



PDHonline Course G473 (6 PDH)

Industrial Safety

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INDUSTRIAL SAFETY

INTRODUCTION:

In 1986 I joined a Fortune 100 company as a product design engineer. The company had an extensive safety program which included a three day course with first aid, CPR and bio-hazard training. The trainer made one introductory comment I will never forget.

“I don’t care if your time with us is five minutes or fifty years. We want you safe while on your way to work, while you are here and during your commute home”.

This statement, or some version of this statement, has probably been made thousands of times—no doubt with feeling. No one wants injuries to occur whatever the environment and certainly not a workplace injury. It is absolutely imperative employees perform their functions under safe conditions. With that being said, the employee must realize accomplishment of this goal means he or she must meet the company half way. Provisions for a safe working environment are a team effort. OSHA (Occupational Safety and Health Administration) has specific guidelines relative to safe working conditions. Companies and individuals must follow these guidelines to avoid injury. Nineteen (19) states have adopted guidelines governing working conditions with thirty-one states (31) using Federal OSHA standards. These nineteen states may be more stringent than OSHA but generally, state standards fall along the same guidelines striving to produce the same results.

Employers investing in workplace safety and health related activities can expect to reduce fatalities, injuries, and illnesses. This will result in cost savings in a variety of areas, such as lowering workers' compensation costs and medical expenses, avoiding OSHA penalties, and reducing costs to train replacement employees and conduct accident investigations. In addition, employers often find that changes made to improve workplace safety and health can result in significant improvements to their organization's productivity and financial performance. If an employee knows the company he or she works for is involved with providing a safe working environment on a day to day basis, that employee will work with less tension and less fatigue by the end of the day.

There are many elements to industrial safety-areas of training that must be addressed if a complete understanding is to be obtained relative to overall safety. The Occupational Health and Safety Administration (OSHA) is the driving force for safety in the United States. References are made frequently in this document as well as references from Tennessee OSHA (TOSHA) relative to workplace safety. I would like to point out, in the appendix we present a Safety Checklist for forty-eight (48) areas of concern. The reader can “pick and choose” those areas that apply to the working environment he or she is involved with on a daily basis. If you don’t have forklifts, you don’t necessarily need the information presented covering forklifts. I would recommend carefully reading the checklist entitled, “Plant Safety Rules”. It is in the body of this text and covers all the bases providing information fairly generic for any workplace, including office areas. As might be expected

and depending upon the product being produced, differing rules governing safety certainly may be formulated. I am sure a company “stuffing” electronics into PC boards would have safety rules specific to that assembly. **IT IS IMPERATIVE THAT SAFETY BE ADDRESSED TO COVER ALL COMPLEXITIES OF MANUFACTURING PROCESSES.**

If we look at those benefits to the employer, we find the following:

BENEFIT TO EMPLOYEERS AND EMPLOYEES:

- **Attract adequate numbers of highly qualified applicants. If a prospective employee knows the company has safety as a major goal, that employee will be likely to be more interested in employment.**
- **Reduce absenteeism. The dread of coming to work for safety reasons is a terrible indictment on the company and definitely not fair to the employee. Every day is a “crap-shoot”.**
- **Reduce turnover. Training a new employee can be very expensive. If that turnover results from lack of safety, it is truly troubling.**
- **Increase productivity.**
- **Reduce cost of training.**
- **Facilitate compliance with Federal and State Equal Employment Opportunity requirements.**
- **Improve community relations.**
- **Improve employee relations.**
- **Ensure availability of related technical instruction.**
- **Enhance problem-solving ability of craft-workers.**
- **Ensure versatility of craft-workers.**

Even with our best efforts, workplace injuries do occur. OSHA publishes documentation on workplace injuries, some of which might be surprising to you. Let’s take a look.

OSHA STATISTICS:

Worker Injuries, Fatalities and Illnesses:

- **4,383 workers were killed on the job in 2012 [BLS revised 2012 workplace fatality data] (3.2 per 100,000 full-time equivalent workers) – on average, more than 84 a week or nearly 12 deaths every day.**

- **708 Hispanic or Latino workers were killed from work-related injuries in 2012—on average, more than 13 deaths a week or nearly two Latino workers killed every single day of the year, all year long.**
- **Fatal work injuries involving contractors accounted for 16 percent of all fatal work injuries in 2012.**

Construction's "Fatal Four"

- **Out of 3,945 worker fatalities in private industry in calendar year 2012, 775 or 19.6% were in construction. The leading causes of worker deaths on construction sites were falls, followed by struck by object, electrocution, and caught-in/between. These "Fatal Four" were responsible for nearly three out of five (56%) construction worker deaths in 2012, BLS reports. Eliminating the Fatal Four would save 435 workers' lives in America every year.**
 - **Falls – 278 out of 775 total deaths in construction in CY 2012 (36%)**
 - **Struck by Object – 78 (10%)**
 - **Electrocutions – 66 (9%)**
 - **Caught-in/between – 13 (2%)**

Top 10 most frequently cited OSHA standards violated in FY2013

The following were the top 10 most frequently cited standards by Federal OSHA in fiscal year 2013 (October 1, 2012 through September 30, 2013):

- 1. Fall protection, construction (29 CFR 1926.501)**
- 2. Hazard communication standard, general industry (29 CFR 1910.1200)]**
- 3. Scaffolding, general requirements, construction (29 CFR 1926.451)]**
- 4. Respiratory protection, general industry (29 CFR 1910.134)]**
- 5. Electrical, wiring methods, components and equipment, general industry (29 CFR 1910.305)**
- 6. Powered industrial trucks, general industry (29 CFR 1910.178)**
- 7. Ladders, construction (29 CFR 1926.1053)**
- 8. Control of hazardous energy (lockout/tagout), general industry (29 CFR 1910.147)]**
- 9. Electrical systems design, general requirements, general industry (29 CFR 1910.303)]**

10. Machinery and Machine Guarding, general requirements (29 CFR 1910.212)]

TYPICAL OSHA INVESTIGATION DOCUMENT:

When investigating an OSHA recordable event, there is a template used specifically for that purpose. It is a fairly concise and condensed template that strives to give basics descriptions of the specific occurrence. The first block in the template discusses exactly what happened to the employee or worker and how the accident occurred. It also documents any citations issued relative to existing OSHA standards. Space is provided for JPEGs aiding efforts to better define and describe the occurrence. **NOTE: Most accidents are non-OSHA recordable and thankfully involve minor cuts, scrapes, burns, etc. These are taken care of in a normal fashion and do not get elevated to levels higher than in-facility human resources departments. Hopefully though, these events are recorded for future reference and acted upon to correct issues with training and environmental conditions within the facility.**

1. Struck by collapsed wall

A 32-year-old employee of a construction company was killed when the wall of a building adjacent to the construction area collapsed. The construction company was framing and pouring a retaining wall so that a city park could be built. Two sides of the retaining wall had been poured already and the employees were preparing the area so that the portion of the concrete wall adjoining the existing building could be poured later in the day. The site foreman used a trackhoe to complete the digging process so that the grade would be the proper depth for the retaining wall. As a result an area of earth approximately two to three-and-one-half feet deep was dug out spanning 30-to- 36 inches wide at the base next to the foundation of the adjoining building. While two employees were inside the excavated area installing grade stakes and checking the grade of the bottom of the excavation, the wall of the adjoining building collapsed trapping them under the debris. One of the employees was removed from the debris and transported to a local hospital. The other employee died on site.

Citation(s) as Originally Issued

Citation 1

Item 1 1926.21(b)(2)	The employer did not instruct each employee in the recognition and avoidance of unsafe condition(s) and the regulation(s) applicable to his/her work environment to control or eliminate any hazard(s) or other exposure to illness or injury.
Item 2a 1926.651(i)(1)	Where the stability of adjoining buildings, walls, or other structures was endangered by excavation operations, support systems such as shoring, bracing or underpinning was not provided to ensure the stability of such structures for the protection of employees.
Item 3 1926.651(i)(2)(i)	There was no support system, such as underpinning, put in place on the adjoining building to the excavation to prevent a possible collapse.



Please note the very first cause of death was failure on the part of the employer to adequately train each employee relative to recognition and avoidance of unsafe conditions. OSHA looks for employer negligence FIRST when assessing blame for injury and certainly death. This is one reason each employer MUST have a viable safety training program in place. This program should be operating with daily feedback from employees.

Of course, not all injuries are OSHA “reportable”. As a matter of fact, most are not.

NON-OSHA WORKPLACE INJURIES.

(NOTE: These have resulted in worker compensation payments as provided by insurance companies.)

If we look at the ten (10) most common non-OSHA workplace injuries, we see the following:

10. On the Job Violent Acts - Attacks caused by office politics and other arguments have led to serious physical injuries. Workplace violence employee training and employee diligence in watching out for suspicious activities can help keep these incidents at bay. This is, unfortunately, a growing trend in commerce.

9. Repetitive Motion Injuries - This type of workplace injury is one of those less obvious but definitely harmful ones in the long run. Repetitive motions such as typing and using the computer 24/7 can strain muscles and tendons causing back pain, vision problems, and carpal tunnel syndrome. Employee training and the use of proper ergonomic equipment can help keep these incidents low. A good safety program will address repetitive motion injuries and how to prevent them.

8. Machine Entanglement - This type of injury usually occurs in a factory where heavy equipment and machinery are used. Clothing, shoes, fingers, hair, ties, etc., can be ensnared by everyday equipment when precautions are not taken. Protective equipment (PPE) and attention to personal details are necessary to avoid these incidents.

7. Vehicle Accidents – Employees who drive for business purposes are often injured in auto accidents, some of which can be fatal. Employee safe-driver training and employer safe-driving policies are likely to reduce accidents. I think we definitely must include forklift operation.

6. Walking Into Injuries - This happens when a person accidentally runs into concrete objects such as walls, doors, cabinets, glass windows, table, chairs etc. Head, knee, neck, and foot injuries are common results. Employee's diligence and employer focus on keeping the work environment free from hazards are key to preventing these types of injuries.

5. Falling Object Injuries - Objects that fall from shelves or are dropped by another person can cause very serious injuries. Head injuries are a common result of this type of accident. Employee's diligence and employer focus on keeping the work environment free from hazards are paramount in preventing

these types of injuries. Of course, proper personal protection gear usage, such as a hard hat, can be instrumental in keeping the employee safe.

4. Reaction Injuries - These are injuries caused by slipping and tripping without falling. These incidents can cause muscle injuries, body trauma, and a variety of other medical issues. It can be hard to prevent such incidents but it is important for employees to pay attention to what is going on in the environment around them. It is also critical that aisles be cleared of any debris and/ or work material at all times. A cluttered work place is a safety hazard.

3. Falling from Heights - This type of fall happens from an elevated area such as roofs, ladders, and stairways. They can be caused by slip and fall accidents or due to faulty equipment. These types of accidents can be reduced by the use of proper personal protection gear, training and employee diligence.

2. Slipping/Tripping – The number two cause of workplace injuries pertains to falls on wet and slippery floors or trips over items lying on the floor. Attention to surroundings is required of employees for continued safety. Employers must have safety guidelines ensuring that spills are promptly cleaned and no debris is present which can generate dangerous situations. Employees must be trained to look for and report conditions that present hazards.

1. Overexertion Injuries - This includes injuries related to pulling, lifting, pushing, holding, carrying, and throwing activities at work. Overexertion not only has consistently been the number one workplace injury but is also the most expensive. According to the 2008 Liberty Mutual Workplace Safety Index, overexertion incidents account for \$3.4 million in benefit costs annually.

These top 10 reported worker's compensation injuries are listed by top insurance companies around the country. I must admit, number ten (10) is a big surprise to me. I think we can all identify individuals who have experienced injuries such as these. As mentioned, proper training and attention to surrounding work areas can go a long way towards avoiding these "top ten".

GENERAL WORKPLACE AND FACTORY SAFETY RULES:

The following safety rules are admittedly somewhat "generic" but definitely apply to commercial concerns working to insure safety of personnel in the physical facility and in areas such as parking lots and out buildings. It is imperative that companies examine and develop their safety methodology depending upon need. This list might be a very good place to begin.

- Report all incidents or injuries immediately to your supervisor or lead coordinator. Failure to report may result in additional medical problems that could have been prevented. Never "work through" an injury. Never "push on" thinking the condition will get better as time goes by. Seek medical attention immediately to forestall additional difficulties.

- **Be alert at all times and never take shortcuts that conflict with safe procedures. When in doubt, seek advice from supervisory personnel or lead coordinator.**
- **Safety devices, such as interlocks and machine guards are not to be removed or made inoperative unless under the control of safe maintenance practices and lockout/tagout procedures are being utilized.**
- **Report defective machinery, equipment or unsafe conditions immediately to your supervisor or lead coordinator. It is recommended that a written, as well as verbal, communication be used when discussing the problem.**
- **Safety procedures and personal protective equipment (PPE) must be utilized as specified by the safety committee or safety coordinator. All necessary PPE; I e., gloves, safety glasses, steel-toed boots, hard hats, hearing protection, respirators, wrist bands, protective sleeves, waist belts, etc must be worn at all times and never removed when in the work cell.**
- **Make sure you are dressed appropriately for the environment you are working in. In most industrial facilities, wearing short pants, open-toed shoes, sandals, high heels, loose or baggy clothing, tank tops, halter tops, etc is prohibited.**
- **Long hair extending beyond shoulder level can be very hazardous when operating moving machinery. It must be pulled back. (Use common sense.)**
- **Use proper lifting techniques. Consider the load, keep your back straight and use your legs for lifting. Seek help if the load is too heavy. Don't do the macho-man thing and assume you can lift a load over forty (40) pounds. Anything over forty (40) pounds requires assistance.**
- **Good housekeeping practices are a must in an industrial environment. Keep your work area clean and free from clutter. Keep all aisles clear and all items stored properly in specified locations. Be aware of boxes and components protruding into work areas and remove as needed.**
- **Walk—do NOT run in the facility or on facility grounds.**
- **Horseplay is definitely never condoned and practical jokes may cause injury to you or your co-workers. DON'T DO IT.**
- **Always be aware of overhead work such as cranes and conveyor equipment performing overhead work. Make sure you are not directly under an elevated conveyor system carrying parts through the facility. (NOTE: Industrial engineering departments and personnel must NEVER position a pedestrian walkway directly under an overhead conveyor.)**

- If you are operating an overhead crane, always use a fall-protection device such as a safety belt or guard rail.
- Seatbelts **MUST** be worn while operating forklifts. Operators must drive at safe speeds and sound their horns when approaching **ALL** intersections. All forklift rules must be followed implicitly. **NEVER DRIVE WITH FORKS ELEVATED.**
- Compressed air must never be used to clean dust from your clothing. Hand-actuated air nozzles must not exceed the OSHA thirty (30) PSI maximum pressure rating.
- Safety glasses or safety goggles combined with face shields **MUST** be worn while using pedestal bench grinders, portable grinders, reciprocating saws, skill or circular saws and jig saws. Appropriate gloves must also be worn.
- Follow all plant security procedures while entering and exiting the facility. Keep your personal belongings stored and secured in a way that does not invite theft.
- Be committed to safety by creating a workplace free of recognized hazards. Work as a team to improve safety and reduce “at risk” behavior.
- **NEVER “ride”** a conveyor, static or moving. Use the appropriate “step-overs” when moving from side to side.
- In many facilities robotic systems are used for processes. Always be aware of equipment movements and the path those movements may take. If safety barriers around robotic systems become inoperable, report this to your supervisor and **DO NOT OPERATE** until the condition is fixed.
- Do not allow extension cords to lie on floors where abrasion and tearing can occur. Equipment should be hard-wired where insulated wiring runs through conduit. Temporary wiring should be located above floor level and never placed on the floor. Call your supervisor when problems of this nature arise.
- Anytime ladders are needed they must be in good repair **AND** non-skid feet firmly placed against flooring. Never use a ladder on a sloping surface. Never use a ladder to reach excessive heights. Scissor lift or “cherry-pickers” are much preferred.
- If you see a liquid substance, **NEVER** assume it is benign. Always assume it is a toxin and treat as such.

It is imperative that any vendor or contractor be advised of safety rules within your facility. They must abide by the very same rules you adopt for safety. THIS IS A MUST. Many manufacturing

facilities require vendors and contractors take the same safety training as a new employee. This has definite benefits.

KEY STEPS IN STRUCTURING A SAFETY PROGRAM:

Where do we begin? What elements represent the foundation for a viable safety program? Experience tells us there are three (3) areas needing to be addressed. These are as follows.

- TRAINING:
- DOCUMENTATION:
- CPR AND FIRST AID:

We will now take a look at each step in structuring a viable and workable industrial safety program. Please note, much of what is written will apply to other types of businesses, not just manufacturing and the shop floor.

TRAINING:

There can be no argument that proper training is critical if equipment is used correctly and in a safe manner. In many cases training is the difference between going home safely or taking a ride to the emergency room. Many standards promulgated by the Occupational Safety and Health Administration (OSHA) explicitly require the employer to train employees in the safety and health aspects of their jobs. Other OSHA standards make it the employer's responsibility to limit certain job assignments to employees who are "certified," "competent," or "qualified"—meaning that they have had special previous training, in or out of the workplace. The term "designated" personnel means selected or assigned by the employer or the employer's representative as being qualified to perform specific duties. These requirements reflect OSHA's belief that training is an essential part of every employer's safety and health program for protecting workers from injuries and illnesses. Many researchers conclude that those who are new to a specific job have a higher rate of accidents and injuries than more experienced workers. If ignorance of specific job hazards and of proper work practices is even partly to blame for this higher injury rate, then training will help to provide a solution. As an example of the trend in OSHA safety and health training requirements, the Process Safety Management of Highly Hazardous Chemicals standard (Title 29 Code of Federal Regulations Part 1910.119) contains several training requirements. This standard was issued under the requirements of the Clean Air Act Amendments of 1990. The Process Safety Management Standard requires the employer to evaluate or verify that employees comprehend the training given to them. This means the training to be given must have established goals and objectives regarding what are to be accomplished. Subsequent to the training, an evaluation would be conducted to verify the employees understood the subjects presented or acquired the desired skills or knowledge. If the

established goals and objectives of the training program were not achieved as expected, the employer than would revise the training program to make it more effective, or conduct more frequent refresher training or some combination of these. The requirements of the Process Safety Management Standard follow the concepts embodied in the OSHA training guidelines contained in this booklet. The length and complexity of OSHA standards may make it difficult to find all the references to training. So, to help employers, safety and health professionals, training directors, and others with a need to know, OSHA's training-related requirements have been excerpted and collected in a booklet specifically addressing training necessary for a safe working environment. It is usually a good idea for the employer to keep a record of all safety and health training. Records can provide evidence of the employer's good faith and compliance with OSHA standards. Documentation can also supply an answer to one of the first questions an accident investigator will ask: "Was the injured employee trained to do the job?" Training in the proper performance of a job is time and money well spent, and the employer might regard it as an investment rather than an expense. An effective program of safety and health training for workers can result in fewer injuries and illnesses, better morale, and lower insurance premiums, among other benefits.

DOCUMENTATION:

Documentation relative to training and factory safety can greatly aid efforts to strengthen overall safety and determine what processes need to be altered or additional training given. It is suggested that the following records be kept and reviewed in a timely manner:

- Forklift training and certification
- Lockout/tagout training
- CPR and First Aid training
- All accident reports, OSHA and otherwise noting injuries sustained and the severity of those injuries.
- Fire safety training
- Training on how to deal with Bloodborne Pathogens
- Training on how to handle compressed gas and compressed air
- Training on how to deal with hazardous materials and their proper disposal
- Training on use of PPE (personal protection equipment)

The following guidelines should be followed relative to recordkeeping:

RECORDER-KEEPING:

- Are all OSHA injuries or illnesses, except minor injuries requiring only first aid, being recorded as required on the OSHA 200 logs?
- Are employee medical records and records of employee exposure to hazardous substances or harmful physical agents up-to-date and in compliance with current OSHA standards?
- Are employees training records kept and accessible for review by employees, when required by OSHA standards?
- Have arrangements been made to maintain required records for the legal period of time for each specific type of record? (Some records must be maintained for at least 40 years.)
- Are operating permits and records up-to-date for such items as elevators, air pressure tanks, liquefied petroleum gas tanks, etc?

FIRST-AID OVERVIEW:

Most managers will agree, a safety program involving first aid and CPR training is an absolute must and should be conducted by a certified organization recognized as expert in these fields. This is where you start! There are several organizations certified for training relative to first aid and CPR. The brief list below is just a sampling of those presently giving training:

- American Trauma Event Management
- The American Red Cross
- The American Heart Association
- National Safety Council
- MEDIC First Aid
- American Safety and Health Institute
- Local fire departments
- Local hospitals

One caution: please make sure any on-line classes are fully accredited and can produce evidence of being so.

INTRODUCTION:

Most workplace injuries and illnesses are fairly minor. These incidents normally involve an individual who is breathing. An illness or accident becomes life-threatening when the event affects the amount of oxygen required by the body's tissues and organs. If oxygen levels drop and continue to be low, the results can be: organ failure, brain damage and ultimately death. Within four (4) minutes, brain damage can occur depending upon the circumstances.

HOW AND WHEN TO GET EMERGENCY HELP

Just when should medical care be sought? Given below are specific conditions that warrant calling 911. Do NOT wait for a doctor to call back before dialing 911. The conditions given below are time-sensitive and could have serious medical consequences. Prior to EMT arrival, there are procedures that can be followed. We will discuss these in this block of information.

- **Anaphylaxis--** Anaphylaxis (pronounced anna-fill-axis) is the most serious type of allergic reaction. It can progress very quickly and may cause death without proper medical attention. An allergic reaction usually happens within minutes after being exposed to an allergen, but sometimes it can take place several hours after exposure. A reaction can involve any of these symptoms, and a person could have one or more of these symptoms regardless of the allergen:
 - **Skin system:** hives, swelling, itching, warmth, redness, rash
 - **Respiratory system (breathing):** coughing, wheezing, shortness of breath, chest pain/tightness, throat tightness, hoarse voice, nasal congestion or hay fever-like symptoms (runny itchy nose and watery eyes, sneezing), trouble swallowing
 - **Gastrointestinal system (stomach):** nausea, pain/cramps, vomiting, diarrhea
 - **Cardiovascular system (heart):** pale/blue color, weak pulse, passing out, dizzy/lightheaded, shock
 - **Other:** anxiety, feeling of "impending doom", headache, uterine cramps, metallic taste
- **Chest Pain—**Obviously, chest pain is possibly an indicator of issues involving the heart and circulatory system.
- **Confusion or Disorientation**
- **Dizziness**
- **Drug Overdose**

- Heart Attack
- Puncture Wounds
- Poisoning
- Serious Burns
- Sudden Slurred Speech
- Sudden Blindness or Vision Issues
- Uncontrolled Nosebleed
- Vomiting Blood or Persistent Vomiting
- Broken Bones Visible Through an Open Wound
- Unequal Pupil Size
- Injuries to Hand or Face

NOTE: If the worker is conscious, PERMISSION must be given to the first-aid responder prior to action being taken. A nod is acceptable. If the victim is unconscious or cannot understand you, consent is assumed. This is called “implied consent”. Tell the injured employee your name—ask if you can help. **WHEN IN DOUBT—ASSUME CONSENT HAS BEEN GIVEN.** Don’t lose a fellow employee wondering if you have their permission due to silence. Time is of the essence.

WHAT TO DO

OK, we have a possibility that the situation is serious and not temporary. What do you do?

- Assess the scene making sure the area is safe. Make sure you use personal protective equipment prior to starting any procedure.
- Assess the employee. Tap and shout asking if they are OK and making a determination as to whether or not they are conscious.
- Place the injured worker on their back.
- Lift the chin to ensure the airways are open.
- Extend the employees’ arm nearest you above their head.
- Place the other arm across their chest, with the back of their hand against the opposite cheek.

- Pull up the worker's knee joint. As it bends, keep the foot flat on the ground.
- Roll the patient in the direction toward you.
- Tilt the workers head back to ensure the airway is open.
- The uppermost leg should be adjusted so that the hip and knee are at right angles.
- SEEK IMMEDIATE MEDICAL HELP. Call a first-responder.
- IF THERE IS NO BREATHING, start CPR as quickly as possible using the techniques given below.

Now, it is imperative that ANY person attempting CPR be trained in giving CPR. "U"-tube won't really do it, someone giving you the procedure is NOT sufficient. With that being said, when do you or the first-responder start CPR? ***IF YOU CANNOT WAKE A PERSON AND ARE NOT SURE THEY ARE BREATHING, THEY PROBABLY ARE NOT. IF THE WORKER IS TAKING SUCH SHALLOW BREATHING YOU CANNOT SEE THEIR CHEST RISING AND FALLING, IT IS NOT ENOUGH. IF THE EMPLOYEE IS GASPING EVERY FEW SECONDS FOR AIR—CALLED AGONAL BREATHING—IT'S NOT ENOUGH. AGONAL BREATHING MAY SOUND LIKE SNORING, GURGLING, MOANING OR NOISY BREATHING.***

When CPR is necessary, you being trained with the methodology or the first-responder, will do the following:

- Open the airway
- Give two rescue breaths
- Begin thirty (30) compressions
- Repeat the process
 - Rate at least 100 compressions per minute
 - Compressions depths. At least two (2) inches
 - Allow complete chest recoil after each compression
 - Minimize interruptions in chest compression
 - Avoid excessive ventilation
 - Do NOT stop this cycle unless
 - You are too exhausted to continue

- The employee shows signs of responsiveness
- An AED arrives
- Qualified help arrives and takes over.

NOTE: The procedures given above apply only to adults. There are differing procedures for infants. This is why training is **ABSOLUTELY** necessary prior to administering CPR. You need to know what you are doing.

- The AED or Automated External Defibrillator is the third step in the chain of survival and can greatly improve the worker's chance of survival. These devices are computerized, portable pieces of equipment and can prevent death due to sudden cardiac arrest. Again, it is imperative prior training be given for administering this procedure. The devices today are very straightforward, but prior training will eliminate (or at least lessen) nervousness while using.

STANDARD FIRST AID:

This course will not go into detail relative to standard first aid, **BUT** any first aid course should cover the following basics:

- Allergic reactions (Anaphylaxis)
- Treatment for Asthma
- Bites; i.e. spiders, wasps, hornets, snake, etc.
- Burns; i.e. chemical, electrical, fire, etc.
- Dental injuries
- Diabetic emergencies
- Fainting
- Head trauma
- Heart attack
- Heat-related emergencies
- Hypothermia and frostbite
- Musculoskeletal treatment

- Poisoning
- Shock
- Seizures
- Stroke
- All types of wounds
- Amputations
- Chest injuries
- Impaled objects
- Puncture wounds
- Internal bleeding
- Emergency oxygen administration
- Bloodborne and airborne pathogens
- Personal protection equipment
- Hand washing and general hygiene
- Bio-hazard waste

As you can see, desirable first aid and safety training is a rigorous process. I have taken CPR and first aid three times now and in each case the training lasted four (4) or more hours. It is definitely recommended that more than one employee be given these courses AND a first-responder be designated for each manufacturing department. If the factory or organization is small relative to the number of employees, two (2) people should be designated.

BLOODBORNE PATHOGENS:

Bloodborne pathogens are infectious microorganisms present in blood that can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV), the virus that causes AIDS. Workers exposed to bloodborne pathogens are at risk for serious or life-threatening illnesses. Bloodborne diseases have historically been a serious concern in the United States. Two diseases cause most of the problems. Hepatitis "B" has been present much longer. Hepatitis "B" is the most prevalent form of hepatitis and

infects over 70,000 people annually. In the United States, estimates indicate there are over one million carriers. Over 3 million people carry the Hepatitis "C" (HCV) virus. This is the newest form of hepatitis. The Human Immunodeficiency virus (HIV) is the most publicized bloodborne disease. Estimates indicate the HIV infects over one million people. HIV is the most deadly bloodborne disease in the United States due to there being no vaccine for HIV and no known cure. Symptoms include the following:

- Weakness
- Fever
- Sore throat
- Nausea
- Headaches
- Diarrhea
- Other "flu-like" symptoms.

Many times, people who become infected with HIV exhibit these symptoms fairly quickly, but it is also possible for HIV victims to show no apparent symptoms for years after their infection. The only way a proper diagnosis can be made is through blood chemistry test.

The symptoms for Hepatitis "B" and "C" are very similar to those for HIV, in that many are "flu-like" in nature. These are as follows:

- Fatigue
- Stomach pain
- Loss of appetite
- Nausea
- Jaundice

Jaundice is probably the most recognizable symptom, turning the skin, eyes, urine and even fingernails a dark yellow color. Hepatitis attacks the liver, and one of its first effects is significant inflammation. Unless treated, it can cause cirrhosis or even liver cancer.

While there is no vaccine for Hepatitis “C”, there is a vaccine that can prevent Hepatitis “B” infection. If you could be exposed to the “B” virus, you need to participate in your employer’s vaccination program. You definitely should report any exposure incident immediately after it occurs.

There are things a company can do to preclude exposure to bloodborne infections. These are as follows:

- Establish an exposure control plan.

This is a written plan to eliminate or minimize occupational exposures. The employer must prepare an exposure determination that contains a list of job classifications in which all workers have occupational exposure and a list of job classifications in which some workers have occupational exposure, along with a list of the tasks and procedures performed by those workers that result in their exposure. Employers must update the plan annually to reflect changes in tasks, procedures, and positions that affect occupational exposure, and also technological changes that eliminate or reduce occupational exposure. In addition, employers must annually document in the plan that they have considered and begun using appropriate, commercially-available effective safer medical devices designed to eliminate or minimize occupational exposure. Employers must also document that they have solicited input from frontline workers in identifying, evaluating, and selecting effective engineering and work practice controls. **DOCUMENTATION AND MAINTENANCE OF APPROPRIATE DOCUMENTS IS CRITICAL TO A GOOD PLAN.**

- Use labels and signs to communicate hazards.

Warning labels must be affixed to containers of regulated waste; containers of contaminated reusable sharps; refrigerators and freezers containing blood or OPIM; other containers used to store, transport, or ship blood or OPIM; contaminated equipment that is being shipped or serviced; and bags or containers of contaminated laundry, except as provided in the standard. Facilities may use red bags or red containers instead of labels. In HIV and HBV research laboratories and production facilities, signs must be posted at all access doors when OPIM or infected animals are present in the work area or containment module. Warning labels are commonly found on:

- Refrigerators or freezers storing infectious materials
- Storage and shipping containers
- Contaminated equipment
- Containers of regulated waste.

- **Implement the use of universal precautions.**

It is very important to treat all human blood and OPIM as if known to be infectious for bloodborne pathogens.

- **Identify and use engineering controls.**

These are devices that isolate or remove the bloodborne pathogens hazard from the workplace. They include sharps disposal containers, self-sheathing needles, and safer medical devices, such as sharps with engineered sharps-injury protection and needleless systems.

- **Identify and ensure the use of work practice controls.**

These are practices that reduce the possibility of exposure by changing the way a task is performed, such as appropriate practices for handling and disposing of contaminated sharps, handling specimens, handling laundry, and cleaning contaminated surfaces and items. Engineering controls refer to equipment such as ventilating laboratory hoods and self-sheathing needles that can prevent personnel from encountering bloodborne pathogens. “Work practice controls” are safer ways to perform tasks. Hand washing is an effective and very important example. You should wash your hands immediately after removing gloves or other PPE that may have become contaminated. You **MUST** wash your hands after direct contact with blood or other potentially infectious materials... OSHA recommends the following “good housekeeping practices”:

- **Perform periodic cleaning**
- **Have written cleaning schedules**
- **Decontaminate all surfaces after contact with infectious materials**
- **Change equipment coverings if they are contaminated**

Needles and other “sharps” have their own rules, as follows:

- **They cannot be bent**
- **Should not be recapped**
- **Contaminated “sharps” must be discarded into containers that are closable, puncture-resistant and leak-proof.**
- **Contaminated laundry should be handled as little as possible. Always wear PPE when handling contaminated laundry. Laundry should be bagged or containerized, and transported in labeled or color-coded bags.**

- **Equipment must be decontaminated if at all possible; otherwise, biohazard labels should be applied, and employees must be warned about possible contamination.**
- **The standard also governs handling of other regulated wastes. If your job involves waste handling, make sure you know what the requirements are.**
- **Provide personal protective equipment (PPE), such as gloves, gowns, eye protection, and masks.**

Employers must clean, repair, and replace this equipment as needed. Provision, maintenance, repair and replacement are at no cost to the worker. Gloves must be used whenever hand contact is anticipated. Disposable gloves must be replaced as soon as they are contaminated. Other gloves can be reused, once they are decontaminated.

Mouth and eye protection are especially important if you might be splashed or splattered with infectious material. Goggles provide the best eye protection. "Pocket" or face masks should be worn to protect the mouth.

Gowns, aprons and lab coats are commonly used to protect the major portions of the body. They should be selected based on the type of exposure you are facing. If you face exposure situations, PPE MUST be available in your work area. Take off any PPE before leaving the area and deposit that PPE into "collection" containers.

- **Make available hepatitis B vaccinations to all workers with occupational exposure.**

This vaccination must be offered after the worker has received the required bloodborne pathogens training and within 10 days of initial assignment to a job with occupational exposure.

- **Maintain worker medical and training records.**

The employer also must maintain a sharps injury log, unless it is exempt under Part 1904 --Recording and Reporting Occupational Injuries and Illnesses, in Title 29 of the Code of Federal Regulations.

- **Make available post-exposure evaluation and follow-up to any occupationally exposed worker who experiences an exposure incident.**

An exposure incident is a specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or OPIM. This evaluation and follow-up must be at no cost to the worker and includes documenting the route(s) of exposure and the circumstances exposure, Employers must offer this training on initial assignment, at least annually thereafter, and when new or modified tasks or procedures affect a worker's occupational exposure. Also, HIV and HBV laboratory and production facility workers must receive specialized initial training, in addition to the training provided to all

workers with occupational exposure. Workers must have the opportunity to ask the trainer questions. Also, training must be presented at an educational level and in a language that workers understand.

ACCIDENTS

Accidents happen! If you are exposed to an infectious material, wash the area with soap and water immediately. If the material has spilled onto other surfaces do the following:

- **Contain it, using absorbent barriers**
- **Remove any remaining material with an absorbent material**
- **Disinfect the spill area**
- **Dispose materials that are contaminated**
- **Discard or recycle contaminated PPE**
- **Notify supervisor(s) and others about incident**
- **If you have an Environmental Services Dept, make sure they are notified relative to the spill or incident**
- **After all appropriate people have been notified, you will need to complete an “incident report”. This will help to determine other actions deemed necessary.**

SUMMARY:

- **Exposure to bloodborne pathogens can be greatly reduced by following proper workplace procedures.**
- **Biohazard warning labels should be used to identify most infectious materials.**
- **Engineering controls, such as puncture-resistant sharps containers, should be used where appropriate.**
- **PPE, especially gloves, should be used whenever there is the potential for exposure.**
- **Hand washing is a critical work practice control and should be done immediately after exposure.**
- **Never eat, drink, smoke or apply cosmetics in an area where exposure may occur.**
- **It is essential to participate in company Hepatitis “B” vaccination programs.**

FIRE PROTECTION:

I have structured fire protection as a “block” in this course because there is no problem associated with manufacturing as destructive as a facility fire. Fire safety should always be a concern to individuals employed in any field, but industrial fire safety should receive special attention in particular. By nature, an industrial work atmosphere presents fire safety issues that are unique, with the components for disaster in place. The use of chemicals, heavy machinery and solvents when mixed with apathetic management strategies can result in dire consequences ending in injury and death for employees. While in most industrialized countries there are a considerable number of directives governing manufacturing fire safety, fire safety in industry is largely based upon an honor system that some employers choose to ignore.

The basic principles of fire safety in manufacturing start with proper training for all employees, beginning with their first day on the job. This is aided in part by showing various OSHA approved fire safety videos, and ensuring that the most simple of fire safety precautions are understood by each employee. Employees should become familiar with the physical plant, and where fire alarms and extinguishers are located. Emergency exits should be clearly marked, and there should be a company policy on employee evacuation procedures in the event of fire. There should be several individuals designated within the company to ensure that all employees are accounted for in the worst case scenario.

Every manufacturing company should create a safety committee that implements fire safety procedures and education for staff. With new hires, the individual aspects of a particular position require supervision frequently to ensure fire safety is kept in mind at all times. Every manufacturing facility should have designated areas in which to store potentially dangerous chemicals or equipment, and only those employees that have received the proper fire safety training should be allowed access. Employees should only be allowed to smoke in predetermined areas, outside of the building. Fire evacuation drills are an excellent manner in which to ensure everyone understands their responsibilities in an emergency, and should be practiced at least several times annually.

In any manufacturing setting, it is largely incumbent upon each individual employed to serve as a steward of the collective well-being of all. By setting a high standard, a company can instill a sense of responsibility in each employee. This will have a domino effect and will highlight fire safety as a daily component for the corporate setting. Safety of employees should be at the forefront of concern, and in the manufacturing.

The National Fire Protection Association (NFPA) develops, publishes, and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. Virtually every building, process, service, design, and installation in society today is affected by NFPA

documents. The NFPA web site is definitely worthwhile when researching needs for fire protection safety.

Fire in an industrial setting can pose a number of hazards for the facility, its personnel, and the surrounding communities and can result in an assortment of damage. The release of a flammable material may result in several scenarios: a fireball, pool fire, flash fire, flare or jet fire, and an unconfined vapor cloud explosion.

Two of the main inherent hazards associated with fires are thermal radiation and smoke. Smoke is defined as the products of combustion, including toxic gases, water vapor, and carbon soot particles. The smoke created from fire poses two types of danger. Soot particles may obscure visibility, and hazardous chemicals may constitute a health hazard due to inhalation and eye irritation.

A fire also may present indirect hazards. One is its possible impingement on a vessel containing liquid, such as a large storage tank. In this circumstance, a condition called BLEVE (Boiling Liquid Expanding Vapor Explosion) may occur. Boil-over is a second indirect hazard caused by the effects of a fire. Boil-over is especially dangerous when water is used to put out oily hydrocarbon liquid fires from a vessel. In the following paragraphs, we describe each of the above items in more detail.

Explosion accidents are of major concern to the owners and operators of refineries and petrochemical, gas processing, terminal, and offshore facilities. Statistics have shown that the majority of monetary loss in these types of complexes is due to fire and explosion. According to statistics, 77 percent of the monetary loss in refinery and petrochemical complexes is due to fire and explosion. The breakout of accidents due to fire and explosion is 65 percent vessel (container) and vapor cloud explosion and 35 percent fire. The causes of these accidents are mostly attributed to mechanical issues, process upset, and operator error.

TYPES OF FIRE HAZARDS:

- **Thermal radiation.** One of the main dangers of fire is its thermal radiation and the effect of that radiation on people and property. Thermal radiation diminishes with the inverse square of distance. The American Petroleum Institute and TNO, a Dutch research group, have published books explaining how to estimate the thermal radiation impact and the radiation's estimated damage potential based on distance from a fire. According to these guides, the thermal radiation necessary to generate second degree burns on exposed skin is 9500W/m² (~370 C), given an exposure duration of more than 20 seconds.
- **Smoke.** Fires generate smoke, which is a mixture of soot particles, toxic gases, and water vapor. Factors such as smoke yield, fire size, particle size, and ambient conditions dictate smoke's transport into the environment. Studies show that soot particles can be generated in a range of 0 to 20 percent of fuel by weight during a pool fire. However, the air-to-fuel ratio

and the amount of carbon in the molecular structure of chemicals play a major role in soot yield.

A higher soot rate is expected for a large pool fire with heavy hydrocarbon fuels. Soot particles in a range of 0.01 to 10 microns are respirable and can penetrate into the alveolar region of the lungs. A mean soot particle size for the majority of these fuels can be considered five (5) microns. The generated soot particles may adsorb toxic gases from the products of combustion, which present public health concerns due to the inhalation potential of these toxic particles. Given this, the downwind dispersion and deposition of these particles and their effects on the environment and humans is of major concern.

For example, consider a pool fire of 4500 Kg crude oil in a diameter of forty (40) meters that generates a soot particle plume. The soot particles yield a maximum of twenty (20) percent of crude oil mass. The weather conditions are assumed to be unstable with a wind speed of five (5) m/s and ambient temperature of 70° F.

Soot particle concentrations are considered in the three isopleth levels of 1, 10, and 100 mg/m³. In this case, the soot particles are rising to high elevation due to high temperature and buoyancy. Thereafter, the soot particle plume starts to touch the ground about 1,200 meters distance from the fire source. In this example, calculations show soot particles can expose a region of 4,500 meters distance, after two hours of simulation, which would represent the area to be notified of possible evacuation or shelter-in-place.

Ground-level soot particle deposition occurs in a wide area with a distance of 8,000 meters. The isopleth concentrations on the ground are defined in the three levels of 1, 10, and 100 mg/m². This mapped information helps hazmat and emergency responders to identify the high impact areas of soot particle deposition for immediate evacuation. However, it should be noted that wind speed and direction, pool fire size, soot yield, and soot particle size can change the impact of the soot plume on the environment and the population located near the fire.

Deliberate ignition

Fire can sometimes be a great tool for mitigating a hazardous chemical's potential impact. The technique of igniting gases containing hazardous chemical substances has been successfully used for many years at oil and gas well sites. A prime example is the sour gas from wells; considerable amounts of hydrogen sulfide (H₂S) are contained in the natural gas.

Hydrogen sulfide smells like rotten eggs and is extremely toxic and irritating, even in a lower concentration such as 100 ppm. The dispersion of 40,000 ppm H₂S in the sour gas can create a large hazard zone in the ambient. However, igniting the sour gas will produce CO₂, CO, and a small amount

of SO₂, plus un-burnt H₂S, with no ground-level impact of the H₂S. Therefore, fire can sometimes serve as an effective mitigation technique for hazard reduction.

BLEVE (Boiling Liquid Expanding Vapor Explosion)

BLEVE is a phenomenon that is caused by an external fire impinging on a storage vessel, causing the heating of the liquid contents with a resulting pressure buildup. If the vessel's relief valve is not designed to vent the vapor as fast as it is generated or the relief valve malfunctions, then the vessel may fail completely, resulting in an explosion with vessel fragments being projected over the surrounding area. These fragments have the real potential to puncture pipes or other vessels in the vicinity of the explosion, causing a domino effect. Fragment projectiles traveling distances of up to one mile have been reported in a BLEVE.

Boil-over

When fighting semi-enclosed oil or petrochemical fueled fires using water, a secondary hazardous event called boil-over may occur that is extremely dangerous. Some of the water will sink to the bottom of the tank or other vessel due to density differences, which will result in the formation of a water layer. The heat from the fuel will ultimately boil the water, creating steam. The rapidly expanding steam expels the fuel upward to boil over and out of the container, discharging the still-ignited fuel onto a large and uncontrolled area outside the container. The best way to prevent this phenomenon is to open the valve at the bottom of the tank to drain the water.

A common household example of this phenomenon can occur when water is used to put out a burning pan of cooking oil.

Vessel Venting/Flare

When dealing with a vessel that is about to explode, one option is to vent and burn the discharging material, basically turning the explosive event with its uncontrolled disaster potential into fire which has a lower hazard impact and is more controllable.

FIRE STATISTICS

If we take a look at statistics for the United States, we find the following for 2012:

In 2012, there were 1,375,000 fires reported in the United States. These fires caused 2,855 civilian deaths, 16,500 civilian injuries, and \$12.4 billion in property damage.

- 480,500 were structure fires, causing 2,470 civilian deaths, 14,700 civilian injuries, and \$9.8 billion in property damage.
- 172,500 were vehicle fires, causing 300 civilian fire deaths, 800 civilian fire injuries, and \$1.1 billion in property damage.

- 692,000 were outside and other fires, causing 60 civilian fire deaths, 825 civilian fire injuries, and \$813 million in property damage.

In 2012 fire departments responded to a fire every 23 seconds. One structure fire was reported every 66 seconds.

- One home structure fire was reported every 85 seconds.
- One civilian fire injury was reported every 32 minutes.
- One civilian fire death occurred every 3 hours and 4 minutes.
- One outside fire was reported every 46 seconds.
- One vehicle fire was reported every 156 seconds.

I would like to now indicate what OSHA describes as a checklist to lessen or eliminate fires in the workplace.

FIRE PROTECTION CHECKLIST

- Is your local fire department well acquainted with your facilities, its location and specific hazards?
- If you have a fire alarm system, is it certified as required?
- If you have a fire alarm system, is it tested at least annually?
- If you have interior stand pipes and valves, are they inspected regularly?
- If you have outside private fire hydrants, are they flushed at least once a year and on a routine preventative maintenance schedule?
- Are fire doors and shutters in good operating condition?
- Are fire doors and shutters unobstructed and protected against obstructions, including their counterweights?
- Are fire door and shutter fusible links in place?
- Are automatic sprinkler system water control valves, air and water pressure checked weekly/periodically as required?
- Is the maintenance of automatic sprinkler systems assigned to responsible persons or to a sprinkler contractor?

- Are sprinkler heads protected by metal guards when exposed to physical damage?
- Is proper clearance maintained below sprinkler heads?
- Are portable fire extinguishers provided in adequate number and type?
- Are fire extinguishers mounted in readily accessible locations?
- Are fire extinguishers recharged regularly and noted on the inspection tag?
- Are employees periodically instructed in the use of extinguishers and fire protection procedures?

∴ With this checklist, we must also give a very brief description of how to handle combustible materials.

FLAMMABLE AND COMBUSTIBLE MATERIALS:

- Are combustible scrap, debris and waste materials (oily rags, etc.) stored in covered metal receptacles and removed from the workplace promptly?
- Is proper storage practiced to minimize the risk of fire, including spontaneous combustion?
- Are approved containers and tanks used for the storage and handling of flammable and combustible liquids?
- Are all connections on drums and combustible liquid piping, vapor and liquid tight?
- Are all flammable liquid kept in closed containers when not in use (e.g. parts cleaning tanks, pans, etc.)?
- Are bulk drums of flammable liquids grounded and bonded to containers during dispensing?
- Do storage rooms for flammable and combustible liquids have explosion-proof lights?
- Do storage rooms for flammable and combustible liquids have mechanical or gravity ventilation?
- Is liquefied petroleum gas stored, handled, and used in accordance with safe practices and standards?
- Are “NO SMOKING” signs posted on liquefied petroleum gas tanks?
- Are liquefied petroleum storage tanks guarded to prevent damage from vehicles?

- Are all solvent wastes and flammable liquids kept in fire-resistant, covered containers until they are removed from the workplace?
- Is vacuuming used whenever possible rather than blowing or sweeping combustible dust?
- Are firm separators placed between containers of combustibles or flammables, when stacked one on another, to assure their support and stability?
- Are fuel gas cylinders and oxygen cylinders separated by distance, fire resistant barriers, etc. while in storage?
- Are fire extinguishers selected and provided for the types of materials in areas where they are to be used?
 - Class A Ordinary combustible material fires.
 - Class B Flammable liquid, gas or grease fires.
 - Class C Energized-electrical equipment fires.
- Are appropriate fire extinguishers mounted with 75 feet of outside areas containing flammable liquids, and within 10 feet of any inside storage area for such materials?
- Are extinguishers free from obstructions or blockage?
- Are all extinguishers serviced, maintained and tagged at interval not to exceed one year?
- Are all extinguishers fully charged and in their designated places?
- Where sprinkler systems are permanently installed, are the nozzle heads so directed or arranged that water will not be sprayed into operating electrical switchboards and equipment?
- Are safety cans used for dispensing flammable or combustible liquids at a point of use?
- Are all spills of flammable or combustible liquids cleaned up promptly?
- Are storage tanks adequately vented to prevent the development of excessive vacuum or pressure as a result of filling, emptying, or atmosphere temperature changes?
- Are storage tanks equipped with emergency venting that will relieve excessive internal pressure caused by fire exposure?
- Are “NO SMOKING” rules enforced in areas involving storage and use of hazardous materials?

ELECTRICAL AND ELECTRONIC SAFETY:

Power systems that drive devices providing voltage can be the cause for significant safety issues. It is absolutely imperative that a complete understanding through training and prior experience be made available to employees performing industrial operations and maintenance on electrical and electromechanical equipment. The following check list is provided to indicate issues that can be resolved by noting potential danger.

- Do you specify compliance with OSHA for all contract electrical work?
- Are all employees required to report as soon as practicable any obvious hazard to life or property observed in connection with electrical equipment or lines?
- Are employees instructed to make preliminary inspections and/or appropriate tests to determine what conditions exist before starting work on electrical equipment or lines?
- When electrical equipment or lines are to be serviced, maintained or adjusted, are necessary switches opened, locked-out and tagged whenever possible?
- Are portable electrical tools and equipment grounded or of the double-insulated type?
- Are electrical appliances such as vacuum cleaners, polishers, vending machines, etc., grounded?
- Do extension cords being used have a grounding conductor?
- Are multiple plug adaptors prohibited?
- Are ground-fault circuit interrupters installed on each temporary 15 or 20 ampere, 120 VAC circuit at locations construction, demolition, modifications, alterations or excavations are being performed?
- Are all temporary circuits protected by suitable disconnecting switches or plug connectors at the junctions with permanent wiring?
- Do you have electrical installations in hazardous dust or vapor areas? If so, do they meet NEC codes for hazardous locations?
- Exposed wiring and cords with frayed or deteriorated insulation repaired or replaced promptly?
- Are flexible cords and cables free of splices or taps?

- Are clamps or other securing means provided on flexible cords or cables at plugs, receptacles, tools, equipment, etc., and is the cord jacket securely held in place?
- Are all cord, cable and raceway connections intact and secure?
- In wet or damp locations, are electrical tools and equipment appropriate for the use or locations or otherwise protected?
- Is the location of electrical power lines and cables (overhead, underground, under-floor, other side of walls, etc.) determined before digging, drilling or similar work is begun?
- Are metal measuring tapes, ropes, hand-lines or similar devices with metallic thread woven into the fabric prohibited where they could come in contact with energized parts of equipment or circuit conductors?
- Is the use of metal ladders prohibited in areas where the ladder or the person using the ladder could come in contact with energized parts of equipment, fixtures or circuit conductors?
- Are all disconnecting switches and circuit breakers labeled to indicate their use or equipment served?
- Are disconnecting means always opened before fuses are replaced?
- Do all interior wiring systems include provisions for grounding metal parts of electrical raceways, equipment and enclosures?
- Are all electrical raceways and enclosures fastened in place?
- Are all energized parts of electrical circuits and equipment guarded against accidental contact by approved cabinets or enclosures?
- Is sufficient access and working space provided and maintained about all electrical equipment to permit ready and safe operation and maintenance?
- Are all unused openings (including conduit knockouts) in electrical enclosures and fittings closed with appropriate covers, plugs or plates?
- Are disconnecting switches for electrical motors in excess of two horsepower capable of opening the circuit when the motor is in a stalled condition? This is necessary without exploding the switch exploding? (Switches must be horsepower rated and equal to or in excess of the motor HP rating.)

- Is low voltage protection provided in the control device of motor driving machines or equipment which could cause probable injury from inadvertent starting?
- Is each motor disconnecting switch or circuit breaker located within sight of the motor control device?
- Is each motor located within sight of its controller or the controller disconnecting means capable of being locked in the open position or is a separate disconnecting means installed in the circuit within sight of the motor?
- Is the controller for each motor in excess of two horsepower, rated in HP equal to or in excess of the rating of the motor it serves?
- Are employees who regularly work on or around energized electrical equipment or lines instructed in CPR methods?
- Are employees prohibited from working alone on energized lines or equipment over 600 volts?

PERSONAL PROTECTIVE EQUIPMENT:

Personal protective equipment or PPE is equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. PPE may include items such as gloves, safety glasses, shoes, earplugs or muffs, hard hats, respirators, coveralls, vests and full-body suits.

All PPE should be of safe design and construction, and should be maintained in a clean and reliable fashion. It should fit well and comfortable to wear, encouraging worker use. If the personal protective equipment does not fit properly, it can make the difference between the worker being safely covered or dangerously exposed. When engineering, work practice, and administrative controls are not feasible or do not provide sufficient protection, employers must provide PPE to their workers and ensure its proper use. Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- Limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a program should be implemented. This program should address the hazards present; the selection, maintenance, and use of equipment. Employers **MUST** train employees and monitor the program to ensure ongoing effectiveness. **IT IS IMPERATIVE THAT ALL EMPLOYERS PROVIDE NECESSARY PPE FOR THE EMPLOYEE AND INSTRUCTIONS ON HOW TO USE AND CARE FOR THAT EQUIPMENT.**

I would now like to show various examples of personal protective equipment used in every-day situations.

There are environments that require safety masks, safety glasses and ear plugs or muffs be worn at all times. When air-borne particulate matter is above a certain level, safety masks of the type shown above become mandatory. Other environments demand ear plugs to preclude issues resulting from excessive noise. Generally, 60 Db is the threshold beyond which ear plugs are required. Safety glasses in manufacturing and industry have just about become the standard regardless of the product or service being provided.



The equipment above is generally required for construction sites and where overhead cranes and hoists are operating. Notice the heavy gloves, safety goggles and the “ear-muffs”. PPE of this type would not be used in light manufacturing operations.

The JPEG shown below may seem extreme but the worker is operating a very high pressure steam “wand” to clean a part or assembly. Adequate protection is definitely required in this instance. You will notice the worker has 1.) Apron, 2.) Very heavy gloves, 3.) Face shield, 4.) Boots, 5.) Leggings to protect shins and lower legs, 6.) Hard hat, 7.) Protective pants, 8.) Protective clothing for his upper body and 9.) A protective material for his neck—front and back.



The most important point to note is PPE must be determined by a safety committee or safety officer relative to the process or operation needing to be accomplished. We might also add the following to the list of often-used safety equipment:

- Boots or even steel-toed boots. These are generally required when handling heavy equipment such as dies, coiled steel, molds, etc etc.
- Aprons fabricated from vinyl or leather are often required depending upon the material being handled. Steel mills and foundries will require employees to wear aprons at all times.
- Arm sleeves are required when handling articles of glass. This is to prevent accidental cutting of tissues. The material may vary depending upon the probability of injury.

- In most manufacturing operations, the use of shower shoes, short pants, tank-tops and sometimes short sleeves are prohibited.
- In clean room environments, jewelry, makeup and facial powder is not allowed.
- In most manufacturing organizations, wearing ties and long sleeves without arm-guards is not allowed.

It actually comes to this—the workplace-the work cell itself and the processes to be accomplished determine the PPE necessary.

COMPLYING WITH OSHA'S HAZARDOUS MATERIAL REQUIREMENTS:

If your business involves hazardous materials, to be in compliance with the Occupational Safety and Health Administration's workplace safety rules you must not only follow safety precautions, but also maintain records and communicate information to employees and community emergency organizations.

It seems logical that an important piece of OSHA's safety rules is the appropriate handling of hazardous materials in the workplace. Complying with these hazardous material regulations involves much more than following safety protocols. Recordkeeping and communication regarding hazardous materials are an integral part of compliance as well.

Generally, if your business involves hazardous materials you must maintain records and communicate information to two entities — employees and community emergency organizations. Your business must provide:

- **Notice of hazards.** Information about chemical hazards present in the workplace must be noted on the container labels, communicated to specific parties, and maintained in certain records.
- **Access to medical and exposure records.** You must grant employees access to any of their individual medical records that you maintain and to records you maintain on the employees' exposure to toxic substances.

Your Duties as an Employer

Your obligation to provide information to employees and others varies, depending on the nature of your business. Basically, you must:

- **measure and communicate the possible hazards of chemicals you manufacture or import, if any**

- communicate dangers to any purchaser, if you distribute chemicals
- ensure that warning labels are in place prior to bringing chemicals into the workplace
- never remove or deface warning labels
- obtain material safety data sheets (MSDS) and display them prominently in the workplace
- make sure employees receive information and training and know what to do in the event of a spill or leak.

Exceptions. What items are excluded from these rules? The regulations do not apply to:

- tobacco and tobacco products
- wood and wood products
- foods
- drugs
- cosmetics
- beverages packaged for retail sale
- consumer products used in the workplace
- food, drugs, or cosmetics brought in by employees for their own use
- drugs in final form dispensed as medicine in a health care facility
- articles created with chemicals that are harmless in their final form

State laws regarding hazardous materials. When states regulate this process, generally the focus is on increasing access of local safety officials and health care providers to the material that the company must maintain on hazardous chemicals in the workplace.

Enforcement of communication requirements. Enforcement of the employer requirements for employee communication is achieved by requiring comprehensive hazard communication programs, including:

- labeling of containers
- material safety data sheets (MSDS)
- written communications programs

- **communicating with the community about serious hazards**

Hazardous Material Communication and Recordkeeping Requirements

Material safety data sheets (MSDS) play significant roles in several OSHA hazardous material recordkeeping and communication requirements. The following is an explanation of what information is contained in an MSDS and how they are used for compliance purposes:

- **They are created and distributed as a part of comprehensive hazard communication program.**
- **They are required as a part of any compliance obligation to be available and displayed prominently in the workplace. The public has a right to MSDS data upon request.**
- **They must be written in English and contain:**
 - **the name of the chemical (same as on the label)**
 - **the chemical and common names of the substance**
 - **a listing of the ingredients**
 - **a statement of the ingredients that are known carcinogens or that present other known hazards**
 - **any specific hazards**

In general, if your business uses hazardous chemicals (as opposed to manufacturing or importing them for sale to others) you should be able to obtain a MSDS from the manufacturer, so that you can post it in the workplace and keep it in your records.

Written Hazard Communication Program

You must develop and maintain a written hazard communication program for your employees. This program must:

- **Describe the methods you will use to implement the regulations, with emphasis on labels and warnings.**
- **Provide names and contact information for all individuals responsible for identification of hazardous substances, maintenance of MSDS, and other delegated responsibilities.**
- **Explain the labels used.**
- **Train on content and implementation.**

- Advise how MSDSs are distributed.
- List all known hazardous chemicals cross-referenced with the MSDS.
- Describe the procedure for employee access to MSDS.
- Explain the process of informing employees of hazards in performing routine and nonroutine tasks and of the presence of chemicals in the workplace, including those carried in unlabeled containers, pipes, etc.
- Ensure that notice to employees includes employee representatives.
- Explain the method to inform outside contractors and their employees of any exposure to hazards.
- Provide for a method to review and update all aspects of this communication program.
- Describe how the written program must be available on request to employees, OSHA representatives, and representatives from the National Institute for Occupational Safety and Health (NIOSH).
- **Community Information About Hazards**
 - In the event that your business uses or stores extremely hazardous or toxic substances (such as hydrochloric acid or methane), you have to let the community know so that it can prepare itself in the event of accidental spills or emissions of those substances. This is more than just consideration; it is required by federal law.
 - The Emergency Planning and Community Right to Know Act is designed, in the event of an emergency, to avoid further catastrophe when unacceptable levels of hazardous materials are released into the environment.
 - Owners or operators of facilities that have extremely hazardous materials must notify the state's emergency response commission that the facility is subject to the Act.

OSHA FORM 174—MATERIAL SAFETY DATA SHEET (MSDS):

Federal law dictates that employers must provide information to their employees about hazardous materials and chemicals that employees may be exposed to in the workplace. The vehicle for that information is the Material Safety Data Sheet (MSDS).

While there is no specified format for the MSDS, OSHA has developed a non-mandatory format, OSHA Form 174, which may be used by chemical manufacturers and importers to comply with OSHA's Hazard Communication Standard. You are entitled to receive a data sheet from your supplier.

Given below is an MSDA template showing you what kind of information you need to get from your suppliers and to convey to your employees regarding the chemicals, including the identity, characteristics, and hazard data.

Material Safety Data Sheet

U.S. Department of Labor

May be used to comply with OSHA’s Hazard Communication Standard, 29 CFR 1910 1200. Standard must be consulted for specific requirements.

**Occupational Safety and Health Administration
(Non-Mandatory Form)**

Form Approved

OMB No. 1218-0072

IDENTITY (as Used on Label and List)

Note: Blank spaces are not permitted. If any item is not applicable or no information is available, the space must be marked to indicate that.

Section I

Manufacturer’s name	Emergency Telephone Number
Address (Number, Street, City, State and ZIP Code)	Telephone Number for Information
	Date Prepared
	Signature of Preparer (optional)

Section II—Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits	
			Recommend ed	% (optional)

Section III—Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H ₂ O = 1)	
Vapor Pressure (mm Hg)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	
Solubility in Water			
Appearance and Odor			

Section IV—Fire and Explosion Hazard Data

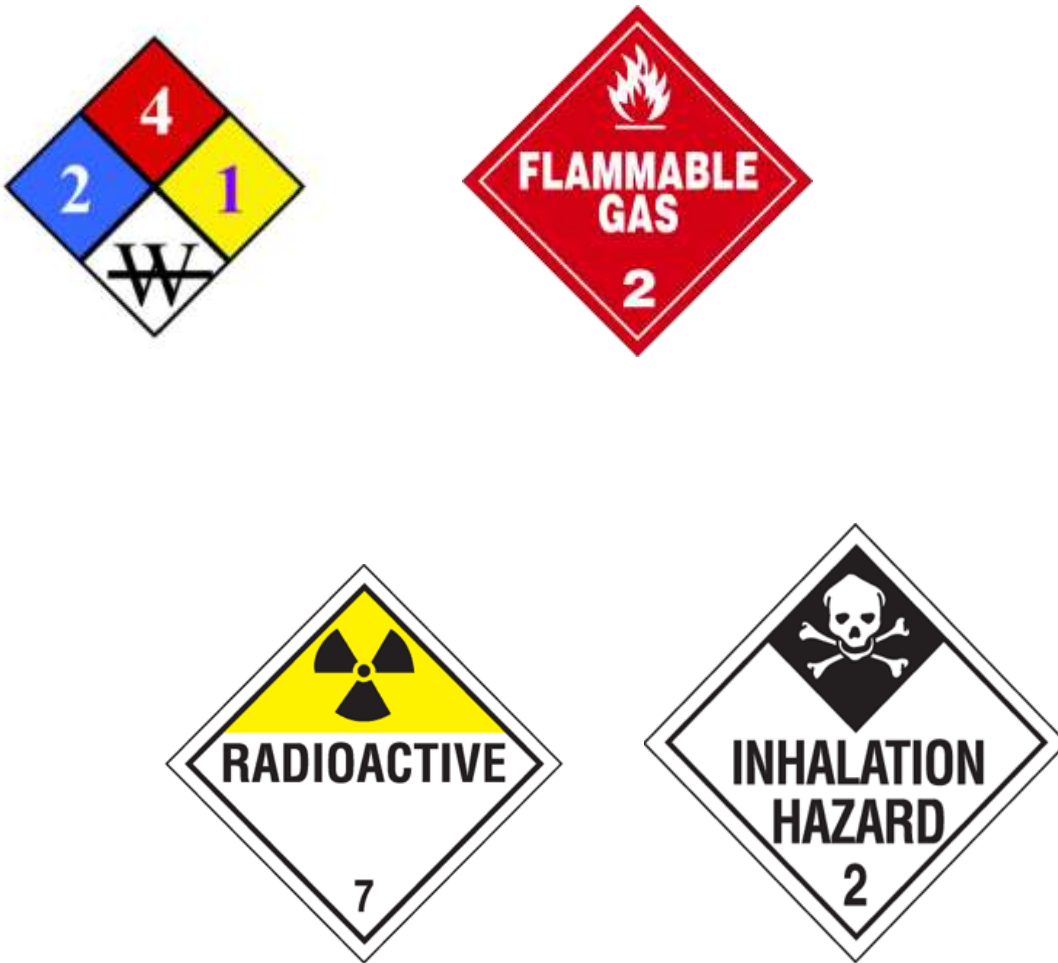
Flash Point (Method Used)	Flammable Limits	LEL	UEL
Extinguishing Media			
Special Fire Fighting Procedures			
Unusual Fire and Explosion Hazards			

(Reproduce locally)

OSHA 174 Sept. 1985

PLACARDS

I have copied four representative placards that might be found in an industrial environment. There are many others but these will show what OSHA and state safety organizations require as far as warnings.



MECHANICAL COMPONENTS AND ROTATING ASSEMBLIES—GUARDING TECHNIQUES:

The operation of equipment in a manufacturing environment can be hazardous. **IT IS IMPERATIVE** that proper training be provided employees **PRIOR** to the use of rotating equipment, robotic equipment, conveyor assemblies, presses of all types, power shears and other powered mechanical devices. It is also imperative to carry out risk assessment and inspect all machinery on-site to identify the hazard of the machine assessing risks posed by that particular machine and hazard. When the risk

is properly assessed, the next step is to provide suitable and appropriate controls to minimize or expel those risks altogether.

The full scope of the risk such as the likelihood of an injury occurring with machine usage as well as the severity of an injury associated with that machine should be investigated. A risk assessment will also highlight the correct and suitable machine guarding that is required. Other factors should also be assessed such as environmental conditions and ergonomic requirements.

To help identify machine parts that pose a serious danger, areas and points should be observed and investigated. In machines with moving parts, parts of the machine may involve guillotines and blades, cutters, saws and drills. Machines may also include power points such as pulleys and belts, shafts and flywheels. Other high-risk parts of a machine would include cutting areas, entanglement areas, abrasion areas, crushing areas and impact areas. Shear points, stabbing points and protrusions that can cause injury should also be identified.

GUARDING TECHNIQUES

The type of operation, the size or shape of stock, the method of handling, the physical layout of the work area, and the type of material and production requirements or limitations will help you determine the best method for safeguarding.

As a general rule, fixed guards that enclose the danger area best protect power transmission apparatuses. However, there are several options for point-of-operation hazards that have moving parts. Choose the most effective and practical option.

Safeguards can be grouped under five general classifications: Guards, devices, safety controls, gates and location/distance.

There are five (5) basic guarding techniques incorporated on mechanical equipment. These are as follows:

- **Barrier Guards**—The JPEG below shows a machine guard applied to a vertical drilling operation. With this barrier, the operator is protected from the moving machine tool and the work piece being processed. *Fixed guards* are permanent parts of a machine. These guards are preferable because they're simple and permanent.
 - *Interlocked guards* automatically shut off or disengage a machine through a tripping mechanism or power when the guard is opened or removed. The machine cannot cycle or start until the guard is replaced.
 - *Adjustable guards* are useful because they accommodate various sizes of stock.

- ***Self-adjusting guards allow the opening of the barrier to be determined by the stock. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening that only is large enough for the stock.***



Below is given proper guarding techniques for rotating components of high-speed equipment. Please note, in the figures above and below, a specific color, yellow, is used to bring attention to the guards. This is common practice in manufacturing and should be followed to indicate the presence of guards in general.



- **Presence Sensing-** *Presence-sensing devices* are divided into two groups. Photoelectrical devices use light sources and controls that can interrupt the machine. Radiofrequency or capacitance devices use a radio beam that is part of the machine circuit. When the capacitance field is broken, the machine will stop.
 - *Electromechanical sensing devices* have a probe or contact bar that descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending to its full, predetermined distance, the control circuit does not start the machine.

In the JPEG below, two light curtains are positioned on either side of the press bed. The sensing units are the two black vertical pieces of equipment positioned on support members. These supports are fastened to the floor. Signals are sent between the two devices on a continuous basis. During press engagement, any object; i.e. hand, arm, etc. breaking the signals will de-energize thus bringing the press ram to a complete stop.



The same type of sensing unit is frequently used for press brakes and shears. The figure given below shows a similar type of installation.



- **Pullouts and Restraints--** *Pullback devices* use cables attached to the operator's hands, wrists and/or arms. They primarily are used on machines with striking-action hazards. When the slide/ram is up, the operator is allowed access to the points of operation. When the slide/ram descends, a mechanical link automatically assures that the operator's hands move away from the points of operation. Restraint devices allow the operator's hands to travel only in a predetermined safe area. Pullbacks/pullouts are used as safeguarding devices on both full and part revolution power presses. They are similar to restraints, but pullbacks are designed to pull the operator's hands away from the area of the closing dies (point of operation) during each stroke of the power press. Wrist bands are secured around both wrists of the operator, and the pullback is adjusted for the particular operator and the particular die installed within the press. When the press stroke begins, the pullback device pulls the wrist bands away from the die located within the press. An overhead pullback device (above) is commonly used in press brakes that perform long-run jobs and when small- to- medium-size parts are being produced. It allows the operator freedom of movement for loading and unloading parts without interference. This method is effective but most operators don't like wearing the devices. Some feel it restricts their movement.



- **Two-Hand Controls and Two-Hand Trip Mechanisms—**The double palm buttons in the figures below indicate the basic installation for this type of protection. As you might suspect, both palm buttons must be engaged simultaneously before the mechanical device, in this case the press, cycles. In other words, both hands must be located outside the bolster plate to initiate the operation.



- **Type "A" and Type "B" Gates--** Gates are movable barriers that protect the operator at the point of operation before the machine cycle starts.
 - **Type "A" Gates** protect the operator during the entire machine stroke. This means the gate will not open until after the crankshaft rotation is complete (360°) and the machine is stopped at top dead center. Although Type "A" Gates can be used on either part or full revolution clutch presses, best safety practice is the "A" gate should be used only on full revolution clutch presses.
 - **Type "B" Gates** protect the operator during the downstroke only. The gate starts to open before the crankshaft rotation is complete (generally after 180° crankshaft rotation). The gates must open on the upstroke of the machine cycle before the crankshaft rotation is complete.

Let us now review those requirements considered necessary for worker safety relative to moving mechanical equipment. These are as follows:

REQUIREMENTS FOR SAFEGUARDS

Safeguards must meet these minimum general requirements:

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1. **Prevent contact:** The safeguard must prevent hands, arms or any other part of a worker's body from making contact with dangerous moving parts.
2. **Be secure:** Workers should not be able to easily remove or tamper with the safeguard. Guards and safety devices should be made of durable materials that will withstand normal use. They must be firmly secured to the machine where possible or secured elsewhere if attachment to the machine is not possible.
3. **Protect from falling objects:** The safeguard should ensure that no objects can fall into moving parts.
4. **Create no new hazards:** A safeguard defeats its purpose if it creates a hazard such as a shear point, a jagged edge or an unfinished surface.
5. **Create no interference:** Any safeguard that impedes a worker from performing a job quickly and comfortably might soon be bypassed or disregarded. Proper safeguarding can actually enhance efficiency because it relieves a worker's injury apprehensions.
6. **Allow safe lubrication:** If possible, one should be able to lubricate the machine without removing the safeguard. Locating oil reservoirs outside the guard, with a line leading to the lubrication point, will reduce the need for the operator or maintenance worker to enter the hazardous area.

Though not actual guards, location and distance can keep employees safe. You can place a machine in an infrequently traveled area or where its dangerous moving parts are not accessible. A thorough hazard analysis of each machine and particular situation is essential before using this safeguarding technique.

GUARD CONSTRUCTION

Guards designed and installed by the machine producer are desirable because they conform to the design and function of the machine, and they can be designed to strengthen the machine or to serve some additional functional purpose.

User-built guards are sometimes necessary and have some advantages. Often, with older machines, they are the only practical solution. They also might be the only choice for mechanical power transmission apparatuses in older plants. User-built guards can be designed and built to fit unique and changing situations and can be installed on individual dies and feeding mechanisms. Also, when your workers design and install machine guards, they develop a better knowledge of those guards and how they work.

However, there are some disadvantages. User-built guards might not conform well to the machine and might be poorly designed or built.

GUARD MATERIALS

Metal, plastic and wood all are used as construction materials for machine guards. In many circumstances, metal is the best material for guards. It might also be feasible to use plastic where higher machine visibility is required. Guards made of wood are generally not recommended because of their flammability and lack of durability and strength.

Wood guards can be options in woodworking and chemicals industries and in industries where vapors or gases would deteriorate metal guards. Wood guards also may be used in construction work and in outdoor locations where extreme cold makes metal guards undesirable. In all other industries, wood guards are not allowed (29 CFR 1910.219 (O) (2)).

Please note: In the appendix to this course is SAFETY CHECKLIST that covers machine guarding and safety of rotating and high-speed equipment.

SAFETY WHEN USING FORK LIFT AND POWER-LIFT EQUIPMENT:

The powered industrial truck, commonly referred to as the forklift, is an essential piece of equipment in factories and manufacturing facilities across our country and the world. As important and productive as forklifts are, they also can be dangerous if not properly used. Of the 998,671 trucks in use in our country, it is estimated that there will be 1.4 accidents per vehicle over each vehicle's eight-year average lifetime.

The Occupational Safety and Health Administration (OSHA) clarified the training requirements for powered industrial truck operator training. It was added to *Title 29 Code of Federal Regulations Part 1910.178*. The clarification was issued to improve the training of operators. By improving the regulations, it is hoped that there will be a reduction in the number of injuries and deaths that occur as a result of inadequate operator training. The changes apply to both general industry and the construction industry.

The training program should be based upon:

1. The operator's prior knowledge and skill
2. The types of powered industrial trucks the operator will operate in the workplace
3. The hazards present in the workplace
4. The operator's demonstrated ability to operate a powered industrial truck safely

Refresher training may be required if:

- 1. The operator is involved in an accident or a near-miss incident**
- 2. The operator has been observed operating the vehicle in an unsafe manner**
- 3. The operator has been determined during an evaluation to need additional training**
- 4. There are changes in the workplace that could affect safe operation of the truck**
- 5. The operator is assigned to operate a different type of truck**

Evaluations of each operator's performance are required as part of the initial and refresher training and at least once every three years. OPERATOR TRAINING IS CRITICAL TO SAFETY WHEN POWERED FORKLIFT EQUIPMENT IS USED IN A FACILITY.

Each type of powered industrial truck has its own unique characteristics and some inherent hazards. Powered industrial trucks may operate on almost any surface, from smooth level floors to rocky uneven ground. Trucks are designed and manufactured to operate in different work environments. Powered industrial trucks can be equipped with or can be modified to accept attachments to fit the intended load. They can be used to lift personnel. They can be used in hazardous locations. The hazards commonly associated with powered industrial trucks vary for different vehicle types, makes and models. Each type of truck has different operating hazards. The methods and means to prevent an accident and to protect employees from injury vary; therefore, site-specific training, in typical working conditions, is required to address all possible scenarios.

Just about every manufacturing facility has lift trucks or fork lift equipment of the following types:





The capacity varies but the uses are definitely similar, i.e. moving heavy material from point “A” to point “B”. The following list is given as a checklist for manufacturers when forklifts are a part of everyday processes.

SAFETY CHECKLIST:

- Are only employees who have been trained in the proper use of hoists allowed to operate them?
- Are only trained personnel allowed to operate industrial trucks?
- Is substantial overhead protective equipment provided on high-lift rider equipment?
- Is directional lighting provided on each industrial truck that operates in an area with less than 2 foot candles per square feet of general lighting?

- Does each industrial truck have a warning horn, whistle, gong, or other device which can be clearly heard above the normal noise in the areas where operated?
- Are the brakes on each industrial truck capable of bringing the vehicle to a complete and safe stop when fully loaded?
- Will the industrial truck's parking brake effectively prevent the vehicle from moving when unattended?
- Are industrial trucks operating in areas where flammable gases or vapors, or combustible dust or ignitable fibers may be present in the atmosphere, approved for such locations?
- Are motorized hand and hand/rider trucks so designated that the brakes are applied, and power to the drive motor shuts off when the operator releases his or her grip on the device that controls the travel?
- Are industrial trucks with internal combustion engines, operated in building or enclosed areas, carefully checked to ensure such operations do not cause harmful concentrations of dangerous gases or fumes?

SAFETY WHEN USING ROBOTIC SYSTEMS:

Over the past ten to fifteen years we have seen a remarkable increase in the use of robotic systems to automate manufacturing processes. Various industries rely heavily on robotic systems for smooth and continuous operation. Today, major technological advances, including microprocessors, artificial intelligence techniques, and innovations in automation and control systems have ushered in a new age of robotics in which once-futuristic visions have either become realities or are on the horizon. With these advances, much smaller manufacturers can afford to purchase, operate and maintain robotic systems on an annual basis. There has also been much greater simplicity structured into the operation of robotic systems allowing use by operators with minimal experience. The advent of the "teach pendant" has allowed programming without knowing how to "code" the microprocessor that drives the process.

Without the proper precautions in place, robotic systems experiencing a fault or failure might cause serious injuries to people and damage capital equipment in or around the work cell. Investigations in Japan indicate that more than 50% of working accidents with robots can be attributed to faults in the electronic circuits of the control system. In the same investigations, "human error" was responsible for less than 20%. The logical conclusion of this finding is that hazards which are caused by system faults cannot be avoided by behavioral measures taken by human beings. Designers and operators therefore need to provide and implement appropriate technical safety measures.

Why can robotic systems be hazardous? Let's take a look.

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- **Movements and sequences of movements are, at times, almost impossible to follow. The robot's high-speed movements within its radius of action often overlap with those of other machines and equipment. It is not uncommon at all to have several robots operating at the same time and sequenced so that "near-misses" seem to occur. This is THE reason operational personnel MUST be trained in all operations within a work cell.**
- **Release of energy caused by flying parts or beams of energy such as those emitted by lasers or by water jets.**
- **Free programmability in terms of direction and speed. Speed control is one valuable feature of any robotic system. Obviously, the faster the movement, the more productivity results. It is advantageous for the system to travel as quickly as possible providing maximum quality.**
- **Susceptibility to influence by external errors (e.g., electromagnetic compatibility) and certainly human factors. Factors external to the system can, at times, affect the operation of the system. These unknown factors must be discovered, if possible, prior to the system becoming operational. This involves testing in a very thorough fashion before putting the system or work cell into production.**

To address the increasing sophistication, complexity and needs of robotic systems, stake-holders in the robotics and automation industries are working to establish new international safety standards through the International Organization for Standardization (ISO) for robots and robot systems integration. ISO10218-1, the initial updated standard, published in 2006, specifies requirements and provides guidance for the assurance of safety in design and construction of the robot itself, not the entire robot system. Part 2 of ISO10218-2 was published in 2011 and covers the integration and installation of robotic systems or cells, thereby providing a more comprehensive set of requirements for robot safety. I have designed work cells using robotic systems and definitely recommend the following safety measures be observed at all times:

- **The work cell must be laid out in a fashion that allows access to all components and assemblies required to "function" the system. This means front, back, sides, walls and any overhead space needed for ventilation and access. With this being the case, it is mandatory the design engineer know the travel characteristics of the robotic structure itself. Visualize the work cell as a cube and do the equipment layout in that fashion.**
- **Always provide voltage to the robot with a switch completely accessible to the operator AND in sight of the operator. The switch is considered an integral part of the work cell. Label the electrical enclosure with voltage and phase.**

- Over-amperage protection, i.e. fusing, must be recommended by the manufacturer of the system and adequate to handle all operational situations. I definitely recommend power to the robot be exclusive to the robot. Label the breakers with voltage and amperage.
- Make sure the electrical layout segregates lights, ventilation hoods, fans, etc from the robotic system itself. When working on the robot, you don't want the lights and fans on the same electrical switch and enclosure. You need to see what you are doing with performing maintenance or making necessary repairs.
- **ONLY TRAINED PERSONNEL CAN OPERATE THE ROBOTIC SYSTEM WORK CELL.** No one else.
- Always make sure PPE is used by personnel if necessary during operation of the system. I would DEMAND safety glasses be used at all times with operating the system.
- Robotic systems are "dumb" devices absolutely dependent upon adequate programming. I have never programmed a robotic system right the first time. Everything looks good on paper and with that being the case, great caution must be observed when taking the system through its initial cycle phases and testing. Know the reach dimensions of the arm. Know where it travels at each point on the program and inform the operator.
- It is recommended that a light barrier or physical barrier be designed into the system so that inadvertent contact by personnel is impossible. Tell the operator that at no time should he or she try to bypass ANY safety measure.
- Only authorized personnel should attempt to modify the control features of the system.
- The electrical system should have safeguards that "kick in" during power outages and brownouts.
- Central processing units (CPUs) driving the system should have battery backup to preserve the program unless the memory is non-volatile.

The following must be prevented during rectification of a breakdown in the production process:

- Manual or physical access to areas which are hazardous due to automatic movements by the robot or by peripheral equipment
- Hazards which arise from faulty behavior on the part of the system or from inadmissible command input if persons or parts of the body are in the area exposed to hazardous movements
- Hazardous movements or conditions initiated by the movement or removal of production material or waste products

- Injuries caused by peripheral equipment
- Movements that have to be carried out with the safety guard(s) for normal operation removed, to be carried out only within the operational scope and speed, and only as long as instructed. Additionally, no person(s) or parts of the body may be present in the area at risk.

Troubleshooting often requires starting the robot machine while it is in a potentially hazardous condition, and special safe work procedures such as the following should be implemented:

- Access to areas which are hazardous as a result of automatic movements must be prevented.
- The starting up of a drive unit as a result of a faulty command or false command input must be prevented.
- In handling a defective part, all movements on the part of the robot must be prevented.
- Injuries caused by machine parts which are ejected or fall off must be prevented.
- If, during troubleshooting, movements have to be carried out with the safety guard(s) for normal operation removed, such movements may be carried out only within the scope and speed laid down and only as long as instructed. Additionally, no person(s) or parts of the body may be present in the area at risk.
- Injuries caused by peripheral equipment must be prevented.

SAFETY WHEN USING MECHANICAL POWERED PRESSES:

We have discussed the importance of using guards and barriers when performing processes using rotating machinery, presses, and robotic systems. These safety devices are absolutely critical within a manufacturing environment. We would like now to present a basic check list giving a very concise checklist of do's and don'ts relative to press safety. This checklist covers presses of the type given by the example below.



POWER PRESS SAFETY AUDIT CHECKLIST

An effective program for mechanical power press safety requires regular monitoring by management and supervision. The following questions should guide you in evaluating your power presses. A negative answer indicates the need for immediate corrective action.

YES NO

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Are all electrical power disconnect switches capable of being locked ONLY in the off position? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do all presses have a functioning "anti-repeat" or "single-stroke" mechanism? |
| <input type="checkbox"/> | <input type="checkbox"/> | Does the circuitry for all two-hand controls and two-hand trips incorporate an anti-tie down feature? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are all two-hand controls and trips constructed or located to require the use of both hands to operate? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are all part revolution presses equipped with a RED colored stop button? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are ONLY the STOP buttons colored RED? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are fully functional two-hand controls provided for each operator on multiple operator presses? |
| <input type="checkbox"/> | <input type="checkbox"/> | Is control of the mode selection means retained by management (usually by use of key-operated switches)? |
| <input type="checkbox"/> | <input type="checkbox"/> | Does the initiation of "Continuous Run" mode require a separate prior action, in addition to the selection of the mode, to activate continuous stroking? |
| <input type="checkbox"/> | <input type="checkbox"/> | Does the "Inch" mode of operation require the use of both hands to activate the clutch, or, if a single control, is it located so that the worker cannot reach into the point of operation while operating the control? |
| <input type="checkbox"/> | <input type="checkbox"/> | If forward/reverse is available on the drive motor, do the controls permit the use of reverse ONLY in the "Inch" mode? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are additional means provided for securing the upper die shoe to the slide when punch stems are used? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are safety blocks available at each press and used whenever a person must repair or adjust the dies within the press? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are all dies marked with the stroke and tonnage requirements and total die weight as well as the upper die weight? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are die stops provided on all inclined presses? |
| <input type="checkbox"/> | <input type="checkbox"/> | Do turnover bars (if available) have a positive means to prevent their being left in the bar hole? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are foot pedals (if available) covered to prevent unintended operation? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are all pinch points with an opening greater than ¼ inch totally enclosed to prevent entry by any part of the body? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are all points of operation enclosed on all sides to prevent entry by the operator as well as any other person in this area? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are all pull back devices (if available) inspected at each shift change, each die change, and each time the operator changes, with records kept of all inspections? |
| <input type="checkbox"/> | <input type="checkbox"/> | Are weekly inspections made and recorded of the clutch/brake mechanism and the single stroke (anti-repeat) mechanism? |

ELEVATED SURFACES/ENTERING CONFINED SPACES/EXIT DOORS:

The checklist given in the Appendix covers these three critical areas found within a workplace. We sometimes overlook the most common and oft-used entry and exit ways during a normal day even though they can present hazards in themselves. I definitely invite your attention to the checklists governing these three vital areas of concern.

SUMMARY:

As mentioned earlier, every company is unique when addressing safety issues because the product and method of production is different. The text above is merely a starting point striving to provide basic and accepted principals governing safety within a working environment. I feel the key elements to safety are training and planning. It is important also to mention that many companies require visiting vendors to take safety training before entering manufacturing facilities. Proper PPE is absolutely mandatory and stressed at every level for all individuals within the facility. It is impossible to cover all elements due to the complexity of products commercialized in today's marketplace. We have tried to give you a "head start" on how to structure a viable and workable safety program within you company.

APPENDIX

- **SELF-INSPECTION CHECK LIST**
- **REFERENCES**

SELF INSPECTION CHECKLIST:

I would like now to provide a self-inspection check list that will give the basics when trying to insure safe working conditions within a manufacturing facility. I am trying to be all-inclusive so this is a fairly long list with several bullet points per item. You will notice that I have put these items in alphabetical order. Each is separately listed in the Table of Contents so you can choose the item that fits your facility. Depending upon the operation you manage, there will surely be others you will wish to add to this list.

ABRASIVE WHEEL GRINDERS:

- Is the work rest used and kept adjusted to within 0.125 inches of the rotating wheel?
- Is the adjustable tongue at the top side of the grinder?
- Do side guards cover the spindle, nut and flange AND seventy-five (75) percent of the wheel diameter?
- Are bench and pedestal grinders permanently mounted?
- Are goggles and face shields always worn when grinding? Are they available to operator?
- Is the maximum RPM rating of each abrasive wheel compatible with the RPM rotation of the grinder motor?
- Are fixed or permanently mounted grinders connected to their electrical supply system with metallic conduit or another permanent wiring method?
- Does each grinder have an individual on and off control switch?
- Is each electrically-operated grinder effectively grounded?
- Before new abrasive wheels are mounted, are they visually inspected and ring tested?
- Are dust collectors and power exhausts provided on grinders used in operations that produce large amounts of dust?
- Are splash guards mounted on grinders that use coolant to prevent the coolant from reaching employees?
- Is cleanliness maintained around grinder?

COMPRESSED GAS CYLINDERS: (Propane cylinders used to power forklifts.)

- Are cylinders with a water weight capacity over thirty (30) pounds, equipped with means for connecting a valve protector device, or with a collar or recess to protect the valve?
- Are cylinders legibly marked to clearly identify the gas contained?
- Are compressed gas cylinders stored in areas protected from external heat sources such as flame impingement, intense radiant heat, electric arcs, or high temperature lines?
- Are cylinders located or stored in areas where they will not be damaged by passing of falling objects or subjected to tampering by unauthorized persons? Some companies provide a storage area enclosed with fencing and locked during and after working hours.
- Are cylinders stored or transported in a manner to protect them from creating a hazard by tipping, falling or rolling?
- Are cylinders containing liquefied fuel gas, stored or transported in a position so the safety relief valve is always in direct contact with the vapor space in the cylinder?
- Are valve protectors; i.e. valve covers, always placed on cylinders when the cylinder is empty and at the completion of each job?
- Are all valves closed off before a cylinder is moved, when the cylinder is empty, and at the completion of each job?
- Are low pressure fuel-gas cylinders checked periodically for corrosion, general distortion, cracks, or any other defect that might indicate a weakness or render it unfit for service?
- Does a periodic check of low-pressure fuel-gas cylinders include a close inspection of the cylinder's bottom?

COMPRESSED AIR RECEIVERS:

- Is every receiver equipped with a pressure gauge and with one or more automatic, spring-loaded safety valve?
- Is the total receiving capacity of the safety valve capable of preventing pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than ten (10) percent?
- Is every receiver provided with a drain pipe and valve at the lowest point for the removal of accumulated oil and water?
- Are compressed air receivers periodically drained of moisture and oil?

- Are all safety valves tested frequently and at regular intervals to determine whether they are in good operational condition?
- Is there a current operating permit used by the Division of Occupational Safety and Health?
- Is the inlet of the receiver and piping system kept free of accumulated oil and carbonaceous material?

COMPRESSORS AND COMPRESSED AIR:

- Are compressors equipped with pressure relief valves and pressure gauges?
- Are compressor air intakes installed and equipped so as to ensure only clean, uncontaminated air enters the device?
- Are air filters installed on the compressor intake?
- Are compressors operated and lubricated in accordance with manufacturer's recommendations?
- Are safety devices on compressed-air systems checked frequently?
- Before any repair work is done on the pressure system, is the pressure bled off and the system locked out?
- Are signs posted to warn of the automatic starting feature of the compressor?
- Is the belt-drive system totally enclosed to provide protection for the front, back, top, and sides?
- Is it strictly prohibited to direct compressed air toward a person?
- Are employees prohibited from using highly compressed air for cleaning purposes?
- If compressed air is used for cleaning off clothing, is the pressure reduced to less than 30 PSI?
- When using compressed air for cleaning, do employees wear protective chip guarding and personal protective equipment?
- Are safety chains or other suitable locking devices used at couplings or high pressure hose lines where a connection failure would create a hazard?
- Before compressed air is used to empty containers of liquid, is the safe working pressure of the containers checked?

- When compressed air is used with abrasive blast-cleaning equipment, is the operating valve a type that must be held open manually?
- When compressed air is used to inflate auto tires, is a clip-on chuck and an inline regulator preset to 40 PSI required?
- Is it prohibited to use compressed air to clean up or move combustible dust if such action could cause the dust to be suspended in air and cause a fire or explosion hazard?

CONTROL OF HARMFUL SUBSTANCES BY VENTILATION:

- Is the volume and velocity of air in each exhaust system sufficient to gather the dusts, fumes, mists, vapors or gases to be controlled, and to convey them to a suitable point of disposal?
- Are exhausts inlets, ducts and plenums designed, constructed, and supported to prevent collapse or failure of any part of the system?
- Are clean-out ports or doors provided at intervals not to exceed 12 feet in all horizontal runs of exhaust ducts?
- When two or more different types of operations are being controlled through the same exhaust system, will the combination of substances being controlled constitute a fire, explosion or chemical reaction hazard in the dust?
- Is adequate makeup air provided to areas where exhaust systems are operating?
- Is the source point for makeup air located so that only clean, fresh air, which is free of contaminants will enter the work environment?
- Where two or more ventilation systems are serving a work area, is their operation such that one will not offset the functions of the other?

ELECTRICAL:

- Do you specify compliance with OSHA for all contract electrical work?
- Are all employees required to report as soon as practicable any obvious hazard to life or property observed in connection with electrical equipment or lines?
- Are employees instructed to make preliminary inspections and/or appropriate tests to determine what conditions exist before starting work on electrical equipment or lines?

- **When electrical equipment or lines are to be serviced, maintained or adjusted, are necessary switches opened, locked-out and tagged whenever possible?**
- **Are portable electrical tools and equipment grounded or of the double insulated type?**
- **Are electrical appliances such as vacuum cleaners, polishers, vending machines, etc., grounded?**
- **Do extension cords being used have a grounding conductor?**
- **Are multiple plug adaptors prohibited?**
- **Are ground-fault circuit interrupters installed on each temporary 15 or 20 ampere, 120 VAC circuit at locations construction, demolition, modifications, alterations or excavations are being performed?**
- **Are all temporary circuits protected by suitable disconnecting switches or plug connectors at the junctions with permanent wiring?**
- **Do you have electrical installations in hazardous dust or vapor areas? If so, do they meet NEC codes for hazardous locations?**
- **Exposed wiring and cords with frayed or deteriorated insulation repaired or replaced promptly?**
- **Are flexible cords and cables free of splices or taps?**
- **Are clamps or other securing means provided on flexible cords or cables at plugs, receptacles, tools, equipment, etc., and is the cord jacket securely held in place?**
- **Are all cord, cable and raceway connections intact and secure?**
- **In wet or damp locations, are electrical tools and equipment appropriate for the use or locations or otherwise protected?**
- **Is the location of electrical power lines and cables (overhead, underground, under-floor, other side of walls, etc.) determined before digging, drilling or similar work is begun?**
- **Are metal measuring tapes, ropes, hand-lines or similar devices with metallic thread woven into the fabric prohibited where they could come in contact with energized parts of equipment or circuit conductors?**

- Is the use of metal ladders prohibited in areas where the ladder or the person using the ladder could come in contact with energized parts of equipment, fixtures or circuit conductors?
- Are all disconnecting switches and circuit breakers labeled to indicate their use or equipment served?
- Are disconnecting means always opened before fuses are replaced?
- Do all interior wiring systems include provisions for grounding metal parts of electrical raceways, equipment and enclosures?
- Are all electrical raceways and enclosures fastened in place?
- Are all energized parts of electrical circuits and equipment guarded against accidental contact by approved cabinets or enclosures?
- Is sufficient access and working space provided and maintained about all electrical equipment to permit ready and safe operation and maintenance?
- Are all unused openings (including conduit knockouts) in electrical enclosures and fittings closed with appropriate covers, plugs or plates?
- Are disconnecting switches for electrical motors in excess of two horsepower capable of opening the circuit when the motor is in a stalled condition? This, of course, is without exploding? (Switches must be horsepower rated and equal to or in excess of the motor HP rating.)
- Is low voltage protection provided in the control device of motor driving machines or equipment which could cause probable injury from inadvertent starting?
- Is each motor disconnecting switch or circuit breaker located within sight of the motor control device?
- Is each motor located within sight of its controller or the controller disconnecting means capable of being locked in the open position or is a separate disconnecting means installed in the circuit within sight of the motor?
- Is the controller for each motor in excess of two horsepower, rated in HP equal to or in excess of the rating of the motor it serves?
- Are employees who regularly work on or around energized electrical equipment or lines instructed in CPR methods?

- Are employees prohibited from working alone on energized lines or equipment over 600 volts?

ELEVATED SURFACES:

- Are signs posted, when appropriate, showing the elevated surface load capacity?
- Are surfaces elevated more than thirty (30) inches above the floor or ground level provided with standard guardrails?
- Are all elevated surfaces (beneath which people or machinery could be exposed to falling objects) provided with standard four (4) inch toeboards?
- Is a permanent means of access and egress provided to elevated storage and work surfaces?
- Is required headroom provided where necessary?
- Is material on elevated surfaces stacked or racked in a manner to prevent it from tipping, falling, collapsing, rolling or spreading?
- Are dock boards or bridge plates used when transferring materials between docks and trucks or rail cars?

EMPLOYER POSTING:

- Are OSHA workplace posters displayed in a prominent location where all employees are likely to see them?
- Are emergency telephone numbers posted where they can be readily found in case of emergency?
- Where employees may be exposed to any toxic substances or harmful physical agents, has appropriate information concerning employee access to medical and exposure records and MSDS data been posted or otherwise made readily available to affected employees?
- Are signs concerning exiting from buildings, room capacities, floor loading, biohazards, and exposures to x-ray, microwave, or other harmful radiation or substances posted where appropriate?

ENTERING CONFINED SPACES:

- Are confined spaces thoroughly emptied of any corrosive or hazardous substances, such as acids or caustics, before entry?

- Are all lines to a confined space containing inert, toxic, flammable, or corrosive materials valves off and blanked or disconnected and separated before entry?
- Do requirements state that all impellers, agitators, or other moving equipment inside confined spaces be locked-out if they present a hazard?
- Is either natural or mechanical ventilation provided prior to confined space entry?
- Are appropriate atmospheric tests performed to check for oxygen deficiency, toxic substance and explosive concentrations in the confined space before entry?
- Is adequate illumination provided for the work to be performed in the confined space?
- Is the atmosphere inside the confined space frequently tested or continuously monitored during conduct of work?
- Is there an assigned safety standby employee outside of the confined space, when required, whose sole responsibility is to watch the work in progress, sound an alarm if necessary, and render assistance?
- Is the standby employee appropriately trained and equipped to handle an emergency?
- Is the standby employee or other employees prohibited from entering the confined space without lifelines and respiratory equipment if there is any question as to the cause of an emergency?
- Is approved respiratory equipment required if the atmosphere inside the confined space cannot be made acceptable?
- Is all portable electrical equipment used inside confined spaces either grounded and insulated, or equipped with ground-fault protection?
- Before gas welding or burning is started in a confined space, are hoses checked for leaks, compressed gas bottles forbidden inside of the confined space, torches lighted only outside of the confined area and the confined area tested for an explosive atmosphere each time before a lighted torch is to be taken into the space?
- If employees will be using oxygen-consuming equipment such as salamanders, torches, furnaces, etc. in a confined space, is sufficient air provided to assure combustion without reducing the oxygen concentration of the atmosphere below 19.5 percent by volume?
- Whenever combustion-type equipment is used in a confined space, are provisions made to ensure the exhaust gases are vented outside the enclosure?

- Is each confined space checked for decaying vegetation or animal matter which may produce methane?
- Is the confined space checked for possible industrial waste which could contain toxic properties?
- If the confined space is below ground level and near areas where motor vehicles will be operating, is it possible for vehicle exhaust or carbon monoxide to enter the space?

ENVIRONMENTAL CONTROLS:

- Are all work areas properly illuminated?
- Are employees instructed in proper first-aid and other emergency procedures?
- Are hazardous substances, blood, and other potentially infectious materials identified, which may cause harm by inhalation, ingestion or skin absorption or contact?
- Are employees aware of the hazards involved with the various chemicals they may be exposed to in their work environment, such as ammonia, chlorine, epoxies, caustics, etc.?
- Is employee exposure to chemicals in the workplace kept within acceptable levels?
- Can a less harmful method or product be used?
- Is the work area's ventilation system appropriate for the work being performed?
- Are spray painting operations done in a spray room or booth equipped with an appropriate exhaust system?
- Is employee exposure to welding fumes controlled by ventilation, use of respirator, exposure time, or other means?
- Are welders and other workers nearby provided with flash shields during welding operations?
- If forklifts and other vehicles are used in buildings or other enclosed areas, are the carbon monoxide levels below maximum acceptable concentrations?
- Has there been a determination that noise levels in the facilities are within acceptable levels?
- Are steps being taken to use engineering controls to reduce excessive noise levels?
- Are proper precautions being taken when handling asbestos and other fibrous materials?

- Are caution labels and signs used to warn of hazardous substances (e.g. asbestos) and biohazards (e.g. bloodborne pathogens)?
- Are wet methods used, when practicable, to prevent the emission of airborne asbestos fibers, silica dust and similar hazardous materials?
- Are engineering controls examined and maintained or replaced on a scheduled basis?
- Is vacuuming with appropriate equipment used whenever possible rather than blowing or sweeping dust?
- Are grinders, saws, and other machines that produce respirable dusts vented to an industrial collector or central exhaust system?
- Are all local exhaust ventilation systems designed to operate properly? These designs include air flow and air volume necessary with ducts not plugged or belts slipping?
- Is personal protective equipment provided, used and maintained whenever required?
- Are there written standard operating procedures for the selection and use of respirators where needed?
- Are restrooms and washrooms kept clean and sanitary?
- Is all water provided for drinking, washing, and cooking potable?
- Are outlets for water not suitable for drinking clearly identified?
- Are employees' physical capacities assessed before being assigned to jobs requiring heavy work?
- Are employees instructed in the proper manner of lifting heavy objects?
- Where heat is a problem have all fixed work areas been provided with spot cooling or air conditioning?
- Are employees screened before assignment to areas of high heat to determine if their health condition might make them more susceptible to having an adverse reaction?
- Are employees working on streets and roadways, where they are exposed to the hazards of traffic, required to wear bright colored (traffic orange) warning vests?
- Are exhaust stacks and air intakes so located that contaminated air will not be recirculated within a building or other enclosed area?

- Is equipment producing ultra-violet radiation properly shielded?
- Are universal precautions observed where occupational exposure to blood or other potentially infectious materials can occur, and in all instances where differentiation of types of body fluids or potentially infectious materials is difficult or impossible?

EXIT DOORS:

- Are doors which are required to serve as exits designed and constructed so the direction of exit travel is obvious and direct?
- Are windows which could be mistaken for exit doors, made inaccessible by means of barriers or railings?
- Are exit doors capable of being opened from the direction of exit travel without the use of a key or any special knowledge or effort when the building is occupied?
- Is a revolving, sliding or overhead door prohibited from serving as a required exit door?
- Where panic hardware is installed on a required exit door, will it allow the door to open by applying force of 15 pounds or less in the direction of the exit traffic?
- Are doors on cold storage rooms provided with an inside release mechanism which will release the latch and open the door even if it is padlocked or otherwise locked on the outside?
- Where exit doors open directly onto any street, alley or other area where vehicles may be operated, are adequate barriers and warning provided to prevent employees from stepping into the path of traffic?
- Are doors that swing in both directions and are located between rooms where there is frequent traffic, provided with viewing panels in each door?

EXITING OR EGRESS:

- Are all exits marked with an exit sign and illuminated by a reliable light source?
- Are the directions to exits, when not immediately apparent, marked with visible signs?
- Are doors, passageways or stairways, that are neither exits nor access to exits and which could be mistaken for exits, appropriately marked "NOT AN EXIT", "TO BASEMENT," "STOREROOM", etc?

- Are exit signs provided with the word "EXIT" in lettering at least 5 inches high and the stroke of the lettering at least ½ inches wide?
- Are exit doors side-hinged?
- Are all exits kept free of obstructions?
- Are at least two means of egress provided from elevated platforms, pits or rooms where the absence of a second exit would increase the risk of injury from hot, poisonous, corrosive, suffocating, flammable, or explosive substances?
- Are there sufficient exits to permit prompt escape in the case of emergency?
- Are special precautions taken to protect employees during construction and repair operations?
- Is the number of exits from each floor of a building and the number of exits from the building itself, appropriate for the building occupancy load?
- Are exit stairways which require separation from other parts of a building, enclosed by at least 2-hour fire-restrictive construction? This is for buildings more than four stories high, and not less than 1-hour fire-resistive construction elsewhere?
- Where ramps are used as part of required exiting from a building, is the ramp slope limited to 1 foot vertical and 12 feet horizontal?
- Where exiting will be through frameless glass doors, glass exit doors, storm doors, etc, are the doors fully tempered and meet the safety requirements for human impact?

FIRE PROTECTION:

- Is your local fire department well acquainted with your facilities, its location and specific hazards?
- If you have a fire alarm system, is it certified as required?
- If you have a fire alarm system, is it tested at least annually?
- If you have interior stand pipes and valves, are they inspected regularly?
- If you have outside private fire hydrants, are they flushed at least once a year and on a routine preventative maintenance schedule?
- Are fire doors and shutters in good operating condition?

- Are fire doors and shutters unobstructed and protected against obstructions, including their counterweights?
- Are fire doors and shutter fusible links in place?
- Are automatic sprinkler system water control valves, air and water pressure checked weekly/periodically as required?
- Is the maintenance of automatic sprinkler systems assigned to responsible persons or to a sprinkler contractor?
- Are sprinkler heads protected by metal guards when exposed to physical damage?
- Is proper clearance maintained below sprinkler heads?
- Are portable fire extinguishers provided in adequate number and type?
- Are fire extinguishers mounted in readily accessible locations?
- Are fire extinguishers recharged regularly and noted on the inspection tag?
- Are employees periodically instructed in the use of extinguishers and fire protection procedures?

FLAMMABLE AND COMBUSTIBLE MATERIALS:

- Are combustible scrap, debris and waste materials (oily rags, etc.) stored in covered metal receptacles and removed from the workplace promptly?
- Is proper storage practiced to minimize the risk of fire, including spontaneous combustion?
- Are approved containers and tanks used for the storage and handling of flammable and combustible liquids?
- Are all connections on drums and combustible liquid piping, vapor and liquid tight?
- Are all flammable liquids kept in closed containers when not in use (e.g. parts cleaning tanks, pans, etc.)?
- Are bulk drums of flammable liquids grounded and bonded to containers during dispensing?
- Do storage rooms for flammable and combustible liquids have explosion-proof lights?

- Do storage rooms for flammable and combustible liquids have mechanical or gravity ventilation?
- Is liquefied petroleum gas stored, handled, and used in accordance with safe practices and standards?
- Are “NO SMOKING” signs posted on liquefied petroleum gas tanks?
- Are liquefied petroleum storage tanks guarded to prevent damage from vehicles?
- Are all solvent wastes and flammable liquids kept in fire-resistant, covered containers until they are removed from the workplace?
- Is vacuuming used whenever possible rather than blowing or sweeping combustible dust?
- Are firm separators placed between containers of combustibles or flammables, when stacked one on another, to assure their support and stability?
- Are fuel gas cylinders and oxygen cylinders separated by distance, fire resistant barriers, etc. while in storage?
- Are fire extinguishers selected and provided for the types of materials in areas where they are to be used?
 - Class A Ordinary combustible material fires.
 - Class B Flammable liquid, gas or grease fires.
 - Class C Energized-electrical equipment fires.
- Are appropriate fire extinguishers mounted with 75 feet of outside areas containing flammable liquids, and within 10 feet of any inside storage area for such materials?
- Are extinguishers free from obstructions or blockage?
- Are all extinguishers serviced, maintained and tagged at intervals not to exceed one year?
- Are all extinguishers fully charged and in their designated places?
- Where sprinkler systems are permanently installed, are the nozzle heads so directed or arranged that water will not be sprayed into operating electrical switch boards and equipment?
- Are safety cans used for dispensing flammable or combustible liquids at a point of use?

- Are all spills of flammable or combustible liquids cleaned up promptly?
- Are storage tanks adequately vented to prevent the development of excessive vacuum or pressure as a result of filling, emptying, or atmosphere temperature changes?
- Are storage tanks equipped with emergency venting that will relieve excessive internal pressure caused by fire exposure?
- Are “NO SMOKING” rules enforced in areas involving storage and use of hazardous materials?

FLOOR AND WALL OPENINGS:

- Are floor openings guarded by a cover, a guardrail, or equivalent on all sides (except at entrance to stairways or ladders)?
- Are toeboards installed around the edges of permanent floor opening (where persons may pass below the opening)?
- Are skylight screens of such construction and mounting that they will withstand a load of at least 200 pounds?
- Is the glass in the windows, doors, glass walls, etc, which are subject to human impact, of sufficient thickness and type for the conditions of use?
- Are grates or similar type covers over floor openings, such as floor drains, of such design that foot traffic or rolling equipment will not be affected by the grate spacing?
- Are unused portions of service pits and pits not actually in use either covered or protected by guardrails or equivalent?
- Are manhole covers, trench covers and similar covers, plus their supports, designed to carry a truck rear axle load of at least 20,000 pounds when located in roadways and subject to vehicle traffic?
- Are floor or wall openings in fire resistive construction provided with doors or covers compatible with the fire rating of the structure provided with self-closing feature where appropriate?

FUELING:

- Is it prohibited to fuel an internal combustion engine with a flammable liquid while the engine is running?

- Are fueling operations done in such a manner that likelihood of spillage will be minimal?
- When spillage occurs during fueling operations, is the spilled fuel washed away completely, evaporated, or other measures taken to control vapors before restarting the engine?
- Are fuel tank caps replaced and secured before starting the engine?
- In fueling operations, is there always metal contact between the container and the fuel tank?
- Are fueling hoses of a type designed to handle the specific type of fuel?
- Is it prohibited to handle or transfer gasoline in open containers?
- Are open lights, open flames, or sparking, or arcing equipment prohibited near fueling or transfer of fuel operations?
- Is smoking prohibited in the vicinity of fueling operations?
- Are fueling operations prohibited in building or other enclosed areas that are not specifically ventilated for this purpose?
- Where fueling or transfer of fuel is done through a gravity flow system are the nozzles of the self-closing type?

GENERAL WORK ENVIRONMENT:

- Are all worksites clean, sanitary, and orderly?
- Are work surfaces kept dry or appropriate means taken to assure the surfaces are slip-resistant?
- Are spilled hazardous materials or liquids, including blood and other potential infectious materials, cleaned up immediately and according to proper procedures?
- Is combustible scrap, debris and waste stored safely and removed from the workplace promptly?
- Is all regulated waste, as defined in OSHA bloodborne pathogens standard (29 CFR 1910.1030), discarded according to federal, state, and local regulations?
- Are accumulations of combustible dust routinely removed from elevated surfaces including the overhead structure of buildings, etc?

- Is combustible dust cleaned up with a vacuum system to prevent the dust going into suspension?
- Is metallic or conductive dust prevented from entering or accumulating on or around electrical enclosures or equipment?
- Are covered metal waste cans used for oily and paint-soaked waste?
- Are all oil and gas fired devices equipped with flame failure controls that will prevent flow of fuel if pilot or main burners are not working?
- Are paint spray booths, dip tanks, etc. clean and sanitary?
- Are the minimum number of toilets and washing facilities provided?
- Are all toilets and washing facilities clean and sanitary?
- Are all work areas adequately illuminated?
- Are pits and floor openings covered or otherwise guarded?

HAND TOOLS AND EQUIPMENT:

- Are all tools and equipment (both company and employee-owned) used by employees at their workplaces in good condition?
- Are hand tools such as chisels, punches, etc. which develop mushroomed heads during use, reconditioned or replaced as necessary?
- Are broken or fractured handles on hammers, axes and similar equipment replaced promptly?
- Are work or bent wrenches replaced regularly?
- Are appropriate handles used on files and similar tools?
- Are employees made aware of the hazards caused by faulty or improperly used hand tools?
- Are appropriate safety glasses, face shields, etc. required while using hand tools or equipment which might product filing materials or subject to breakage?
- Are jacks checked periodically to assure they are in good operating condition?
- Are tool handles wedged tightly in the head of all tools?
- Are tool cutting edges kept sharp so the tool will move smoothly without binding or skipping?

- Are tools stored in dry, secure locations where they will not be tampered with?
- Is eye and face protection used when driving hardened or tempered spuds or nails?

HAZARDOUS CHEMICAL EXPOSURE:

- Are employees trained in the safe-handling practices of hazardous chemicals such as acids, caustic, etc?
- Are employees aware of the potential hazards involving various chemicals stored or used in the workplace such as acids, caustics, epoxies, phenols, etc?
- Is employee exposure to chemicals kept within acceptable levels?
- Are eye wash fountains and safety showers provided in areas where corrosive chemicals are handled?
- Are all containers such as vats, storage tanks, etc., labeled as to their contents, e.g. "CAUSTICS"?
- Are employees required to use PPE when handling chemicals (gloves, eye protection, respirators, etc.)?
- Are flammable or toxic chemicals kept in closed containers when not in use?
- Are chemical piping systems clearly marked as to their content?
- Where corrosive liquids are frequently handled in open containers or drawn from storage vessels or pipe lines, are adequate means readily available for neutralizing or disposing of spills or overflows properly and safely?
- Have standard operating procedures been established and are they being followed when cleaning up chemical spills?
- Where needed for emergency use, are respirators stored in a convenient, clean, and sanitary location?
- Are respirators intended for emergency use adequate for the various uses for which they may be needed?
- Are employees prohibited from eating in areas where hazardous chemicals are present?
- Is personal protective equipment provided, used and maintained whenever necessary?

- Are there written standard operating procedures for the selection and use of respirators where needed?
- If you have a respirator protection program, are your employees instructed on the correct usage and limitations of the respirators? Are the respirators NIOSH approved for this particular application? Are they inspected on a regular basis and cleaned and sanitized?
- If hazardous substances are used in your processes, do you have a medical or biological monitoring system in operation?
- Are you familiar with the Threshold Limit Values or Permissible Exposure Limits of airborne contaminants and physical agents used in our workplace?
- Have control procedures been instituted for hazardous materials, where appropriate, such as respirators, ventilation systems, handling practices, etc.?
- Whenever possible, are hazardous substances handled in properly designated and exhausted booths or similar locations?
- Do you use general dilution or local exhaust ventilation systems to control dusts, vapors, gases, fumes, smoke, solvents or mists which may be generated in your workplace?
- Is ventilation equipment provided for removal of contaminants from such operations as: production grinding, buffing, spray painting, and/or vapor degreasing, and is it operating properly?
- Do employees complain about dizziness, headaches, nausea, irritation, or other factors of discomfort when they use solvents or other chemicals?
- Is there a dermatitis problem? Do employees complain about dryness, irritation, or sensitization of the skin?
- Have you considered the use of an industrial hygienist or environmental health specialist to evaluate your operation?
- If internal combustion engines are used, is carbon monoxide kept within acceptable levels?
- Is vacuuming used rather than blowing or sweeping dusts whenever possible for clean-up?
- Are materials which give off toxic asphyxiant, suffocating or anesthetic fumes, stored in remote or isolated locations when not in use?

HAZARDOUS SUBSTANCES COMMUNICATION:

- **Is there a list of hazardous substances used in your workplace?**
- **Is there a current written exposure control plan for occupational exposure to bloodborne pathogens and other potentially infectious materials, where applicable?**
- **Is there a written hazard communication program dealing with Material Safety Data Sheets (MSDS), labeling, and employee training?**
- **Is each container for a hazardous substance (i.e. vats, bottles, storage tanks, etc.) labeled with product identify and hazard warning (communication of the specific health hazards and physical hazards)?**
- **Is there a Material Safety Data Sheet readily available for each hazardous substance used?**
- **Is there an employee training program for hazardous substances?**
Does this program include
 - **An explanation of what an MSDA is and how to use and obtain one?**
 - **MSDS contents for each hazardous substance or class of substances?**
 - **Explanation of “Right to Know”?**
 - **Identification of where an employee can see the employer’s written hazard communication program and where hazardous substances are present in their work areas?**
 - **The physical and health hazards of substances in the work area, and specific protective measures to be used?**
 - **Details of the hazard communication program, including how to use the labeling system and MSDS’s?**
 - **Are employees trained in how to handle bloodborne pathogens?**
- **Are employees trained on how to recognize tasks that might result in occupational exposure?**
- **Are employees trained on how to work practices and engineering controls and PPE and to know their limitations?**
- **Are employees trained on how to obtain information relative to the types, selection, proper use, location, removal, handling, decontamination, and disposal of PPE?**
- **Are employees trained on who to contact and what to do in an emergency?**

HOIST AND AUXILIARY EQUIPMENT:

- Is each overhead electric hoist equipped with a limit device to stop the hook travel as its highest and lowest point of safe travel?
- Will each hoist automatically stop and hold any load up to 125 percent of its rated load if its actuating force is removed?
- Is the rated load of each hoist legibly marked and visible to the operator?
- Are stops provided at the safe limits of travel for trolley hoist?
- Are the controls of hoist plainly marked to indicate the direction of travel or motion?
- Is each cage-controlled hoist equipped with an effective warning device?
- Are close-fitting guards or other suitable devices installed on hoist to assure hoist ropes will be maintained in the sheave grooves?
- Are all hoist chains or proper of sufficient length to handle the full range of movement of the applications while still maintaining two full wraps on the drum at all times?
- Are nip points or contact points between hoist ropes and sheaves which are permanently located within seven feet of the floor, ground or working platform guarded?
- Is it prohibited to use chains or rope slings that are kinked or twisted?
- Is it prohibited to use the hoist rope or chain wrapped around the load as a substitute for a sling?
- Is the operator instructed to avoid carrying loads over people?

IDENTIFICATION OF PIPING SYSTEMS:

- When non-potable water is piped through a facility, are outlets or taps posted to alert employees that it is unsafe and not to be used for drinking, washing or other personal use?
- When hazardous substances are transported through above ground piping, is each pipeline identified as points where confusion could introduce hazards to employees?
- When pipelines are identified by color painting, are the visible parts of the line so identified?
- When pipelines are identified by color painted bands or tape, are the bands or tapes located at reasonable intervals and at each outlet, valve or connection?

- When pipelines are identified by color, is the color code posted at all locations where confusion could introduce hazards to employees?
- When the contents of pipelines are identified by name or name abbreviation, is the information readily visible on the pipe near each valve or outlet?
- When pipelines carrying hazardous substances are identified by tags, are the tags constructed of durable materials, the message carried clearly and permanently distinguishable, and are tags installed at each valve or outlet?
- When pipelines are heated by electricity, steam or other external source, are suitable warning signs or tags placed at unions, valves, or other serviceable parts of the system?

INDUSTRIAL TRUCKS—FORKLIFTS:

- Are only employees who have been trained in the proper use of hoists allowed to operate them?
- Are only trained personnel allowed to operate industrial trucks?
- Is substantial overhead protective equipment provided on high lift rider equipment?
- Is directional lighting provided on each industrial truck that operates in an area with less than 2 foot candles per square feet of general lighting?
- Does each industrial truck have a warning horn, whistle, gong, or other device which can be clearly heard above the normal noise in the areas where operated?
- Are the brakes on each industrial truck capable of bringing the vehicle to a complete and safe stop when fully loaded?
- Will the industrial truck's parking brake effectively prevent the vehicle from moving when unattended?
- Are industrial trucks operating in areas where flammable gases or vapors, or combustible dust or ignitable fibers may be present in the atmosphere, approved for such locations?
- Are motorized hand and hand/rider trucks so designated that the brakes are applied, and power to the drive motor shuts off when the operator releases his or her grip on the device that controls the travel?

- Are industrial trucks with internal combustion engines, operated in building or enclosed areas, carefully checked to ensure such operations do not cause harmful concentrations of dangerous gases or fumes?

LOCKOUT/TAGOUT PROCEDURES:

- Is all machinery or equipment capable of movement required to be de-energized or disengaged and blocked or locked-out during cleaning, servicing, adjusting or setting up operations?
- Where the power disconnecting means for equipment does not also disconnect the electrical control circuit
 - Are appropriate electrical enclosures identified?
 - Is means provided to assure the control circuit can also be disconnected and locked-out?
- Is the locking-out of control circuits in lieu of locking-out main power disconnects prohibited?
- Are all equipment control valve handles provided with a means for locking-out?
- Does the lock-out procedure require that stored energy (mechanical, hydraulic, air, etc.) be released or blocked before equipment is locked-out for repairs?
- Are appropriate employees provided with individually keyed personal safety locks?
- Are employees required to keep personal control of their keys while they have safety locks in use?
- Is it required that only the employee exposed to the hazard place or remove the safety lock?
- Is it required that employees check the safety of the lock-out by attempting a start-up after making sure no one is exposed?
- Are employees instructed to always push the control circuit stop button prior to re-energizing the main power switch?
- Is there a means provided to identify any or all employees who are working on locked-out equipment by their locks or accompanying tags?
- Are sufficient number of accidental preventive signs of tags and safety padlocks provided for any reasonable foreseeable repair emergency?

- **When machine operations, configuration or size require the operator to leave his or her control station to install tools or perform other operations, and that part of the machine could move is accidentally activated, is such element required to be separately locked or blocked out?**
- **In the event that equipment or lines cannot be shut down, locked-out and tagged, is a safe job procedure established and rigidly followed?**

MACHINE GUARDING:

- **Is there a training program to instruct employees on safe methods of machine operations?**
- **Is there adequate supervision to ensure that employees are following safe machine operating procedures?**
- **Is there a regular program of safety inspections of machinery and equipment?**
- **Is all machinery and equipment kept clean and properly maintained?**
- **Is sufficient clearance provided around and between machines to allow for safe operations, set up and servicing, material handling and waste removal?**
- **Is equipment and machinery securely placed and anchored when necessary to prevent tipping or other movement that could result in personal injury?**
- **Is there a power shut-off switch within reach of the operator's position at each machine?**
- **Can electric power to each machine be locked out for maintenance, repair, or security?**
- **Are the noncurrent-carrying metal parts of electrically operated machines bonded and grounded?**
- **Are foot-operated switches guarded or arranged to prevent accidental actuation by personnel or falling objects?**
- **Are manually operated valves and switches controlling the operation of equipment and machines clearly identified readily accessible?**
- **Are all emergency stop buttons colored red?**
- **Are all pulleys and belts that are within seven (7) feet of the floor or working level properly guarded?**

- Are splash guards mounted on machines that use coolant to prevent the coolant from reaching employees?
- Are methods provided to protect the operator and other employees in the machine area from hazards created at the point of operation, ingoing nip points, rotating parts, fling chips, and sparks?
- Are machinery guards secure and so arranged that they do not offer a hazard in their use?
- If special hand tools are used for placing and removing material, do they protect the operator's hands?
- Are revolving drums, barrels, and containers required to be guarded by an enclosure that is interlocked with the drive mechanism, so that revolution cannot occur unless the guard enclosures is in place, or guarded?
- Do arbors and mandrels have firm and secure bearings and are they free from play?
- Are provisions made to prevent machines from automatically starting when power is restored after a power failure or shutdown?
- Are machines constructed so as to be free from excessive vibrations when the largest size tool is mounted and run at full speed?
- If machinery is cleaned with compressed air, is air pressure controlled and PPE or other safeguards utilized to protect operators and other workers from eye and body injury?
- Are fan blades protected with a guard having openings no larger than ½ inch, when operating within seven (7) feet of the floor?
- Are saws used for ripping, equipped with anti-kickback devices and spreaders?
- Are radial arm saws so arranged that the cutting head will gently return to the back of the table when released?

MATERIAL HANDLING:

- Is there safe clearance for equipment through aisles and doorways?
- Are aisleways designated, permanently marked, and kept clear to allow unhindered passage?
- Are motorized vehicles and mechanized equipment inspected daily or prior to use?
- Are vehicles shut off and brakes set prior to loading or unloading?

- Are containers of combustibles or flammables, when stacked while being moved, always separated by dunnage sufficient to provide stability?
- Are dock boards (bridge plates) used when loading or unloading operations are taking place between vehicles and docks?
- Are trucks and trailers secured from movement during loading and unloading operations?
- Are dock plates and loading ramps constructed and maintained with sufficient strength to support imposed loading?
- Are hand trucks maintained in a safe operating condition?
- Are chutes equipped with sideboards of sufficient height to prevent the materials being handled from falling off?
- Are chutes and gravity roller sections firmly placed or secured to prevent displacement?
- At the delivery end of the rollers or chutes, are provisions made to brake the movement of the handled materials?
- Are pallets usually inspected before being loaded or moved?
- Are hooks with safety latches or other arrangements used when hoisting materials so that slings or load attachments won't accidentally slip off the hoist hooks?
- Are securing chains, ropes, chockers or slings adequate for the job to be performed?
- When considering hoisting material or equipment, are provisions made to assure no one will be passing under the suspended loads?
- Are material safety data sheets available to employees handling hazardous substances?

MEDICAL SERVICES AND FIRST-AID:

- Is there a hospital, clinic, or infirmary for medical care in proximity to your workplace?
- If medical and first-aid facilities are not in proximity to your workplace, is at least one employee on each shift currently qualified to render first-aid?
- Have all employees who are expected to respond to medical emergencies as a part of their work
 - Received first-aid training

- Had hepatitis “B” vaccination made available to them
- Had appropriate training on procedures to protect them from bloodborne pathogens, including universal precautions
- Have available and understand how to use appropriate PPE to protect against exposure bloodborne diseases?
- Where employees have had an exposure incident involving bloodborne pathogens, did you provide an immediate post-exposure medical evaluation and follow-up?
- Are medical personnel readily available for advice and consultation on matters of employees’ health?
- Are emergency phone numbers posted?
- Are first aid kits easily accessible to each work area, with necessary supplies available, periodically inspected and replenished as needed?
- Have first aid kit supplies been approved by a physician, indicating they are adequate for a particular area or operation?
- Are means provided for quick drenching or flushing of the eyes and body in areas where corrosive liquids or materials are handled?

NOISE:

- Are there areas in the workplace where continuous noise levels exceed 85 dBA?
- If there an ongoing preventive health program to educate employees in safe levels of noise exposure, effects of noise on their health, and the use of personal protection?
- Have work areas where noise levels make voice communication between employees difficult been identified and posted?
- Are noise levels being measured using a sound level meter or an octave band analyzer and are records being kept?
- Have engineering controls been used to reduce excessive noise levels? Where engineering controls are determined not to be feasible, are administrative controls (i.e. worker rotation) being used to minimize individual employee’s exposure to noise?

- Is approved hearing protective equipment (noise attenuating devices) available to every employee working in noisy areas?
- Have you tried isolating noisy machinery from the rest of your operation?
- If you use ear protectors, are employees properly fitted and instructed in their use?
- Are employees in high noise areas given periodic audiometric testing to ensure you have effective hearing protection system?

PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING:

- Are protective goggles or face shields provided and worn where there is any danger of flying particles or corrosive materials?
- Are approved safety glasses required to be worn at all times in areas where there is a risk of eye injuries such as punctures, abrasions, contusions or burns?
- Are employees who need corrective lenses (glasses or contacts) in working environments having harmful exposures, required to wear only approved safety glasses, protective goggles, or use other medically approved precautionary procedures?
- Are protective gloves, aprons, shields, or other means provided and required where employees could be cut or where there is reasonably anticipated exposure to corrosive liquids, chemicals, blood, or other potential infectious materials
- Are hard hats provided and worn where danger of falling objects exists?
- Are hard hats inspected periodically for damage to the shell and suspension system?
- Is appropriate foot protection required where there is the risk of foot injuries from hot, corrosive, poisonous substances, falling objects, crushing or penetrating actions?
- Are approved respirators provided for regular or emergency use where needed?
- Is all protective equipment maintained in a sanitary condition ready for use?
- Do you have eye wash facilities and a quick Drench Shower within the work area where employees are exposed to injurious corrosive materials?
- Where special equipment is needed for electrical workers, is it available?
- Where food or beverages are consumed on the premises, are they consumed in areas where there is no exposure to toxic materials, blood, or other potentially infectious materials?

- Where special equipment is needed for electrical workers, is it available?
- Where food or beverages are consumed on the premises, are they consumed in areas where there is no exposure to toxic materials, blood, or other potentially infectious materials?
- Is protection against the effects of occupational noise exposure provided when sound levels exceed those of the OSHA noise standard?
- Are adequate work procedures, protective clothing and equipment provided and used when cleaning up spilled toxic or otherwise hazardous material or liquids?
- Are there appropriate procedures in place for disposing of or decontaminating personal protective equipment contaminated with, or reasonably anticipated to be contaminated with, blood or other potentially infectious materials?

PORTABLE LADDERS:

- Are all ladders maintained in good condition, joints between steps and side rails tight, all hardware and fittings securely attached and movable parts operating freely without binding or undue play?
- Are non-slip safety feet provided on each ladder?
- Are ladder runs and steps free of grease and/or oil?
- Is it prohibited to place a ladder in front of doors opening toward the ladder except when the door is blocked open, locked or guarded?
- Is it prohibited to place ladders on boxes, barrels, or other unstable bases to obtain additional height?
- Are employees instructed to face the ladder when ascending or descending?
- Are employees prohibited from using ladders that are broken; missing steps; rungs or cleats, broken side rails or other faulty equipment?
- Are employees instructed not to use the top step of ordinary stepladders as a step?
- When portable rung ladders are used to gain access to elevated platforms, roofs, etc. does the ladder always extend at least three (3) feet above the elevated surface?
- Is it required that when portable rung or cleat type ladders are used, the base is so placed that slipping will not occur, or it is lashed or otherwise held in place?

- Are portable metal ladders legibly marked with signs reading “CAUTION—DO NOT USE AROUND ELECTRICAL EQUIPMENT” or equivalent wording?
- Are employees prohibited from using ladders as guys, braces, skids, gin poles, or for other than their intended purposes?
- Are employees instructed to only adjust extension ladders while standing at a base (not while standing on the ladder or from a position above the ladder)?
- Are metal ladders inspected for damage?
- Are the rungs of ladders uniformly spread at twelve (12) inches, center to center?

PORTABLE (POWER OPERATED) TOOLS AND EQUIPMENT:

- Are grinders, saws and similar equipment provided with appropriate safety guards?
- Are power tools used with the correct shield, guard, or attachment recommended by the manufacturer?
- Are portable circular saws equipped with guards above and below the base shoe?
- Are circular saw guards checked to assure they are not wedged up, thus leaving the lower portion of the blade unguarded?
- Are rotating or moving parts of equipment guarded to prevent physical contact?
- Are all cord-connected, electrically-operated tools and equipment effectively grounded or of the approved double-insulated type?
- Are effective guards in place over belts, pulleys, chains, sprockets; on equipment such as concrete mixers, air compressors, etc.?
- Are portable fans provided with full guards or screens having openings ½ inch or less?
- Is hoisting equipment available and used for lifting heavy objects, and are hoist ratings and characteristics appropriate for the task?
- Are ground-fault circuit interrupters provided on all temporary electrical fifteen (15) and twenty (20) ampere circuit, used during periods of construction?
- Are pneumatic and hydraulic hoses on power-operated tools checked regularly for deterioration or damage?

POWER-ACTUATED TOOLS:

- Are employees who operate power-actuated tools trained in their use and carry a valid operator's card?
- Is each power-actuated tool stored in its own locked container when not being used?
- Is a sign at least 7 inches by 10 inches with bold face type reading "POWER-ACTUATED TOOL IN USE", conspicuously posted when the tool is being used?
- Are power-actuated tools left unloaded until they are actually ready to be used?
- Are power-actuated tools inspected for obstructions or defects each day before use?
- Do power-actuated tool operators have and use appropriate PPE such as hard hats, safety goggles, and safety shoes and ear protection?

RECORDER-KEEPING:

- Are all OSHA injuries or illnesses, except minor injuries requiring only first aid, being recorded as required on the OSHA 200 log?
- Are employees' medical records and records of employee exposure to hazardous substances or harmful physical agents up-to-date and in compliance with current OSHA standards?
- Are employees training records kept and accessible for review by employees, when required by OSHA standards?
- Have arrangements been made to maintain required records for the legal period of time for each specific type of record? (Some records must be maintained for at least 40 years.)
- Are operating permits and records up-to-date for such items as elevators, air pressure tanks, liquefied petroleum gas tanks, etc?

SAFETY AND HEALTH PROGRAMS:

- Do you have an active health and safety program in operation that deals with general safety and health program elements as well as management of hazards specific to your worksite?
- Is one person clearly responsible for the overall activities of the safety and health program?
- Do you have a safety committee or group made up of management and labor representatives that meets on a regular basis and reports in writing on activities?

- Do you have a working procedure for handling in-house employee complaints regarding safety and health?
- Are you keeping your employees advised of the successful efforts and accomplishments you and/or your safety committee have made in assuring they will have a workplace that is safe and healthful?

SANATIZING EQUIPMENT AND CLOTHING:

- Is personal protective clothing or equipment that employees are required to wear or use of a type capable of being cleaned easily and disinfected?
- Are employees prohibited from interchanging personal protective clothing or equipment unless it has been properly cleaned?
- Are machines and equipment which process, handle or apply material that could be injurious to employees, cleaned and/or decontaminated before being overhauled or placed in storage?
- Are employees prohibited from smoking or eating in any area where contaminants that could be injurious if ingested are present?
- When employees are required to change from street clothing into protective clothing, is a clean change room with separate storage facility for street and protective clothing provided?
- Are employees required to shower and wash their hair as soon as possible after known contact has occurred with a carcinogen?
- When equipment, materials, or other items are taken into or removed from a carcinogen regulated area, is it done in a manner that will contaminate non-regulated areas or the external environment?

SPRAYING OPERATIONS:

- Is adequate ventilation assured before spray operations are started?
- Is mechanical ventilation provided when spraying operations are done in enclosed areas?
- When mechanical ventilation is provided during spraying operations, is it so arranged that it will not circulate the contaminated air?
- Is the spray area free of hot surfaces?

- Is the spray area at least twenty (20) feet from flames, sparks, operating electrical motors and other ignition sources?
- Are portable lamps used to illuminate spray areas, suitable for use in a hazardous location?
- Is approved respiratory equipment provided and used when appropriate during spraying operations?
- Do solvents used for cleaning have a flash point to 100° F or more?
- Are fire control sprinkler heads kept clean?
- Are “NO SMOKING” signs posted in spray areas, paint rooms, paint booths, and paint storage areas?
- Is the spray area kept clean of combustible residue?
- Are spray booths constructed of metal, masonry, or other substantial noncombustible material?
- Are spray booth floors and baffles noncombustible and easily cleaned?
- Is infrared drying apparatus kept out of the spray area during spraying operations?
- Is the spray booth completely ventilated before using the drying apparatus?
- Is the electric drying apparatus properly grounded?
- Are lighting fixtures for spray booths located outside of the booth and the interior lighted through sealed clear panels?
- Are the electric motors for exhaust fans placed outside booths or ducts?
- Are belts and pulleys inside the booth fully enclosed?
- Do ducts have access doors to allow for cleaning?
- Do all drying spaces have adequate ventilation?
- Are there written standard operating procedures for the selection and use of respirators where needed?
- Are restrooms and washrooms kept clean and sanitary?
- Is all water provided for drinking, washing, and cooking potable?

- Are all outlets for water not suitable for drinking clearly identified?
- Are employees' physical capacities assessed before being assigned to jobs requiring heavy work?
- Are employees instructed in the proper manner of lifting heavy objects?
- Where heat is a problem have all fixed work areas been provided with spot cooling or air conditioning?
- Are employees screened before assignment to areas of high heat to determine if their health condition might make them more susceptible to having adverse reactions?
- Are employees working on streets and roadways where they are exposed to the hazards of traffic, required to wear bright colored (traffic orange) warning vests?
- Are exhaust stacks and air intakes so located that contaminated air will not be re-circulated within a building or other enclosed areas?
- Is equipment producing ultra-violet radiation properly shielded?
- Are universal precautions observed where occupational exposure to blood or other potentially infectious materials can occur and in all instances where differentiation of types of body fluids or potentially infectious material is difficult or impossible?

STAIRS AND STAIRWAYS:

- Are standard stair rails or handrails on all stairways having four or more risers?
- Are all stairways at least twenty-two (22) inches wide?
- Do stairs have landing platforms not less than thirty (30) inches in the direction of travel and extend twenty-two (22) inches in width at every twelve (12) feet or less of vertical rise?
- Do stairs angle no more than fifty (50) degrees and no less than thirty (30) degrees?
- Are stairs of hollow-pan type treads and landings filed to the top edge of the pan with solid material?
- Are step risers on stairs uniform from the top to the bottom?
- Are steps on stairs and stairways designed or provided with a surface that renders them slip-resistant?

- Are stairway handrails located between thirty (30) and thirty-four (34) inches above the leading edge of stair treads?
- Do stairway handrails have at least three (3) inches of clearance between the handrails and the wall or surface they are mounted on?
- Where doors or gates open directly on a stairway, is there a platform provided or the swing of the door does not reduce the width of the platform to less than twenty-one inches?
- Are stairway handrails capable of withstanding a load of two hundred (200) pounds, applied within two (2) inches of the top edge, in any downward or outward direction?
- Where stairs or stairways exit directly into any area where vehicles may be operated, are adequate barriers and warnings provided to prevent employees stepping into the path of traffic?
- Do stairway landings have a dimension measured in the direction of travel at least equal to the width of the stairway?
- Is the vertical distance between stairway landings limited to twelve (12) feet or less?

TIRE INFLATION:

- Where tires are mounted and / or inflated on drop center wheels, is a safe practice procedure posted and enforced?
- Where tires are mounted and / or inflated on wheels with split rims and / or retainer rings, is a safe practice procedure posted and enforced?
- Does each tire inflation hose have a clip-on chuck with at least 24 inches of hose between the chuck and an in-line hand valve and gauge?
- Does the tire inflation control valve automatically shut off the air flow when the valve is released?
- Is a tire restraining device such as a cage, rack or other effective means used while inflating tires mounted on split rims or rims using retainer rings?
- Are employees forbidden from taking a position directly over or in front of a tire while it's being inflated?

TRANSPORTING EMPLOYEES AND MATERIALS:

- Do employees who operate vehicles on public thoroughfares have valid operator's licenses?
- When seven or more employees are regularly transported in a van, bus or truck, is the operator's license appropriate for the class of vehicle being driven?
- Is each van, bus or truck used regularly to transport employees, equipped with an adequate number of seats?
- When employees are transported by truck, are provisions provided to prevent their falling from the vehicle?
- Are vehicles used to transport employees equipped with lamps, brakes, horns, mirrors,

Wind shields and turn signals in good repair?

- Are transport vehicles provided with handrails, steps, stirrups or similar devices, arranged so employees can safely mount or dismount?
- Are employee transport vehicles equipped at all times with at least two reflective type flares?
- Is a fully charged fire extinguisher, in good condition, with at least four (4) BC rating maintained in each employee transport vehicle?
- When cutting tools or tools with sharp edges are carried in passenger compartments of employee transport vehicles, are they placed in closed boxes or containers which are secured in place?
- Are employees prohibited from riding on top of any load which can shift, topple, or otherwise become unstable?

WALKWAYS:

- Are aisles and passageways kept clear?
- Are aisles and walkways marked as appropriate?
- Are wet surfaces covered with non-slip materials?
- Are holes in the floor, sidewalk or other walking surface repaired properly, covered or otherwise made safe?
- Is there safe clearance for walking in aisles where motorized or mechanical handling equipment is operating?

- Are materials or equipment stored in such a way that sharp projections will not interfere with the walkway?
- Are spilled materials cleaned up immediately?
- Are changes of direction or elevations readily identifiable?
- Are aisles or walkways that pass near moving or operating machinery, welding operations or similar operations arranged so employees will not be subjected to potential hazards?
- Is adequate headroom provided for the entire length of the aisle or walkway?
- Are standard guardrails provided whenever aisle or walkway surfaces are elevated more than thirty (30) inches above any adjacent floor or the ground?
- Are bridges provided over conveyors and similar hazards?

WELDING, CUTTING AND BRAZING:

- Are only authorized and trained personnel permitted to use welding, cutting or brazing equipment?
- Does each operator have a copy of the appropriate operating instructions, and are they directed to follow them?
- Are compressed gas-cylinders regularly examined for obvious signs of defects, deep rusting, or leakage?
- Is care used in handling and storage of cylinders, safety valves, relief valves, etc. to prevent damage?
- Are precautions taken to prevent the mixture of air or oxygen with flammable gases, except at a burner or in a standard torch?
- Are only approved apparatus (torches, regulators, pressure-reducing valves, acetylene generators, manifolds) used?
- Are cylinders kept away from sources of heat?
- Are the cylinders kept away from elevators, stairs, or gangways?
- Is it prohibited to use cylinders as rollers or supports?
- Are empty cylinders appropriately marked and their valves closed?

- Are signs reading “DANGER-NO SMOKING, MATCHES, OR OPEN LIGHTS” or equivalent, posted?
- Are cylinders, cylinder valves, couplings, regulators, hoses, and apparatus kept free of oily or greasy substances?
- Is care taken not to drop or strike cylinders?
- Unless secured on special trucks, are regulators removed and valve-protection caps put in place before moving cylinders?
- Do cylinders without fixed end wheels have keys, handles, or non-adjustable wrenches on stem valves when in service?
- Are liquefied gases stored and shipped valve-end up with valve covers in place?
- Are provisions made to never crack a fuel-gas cylinder valve near sources of ignition?
- Before a regulator is removed, is the valve closed and gas released from the regulator?
- Is red used to identify the acetylene (and other fuel-gas) hose, green for oxygen hose, and black for inert gas and air hose?
- Are pressure-reducing regulators used only for the gas and pressure for which they are intended?
- Is open circuit (NO LOAD) voltage of arc welding and cutting machines as low as possible and not in excess of the recommended limits?
- Under wet conditions, are automatic controls for reducing no-load voltage used?
- Is grounding of the machine frame and safety ground connections of portable machines checked periodically?
- Are electrodes removed from the holders when not in use?
- Is it required that electric power to the welder be shut off when no one is in attendance?
- Is suitable fire extinguishing equipment available for immediate use?
- Is the welder forbidden to coil or loop welding electrode cable around his body?
- Are wet machines thoroughly dried and tested before being used?

- Are work and electrode lead cables frequently inspected for wear and damage and replaced when needed?
- Do means for connecting cable lengths have adequate insulation?
- When object to be welded cannot be moved and fire hazard cannot be removed, are shields used to confine heat, sparks, and slag?
- Are fire watchers assigned when welding or cutting is performed in locations where a serious fire might develop?
- Are combustible floors kept wet, covered by damp sand, or protected by fire-resistant shields?
- When floors are wet down, are personnel protected from possible electrical shock?
- When welding is done on metal walls, are precautions taken to protect combustibles on the other side?
- Before hot work is begun, are used drums, barrels, tanks, and other containers so thoroughly cleaned that no substance remains that could explode, ignite, or produce toxic vapor?
- Is it required that eye protection helmets, hand shields and goggles meet appropriate standards?
- Are employees exposed to the hazards created by welding, cutting, or brazing operations protected with PPE?
- Is a check made for adequate ventilation in and where welding or cutting is performed?
- When working in confined places, are environmental monitoring tests taken and means provided for quick removal of welders in case of an emergency?

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