



# Machine Safety in Hydraulic Press and Machining tools in Manufacturing industries

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## Abstract:

Deficiencies in safety cause negative consequences for companies, national economy and individuals and therefore safer and healthier products and work environments are required. Improvements in safety of existing workplaces increase job satisfaction, decrease absenteeism and accidents in companies and may also have positive effects on the quality of the products of companies. The responsibility for ensuring that manufacturing equipment complies with regulatory and safety requirements frequently falls to the manufacturing engineer. A significant challenge to exploring machine guarding is for the workers who are working in machines in the machinery. Studies have found that engineers, many of whom have responsibility for machine safety, are either uneducated or poorly educated on the subject of machine guarding and safety standards. Machine operators in particular face high risks, often stemming from the absence or improper use of machine safeguarding or the failure to implement lockout procedures. The machine related injuries have a potential for uprooting if the research can provide better knowledge for machine workers, designers etc. Because machines are frequent and persist source for occupational injury. This paper clearly explains about the machine guarding purposes

and uses of guarding so that the accidents that occur at industries can be minimized.

## 1. INTRODUCTION

Machinery and equipment have been evolved to meet a need whether for producing, changing or moving materials and components. Initially they were essentially functional with scant regard for the health and safety of those using them. But attitudes have changed and all work equipment must now be designed and built so that it does not put the user at risk of damage to health or injury. Most people think of a machine guard when industrial safety is mentioned, and for good reason. More efforts and resources have been expended to guard machines than for any other industrial safety and health endeavour. To modify or guard a single machine is generally not a major project when compared with installing a ventilation system or a noise-abatement system. However, although each machine guarding modification is usually small, the aggregate becomes a major undertaking involving plant maintenance, operations, purchasing, scheduling, and, of course, the safety and health manager. The safety and health manager should take a leadership role in the implementation of machine guards—enumerating problem areas, setting priorities, selecting safeguarding alternatives, and ensuring compliance with standards.

### 1.1 Introduction to Hydraulic press

Hydraulic press is a tool to produce compressive force by means of fluid. It depends upon Pascal's principle that the pressure throughout an enclosed entity is constant. By means of hydraulic system larger forces can be produced in contrast with mechanical and electrical systems. Press working forces are set up, guided and controlled in a machine referred to as a Press. Thus an attempt has been made to atomize the process of press work using Hydraulic mechanism in press machine. The inputs and outputs of the control system including hydraulic mechanism are solely mechanical such as rotating shaft or reciprocating plunger.

### 1.1 Introduction to Machining tools

Machining is the process to shape any raw material (work piece), metal or non-metal, into a part (product) or to improve the tolerance and surface finish of a previously formed work piece by removing a portion of the raw material. This can be done either mechanically (turning, drilling, milling, grinding, water-jet machining, ultrasonic machining, etc.), chemically (chemical machining, electrochemical machining, etc.), electrically (electrical discharge machining), or thermally (laser machining, electron beam machining, etc.). Metal cutting is a process in which excess material is removed by a harder tool, through a mechanical process of extensive plastic deformation or controlled fracture. Metal cutting, in this definition, is a subset of machining.

### 1.2 Hydraulic Press Machines

It is an assembly of support frame and bed. Both the channels bolster each other with the help of a supportive plate welded at the top of the structure. Further it is welded at the foundation to give the whole assembly a framed structure. The bed which holds a die is clamped on the holes.



**Fig 1 Hydraulic Press**

#### 1.2.1 Bed

Bed is a plate on which the die is supposed to hold. It is used for mounting the die on support frame at desired position. The holes produced on the sides is the support plate to be clamped on support frame.

#### 1.2.2 Die

Die is an integral part of any manufacturing process which enables the desired shape that one require. Here for the experimental purpose a compound die have been used which produces a washer from the strip of sheet metal. A blanking die produces a flat piece of material by cutting the desired shape in single operation. The finished part is referred to as a blank. Generally a blanking die may only cut an outer contour of part, often used for parts with no internal features.

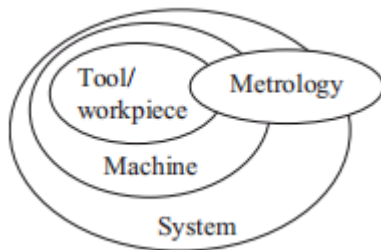
#### 1.2.3 Punch

Punch is the male component of die. In compound die we used two punch one cuts inner diameter of washer and another cuts outer diameter of same. Punch which cuts outer diameter, is placed at bottom side of female die. Second punch that cuts outer diameter of washer is attached with piston rod of hydraulic cylinder. Position of same punch is above side of die.

#### 1.2.4 Plunger and Hydraulic cylinder

Plunger has been purchased from the market. Main function of plunger in our project is it provides required hydraulic pressure to our hydraulic cylinder. Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a

piston rod moves back and forth. The barrel is closed on each end by the cylinder bottom (also called the cap end) and by the cylinder head where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder in two chambers, the bottom chamber (cap end) and the piston rod side chamber (rod end). The hydraulic pressure acts on the piston to do linear work and motion.



**Fig 2 Relationship among the tool/work piece, machine, system, and metrology**

### 1.3 REQUIREMENTS IN THE CONSTRUCTION OF MACHINE TOOLS

Machine tools are expected to fulfil the highest demands put upon them to implement technological advances in production. Apart from the purely functional capabilities that must be fulfilled, the ease of operation of the machine must be provided for its economic operation (attention to controls and layout). The adherence to a variety of legal requirements is a further constraint.

### 1.4 INTERLOCKING DEVICES

On machinery to which movable guards have been fitted, an increased level of protection can be provided by the addition of interlocking devices that are actuated as the guard moves from the safe position. The interlocks fitted to a machine can be mechanical, electrical, electronic, hydraulic or pneumatic or a combination of two or more of these media. Duplication of devices of the same media (redundancy) improves safety integrity but is subject to the possibility of common mode failure while combinations of different media (diversity) can increase safety integrity further by reducing the possibility of common mode failures.

### 2.1 Guard locking

Interlocking with guard locking should be applied where it is essential that the power is isolated before the guard can be opened. With machines that have a long run-down time to stopping the guard lock should be provided with a time delay device to ensure the operator cannot reach the dangerous part before it has ceased moving. The medium for power locking devices can be electrical (solenoid), pneumatic or hydraulic. The guard locking arrangement must be designed so that on closing the guard, the machine cannot be started until the guard lock is fully in position. The electrical interlocking switch, timer and guard lock can be an integral unit.

### 2.2 Interlocking systems

The interlocking systems, whether electrical, pneumatic or hydraulic or a combination of these, can be either:

1. Control interlocking in which the interlocking device interacts with the machine controls causing them to bring the machine to a stop, or
2. Power interlocking in which the interlocking device is in the main power supply line to the machine where actuation of the interlock results in the machine being isolated from its source of power.

### 2.3 Electrical interlocking

Electrical interlocking can be either:

- Power interlocking
- Control interlocking

The integrity of electrical interlocking systems can be enhanced by the inclusion in the control circuit of monitors and electronic function checking equipment.

### 2.4 Hydraulic interlocking

Hydraulic interlocking can be either:

- Power interlocking in which the main hydraulic oil supply passes through a guard operated interlocking valve or
- Control interlocking in which a pilot supply from a guard actuated interlocking valve actuates

a control valve or valves interposed in the main supply line to the machine cylinders.

### 2.5 Pneumatic interlocking

Pneumatic interlocking can be either:

- Power interlocking of the main air supply by a guard actuated valve or
- Control interlocking by pilot air from an interlocking valve actuating an interposed valve or valves in the main air supply to the machine.

### 2.6 Emergency stop switches

Emergency stop switches should override all other controls to bring the machine to a stop. All machines should be provided with an emergency stop switch unless it can be shown that such a device would not contribute to minimizing the risk. Emergency stop switches should be of the large mushroomed headed type to enable them to be actuated by various parts of the body. The actuating button should be coloured red. When actuated, the switch must lock in the open circuit condition and require a positive action to release it. After actuation and release of the emergency stop button the machine controls should require resetting before the machine can be restarted using the normal start controls. The machine should not restart as the emergency stop button is released. Emergency stop devices should be located at suitable easily accessible points around a machine and be clearly identified.

### 2.7 Proximity switches

Proximity switches operate through the positioning of two associated parts, one containing the operating (switching) mechanism and the other the actuating means. There are no physical contacts between the parts and the devices can be tolerant of a reasonable degree of misalignment. Each part can be hermetically sealed and be resistant to a wide range of operating environments. They are particularly suitable for use where regular washing down of equipment is necessary, i.e. in the pharmaceutical and food industries.

The two main types of proximity switch are magnetic and electronic.

- In magnetic switches, the actuator comprises a series of magnets to form a code to which the sensor reacts. The contacts in the sensor should be generously rated with the moving contact mounted on a leaf spring. There should be built-in over-current protection and external circuits should incorporate a fast-break fuse of a slightly lower rating.

- Electronic proximity switches employ an electronically coded link between the sensor unit and the actuator. For high risk applications the sensor unit can include self-checking facilities and be incorporated into high integrity safety circuits.

## 3 RESULT AND DISCUSSION

### 3.1 Identifying the Hazards

The foreseeable hazards at all stages of the equipment's use need to be taken into account and Include:

- (a) Its physical dimensions
- (b) Parameters of speed, pressure, temperature, size of cut, mobility etc.
- (c) Materials to be processed or handled and method of feed
- (d) Operator position and controls
- (e) Access for setting, adjustments and maintenance
- (f) Environmental factors such as dust, fumes, noise, temperature, humidity etc.
- (g) Operating requirements including what the operator needs to do.

Thus an overall picture can be obtained of any limitations or constraints on the design of suitable safeguards and give a pointer to providing the most effective measures for the safe operation of the equipment.

### 3.2 Personal protective equipment

Personal protective equipment (PPE) does not provide protection against the dangers that arise from the use of machinery but only against contamination by the material being worked on, the sharp edges of materials (burrs) and against the ill health effects of process

substances in the form of dusts, fumes, liquids, etc. In respect of machinery guarding, PPE should only be used as a means to supplement other protective measures. However, PPE is essential for some processes such as welding, the cutting of metals by gas, the use of lasers or water jets, handling high or low temperature items and maintenance work on plant processing corrosives and other hazardous substances.

### 3.3 Pressure sensitive mats

A pressure sensitive mat laid across the approach floor to a machine provides protection against inadvertent entry to the hazard zone. Stepping on that mat triggers a signal to the control equipment causing the output signal switching device to go to open circuit. The mats must cover all the floor area without gaps, be arranged so they cannot be straddled and be of a material that is resistant to any contaminants present in the workplace. Pressure sensitive mats can be integrated into a safeguarding system with photo-electric equipment by feeding the signal from the mat control unit into an ESPE. The construction of the mats should conform and the positioning and size of pressure sensitive mats should meet the requirements in respect of both approach speeds and control response time.

### 3.4 Pressure sensitive edges and wires

A single mounting strip containing a pressure sensitive conductor can be used in applications where there is a risk of trapping between powered closing doors (Figure 6.18), as a trip at a feed entry for manual feeding or as bumper guards on the front of remote controlled or automatic power trucks. Deflection of the surface of the device causes changes in its electrical or optical characteristics which are monitored by the control equipment. In this they employ the same technology as pressure sensitive mats. The design of the device should ensure that it stops any movement before injury is caused.

### 3.5 Tagouts and Lockouts

A surprising number of industrial machine accidents occur not when the machine is in operation, but when it is down for repair or cleaning. A worker simply turns a machine back on, not realizing that it is down for repair and that a maintenance worker is still close to or inside the

machine! Such accidents seem like freak occurrences, but that is because most of us are more accustomed to small machines around the home, where only a few persons, usually family members, may be in the area. However, factory machines may be large, and their repair status may not be obvious. Large numbers of personnel may have access to the machine, and a miscommunication between operating supervisors and maintenance crews can easily occur.

Some types of switches are good for normal starting and stopping of a machine, but they are inadequate for assuring that the machine cannot be turned on accidentally. Push-button switches and selector switches, for instance, do not qualify as energy isolation devices, since they cannot safely be locked off. To qualify for lockout, a disconnect switch or circuit breaker should be locked off to nullify the effect of a normal pushbutton or selector start switch.

### 3.6 SAFEGUARDING THE POINT OF OPERATION

Injury statistics bear witness to the fact that the point of operation is the most dangerous part of machines in general. On some machines, the point of operation is so dangerous that some type of safeguarding is required for every setup; mechanical power presses are one example. Taking guidance from the specific rules for mechanical power presses, the safety and health manager can extend the principles to other machines because most of the safeguarding methods specified will work also for other machines.

The following points must be considered:

- a) Use of protective equipment e.g. rubber gloves and insulated tools/ appliances;
- b) Isolation and locking off of circuits prior to work
- e) Trained and competent staff; and
- f) Use of a safe system of work/Permit to Work system.

## CONCLUSION

Safeguards were frequently absent or inadequate for hazardous areas of machines such as the point of operation and other moving parts. Elements of critical machine safety programs such as LOTO were also found lacking. An integrated approach to machine safety should include enhancements to safeguarding equipment as well as low-cost measures such as development and posting of machine-specific LOTO procedures. OSHA inspections should ensure the assessment of all aspects of machine guarding. This effort should be enhanced. The main benefit of the approach fulfilling the Indian safety requirements was the clarification of the safety design requirements. The hazards of a machine and possible losses cause design problems that must be solved during the design process. Hence, risk assessment and the design for risk-reduction measures can be carried out simultaneously with other design objectives in all design stages by multidisciplinary design teams. Therefore, sufficient training in safety design is needed to create the necessary safety design capabilities. Safeguards at the point of operation were missing or inadequate on 33% of machines. Safeguards for other mechanical hazards were missing on 28% of machines. Older machines were both widely used and less likely than newer machines to be properly guarded. Lockout/tag out procedures were posted at only 9% of machine workstations.

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