should be partially cut through first, and then the binder wires cut on the opposite side. Wire cutters equipped with long extension handles shall be used. No person shall be permitted along the dumping side of the car after the stakes have been cut.

Cutting Bands on Log Bundles

When cutting bands on bundled logs, workers shall position themselves in a safe location. Double bitted axes shall not be used for cutting bands. Caution shall be used to prevent being struck by ends of bands being cut and, if needed, personal protective equipment shall be worn. Flat cars and all other cars shall be chocked during unloading. Where equipment is not provided with hand brakes, rail clamping chocks shall be used.

Handling Pulpwood from Trucks

Binders or stakes shall not be loosened or removed until the logs are secured and held by equipment which will prevent them from rolling off the truck, or barricades shall be provided which will prevent logs from striking the person removing the binders or stakes. Where binder chains and crane slings are used, the crane slings shall be attached and taut before the binder chains are released. The hooker shall see that the helper is clear before signaling for the movement of the load. The truck driver shall leave the truck cab and be in the clear, preferably in a designated area, and shall be in clear view of the unloading equipment operator while the unloader is approaching the loaded truck. The truck driver shall remain outside the cab and clear of the load while logs are being unloaded except, that after a complete load is lifted as a unit and held stationary, he may enter the cab and drive forward from under the suspended load. Properly constructed bridge or dock plates shall be furnished and used to bridge the area between a dock and truck or railroad car.

Handling Dry Sulfur

Sulfur-burner houses shall be safely and adequately ventilated, and every precaution shall be taken to guard against dust, explosion hazards and fires, in accordance with American National Standards Z9.2-1960 and Z12.12-1968. Non-sparking tools and equipment shall be used in handling dry sulfur. Sulfur storage bins shall be kept free of sulfur dust accumulation, and buildings should be designed with explosion relief, in accordance with American National Standard Z9.2-1960. Electrical equipment shall be of the explosion-proof type. Sulfur-melting equipment shall not be located in the burner room.

Handling Liquid Sulfur

Each facility utilizing liquid sulfur shall carefully examine its own handling system and formulate a written procedure for maintenance, receiving, storing and using this product. Minimum requirements for the procedure shall be as follows: Maintenance personnel and all personnel who work at unloading or

usage points shall be adequately trained to recognize the dangers of escapement from the system and first aid practices to be followed in the event of exposure. Adequate protective equipment (gloves, goggles, etc.) and respiratory protective equipment shall be provided at appropriate locations and personnel who reasonably could be exposed shall be trained in the proper use of these items. A minimum of two trained employees shall be assigned when a tank car is first opened in preparation for venting and unloading. Approved respiratory protective equipment for H₂S exposure, chemical splash goggles and gloves shall be worn when performing this work. Spark producing or electric operated tools shall not be used to unplug railroad car vents. Where venting can cause harmful exposure to other unprotected workers in the area, a venting system shall be installed which adequately contains any gas escapement from a tank car while venting. The vented gas shall be carried to a safe location for discharge or circulated through a scrubbing system. The venting system shall be connected before valves which would allow escapement are opened. No smoking, open burning or welding shall be permitted while unloading is in process or danger of gas escapement exists.

Pulpwood Storage & Handling

Logs shall be piled or removed in an orderly manner. The piles shall be stable and individual logs properly placed to prevent them from rolling or falling. The ends shall not project into walkways, roadways or areas reserved for other purposes and sufficient clearance shall be maintained for safe travel of all vehicles and loads. Wire rope dog lines used for towing or rafting shall not be used when they acquire jiggers to the extent that they present a hazard to the employees handling them; or when they are weakened to the extent that they are hazardous. Boom sticks shall be capable of safely supporting the weight imposed upon them. Stiff booms shall be made by fastening not less than two boom sticks together. The width of the stiff boom shall be not less than 36" measured from outside to outside of the outer logs. The boom sticks shall be fastened together with not less than 4" by 6" cross ties or cable lashing properly recessed into notches in the boom sticks and secured.

Pike poles shall be kept in good repair. Conductive pike poles shall not be used when it is possible that they may come in contact with electrical conductors. Logs shall not be lifted over employees and employees shall stay clear of the hazardous area near where logs are being lifted or swung. Storing or sorting on water or any boom work other than boom boat operations, shall require a minimum of two persons. All mobile equipment used to handle logs, blocks or cants shall be provided with adequate overhead protection. Unloading lines shall be so arranged that it is not necessary for the worker to attach them on the pond or dump side of the load. Unauthorized vehicles and unauthorized foot traffic shall not be allowed in any active sorting, storing, loading, or unloading areas. Log unloaders shall not be moved about the premises with loads raised higher than absolutely necessary. Jackets or vests of fluorescent or other high visibility material shall be worn by persons working on dry land log storage. All log dumps shall be periodically cleared of bark and other debris. Handles of wood hooks shall be locked to the shank to prevent them from rotating.

Barkers, Chippers & Hog Feed Devices

Barker feeding devices shall be designed in such a manner that the operator will not be required to hold or make any physical contact with any log or bolt during the barking operations. Walkways or floors alongside the drum of any barker shall be equipped with standard guardrails on each side exposed to the drum. Employees shall not enter any hazardous area in or around a barker until the main disconnect switch has been opened and locked or tagged out and the switch has been tried to assure that the equipment is de-energized. A dog or locking device in addition to the motor switch, clutch, belt shifter or other power disconnecting device shall be installed on all intermittent barking drums to prevent the drum from moving while it is being filled or emptied.

Log Hauls, Slips & Carriages

Controls shall be arranged to operate from a position where the operator will at all times be in the clear of logs, machinery, lines, and rigging. Controls shall be marked to indicate their function. A guard shall be provided to prevent logs from rolling off the log deck into the well. When needed for protection of personnel, an automatic stop or interlocking device shall be installed on log hauls or slips. A barricade or other positive stop of adequate strength shall be provided to protect the sawyer from rolling logs. Canting gear or other equipment shall not be allowed to hang over the log deck in such a manner as to endanger employees. Canting gear controls shall be marked to indicate their function. The sawyer shall be primarily responsible for the safety of the carriage crew and off bearers. He shall exercise due care in the operation of the carriage and log turning devices. Feed works and log turning control levers shall be so arranged that they may be secured when not in use and shall be adequately guarded against accidental activation. A control device shall be provided so that the sawyer may stop the head rig section of the mill without leaving his stand. An effective method of disengaging the head rig saws from the power unit shall be installed on all head rigs where the power unit is not directly controlled by the sawyer. The saws shall be disengaged from the source of power and locked or tagged out before repairs or changes are made. The sawyer shall be safeguarded either by his location or by use of substantial screens or approved safety glass. Carriages upon which persons are required to work shall be solidly decked over and the employee properly protected. The feed control lever of friction or belt driven carriage feed works shall be designed to operate away from the saws or carriage track. A substantial stop or bumper shall be installed at each end of the carriage run. Substantial sweeps shall be installed in front of each carriage wheel. Such sweeps shall extend to within 1/4 inch of the rails. Where power operated log turners are used, carriage knees shall be provided with goosenecks or other substantial means of protecting the carriage crew.

Band Saws

Band saws shall be given a thorough daily inspection and any deficiency reported and corrected. Any band saw found to have developed a crack greater than one-tenth the width of the saw shall be removed from service until the width of the saw is reduced to eliminate the crack, the cracked section is removed, or the development of the crack is arrested by welding. Band saws shall not be continued in use on the head rig for which they have been designed after they have been reduced 40% in width. Band saw guides shall be maintained in good condition and proper alignment at all times. All head band saw wheels shall have a minimum rim thickness of 5/8", except for a distance not to exceed one inch from the front edge of the wheel. Band saws shall not be run at a speed in excess of the manufacturer's recommendations. A band wheel that has developed a crack in the rim shall be immediately removed from service. If a crack has developed in a spoke, the wheel shall be removed from service until properly repaired. All band wheel guards shall be constructed of not lighter than ten U.S. Gauge metal, or not less than two-inch wood material or equivalent, attached to substantial frames. Necessary ventilating ports, not larger than two by four inches, and suitable doors or gates for the lubrication and repair of the saw will be permitted. Every band mill shall be equipped with a saw catcher, rest or guard of substantial construction. Each gang ripper of band or straight saw type shall have the cutting edges of the saw guarded by a hood or screen substantially secured to the framework of the machine.

Circular Saws Speeds & Repairs

Circular saws shall not be operated at speeds in excess of those specified by the manufacturers. Circular saws shall be inspected for cracks each time the teeth are filed or set. They shall be discontinued from use until properly repaired when found to have developed a crack exceeding the safe limits specified by the manufacturer. Damaged saws shall be repaired only by persons experienced and knowledgeable in this type of work or by a manufacturers representative.

Circular Swing Saws

Each circular swing saw shall be provided with a hood guard that completely encloses the upper half of the saw. Each swing saw shall be equipped with a positive stop at the extent of the swing necessary to cut the material.

Drag Fixed Chain / Circular Cutoff Saws

Saws shall be so arranged that they will not project into any passageway when in an idle or working position. When existing conditions do not leave clear passage the saws shall be fenced off in order to make it impossible for anyone to walk into them. Log decks shall be equipped with a device to hold the material stable when being cut. Drag saws and fixed chain saws shall be equipped with a device that will safely lock them in an "up" position. All persons shall be in the clear before starting operations of a drag-chain or swing saw.

Unplugging Quick Lime Stoppages

Water shall not be used to unplug quick lime stops or plugs in pipes or confined spaces.

Bleach Plant

Work areas used for preparation and processing of bleaching mixtures shall be equipped with properly designed exhaust ventilation systems capable of clearing the area of toxic gases. Bleaching containers, such as cells, towers, etc., except the Bellmer type, shall be completely covered on the top, with the exception of one small opening large enough to allow filling but too small to admit a person. This opening should be covered by a door and guarded with standard guardrail and toe boards. Platforms leading from one engine to another shall have standard guardrails.

Clearing Shredder Jams

To clear jams or blockage to the machine, the operator shall use objects which will not create a hazard. The use of metal bars for such purposes is prohibited.

Repairing Shredders

Repairs shall be done only when the shredder is shut down and the control devices are locked or tagged out.

Guillotine Type Roll Splitters

The engaging control for activating the guillotine blade shall be a positive two-hand operating control or located far enough from the cutting location so that the operator cannot reach the blade during the cutting process. In either control method, "dead man type" switch gear which demands continuous operator activation shall be installed and used. Personnel shall not position any part of the body under the blade. Rolls shall be in the horizontal position while being split. Rolls shall be centered directly below the blade.

Broke Hole

An alarm bell or flashing light shall be actuated or other suitable warning shall be given before dropping material through a broke hole when persons working below may be endangered. Broke holes shall be guarded to the fullest extent possible consistent with operational necessities. The degree of guarding provided by standard height and strength guardrails will be considered as a minimum acceptable level of

protection. When repulping devices or feed conveyor systems for repulping devices are located beneath broke holes, special precautions shall be used. The broke hole opening shall be reduced to the smallest practical dimension. If such broke hole opening must be large enough to permit a worker to fall through and the opening is not guarded at least to the equivalent degree of protection provided by standard guardrails, any employee pushing broke down the broke hole shall wear a safety belt attached to a safety belt line. The safety belt line shall be fastened in such a manner that it is impossible for the person to fall into the repulping device.

Piling & Unpiling Pulp

Piles of wet lap pulp (unless palletized) shall be stepped back one-half the width of the sheet for each 8 feet of pile height. Sheets of pulp shall be inter lapped to make the pile secure. Pulp shall not be piled over pipelines to jeopardize pipes, or so as to cause overloading of floors, or to within 18 inches below sprinkler heads. Piles of pulp shall not be undermined when being unpiled. Floor capacities shall be clearly marked on all floors. Baled paper and rags shall be stored in stable piles which do not extend into the area necessary for the proper function of sprinkler systems, where sprinklers are used for fire protection in the storage area.

Chocking Rolls

Where pulp or paper rolls are of uniform size, cribbing should be constructed to keep rolls from moving. Where rolls are stacked and not nested two or more high, chocks shall be installed between each roll on the floor and at every row. The face of each chock should be formed on a radius to conform to the average roll size in use, and the chock shall prevent roll movement. When rolls are decked two or more high, the bottom rolls shall be chocked on each side to prevent shifting in either direction. A supply of portable roll chocks should be available to be used where there are gaps in the bottom row of rolls. These should be as light as possible while still providing maximum blocking effect.

Guarding Inrunning Nip Points

The drums on pulp and paper machine winders shall be provided with suitable guards to prevent a person from being caught between the roll and the front drum on the winder when the pinch point is on the operator's side. Any such guard shall be interlocked with the drive mechanism to prevent the winder from running while the guard is not in place except that the winder may be wired to allow it to run at a slow speed only for adjustment and start-up purposes while the guard is not in position. A zero speed switch or locking device shall be installed to prevent the guard from being removed while the roll is turning.

Rewinders

When rewinding large rolls and the nip point is adjacent to the normal work area, the nip point shall be protected by a barrier guard. Such guard shall be interlocked with the drive mechanism to prevent operating the machine above jog speed without the guard in place. A zero speed switch shall be installed to prevent the guard from being raised while the roll is turning. On small rolls 15 inches or less in diameter where barrier guards are impractical they shall not be required if the nip point is separated from the employees by at least 18" while operating at more than jog speed. When the rewinder is running at more than jog speed no worker shall place any part of their body closer than 18" from the nip. In running nips where paper is not being fed into a calender should be protected by barriers. An audible alarm shall be sounded prior to starting up any section of a pulp or paper machine. Sufficient time shall be allowed between activation of the alarm system and start-up of the equipment to allow any persons to clear the hazardous area.

Starting

In starting up a dryer section, steam to heat the drums shall be introduced slowly and while the drums are revolving. When starting paper into the nip of drum type reels or calender stacks a safe method shall be used. This may be accomplished by the use of feeder belts, carrier ropes, air carriage or other device or instrument. A rope carrying system should be used wherever possible at points of transfer. Sheaves should be spaced so that they do not create a nip point with each other and the sheave and its support should be capable of withstanding the speed and breaking strength of the rope for which they are intended. Employees shall not feed a stack with any hand held device which is capable of going through the nip. Employees shall not attempt to remove a broken carrier rope from a dryer while the section is running at operating speed. Employees shall stop dryer to remove a wrap except in cases where it can be safely removed by using air or other safe means. To remove deposits from rolls, a specially designed scraper or tool shall be used. Scraping of rolls shall be performed on the outgoing nip side. Employees shall not place their hands between the sharp edge of an unloaded doctor blade and the roll while cleaning the doctor blade. Sharp edges of doctor blades to be covered. Doctor blades shall have the sharp edges properly guarded during transportation and storage. Handling doctor blades. Special protective gloves shall be provided and shall be worn by employees when filing or handling sharp edged doctor blades.

Sawmills & Wood Working Operations

Log Dumps & Ponds

Log dumps, booms, ponds or storage areas, if used at night, shall be illuminated. A log dump shall be constructed at each log pond or decking ground. Log trucks shall not be unloaded by use of peavies or by hand. The roadbed shall be of hard packed gravel, heavy planking or equivalent material and shall be maintained at all times. Roadbeds at log dumps shall be of width and evenness to insure safe operation of equipment. A mechanical unloading device shall be provided and used for unloading logs. Log unloading areas shall be arranged and maintained to provide a safe working area. Signs prohibiting unauthorized foot or vehicle traffic in log unloading and storage areas shall be posted. At no time shall only one person be permitted to work alone on a log dump, at booming or rafting grounds, or a log pond. Water log dumps. Ungrounded electrically powered hoists using handheld remote control in grounded locations, such as log dumps or mill log lifts, shall be actuated by circuits operating at less than 50 volts to ground.

A brow log, skid timbers or the equivalent shall be installed on all log dumps. Where logs are unloaded onto skids, sufficient space shall be provided between the top of the skids and the ground to accommodate the body of a person. All truck dumps shall be built with not more than six inches variation of level from side to side. All truck log dumps shall be equipped with a positive safeguard to prevent logs from leaving the load on the side opposite the brow log. Jill pokes shall not be used on truck log dumps. Unloading lines shall be attached and tightened or other positive safeguard in place before binder chains are released at any log dump. Stakes and chocks which trip shall be constructed in such manner that the tripping mechanism that releases the stake or chocks is activated at the opposite side of the load being tripped. Binders shall be released only from the side on which the unloader operates, except when released by remote control devices or except when person making release is protected by racks or stanchions or other equivalent means.

Loads on which a binder is fouled by the unloading machine shall have an extra binder or metal band of equal strength placed around the load, or the load shall be otherwise secured so that the fouled binder can be safely removed. Unloading lines, crotch lines, or equally effective means shall be arranged and used in a manner to minimize the possibility of any log swinging or rolling back. In unloading operations, the operator of unloading machine shall have an unobstructed view of the vehicle and the logs being unloaded. Unloading lines shall be arranged so that it is not necessary for the employees to attach them from the pond or dump site of the load except when entire loads are lifted from the log-transporting vehicle.

All log dumps shall be kept reasonably free of bark and other debris. Employees shall remain in the clear until all moving equipment has come to a complete stop. Artificial log ponds subject to unhealthy stagnation shall be drained, cleansed, and water changed at least once every six months. All employees whose regular work requires walking on logs shall wear spiked or calked shoes, except when working in snow. Employees working on, over or along water, where the danger of drowning exists, shall be provided with and shall wear approved personal flotation devices. Employees are not considered exposed to the danger of drowning: When working behind standard height and strength guardrails; When working inside operating cabs or stations which eliminate the possibility of accidentally falling into the water; When wearing approved safety belts with lifeline attached so as to preclude the possibility of falling into the water; When water depth is known to be chest-deep or less. Prior to and after each use, personal floating devices shall be inspected for defects which would reduce their designed effectiveness. Defective personal flotation devices shall not be used. A personal flotation device shall be approved by the United

States Coast Guard as a Type I PFD, Type II PFD, Type III PFD, or Type V PFD, or their equivalent, pursuant to 46 CFR 160 (Coast Guard lifesaving equipment specifications) and 33 CFR 175.23 (Coast Guard table of devices equivalent to personal flotation devices). Ski belt or inflatable type personal flotation devices are specifically prohibited.

Wooden pike poles shall be of continuous, straight grained No. 1 material. Defective poles, blunt or dull pikes shall not be used. Aluminum or other metal poles shall not be used where hazard of coming in contact with live electric wires exists. Walkways and floats shall be provided and security anchored to provide safe passage for workers. Permanent cable swifters shall be so arranged that it will not be necessary to roll boom sticks in order to attach or detach them. Inspection of cable or dogging lines shall be made as necessary to determine when repair or removal from service is necessary. Decks of floats or other walkways shall be kept above the waterline at all times and shall be capable of supporting four times the load to be imposed. Floating donkeys or other power-driven machinery used on booms shall be placed on a raft or float with enough buoyancy to keep the deck above water.

All regular boom sticks and foot logs shall be reasonably straight, have all protruding knots and bark removed, and shall be capable of supporting above the waterline at either end, any necessary weight of workers and equipment. Stiff booms shall be two float logs wide secured by boom chains or other connecting devices, and of a width adequate for the working needs. Walking surfaces shall be free of loose material and maintained in good repair. Boom sticks shall be fastened together with cross ties or couplings.

Log Hauls

Every log haul used as a walkway shall have at least one walkway with standard railing to enable workers to stand clear of the logs in the chute. Cleats shall be installed to provide safe footing on sloping walkways. Workers shall not stand under or dangerously near to logs that are being hoisted vertically to the log deck. Log haul gears and bull chain drive mechanism shall be adequately guarded for the protection of employees. Log haul bull chains or cable shall be designed, installed, and maintained to provide a 4 to 1 safety factor for the intended load. Troughs for the return strand of log haul chains shall be provided over passageways.

Overhead protection shall be provided for employees working below logs being moved to the log deck. Log haul controls shall be arranged to operate from a position where the operator will at all times be in the clear of logs, machinery lines and rigging. Such controls shall operate mechanism only when moved toward the log slip or deck. Where possible an automatic stop shall be installed on all log hauls. A positive stop shall be installed on all log hauls to prevent logs from traveling too far ahead in the mill. Slip persons shall handle pike poles in such manner as to be in the clear in case of a slip back. All sorting gaps shall have a stiff boom on each side. The banks of the log pond in the vicinity of the log haul shall be reinforced to prevent caving in.

Boats & Mechanical Devices

Prior to starting the boat motor, any spilled fuel shall be removed and vapors shall be exhausted from any area in which they may accumulate. The bilge area shall be kept clean and oil, grease, fuel, or highly combustible materials shall not be allowed to accumulate. Adequate ventilation equipment shall be provided and used for the bilge area to prevent the accumulation of toxic or explosive gases or vapors. Adequate ventilation equipment shall be provided and used for the cabin area on enclosed cabin-type boats to prevent an accumulation of harmful gases or vapors. Deck and cabin lighting shall be provided and used where necessary to provide safe levels of illumination aboard boats. Boats operated during the period from sunset to sunrise, or in conditions of restricted visibility, shall display navigation lights as required by the United States Coast Guard. Searchlights or floodlights shall be provided to facilitate safe navigation and to illuminate working or boarding areas adjacent to the craft. On craft used by workers

wearing calked shoes, all areas where the operator or workers must stand or walk shall be made of or be covered with wood or other suitable matting or non slip material and such covering shall be maintained in good condition.

Each boat shall be provided with a fire extinguisher and life ring with at least fifty feet of one-fourth inch line attached. On log broncs, boom-scooters, or other small boom boats where all occupants are required to wear life saving devices and a life ring would present a tripping hazard, the life ring may be omitted. Along docks, walkways, or other fixed installations on or adjacent to open water more than five feet deep, approved life rings with at least ninety feet of one-fourth inch line attached, shall be provided. The life rings shall be spaced at intervals not to exceed two hundred feet and shall be kept in easily visible and readily accessible locations. When employees are assigned work at other casual locations where exposure to drowning exists, at least one approved life ring with at least ninety feet of line attached, shall be provided in the immediate vicinity of the work assigned.

When work is assigned over water where the vertical drop from the accidental fall would exceed fifty feet, special arrangements shall be made with and approved by the department of labor and industries prior to such assignment. Lines attached to life rings on fixed locations shall be at least ninety feet in length, at least one-fourth inch in diameter, and have a minimum breaking strength of five hundred pounds. Similar lines attached to life rings on boats shall be at least fifty feet in length. Life rings must be United States Coast Guard approved thirty- inch size. Life rings and attached lines shall be maintained to retain at least seventy-five percent of their designed buoyancy and strength. Log broncs, boom scooters, and boom boats shall not be loaded with personnel or equipment so as to adversely affect their stability or seaworthiness. Boats shall not be operated at an excessive speed or handled recklessly. Boat fuel shall be transported and stored in approved containers.

Log Decks

Dry deck storage areas shall be kept orderly and shall be maintained in a condition which is conducive to safe operation of mobile equipment. Logs shall be stored in stabilized piles, and roadways and traffic lanes shall be maintained at a width adequate for safe travel of log handling equipment. Logs shall be arranged to minimize the chance of accidentally rolling from the deck. Employees shall not spool cable on winch or drums with their hands. Log wells shall be provided with safeguard to prevent logs from rolling back into well off log deck. Jump skids on log decks shall be installed in grooves in a manner that they cannot work out onto the carriage way. Log decks shall be provided with effective means to prevent logs from accidentally rolling down the deck onto the carriage or its runway.

Swing saws. Swing saws on log decks shall be equipped with a barricade and stops for protection of employees who may be on the opposite side of the log haul chute.

Drag saws. Where reciprocating log cutoff saws (drag saws) are provided, they shall not project into walkway or aisle.

Circular cutoff saws. Circular log bucking or cutoff saws shall be so located and guarded as to allow safe entrance to and exit from the building.

Entrance doorway. Where the cutoff saw partially blocks the entrance from the log haul runway the entrance shall be guarded. A barricade or other positive stop shall be erected between the sawyer's stand and the log deck to protect the sawyer from rolling logs. Such barricade or stop shall be of sufficient strength to stop any log. Chains from overhead canting gear or other equipment shall not be allowed to hang over the log deck in such manner as to endanger workers. Canting gear control levers shall be so arranged that they move away from the carriage to operate. Moving parts or equipment on or about log decks shall be guarded. Peavies, cant hooks and other hand tools shall be kept in good repair at all times. Workers shall not go below logs on decks that are likely to roll or be rolled. Means of access shall be provided to the head rig which does not subject employees to the hazard of moving logs or equipment.

Mechanical Barkers

- Rotary barkers. Rotary barking devices shall be so guarded as to protect employees from flying chips, bark, or other extraneous material. If an elevating ramp or gate is used, it shall be provided with a safety chain, hook, or other means of suspension while employees are underneath.
- Area around barkers. The hazardous area around ring barkers and their conveyors shall be fenced off or posted as a prohibited area for unauthorized persons.
- Enclosing hydraulic barkers. Hydraulic barkers shall be enclosed with strong baffles at the inlet and outlet. The operator shall be protected by adequate safety glass or equivalent.
- Hold down rolls. Hold down rolls shall be installed at the in feed and out feed sections of mechanical ring barkers to control the movement of logs. If such hold down rolls have a tendency to throw logs or chunks, horseshoe or equivalent type guards shall be installed to contain the logs or chunks.

Head Rigs & Feed Works

A clear walkway shall be provided along the upper side of the log deck and around the head rig unless an overhead walkway is provided. The sawyer shall be primarily responsible for the safety of the carriage crew and off-bearers. He shall exercise due care in the operation of the carriage and log turning devices. Feed works and log turning control levers shall be so arranged that they may be securely locked when not in use and shall be guarded against accidental contact. A positive means shall be provided to prevent unintended movement of the carriage. This shall involve a control locking device, a carriage tie-down, or both. An emergency control or equally effective means shall be provided so that the sawyer may stop the head rig section of the mill without leaving the operator station. An effective method of disengaging the head rig saws from the power unit shall be installed on all head rigs where the power unit is not directly controlled by the sawyer. The saws shall be disengaged from the source of power while repairs or changes are made. A shield of lexan, makrolon, merlon, plestar, or equivalent transparent material, shall be installed between the sawyer's stand and the head saws in all circular mills. In band mills and chipper type installations, a wire screen of not less than twelve gauge wire, one-half inch mesh, mounted in a frame is an acceptable substitute for the type shield required in circular mills. Safety glasses, safety shields or other suitable eye protection shall be provided for and use by head rig off-bearers.

Log Carriages

Carriages upon which employees are required to work shall be solidly decked over.

Dogs. Dogging devices shall be adequate to secure logs, cants, or boards, during sawing operations. The feed control lever of friction or belt driven carriage feed works shall be arranged to operate away from the saws or carriage track. A quick action valve, controlled from the sawyer's stand, shall be located in the steam line to any steam operated feed works. The valve shall be tested daily. Valves in steam feeds shall be closed and locked in a neutral position before the sawyer leaves his station. Leaking steam valves or piping shall not be used on carriage drives. Where employees ride the head rig carriage, clearance of the rear edge of the carriage shall be either not more than two inches or shall be not less than thirty inches from the side wall of the building. The side wall shall be boarded over smoothly to height of not less than six feet six inches from the setter's platform and for at least the length of the carriage travel. Where the clearance is thirty inches or more the floor between the back side of the setter's platform and the wall shall be raised to the level of the platform. The clearance between the floor edge and the platform shall not be more than two inches.

Barriers & Warning Signs. A barrier shall be provided to prevent employees from entering the space necessary for travel of the carriage, with head blocks fully retracted, for the full length and extreme ends of carriage runways. Warning signs shall be posted at possible entry points to this area. Safe access to the head rig shall be provided. No roof truss or roof timber or other obstruction shall be located within six

feet six inches of the upper surface of the setter's platform on any carriage. Doors which lead onto a passageway at the end or side of the carriage runway shall be provided with a handrail opposite such doorway. Handrail shall not be less than eighteen inches from the carriage run. A warning sign shall be posted on the entrance side of such doorways. A stop or bumper capable of stopping the loaded carriage at operating speed shall be installed at each end of the carriage run. Rail sweeps shall be installed in front of the front wheels in the direction of travel. Such sweeps shall extend to within one-fourth inch of the rail. Where power operated log turners are used, carriage knees shall be provided with goose necks or other means of protecting the carriage crew from climbing logs. Employees shall use a stick or wire brush to clear head blocks of debris. All weakened or broken carriage boards which will not support the load to be imposed with a safety factor of 4, shall be immediately replaced.

Band Saws

Band head rigs shall be given a thorough daily inspection and any deficiency reported and corrected. Any band saw found to have developed a crack greater than one-tenth the width of the saw shall be removed from service until the width of the saw is reduced to eliminate the crack, the cracked section is removed, or the development of the crack is arrested by welding. Band saws shall not be continued in use of the head rig for which they have been designed after they have been reduced forty percent in width. Leather gloves, or equivalent hand protection, shall be worn by employees while changing band saws. All head band saw wheels shall have a minimum rim thickness of five-eighths inch, except for a distance of not to exceed one inch from the front edge of the wheel. Provisions shall be made for alerting and warning employees before starting band head saws, and measures shall be taken to insure that all persons are in the clear. No band saw shall be run at a peripheral speed in excess of that recommended by the manufacturer. The manufacturer's recommended maximum speed shall be stamped in plainly legible figures on some portion of the assembly. A band wheel that has developed a crack in the rim shall be immediately removed from service. If a crack has developed in a spoke the wheel shall be removed from service until repaired. All band wheels shall be completely encased or guarded on both sides. The exposed part of the saw blade on the up travel between the two wheels shall be encased, and no portion of the blade exposed, except such part of the cutting edge as is essential for sawing the material at hand. All band wheel guards shall be constructed of not less than ten U.S. gauge metal, or not less than two inch wood material or equivalent, attached to the frames. Ventilating ports shall not exceed 2 x 4 inches in size. Openings necessary for lubrication or repair of the saw shall have doors or gates of equivalent strength to the remainder of the guard. Every band mill shall be equipped with a saw catcher, rest or guard of substantial construction. All band saws other than head mills shall be enclosed or guarded except the working side of the blade between the guide and the table. The guard for the portion of the saw between the sliding guide and the upper saw wheel guard shall be adjusted with the guide. Each gang ripper of band or straight saw type shall have the cutting edges of the saw guarded by a hood or screen secured to the framework of the machine.

Circular Saws

Single circular head saws. Circular head saws shall not be operated at speeds in excess of those specified by the manufacturer. Maximum speed shall be etched on the saw. On all circular saw mills the horizontal distance from the side of the saw to the nearest post of the husk or frame shall be at least one inch greater than the clear vertical distance between the collars of the top and bottom saws. Circular head saws shall be equipped with safety guides that can be readily adjusted without use of wrench or other hand tools. Brackets or edging supports shall be installed between the saw and the side of the husk. The upper saw of a double circular mill shall be provided with a hood or guard. A screen or other suitable device shall be placed so as to protect the sawyer from flying particles. All circular sawmills where live rolls are not used behind the head saw shall be equipped with an effective spreader or splitter. In any mill where the head saw is used for edging lumber, the splitter shall be solid and stationary and shall extend above the head

blocks. Drag saws or circular cut-off saws shall be so arranged that they will not project into any passageway. When existing installations do not leave clear passage, saws shall be fenced off in order to make it impossible for anyone to walk into them. Means to securely hold material being sawed shall be provided wherever such material creates a hazard. All employees shall be in the clear before starting operation of drag or swing cut-off saws.

Twin circular head saws. Twin circular head saw rigs such as scrag saws, shall meet the specifications for single circular head saws in subsection of this section, where applicable.

Edgers

Edgers shall be guarded by a metal housing of ten gauge sheet metal, ten gauge by one-half inch mesh wire, screen, or by a baffle of not less than two inch wood material. Openings in end frames shall be enclosed with sheet metal, wire screen or wood and may be hinged or arranged to permit oiling and removal of saws. The top of the edger shall be guarded to prevent contact by employees or debris being thrown and all chains and gears fully enclosed. Vertical arbor edgers installed ahead of the main saw shall be so located and guarded that an employee cannot contact any part of the edger saws from his normal operating position. Edgers shall not be located in the main roll case behind the head saw. All edgers shall be equipped with pressure feed rolls. The controls shall be installed and located so that from the normal work station the operator can quickly stop the in feed drive without releasing the hold down tension of the pressure rolls. All edgers shall be provided with a method of preventing or guarding against kickbacks. Finger units or dogs installed at the edger, or hinged steel plates suspended across the feed table may be used for this purpose. A kickback barricade, in line with the edger, if fenced off may be used. Pressure and feed rolls on edgers shall be guarded against accidental contact by means of roll covers, bars or strips. The pressure rolls shall not be lifted while stock is being run, or while any person is in line with the feed side of the saws. Edger men shall not raise feed rolls and reach between saws while edger is in operation. Edger men shall not put hands on cants being run through the edger. Live rolls in back of edger shall operate at a speed not less than the speed of the edger feed rolls. Tables in back of edgers shall be kept clear of cants, edgings and unnecessary debris.

Equalizer Saws

Equalizer saws for bolts, staves, heading, etc., shall have the saws encased, except that portion immediately adjacent to the feeding device. Feeding devices on all such equipment shall be provided with guards to prevent contact with the feeding device by employees.

Gang Saws & Re-Saws

Gang saws and re-saws shall be fully guarded or housed in accordance with conditions. Cranks, pitman rods, and other moving parts shall be guarded. Feed rolls shall be enclosed by a cover over the top, front, and open ends except where guarded by location. Drive mechanism to feed rolls shall be enclosed. Feed rolls shall be enclosed and if the operator stands within thirty inches of the feed rolls, they shall be so guarded as to prevent operator coming into contact with them. Circular re-saws or rip saws, except power feed rip saws with a roller or wheel back of the saw, shall be provided with splitters or spreaders. A hood of metal or wood of sufficient strength to give protection against splinters or flying teeth shall be provided over all circular rip saws. That portion of the saw extending below the table shall be so guarded as to prevent contact. Circular rip saws shall be equipped with a standard anti- kickback device. Carriage cradles of whole-log sash gang saws, Swedish gangs shall be of height to prevent logs from kicking out while being loaded. Band re-saws. Band re-saws shall meet the specifications for band head saws.

Circular Gang Re-Saws

Banks of circular gang re-saws shall be guarded by a hood to contain teeth or debris which can be thrown by the saws. Circular gang re-saws shall be provided with safety fingers or other anti-kickback devices. Circular gang re-saws shall not be operated at speeds exceeding those recommended by the manufacturer. Feed belts and drive pulleys shall be guarded. Each circular gang re-saw, except self-feed saws with a live roll or wheel at back of saw, shall be provided with spreaders.

Jump Saws

Jump saws shall have guards below the top of the table or roll case. A guard shall be placed over the roll casing to prevent persons from walking into or over the saw. Jump saws, underhung swing saws, or bed trimmers shall be so arranged that the saws are fully enclosed when not in actual use. A positive stop shall be installed to prevent the saw from passing the front edge of the roll case or table. The throat in the table or roll case shall be only wide enough to permit unobstructed operation of the saw. Guards constructed of not less than two inch wood material or of heavy wire mesh mounted in a steel frame shall be placed in front of jump saw trimmers. Stops shall be installed to prevent timber from being thrown off the roll case. Foot treadle operated saws shall be provided with safeguards to prevent accidental contact.

Trimmer & Slasher Saws

Trimmer or slasher saws shall be guarded in front by a flat or round steel framework with a rigid metal screen or light iron bars attached thereto, or by wood baffles of not less than two inch wood material securely bolted to the frame. Maximum speed. Trimmer saws shall not be run at peripheral speeds in excess of those recommended by the manufacturer. Front guards for a series of saws shall be set as close to the top of the feed table as is practical when considering the type of machine in use and the material being cut. The end saws of a series shall be guarded or fenced off. The rear of a series of saws shall have a stationary or swinging guard of not less than two inch wood material or equivalent the full width of the saws and as much wider as is necessary to protect persons at the rear of the trimmer. Safety stops. Automatic trimmer saws shall be provided with safety stops or hangers to prevent saws from dropping on table. Feed chains shall be stopped while employees are on the feed table. Spotters for trimmers or slashers shall be provided with goggles or other eye protection when conditions so warrant.

Swing Saws

Overhead swing cut-off saws shall be guarded by a hood which shall cover the upper half of the cutting edge at least to the depth of the teeth. The driving belts on overhead swing cut-off saws, where exposed to contact, shall be provided with guards. Saws shall be completely enclosed when in idle position. Power operated swing saws shall have controls so arranged that the operators will not stand directly in front of saw when making cut. All swing saws shall be equipped with a counter balance which shall be permanently fastened to the frame of the saw and so arranged or adjusted that it will return the saw beyond the rear edge of the table or roll case without a rebounding motion. Wire rope, chain or nonmetallic rope running to a weight over a sheave shall not be used for attaching counter balance. No swing cut-off or trim saw shall be located directly in line with stock coming from an edger. Swing limit stops shall be provided and so adjusted that at no time shall the forward swing of the saw extend the cutting edge of the saw beyond a line perpendicular with the edge of the saw table, roll case, guard or barrier. Saws that are fed into the cut by means of air, steam, hydraulic cylinders, or other power device or arrangement shall be designed so they can be locked or rendered inoperative. Foot treadle operated saws shall be provided with safeguards to prevent accidental contact. Swing saws on log decks shall be equipped with a positive stop for the protection of persons who may be on the opposite side of the log haul chute. Operators of hand operated swing saws shall not stand directly in front of saw while making cut. Tables or roll casings for swing saws shall be provided with stops or lineup rail to prevent material

being pushed off on opposite side.

Circular Saws, Speeds, Repairs

Circular saws shall not be operated at speeds in excess of that specified by the manufacturer. Speeds shall be etched on all new saws. When saws are repaired, remanufactured or retensioned in any way to change their operating speeds, such change of speed shall be etched on the saw. These etched speeds shall not be exceeded. Circular saws shall be inspected for cracks each time that the teeth are filed or set. A circular saw shall be discontinued from use until properly repaired when found to have developed a crack. Welding or slotting of cracked saws shall be done by a saw smith under a procedure recommended by the saw manufacturer. Holes shall not be drilled in saws as a means of arresting cracks. After saws are repaired they shall be retensioned. Unless a saw smith is employed, saws shall be returned to the manufacturer for welding or tensioning.

Miscellaneous Wood-Working Machines

Each planing, molding, sticking and matching machine shall have all cutting heads, and saws if used, covered by a solid metal guard. Planers, stickers, molding, sticking and matching machines shall be provided with exhaust fans, hoods and dust conveyors to remove the harmful dusts, etc., from the vicinity of the operator. Such hoods may be arranged to serve as guards for cutting heads. Planers and other machinery or equipment shall not be oiled while in motion, unless provided with guards or other devices to permit oiling without any possibility of contact with moving parts of machinery. Feed rolls shall be guarded by means of roll covers, bars or strips, attached to the roll frame in such manner as to remain in adjustment for any thickness of lumber. Levers or controls shall be so arranged or guarded as to prevent accidental operation of machines. Foot treadle operated machines shall have a treadle guard fastened over the treadle. Locks, blocks, or other device shall be provided for positive immobilization of machine controls while repairs or adjustments are being made. Side head hoods shall be of sufficient height to safeguard the head set screw. Side heads shall not be adjusted while machine is in operation, except when extension adjusting devices are provided. Side belt and pulley guards shall be kept in place at all times the machine is in motion. All universal joints shall be enclosed.

Planers

Each planer (stave and heading) shall have all cutting heads, and saws if used, covered by a solid metal guard. Stave and heading planers shall be provided with exhaust fans, hoods and dust conveyors to remove the harmful dusts, etc., from the vicinity of the operator. Such hoods may be arranged to serve as guards for cutting heads. Sectional feed rolls should be provided. Where solid feed rolls are used, a sectional finger device (or other means equally effective) shall be provided to prevent kickbacks.

Stave Croziers

Stave croziers shall have the heads guarded completely by the exhaust hood or other device, except that portion which actually in beds itself in the stock. Each stave crozier shall have all feed chains and sprockets completely enclosed.

Jointers

Each hand feed jointer or buzz planer with horizontal head shall be provided with an automatic guard over the cutting head both in front of and in back of the guide. Each jointer or buzz planer with horizontal head shall be equipped with a cylindrical cutting head, the throat of which shall not exceed three-eighths inch in depth or one-half inch in width. Each jointer or buzz planer with vertical head shall be guarded by

an exhaust hood or other approved device which shall completely enclose the revolving head except for a slot sufficiently wide to permit the application of material. Push sticks shall be provided and used for feeding stock through hand operated jointers or buzz planers.

Stave & Heading Jointers

Stave and heading jointers and matchers shall have the heads guarded completely by the exhaust hood or other device, except that portion where the stock is applied. Foot power stave jointing machines shall have the knife effectively guarded to prevent the operator's fingers from coming in contact with it.

Wood Shapers

The cutting head of each wood shaper, hand feed panel raiser, or other similar machine not automatically fed, shall be guarded with a cage or pulley guard or other device so designed as to keep the operator's hands away from the cutting edge. In no case shall a warning device of leather or other material attached to the spindle be acceptable. Cylindrical heads shall be used wherever the nature of the work permits. The diameter of circular shaper guards shall be not less than the greatest diameter of the cutter. All double spindle shapers shall be provided with a spindle starting and stopping device for each spindle or provision shall be made that only one spindle operate at any one time.

Boring & Mortising Machines

Boring and mortising machines shall be provided with safety bit chucks without projecting set screws. Automatic machines shall be provided with point of operation guards. When necessary to prevent material from revolving with the bit, clamps or stops shall be provided and used to hold material firmly against the guides.

Tenoning Machines

Workers shall be alert and be positioned in the clear where they will not be exposed to the hazards of moving logs, saplings, root wads, chunks, rigging, or any other material which might be put in motion by the rigging or turn, before the "go ahead" signal is given. They shall remain in the clear at all times while the rigging is moving. No person shall be near rigging which is stopped at a hangup, until the rigging has been slacked to reduce the hazard. No person shall stand or remain within the bight of any running line, nor in a position where he could be struck by a line were it to break or come loose. Whenever possible, chokers shall be set from the uphill side of a log. Persons shall not be on the lower side of a log which appears to be unstable or likely to roll. Wire rope used for chokers shall not exceed seventy-five percent of the breaking strength of the mainline. Chokers shall be placed near the end of the log whenever possible. When pulling lines, do not stand close to the material, as it leaves the machine, will be guided to a point within easy reach of the person removing stock at the rear of the tenoner. Single end tenoners, hand fed, shall have a piece of sheet metal placed so that the operator's hands cannot slip off the lever handle into the tool in passing. Such guard shall be fastened to the lever.

Pail & Barrel Lathes

Each profile, swing-head and back-knife lathe shall have all cutting heads covered by a solid metal guard. If sheet metal is used, it shall be not less than ten U.S. gauge in thickness. If cast metal is used, it shall be not less than three- sixteenths inch thick, or if aluminum is used, it shall be not less than five-eighths inch thick. The hood of the exhaust system may form part or all of the guard. When so used, the hood shall be constructed of metal of a thickness not less than that specified above. Pail and barrel lathes shall be guarded in accordance with the specifications for profile and back-knife lathes insofar as they are

applicable.

Sanding Machines

Each belt sanding machine shall have both pulleys enclosed in such a manner as to guard the points where the belt runs onto the pulleys. The edges of the unused run of belt shall be enclosed or otherwise guarded from contact by employees. Each drum sanding machine shall be provided with a guard so arranged as to completely enclose the revolving drum except such portion required for the application of the material to be finished. Guards with hinges to facilitate the insertion of sandpaper may be installed. The exhaust hood may form part or all of this guard. All standard stationary sanding machines shall be provided with exhaust systems in conformity with the section of this code dealing with exhaust systems. All portable sanding machines shall be provided with means of removing excessive dust, or employees using equipment shall be provided with such necessary respiratory protective equipment.

Glue Machines

Personal protective equipment and proper washing facilities with non caustic soap and sterilizers, shall be provided for all employees handling glue. Rubber gloves and other personal equipment must be sterilized when transferred from one person to another. Glue spreaders shall be enclosed on the in-running side, leaving only sufficient space to insert the stock. All glue spreaders shall be equipped with a panic bar or equivalent type device that can be reached from either the in feed or out feed side of the spreader to shut-off the power in an emergency situation. Such device shall be installed on existing glue spreaders no later than April 1, 1982, and be standard equipment on any glue spreader purchased after January 1, 1982. All glue mixing and handling rooms where located above work areas shall have water tight floors. All glue rooms shall be provided with adequate ventilation.

Lath Mills

Lath mills shall be so arranged that stock pickers shall be protected from slabs and blocks from slasher and trimmers. Bolters and lath machines shall be provided with a wall or shield of not less than two inch wood material or equivalent, constructed in front of the machines, to protect stock pickers and passing employees from kickbacks. Lath bolters and lath mills shall have all feed rolls, belts, gears and moving parts provided with approved guards. Feed chains shall be guarded to as low a point as the maximum height of the stock will permit. Lath bolters and lath mill saws shall be provided with a sheet metal guard not less than one-eighth inch thick, or a cast iron guard not less than three-sixteenths inch thick, or equivalent. These hoods may be hinged so that they can be turned back to permit changing of the saws. A metal plate baffle, finger device or other device, shall be installed to prevent kickbacks. The feed rolls on bolters or lath mills shall not be raised while any employee is in line with the saws. The stock shall be pushed through the saws with another piece of stock or push stick. The lath trimmer shall be provided with guards on the ends, the top and the rear so designed as to contain debris and prevent employee contact with the saw. The belt drive shall be provided with guards. The entire top half of all trimmer saws shall be provided with guards. The guards shall be so adjusted as to prevent employees from accidentally contacting saws.

Veneer & Plywood Plants

Where peeling or barking pits are located directly under the log cranes, logs shall not be moved over workers. Single spiked hooks without a bell shall not be used for handling logs. Hooks shall be equipped with hand holds and shall be maintained in condition to safely perform the job application. Mechanical barking devices shall be so guarded as to protect employees from flying chips, bark or other matter. Logs shall not be removed from barker until barking head has ceased to revolve, unless barker is so designed

and arranged that barking head will not create or constitute a hazard to employees.

Veneer Lathe

The elevating ramp (gate) shall be provided with a safety chain and hook or other positive means of suspension while employees are working underneath same. The area under the tipple from lathe to stock trays shall be provided with railings or other suitable means of preventing employees from entering this area, if access is not prevented by the construction of the machine and employees can enter this area. Catwalks shall be provided along stock trays so that employees will not have to climb on the sides of trays to straighten stock. Any section of stock trays shall be locked out or shall have an operator stationed at starting controls while stock is being removed or adjusted. Guards which will cover the cutting edge of veneer lathe and clipper blades shall be provided and used while such blades are being transported about premises.

Veneer Slicer & Cutter

Each veneer slicer and each rotary veneer cutter shall have all revolving and other moving knives provided with guards.

Veneer Clipper

Each veneer clipper shall have either automatic feed or shall be provided with a guard which will make it impossible to place any portion of the hand under the knife while feeding stock. Where practicable, such guard shall be of the vertical finger type. The rear of each manually operated clipper shall be guarded either by a screen or vertical finger guard which shall make it impossible for any portion of the hand to be placed under the knife while removing clipped stock.

Veneer Wringer

The entry side of each veneer wringer other than glue spreader shall be enclosed, leaving only sufficient space to insert stock. A guard shall be provided to prevent the veneer from overriding the top roll and kicking back.

Shake & Shingle Machinery

A power operated track or swing cutoff circular saw shall have controls so arranged that operators are not positioned directly in front of the saw while making a cut. All track or swing cutoff circular saws shall be completely encased or guarded when the saw is in the retract position, except for that portion of the guard that must be left open for the operation of the saw. Track or swing cutoff circular saw guards shall be constructed of sheet metal not less than one-eighth inch thick, or a wood guard of not less than nominal two inch thick wood material, or equivalent. Hinged or removable doors or gates will be permitted where necessary to permit adjusting and oiling. The driving belt on the track or swing cutoff circular saw shall be guarded. A safety catch shall be provided to prevent the track cutoff saw from leaving the track. Panagraph splitters shall have a shroud incorporated on the upper pressure plate to eliminate the possibility of the splitter moving from the operating area. This shroud shall be constructed of solid design with a minimum width of three inches and a minimum thickness of three-eighths inch. Mechanically operated overhead splitters shall have handles moving opposite the stroke of the piston. When the leading edge of the panagraph splitter is completely extended, the maximum clearance from the deck to the splitting edge shall be two inches. Power splitters shall have spreaders behind the saw to prevent materials from squeezing the saw or being thrown back on the operator. The top of the saw shall be completely covered.

A safety catch shall be provided to prevent the bolter carriage from leaving the track. Bolter saws shall be provided with a canopy guard of sheet metal not less than one-eighth inch thick, or cast iron guard not less than three-sixteenths inch thick or a wood guard of not less than nominal four inch thick wood material or equivalent. The bolter canopy guard shall completely enclose the rear portion of the saw. It shall be so arranged and adjusted as to cover the front of the saw; not to exceed twenty inches from the top of the carriage to the bottom of the guard on sixteen inch and eighteen inch block and twenty- six inches on twenty-four inch blocks, of the material being cut. Bolter saws shall be provided with wipers of belting or other suitable material. These wipers shall be installed on both sides of the saw in such a manner as to deflect knots, chips, slivers, etc., that are carried by the saw. A positive device shall be provided and used to manually lock and hold the feed table in the neutral position when not in use. That portion of all bolter saws which is below and behind the saw table shall be guarded by the exhaust hood or other device. Hinged or removable doors or gates will be permitted where necessary to permit adjusting and oiling.

Shake Machinery

A positive de-energizing device shall be provided within ready reach of each shake splitter operator. Each shake splitter shall be provided with an adjustable stroke limiter to eliminate the splitting blade from striking the table. All splitters shall have a maximum clearance of four inches, from the splitting edge to the table surface, when the splitter is in the extended position. All splitter tables shall have a friction surface to reduce kick out of the material being split. Shake splitters shall not be operated at a speed that would cause chunks to be thrown in such a manner as to create a hazard. The use of foot pedal (treadle) mechanisms shall be provided with protection to prevent unintended operation from falling or moving objects or by accidental stepping onto the pedal. The pedal shall have a non-slip surface. The pedal return spring shall be of the compression type, operating on a rod or guided within a hole or tube, or designed to prevent interleaving of spring coils in the event of breakage. If pedal counterweights are provided, the path of the travel of the weight shall be enclosed. Every shake band saw shall be equipped with a saw guard on both sides of the blade down to the top side of the guide. The outside saw guard shall extend a minimum of three and one-half inches below the bottom edge of the saw guide. The maximum opening between the saw guide and table rolls shall be fifteen inches. The band wheels on all shake band saws shall be completely encased or guarded on both sides. The guards shall be constructed of not less than No. 14 U.S. gauge metal or material equal in strength. The metal doors, on such guards, shall have a wood liner of a minimum thickness of one-half inch.

Shake saw band wheel speeds and maintenance: No band wheel shall be run at a peripheral speed in excess of that recommended by the manufacturer. Each band wheel shall be carefully inspected at least once a month by management. Any band wheel in which a crack is found in the rim or in a spoke shall be immediately discontinued from service until properly repaired. Each band saw frame shall be provided with a tension indicator. Every shingle machine carriage shall be equipped with a hand guard which projects at least one inch beyond the cutting edge of the saw. It shall be located not more than one-half inch from the side of the saw blade. Shingle saw guards shall have a rim guard so designed and installed as to prevent chips and knots from flying from the saws. Such guards shall cover the edge of the saw to at least the depth of the teeth, except such part of the cutting edge as is essential for sawing the material. Saw arbors and couplings shall be guarded to prevent contact. Every part of a clipper saw blade, except that part which is exposed to trim shingles, shall be enclosed by a guard, so designed and installed to prevent contact with the clipper saw. An additional guard shall be installed not more than four inches above the clipper board and not more than one-half inch from the vertical plane of the saw. The underside of clipper saw boards shall be equipped with a finger guard to effectively protect the operator's fingers. The guard shall be a minimum of five inches long and one and one-quarter inches deep. Automatic revolving cam set works and rocker arms, on the machine frame, shall be guarded where exposed to contact. The spauld catchers shall be not less than three-sixteenths inch thick and kept sharp at all times.

Missing teeth shall be replaced. The pinion gear, bull wheel and Johnson bar, operating the saw carriage, shall be guarded where exposed to contact. Each shingle machine clutch treadle shall be arranged so that it is necessary to manually operate the treadle to start the machine. Devices which start the machine when the jaw treadle is released shall not be installed or used. The carriage shall have a brake to hold it in a neutral position. Carriage speed shall not exceed thirty-four strokes per minute.

Shake & Shingle Sawing Machinery

A wood or metal guard or its equivalent shall be secured to the sliding table at the side nearest the sawyer to protect him from contact with the cutting edge of the saw when a block is not in the cut. The hip and ridge saws shall be guarded with a hood-like device. This guard shall cover that portion of the saw not needed to cut the material, located above the cutting table. The remaining portion of the saw, located below the table, shall be guarded to prevent contact by employees. The hip and ridge guarding standard is applicable to both shake and shingle hip and ridge saws. The top ends and sides of the shim stock saws shall be guarded. All shim stock saw power transmission mechanism shall be guarded. The top ends and sides of the groover, to include the press rolls, shall be guarded to contain material or debris which can be thrown and to prevent contact. All groover machine power transmission mechanism shall be guarded. No circular saw shall be run at a speed in excess of that recommended by the manufacturer. Shingle saws when reduced in size to less than forty inches in diameter shall be discontinued from service as shingle saws on upright or vertical machines. Shingle saws may be reconditioned for use as clipper saws provided the surface is reground and the proper balance attained. Shingle saws may be used to no less than thirty-six inches on flat or taper saw machines.

Safety Rules

Employees shall not leave shingle machines unattended while the carriage is in motion. Shingle blocks shall not be piled more than one tier high on tables or roll cases. Chunks may be placed horizontally one tier high on top of shingle blocks. Shingle blocks shall be piled in a stable manner, not more than seventy-two inches high, within the immediate working area of the shingle sawyer or the area shall be barricaded. Provisions shall be made to prevent blocks from falling into the packing area. On each machine operated by electric motors, positive means shall be provided for rendering such controls or devices inoperative while repairs or adjustments are being made to the machines they control. Workers shall not stand on top of blocks while in the process of splitting other blocks into bolts. Shingle jointers shall have the front, or cutting face of the knives, housed except for narrow slot through which the shingles may be fed against the knives.

Saw Filing & Grinding Rooms

Approaches to filing rooms shall be kept free from material and equipment at all times. Enclosed grinding and filing rooms shall be well ventilated. Each filing and grinding room shall be provided with two exits so arranged as to permit easy escape in case of fire. Floor shall be cleaned regularly and shall be kept free from oil, grease and other materials that might cause employees to slip or fall. Flooring around machines shall be kept in good repair at all times. Saw grinding machine belts shall be provided with guards where these belts pass through the frame of the machine. All grinding wheels on such machines shall be provided with a metal retaining hood which shall also cover the arbor ends if they are exposed to contact. Filing room employees shall be provided with goggles, face shields, or other necessary protective equipment and are required to wear the same.

Steel & Hot Metal Handling

Definitions

“Forging” means the product of work on metal formed to a desired shape by impact or pressure in hammers, forging machines (upsetters), presses, rolls, and related forming equipment. Forging hammers, counter blow equipment and high-energy-rate forging machines impart impact to the workups, while most other types of forging equipment impart squeeze pressure in shaping the stock. Some metals can be forged at room temperature, but the majority of metals are made more plastic for forging by heating.

“Open frame hammers (or blacksmith hammers)” mean hammers used primarily for the shaping of forgings by means of impact with flat dies. Open frame hammers generally are so constructed that the anvil assembly is separate from the operating mechanism and machine supports; it rests on its own independent foundation. Certain exceptions are forging hammers made with frame mounted on the anvil, e.g., the smaller, single-frame hammers are usually made with the anvil and frame in one piece.

“Steam hammers” mean a type of drop hammer where the ram is raised for each stroke by a double-action steam cylinder and the energy delivered to the work piece is supplied by the velocity and weight of the ram and attached upper die driven downward by steam pressure. Energy delivered during each stroke may be varied.

“Gravity hammers” mean a class of forging hammer wherein energy for forging is obtained by the mass and velocity of a freely falling ram and the attached upper die. Examples: Board hammers and air-lift hammers.

“Forging presses” mean a class of forging equipment wherein the shaping of metal between dies is performed by mechanical or hydraulic pressure, and usually is accomplished with a single work stroke of the press for each die station.

“Trimming presses” mean a class of auxiliary forging equipment which removes flash or excess metal from a forging. This trimming operation can also be done cold, as can coining, a product sizing operation.

“High-energy-rate forging machines” mean a class of forging equipment wherein high ram velocities resulting from the sudden release of a compressed gas against a free piston impart impact to the work piece.

“Forging rolls” mean a class of auxiliary forging equipment wherein stock is shaped between power driven rolls bearing contoured dies. Usually used for preforming, roll forging is often employed to reduce thickness and increase length of stock.

“Ring rolls” mean a class for forging equipment used for shaping weld less rings from pierced discs or thick-walled, ring-shaped blanks between rolls which control wall thickness, ring diameter, height and contour. “Bolt-headers” mean the same as an upsetter or forging machine except that the diameter of stock fed into the machine is much smaller, i.e., commonly three-fourths inch or less.

“Rivet making machines” mean the same as upsetters and bolt-headers when producing rivets with stock diameter of 1-inch or more. Rivet making with less than 1-inch diameter is usually a cold forging operation, and therefore not included here.

“Upsetters (or forging machines, or headers)” means a type of forging equipment, related to the mechanical press, in which the main forming energy is applied horizontally to the work piece which is gripped and held by prior action of the dies.

General Requirements

Use of lead. The safety requirements of this section apply to lead casts or other use of lead in the forge shop or die shop. Thermostatic control of heating elements shall be provided to maintain proper melting temperature and prevent overheating. Fixed or permanent lead pot installations shall be exhausted. Portable units shall be used only in areas where good, general room ventilation is provided. Personal protective equipment (gloves, goggles, aprons, and other items) shall be worn. A covered container shall be provided to store dross skimmings. Equipment shall be kept clean, particularly from accumulations of yellow lead oxide.

Hammers & presses: All hammers shall be positioned or installed in such a manner that they remain on or are anchored to foundations sufficient to support them. All presses shall be installed in such a manner that they remain where they are positioned or they are anchored to foundations sufficient to support them. Means shall be provided for disconnecting the power to the machine and for locking out or rendering cycling controls inoperable. The ram shall be blocked when dies are being changed or other work is being done on the hammer. Tongs shall be of sufficient length to clear the body of the worker in case of kickback, and shall not have sharp handle ends. The worker should be instructed in the proper body position when using tongs. Tongs should be checked periodically to see that they remain at the proper hardness level for the job. When rings or equivalent devices for locking tongs are used they should be inspected periodically to insure safe condition.

Oil swabs, or scale removers, or other devices to remove scale shall be provided. These devices shall be long enough to enable a man to reach the full length of the die without placing his hand or arm between the dies. Material handling equipment shall be of adequate strength, size, and dimension to handle die setting operations safely. A scale guard of substantial construction shall be provided at the back of every hammer, so arranged as to stop flying scale. A scale guard of substantial construction shall be provided at the back of every press, so arranged as to stop flying scale.

Hammers

Keys. Die keys and shims shall be made from a grade of material that will not unduly crack or splinter, and should not project more than 2 inches in front and 4 inches in back of ram or die. Foot operated devices. All foot operated devices (i.e., treadles, pedals, bars, valves, and switches) shall be substantially and effectively protected from unintended operation.

Presses

All manually operated valves and switches shall be clearly identified and readily accessible.

Power Driven Hammers

Safety cylinder head. Every steam or air hammer shall have a safety cylinder head to act as a cushion if the rod should break or pull out of the ram.

Shutoff valve. Steam hammers shall be provided with a quick closing emergency valve in the admission pipeline at a convenient location. This valve shall be closed and locked in the off position while the hammer is being adjusted, repaired, or serviced, or when the dies are being changed.

Cylinder draining. Steam hammers shall be provided with a means of cylinder draining, such as a self-draining arrangement or a quick-acting drain cock.

Pressure pipes. Steam or air piping shall conform to the specifications of American National Standard ANSI B31.1.0-1967, Power Piping with Addenda, ANSI B31.1.06-1971.

Gravity Hammers

Air-lift hammers shall have a safety cylinder head. Air-lift hammers shall have an air shutoff valve and

should be conveniently located and distinctly marked for ease of identification. Air-lift hammers shall be provided with two drain cocks: one on main head cylinder, and one on clamp cylinder. Air piping shall conform to the specifications of the ANSI B31.1.0-1967, Power Piping with Addenda, ANSI B.31.1.06-1971.

Board Drop Hammers

A suitable enclosure shall be provided to prevent damaged or detached boards from falling. The board enclosure shall be securely fastened to the hammer. All major assemblies and fittings which can loosen and fall shall be properly secured in place.

Forging Presses

Mechanical forging presses.

When dies are being changed or maintenance is being performed on the press, the following shall be accomplished: The power to the press shall be locked out. The flywheel shall be at rest. The ram shall be blocked.

Hydraulic forging presses.

When dies are being changed or maintenance is being performed on the press, the following shall be accomplished: The hydraulic pumps and power apparatus shall be locked out. The ram shall be blocked.

Up Setters

General requirements.

All upsetters shall be installed so that they remain on their supporting foundations.

Lockouts.

Upsetters shall be provided with a means for locking out the power at its entry point to the machine and rendering its cycling controls inoperable. Manually operated controls. All manually operated valves and switches shall be clearly identified and readily accessible.

Tongs.

Tongs shall be of sufficient length to clear the body of the worker in case of kickback, and shall not have sharp handle ends. The worker should be instructed in the proper body position when using tongs. Tongs should be checked periodically to see that they remain at the proper hardness level for the job. When rings or equivalent devices for locking tongs are used they should be inspected periodically to assure safe condition.

Changing dies.

When dies are being changed, maintenance performed, or any work done on the machine, the power to the upsetter shall be locked out, and the flywheel shall be at rest.

Other Forging Equipment

Billet shears

A positive-type lockout device for disconnecting the power to the shear shall be provided.

Saws

Every saw shall be provided with a guard of not less than one-eighth inch sheet metal positioned to stop

flying sparks. Suitable means should be provided to trap sparks below the saw. A tank of water placed below the saw is also desirable.

Conveyors

Conveyor power transmission equipment shall be guarded in accordance with ANSI B20.1-1957, Safety Code for Conveyors, Cableways, and Related Equipment.

Shot blast

The cleaning chamber shall have doors or guards to protect operators.

Grinding

Personal protective equipment shall be used in grinding operations, and equipment shall be used and maintained in accordance with ANSI B7.1-1970, Safety Code for the Use, Care, and Protection of Abrasive Wheels.