



Safety at compression moulding machines

Plastics Processing Sheet No 9

Introduction

This sheet was produced by the Health and Safety Executive (HSE) in consultation with the Plastics Processors Health and Safety Liaison Committee. This committee comprises HSE, employers and employee representatives in the plastics industry. It is one of a series dealing with safety at specific machines used within the plastics industry. It describes the causes of accidents at compression moulding machines and details safeguarding standards, checklists and safety precautions for use during mould change.

These sheets have been designed to be read in conjunction with Plastics Processing Sheet No 3 *Managing machinery safety in small plastics factories*.

Accident history and causes

Over 40 accidents at compression moulding machines were investigated by HSE inspectors from 1986-1996. Table 1 summarises the parts which caused the injury and why the incident occurred. These machines were being used in the manufacture of both plastic and rubber products.

Of the above accidents, 30 happened during normal operation and 11 during maintenance/setting activity.

The commonest causes of accidents were the following:

- inadequate safeguarding fitted;
- the safeguarding had fallen into disrepair; or
- the safeguarding had been overridden.

Guarding standards for production

The standards outlined in Table 2 describe acceptable and practicable safeguards for the significant hazards on compression moulding machines supplied before April 1994 (when the European Standard BS EN 289:1994 was published for new machinery).

Table 1 Causes of accidents

<i>Part causing injury</i>	<i>No</i>	<i>Cause</i>	<i>No</i>
Tools in powered motion	26	Guarding incomplete or none fitted	11
		Interlock defective/overridden	9
		Working inside guard/machine not isolated	4
		Two-hand control used but another operator present	2
Tools in gravity fall	9	Levering open stuck platens on multi-daylight press	4
		Descent due to poor maintenance	2
		Descent due to poor modification of valves	1
		Bolts on top mould sheared	1
		Scotch removed	1
Ejector pin assembly	6	Unsafe systems of work	2
		Inadequate guarding	2
		Failure to use two-hand control	1
		Cause unknown	1
Insufficient detail to classify	3		
Total	44		

Table 2

<i>Hazard</i>	<i>Safeguard</i>
<p>Traps between the moving platens/moulds from operator's position</p>	<p>Fixed mould presses:</p> <p><i>Either:</i></p> <ul style="list-style-type: none"> ● dual-channel interlocking, with the first channel having two guard position sensors acting on the control circuit and the second channel having a device which directly or indirectly interrupts a power medium when the guard is open; <i>or</i> ● guard inhibited power interlocking; <i>or</i> ● dual-channel interlocking, with one position sensor for each channel; <i>or</i> ● photoelectric systems; <i>or</i> ● on smaller machines, two-hand control with additional fixed guards to prevent the possibility of access by another person. <p>If platen movement on upstroking presses is slower than 12 mm/s see Note.*</p> <p>Loose mould presses:</p> <p>If platen movement is faster than 12 mm/s, access to the trapping points between the platens should be prevented by single-channel interlocking with two guard position sensors. Where there is any reason for an operator's hand to go between the moulds/platens, safeguarding should be as for fixed mould presses. If platen movement on upstroking presses is slower than 12 mm/s see Note.*</p>
<p>Traps in the core and ejector mechanism</p>	<p>Access to the dangerous parts should be prevented either by interlocking them with the front operator's guard, or by using localised fixed guards.</p>
<p>Traps between platens/moulds as a result of gravity fall (where applicable)</p>	<p>To prevent trapping between the moulds on downstroking presses some form of physical restraint should be provided.</p> <p><i>Either:</i></p> <ul style="list-style-type: none"> ● one or more scotches, capable of supporting the weight of the ram, platen and tool, inserted when the platen has returned to the top of its stroke. On large machines (>800 mm in any platen dimension and >500 mm maximum stroke) engagement of the scotch should be automatic; on small machines (<800mm in any platen dimension and <500mm maximum stroke) the scotch may be manually engaged if it is interlocked with the guard; <i>or</i> ● a pilot-operated check valve and counterbalance valve assembly connected to the lower end of the hydraulic cylinder. <ul style="list-style-type: none"> - Where a scotch operates in conjunction with an interlocked guard, the guard should not be able to open until the scotch is in place. - Where a scotch operates in conjunction with an electro-sensitive device, scotches should be capable of arresting the closing stroke at any point at which trapping can occur.
<p>Traps between the platens and presses where full body access is possible</p>	<p>Where operators can walk into the area between the platens (usually when the machine bed is at floor level or below), a person-sensing device should be provided which will not allow the platens to close if an operator is present in the danger area. Relevant technologies include different forms of electro-sensitive devices, such as photo-electrics and scanning devices.</p>
<p>Traps between the moving platens/moulds at the rear of machines</p>	<p>If the machine can be operated from the rear, safeguarding there should be to the same standard as that at the operator's position described above. If access is for setting or maintenance only, <i>either:</i></p> <ul style="list-style-type: none"> ● a fixed guard should be provided; <i>or</i>

<i>Hazard</i>	<i>Safeguard</i>
	<ul style="list-style-type: none"> ● an interlocked guard which positively interrupts the control signal initiating a dangerous movement and which blocks any energy accumulator.
Traps between the platens on multi-daylight presses	The guard should be interlocked with the platens in such a way that it should remain closed if a platen fails to open during an opening stroke. Alternatively a mechanism can be used to ensure the platens separate at the opening stroke of the press.
Dangerous moving parts at loading/unloading mechanisms	Fixed guards if access is only for maintenance; otherwise interlocked guards with two position sensors.
Burns at hot surfaces	Hot parts above 80°C need to be protected against accidental contact using guards or insulation. Where hot parts are necessarily exposed (eg moulds) warning signs are required.

* Although the accident experience on upstroking presses suggests that presses closing at 12 mm/s or less may not be dangerous, such rules of thumb should always be treated with caution in individual cases. An assessment of the risk of injury for each machine should be made which takes into account not only speed, but also other operational parameters, eg number of operators, amount of daylight, method of work and frequency of approach.

Safety checks

A significant number of accidents have happened at compression moulding machines because of inadequate guarding and because the interlocking devices have deteriorated in use or have been overridden. The following minimum checks should be made to ensure that safety is maintained.

Operational checks (suggested frequency: daily/after mould change)

- Are all fixed and interlocked guards in place, and secure?
- Does opening any interlocked guard immediately stop the dangerous parts it protects?
- Can the machine cycle be started when the front guard is open?
- Are all control unit enclosures closed, locked and the keys removed?

(Weekly)

- Are the mould securing bolts tight?

Maintenance checks (suggested frequency: monthly)

- Are all fixed guards held in place with fastenings that require a tool to undo them?
- Are all interlocking devices correctly aligned and securely attached to the guards?
- Does opening any interlocked guard immediately stop the dangerous parts it protects?

- Can the dangerous parts be started with the guards open?
- Where there are dual-channel interlocking systems, is each channel in good working order and is each independently able to stop the dangerous parts it protects?
- If fitted, does the trip device on the leading edge of the power-operated guard operate when activated?
- Are all pressurised flexible hoses in good condition and their fastenings secured in place?
- Are the high-tensile steel bolts (holding top mould to platen) in good condition?
- Do the emergency stops prevent all continued movement of the machine?
- Is it possible to operate any dangerous parts after activation of the emergency stop(s) before the machine is reset?
- If fitted, is the mechanical restraint sound, properly secured and adjusted, and functioning correctly?
- From a visual inspection, is any electrical wiring showing signs of damage?
- Are control unit enclosures closed, locked and the keys removed and retained by a designated person?
- Is any heat insulation provided in place and in good condition and are hot surface warning signs in place?
- If fitted, are any person-sensing devices in the mould area working correctly?

Safety during mould change

Accidents have occurred during setting because safe systems of work are not followed and interlocks are overridden. You should provide a written safe system of work for your setters based on the following.

Before mould change

- If downstroking, the top platen should be chocked/scotched in the fully raised position.
- The power source to any ejection mechanism should be isolated before access to them is attempted.
- Suitable lifting equipment should be available for the removal and insertion of heavy moulds.
- A sign should be placed on the machine controls stating that tool setting is in progress.

Mould changing with guards/interlocks in use (preferred method)

- No mould changing, setting or try-out operation should be undertaken without first checking on the function of the machine's safety devices for the mould area.
- If any bodily access is required between the platens, the emergency stop control should be used (despite the fact that all the guards and interlocks are operational).
- If powered movement of the platen is required with the guards open, such operations should only be permitted if suitable override facilities have been built in to the machine controls. To be suitable, such facilities should include low pressure together with two-hand control and slow speed or limited movement (inch), all of which should be engaged automatically, on selection of the override mode.
- If there are prolonged periods during the setting procedure when powered movement of the presses is not required, the machine should be isolated from its power supply, locked off and stored energy dissipated.

Mould changing with guards/interlocks removed (only if essential)

- If any of the guards or interlocks have to be removed, the machine should be isolated from its power supply, locked off and any stored energy dissipated.

with the guards removed, this should only be possible through the use of a lockable mode selector key which automatically engages limited movement (inch) or low pressure movement under the control of a hold-to-run device or a two-hand control.

After mould change

- When the guards/interlocks are reinstated, and before returning the machine to the operator, relevant checks from the monthly maintenance list should be carried out to prove the guards are functioning properly.
- Ensure that the mechanical restraint is correctly adjusted.
- The operator should conduct the operational checks independently before starting production on the machine.

Further reading

British Polymer Training Association *Thermoset moulding operator handbook* Available from BPTA, Coppice House, Halesfield 7, Telford, Shropshire TF7 4NA Tel: 01952 587020

Further information

HSE priced and free publications are available by mail order from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 6FS. Tel: 01787 881165 Fax: 01787 313995.

HSE priced publications are also available from good booksellers.

For other enquiries ring HSE's InfoLine Tel: 0541 545500, or write to HSE's Information Centre, Broad Lane, Sheffield S3 7HQ.

HSE home page on the World Wide Web:
<http://www.open.gov.uk/hse/hsehome.htm>

This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

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- If powered movement of the press tool is necessary