

Working with the Machine

LESSON 6: Responsibility and Safety with the Machine

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This is a lesson on safety in the operation of plastic injection molding machines. Although it includes information on many of the common hazards associated with molding machines, it does not necessarily cover all of the hazards that may be present in your shop. Be sure to consult with your supervisor for safety information specific to your machinery.

Objectives of Lesson 6

1. Learn about pinch point hazards associated with molding machines
2. Learn about burn hazards associated with molding machines
3. Learn about electrical hazards associated with molding machines
4. Learn about safe purging procedures
5. Learn about PPE's required in your plant

Objective One

Pinch Point Hazards

Like many pieces of machinery, molding machines have several areas where pinch point might occur.

Pinch Points

A pinch point is any place on a machine where a person may insert a finger, hand, or other part of their body into an opening that can close and cause injury.

There are many pinch points on a molding machine. Some of them present serious potential hazards. Figure 1 shows some of the areas where pinch points may occur.



Figure 1 - Pinch Points

Linkages

There are always pinch points in the area of the machine clamping linkages. These linkages are operated by a powerful hydraulic system, and move with a crushing force. Usually, the linkages are completely covered by a fixed guard when the machine is in operation. Sometimes the guards are removed for maintenance or inspection. When the guards are removed, the safety interlocks cut off the electrical and hydraulic power to clamping mechanisms.

Nozzle Contact Point

The area where the nozzle contacts the mold is a pinch point. Make sure that your hands and any tools have been removed from the area around the nozzle and sprue bushing before the carriage is brought forward. The carriage develops a moderate force when seating the nozzle. If a tool or obstruction is in the way, the nozzle or heater band could be damaged. If you must work around the nozzle, be sure that the purge guard is open. This locks out any possible carriage or screw movement. Do not reach around the purge guard to clean off hot plastic.

Exercise One

Linkage Area Guards

Go to several machines and check to see if the guards are in place in the linkage area. Do the guards on these machines give complete protection against injury from pinch points?

Machine Number	Guards Securely Mounted?	Safeties Checked and Working?

Instructor

Date

Feed Throat Safety

When the hopper is pulled back or removed from the feed throat, the screw can be seen through the feed throat. Never allow any tools or foreign objects to fall into the feed throat. The screw can easily be damaged if hard objects are run through it. Foreign particles can also build up in the nozzle or mold gates, causing a flow restriction. Always keep the hopper magnet in place as this keeps tramp metal or mechanical fasteners out of the barrel.

If the feed throat has become clogged with solidified plastic, it must be removed manually. Never place fingers or tools into the feed throat while the screw is turning. Use brass tools or bars to dig out the solidified plastic. Before working on the feed throat, open the purge gate and shut off the hydraulic pump. This will keep the screw from moving while you work.

Never place any part of your body in a pinch area unless the machine has been properly shut down and secured.

Crushing Force

There are other areas where pinch injuries could occur (Figure 1). One of the most dangerous areas is the opening between the mold halves, because of the high clamping force of the machine. Injection molding machines are typically rated by the pressure available to hold the mold halves together.

A 600 ton machine can close and lock with a force of 600 tons. Six hundred tons is equal to 1.2 million pounds of force applied to the mold halves when they lock. 1.2 million

pounds is equal to the weight of fifteen fully loaded semi-trailer trucks.

A force equal to fifteen semi-trailers will completely crush anything in its way. Operating personnel must use great care when working between the mold halves.

Safety Bars

Many molding machines have safety bars that prevent the closing of the mold halves by accident.

The safety bar is illustrated in Figure 2. It is an adjustable safety bar attached to the moveable platen. A safety pawl is

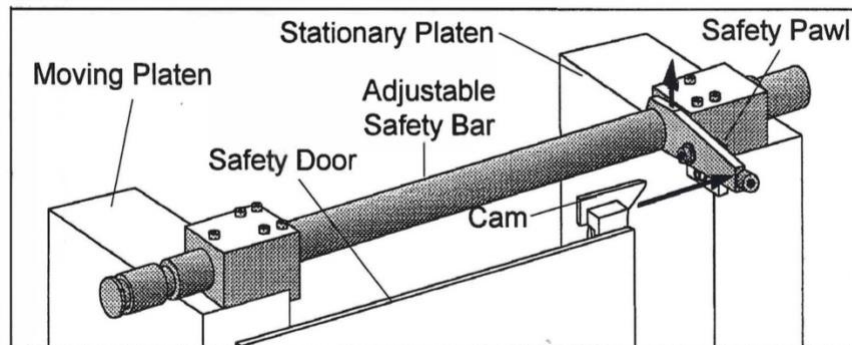


Figure 2 - Safety Drop Bar

attached to the stationary platen. The safety pawl is moved by cams on the safety gate. As the gate closes, the pawl is lifted, removing the mechanical interference so the bar can move forward. If the safety gate is open, the pawl blocks the mold from closing.

Guards and Safety Gates

Because of the many possible pinch points on a molding machine, most of the machine is covered with safety guards

and moveable safety gates, such as those shown in Figure 3. Most of the clamp end of the machine is surrounded with a series of fixed guards.

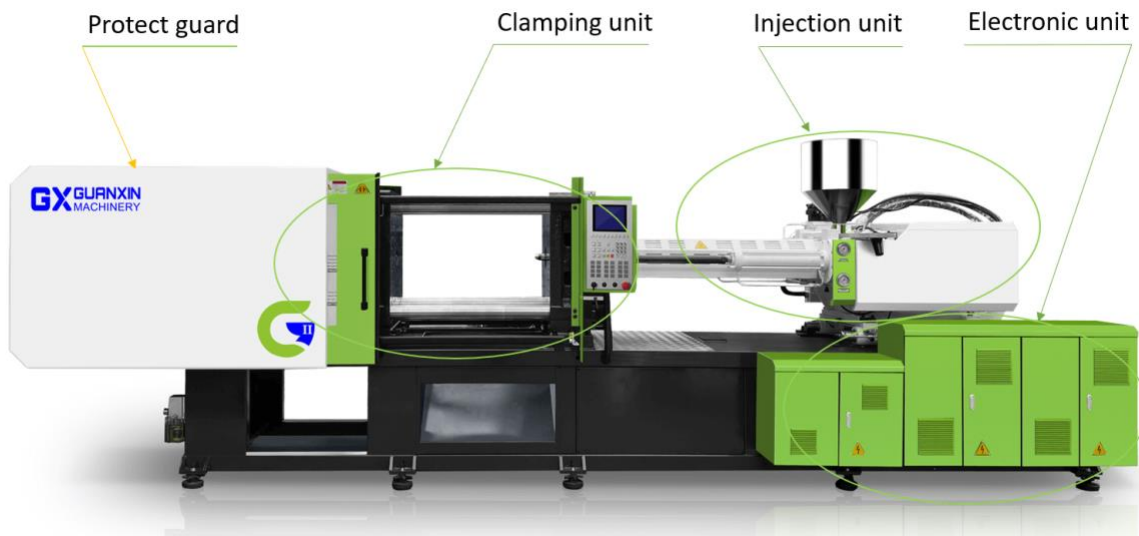


Figure 3 - Guarding

Safety gates are the doors that slide closed and block access to the mold when the clamp mechanism is moving. The safety gate eliminates the possibility of technicians having their hand near the mold when the clamp closes. On many smaller machines, the sliding safety gate covers the front, top, and rear access to the mold.

On many larger machines, a separate rear safety gate is used to cover the back entrance to the clamp area. This guard has interlocks on it. They prevent a technician from closing the clamp from the front of the machine when a service technician might be working on the mold behind the machine. Operating personnel should never reach around or under the safety gates to get parts or work on the mold.

On large machines, the safety gates are often hydraulically or pneumatically powered. The speed and pressure of these gates should be kept low. If the safety gates move too fast they can create their own pinch point. The edges of powered safety gates are often padded to prevent injury. Large gates sometimes have safety bars like elevator doors to stop the gate on contact.

Interlocks

Besides physically blocking access to the molds, safety gates also use interlocks to stop the machine. Interlocks are devices that block the major movements of the machine

when the safety gate opens as illustrated in Figure 4.

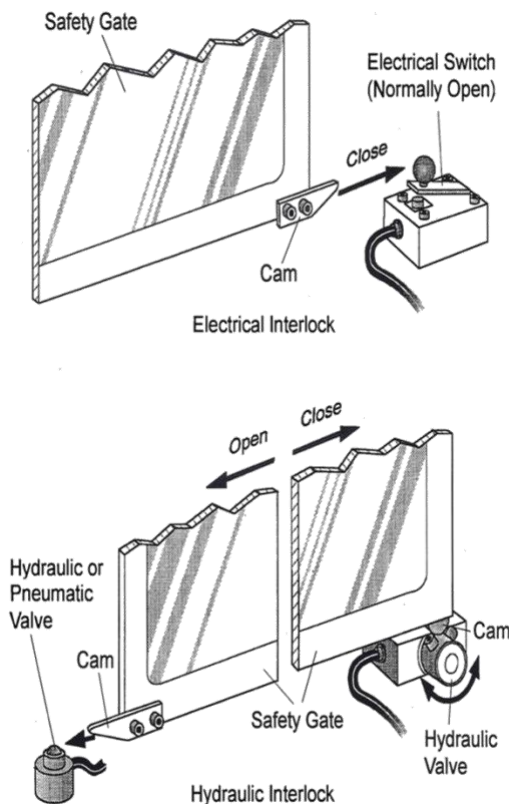


Figure 4 - Machine Interlocks

Hydraulic interlocks are switches that prevent the clamping system from developing hydraulic pressure unless the safety gate is completely closed. When the safety gate closes, it opens the hydraulic interlocking valve, allowing the hydraulic system to deliver pressure to the clamping mechanism and close the mold.

Electrical interlocks are normally open switches that close only when the safety gate closes. The

switch is connected to control circuits so that the clamping mechanism cannot move unless the gate is closed.

The hydraulic and electrical interlocks work with the mechanical drop bars to form three layers of protection against the clamps accidentally closing while the gate is open.

Hand Buttons

Some trimming machines, stampers, and secondary process machines use two hand activation buttons. The buttons are far enough apart so it takes two hands to start the machine. These buttons ensure that the operator must have both hands clear of the mechanism before the machine closes. Never tamper with the operation of double hand buttons. They are there for your protection.

Exercise Two

Safety Devices

Go to several machines and check to see if the guards are in place in the linkage area. Do the guards on these machines give complete protection against injury from pinch points?

Machine Number	Identified Safety Bars	Identified Safety Doors

Instructor

Date

Trimmers, Grinders, and Conveyor Belts

Sprue and gate trimmers have their own pinch points. They can be just as dangerous to hands and arms as the mold. Use caution whenever placing hands into a mechanical trimming mechanism. Hand gate cutters and de-flashing tools can also cause serious cuts if operating personnel are not concentrating on their work.

Grinders, like the one in Figure 5, have high speed cutting blades. Do not put your hands down into the throat of the



Figure 5 - Grinder

grinder. When a grinder jams, be sure it is switched off and disconnected before trying to clear it.

Conveyor belts have exposed pulleys, and belts. They can easily grab long hair, jewelry, or loose clothing. Take extra care to keep clear of moving conveyor parts.

Objective Two

Burn Hazards

Because of the nature of the process, many of the parts of the molding machine are very hot. Any thoughtless action can cause very serious burns to the molding technician, or to other people in the area. It is important to know the dangerous areas on the machine, and to work safely around them.

Hot Zones

Molding machine operators must know the temperatures of the various parts of the machine, and the hot areas to avoid. Figure 9 shows the location of some of the hot zones on a molding machine.

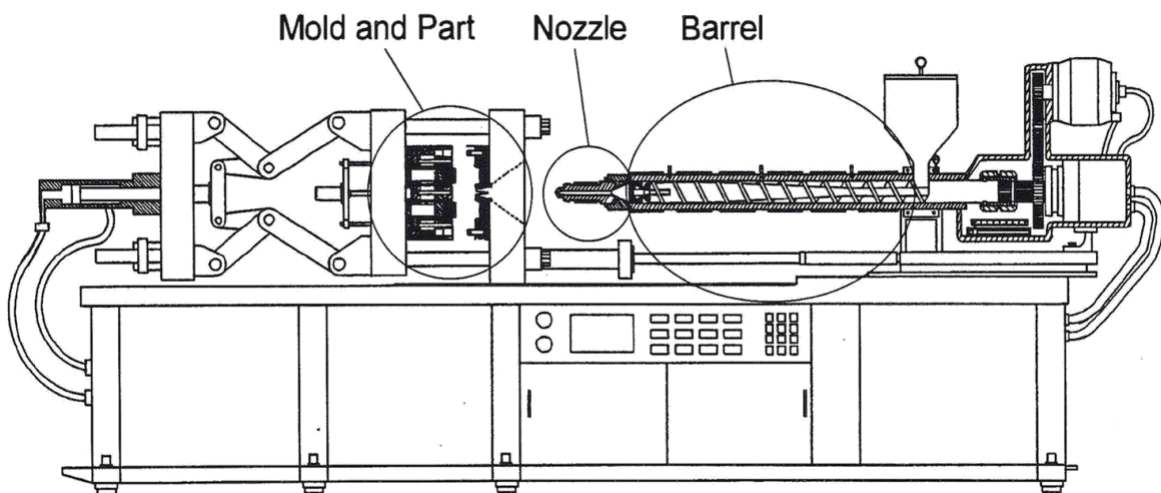


Figure 6 - Hot Zones

Hot Barrel and Nozzle

The hottest area on the machine is the barrel and the nozzle. The barrel is usually surrounded by a sheet metal heat shield. The shield protects the heater bands from damage and protects the operator from burns. The barrel itself is usually between 400° and 700°Fahrenheit. The heater bands are often even hotter. The heat shield around the barrel lowers the potential for serious burns, although it is hot enough itself to cause a bad burn.

Hot Molds

Plastic injection molds can run at temperatures over 300° Fahrenheit. Molding technicians need to develop techniques for working around hot molds without getting burned. If you are operating a machine manually, develop a safe pattern of hand motions when near the mold, and stick to the pattern.

Be especially cautious when doing something outside the normal production operation, such as removing flash or stuck parts. These are the times when an injury is most likely to occur.

Hot Plastic

Hot plastic is by far the most hazardous item in the burn category. Because of the very high temperatures, it can cause severe injury. It is also very sticky. If molten plastic comes into contact with your skin it may stick to you. The material will cause bad burns or blisters before it can be peeled off.

Scrape off nozzle drool with a brass bar or tool. Pick up purging's with a stick, or a piece of cardboard.

Hot Parts

On many semi-automatic jobs, the parts must be removed by the technician. Sometimes the parts are still hot enough to cause burns. The stringy drool at the tip of the sprue may also still be hot.

Some plastics, such as nylon and polycarbonate, can come off the mold at over 200° Fahrenheit. Use cloth gloves if the parts must be grabbed by hand. On some jobs, you can use tools to grab the sprue or runner to remove the parts from the mold.

Be careful not to put hot parts or runners into the granulator. If the part is too hot, the runners may still be molten on the inside. The molten plastic could clog the granulator. Let hot runners cool properly.

Objective Three

Electrical Hazards

Most plastic injection molding machines are operated by large motors. These motors are operated by 220, 240, 440, or 480 volt electrical power. All of these voltages represent serious electrical hazards. Even 110 volt electrical power can be fatal under certain conditions.

Warning!

All electrical circuits over 24 volts can cause fatal accidents. Never do maintenance work on electrical equipment unless it has been properly shut off and locked out. Do NOT attempt to work on electrical equipment

Exercise Three

Electrical Hazards

Go to a molding machine, and ask someone from maintenance or supervision to help you locate all of the 110 volt or higher electrical devices on the machine.

Machine Number	Location

Instructor

Date

Objective Four

Purging Hazards

Purging

Purging means cleaning leftover plastic out of the barrel. Injection machines are often purged when changing plastics, or when shutting down the machine. Sometimes operators purge the barrel by running the new plastic through the machine. Other times a purging compound is run through the barrel to clean it out.

Purging can be a dangerous process. The following action will make purging safer:

1. Allow no bystanders
2. Wear a face shield, gloves, and long sleeves
3. Close the purge guard. Molding machines should have an interlock on the purge guard which prevents purging unless the guard is in place
4. Use low pressure and purge in controlled stages. This reduces the chances of the plastic splattering off of the mold and platen
5. Purge molten plastic onto cardboard for easy disposal
6. Use extra caution if you suspect the plastic in the barrel is overheated, which can generate gases inside the barrel resulting in a build-up of pressure

7. Degraded material is volatile when it comes out of the nozzle
8. Do not stand in the splash zone while purging

Figure 7 illustrates the flash zone on an injection molding machine.

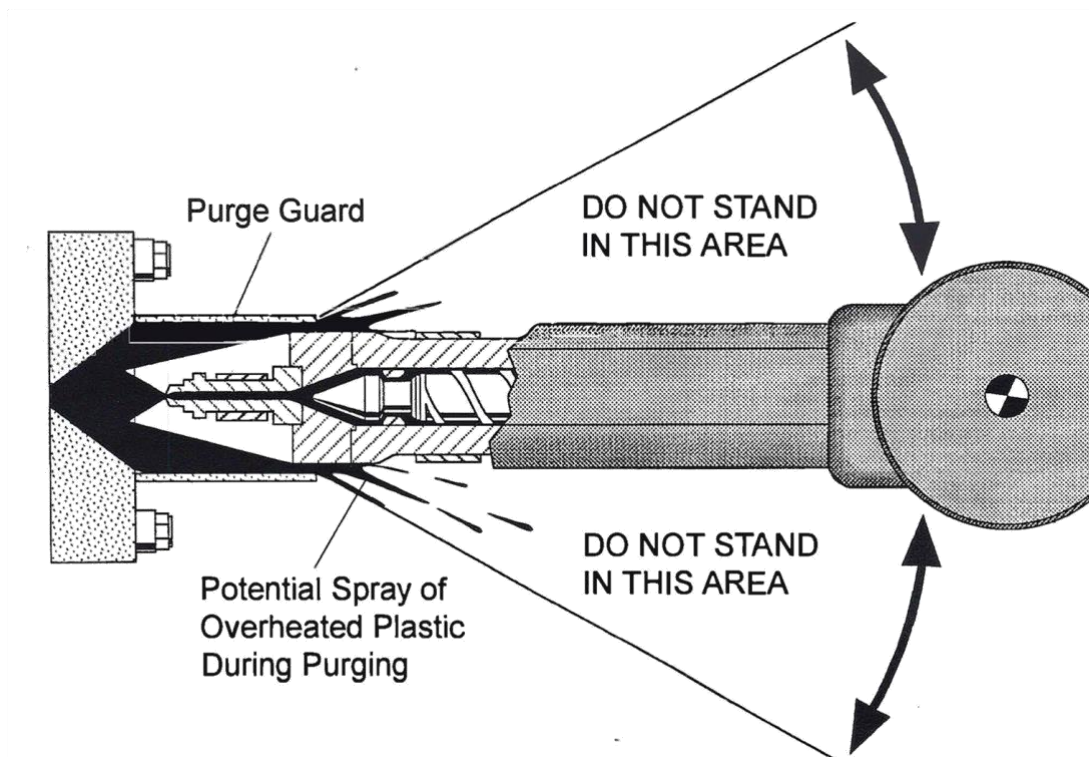


Figure 7 - Flash Zone

Objective Five

Protective Clothing and Equipment

Eye Protection

Most plants require safety glasses or goggles on the shop floor at all times.

Face Shields for Purging

It is a good idea to wear a face shield when purging a machine. The face shield protects the rest of your face against hot spray.

Safety Shoes

If you move heavy objects, it is best to wear strong safety shoes. Safety shoes provide good traction. Most safety shoes have steel toes and sturdy soles and heels.

Fabrics

Cotton clothes give better protection against burns because cotton does not conduct heat as well as many synthetic fabrics. Some synthetic fabrics will melt in contact with hot objects, increasing the possibility of injury.

Cleanliness

Many accidents can be avoided simply by keeping the work area clean. Water and oil leaks should be cleaned up immediately. Plastic pellets on the floor are also safety hazards. They act like tiny ball bearings and are easily slipped on.

Compressed air should not be used to blow plastic pellets off of the machine or off the platform. The compressed air can send the pellets flying through the air and into someone's eyes. Instead, complete the regular pellet clean ups with a vacuum cleaner, broom, or brushes.

Exercise Four

Safety Equipment

List the protective clothing and other protective equipment required in your plant.

1.		8.	
2.		9.	
3.		10.	
4.		11.	
5.		12.	
6.		13.	
7.		14.	

Instructor

Date

Objective Six

Safety Rules

1. Wear proper protective clothing
2. Do not operate the machine if you have not been trained to operate it and its safety devices
3. Follow the directions on the mold setup sheet, do not change mold settings without your supervisor's approval
4. Make sure that all safety devices are fully operational before starting to run the machine
5. If any safety devices are missing, damaged, or inoperative, do not start running the machine - notify your supervisor immediately
6. Never bypass, change, disconnect, or tamper with any safety device or equipment, safety devices are there for your protection
7. Keep the platform and work area clean, clean oil and water spills as soon as possible
8. Report all open receptacles, bare wires, open junction boxes, oil leaks, and water leaks
9. Report even minor hazards to your supervisor, and warn your fellow workers who might be endangered
10. Check that mold and barrel temperatures are within the correct range, and report if the temperatures deviate out of that range

11. Be sure the hydraulic oil is at the correct pressure and temperature
12. Always make sure that the mold halves are locked out before working on the machine
13. Only use tools and equipment that are in good condition, substandard equipment may be hazardous
14. Never climb on or under a machine while it is running
15. Do not leave a machine running unsupervised
16. Do not leave plastic in the barrel if the machine must be shut down
17. Follow all posted signs and warnings - manufacturers place them there because someone has been injured in the past
18. Never block fire exits or fire extinguishers
19. Keep your back straight when lifting and use your legs to lift - get help if the load is heavy
20. Report all injuries immediately

Self-Test

1. It is okay to reach your hand around a safety gate or guard if it does not come too close to a pinch point.
 - a. True
 - b. False
2. As well as mechanical safety bars, hydraulic molding machines are required to have both hydraulic and electrical interlocks to prevent accidental mold closing.
 - a. True
 - b. False
3. When parts jam in a grinder, the power must be disconnected before trying to clear them.
 - a. True
 - b. False
4. Barrel and nozzle heater bands can easily cause serious burns.
 - a. True
 - b. False

5. If the mold is still closing under low pressure, little harm can be done if someone's hands are in between the mold halves.
 - a. True
 - b. False
6. What has the greatest potential to burn the operator when the part is being removed by hand?
 - a. The thickest section of the part
 - b. The runner
 - c. The tip of the spure
7. Purging is safer if the machine controls are set for:
 - a. High screw speed
 - b. Low back pressure
 - c. Low injection pressure
8. Where is it least safe to stand when purging the machine?
 - a. To the left of the purge guard
 - b. In front of the purge guard
 - c. To the right of the purge guard

Glossary

Pinch Point - any place on the machine where operating personnel could insert a hand, or other part of the body, and have it pinched in the mechanism.

Safety Bar - the heavy steel bars that are activated to mechanically inhibit the mold closing when the safety gate is open.

Interlocks - hydraulic, electrical and mechanical devices that lock out the machine so that the mold cannot close when the safety gate is open.

Nozzle Contact Point - the point where the nozzle seats against the mold when the carriage is moved forward.

Linkages - the mechanical links that make up a toggle clamping mechanism.

Feed Throat Opening - the hole in the back of the barrel where the end of the screw will be exposed when the hopper is removed.

Safety Pawl - a peg or wedge that is dropped in front of the end of the safety bar to stop its movement and therefore inhibit accidental mold closure.