



Safety at blow moulding machines

Plastics Processing Sheet No 5

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 blow moulding machines and details safeguarding standards, checklists and safety precautions for use during setting.

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

Table 1 shows the number of accidents at blow moulding machines reported to HSE from 1992-1996 under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). It shows these machines continue to injure very similar numbers of employees each year.

Table 1 Blow moulding machine accidents reported under

Table 2 Causes of accidents

Part causing injury		Cause/reason	
Mould tools	28	Reaching beneath guards to adjust when setting	10
		Guard removed during setting	5
		Interlocks inadequate or poorly maintained	3
		Other	10
Discharge area/conveyor/swing arm	16	Holes in guards to allow removal of fallen articles	7
		Guards defeated for same reason	3
		Other	6
Trimming area	11	Gaps in or under guards giving access to remove flash	5
		Inadequate interlocking	1
		Other	5
Blow pins	5	Access for adjustment through inadequate guards	3
		Guards removed	2
Mould carriage (from extruding to blow station)	4	Trap between it and fixed parts when setting with override key	2
		Inadequate interlocking to hydraulic or pneumatic channel	2
Preform area	2	Access via poorly guarded area on top of machine for adjustment	2
Stripper plate	1	Trapped when servicing: air dumped by emergency stop	1
Other (extruder, hopper, cooling fan)	3	Various	3
Insufficient detail to classify	7		

RIDDOR 1992/93-1995/96

Year	92/93	93/94	94/95	95/96
All	53	51	69	46
Major	5	7	4	5

Causes of accidents

Nearly 80 accidents on blow moulding machines were investigated by HSE inspectors from 1986-1996. Table 2 summarises the parts of the machine and the circumstances involved.

Most of the failings can be reduced to one of the following basic types:

- inadequate safeguarding fitted;
- the safeguarding had been removed, damaged, defeated or fallen into disrepair; or
- the safeguarding had been overridden, usually for setting or maintenance.

Guarding standards for production

The standards outlined in Table 3 describe commonly accepted and practicable safeguards for the significant hazards on blow moulding machines supplied before February 1996. On 15 February 1996 European Standard BS EN 422:1996 was published and came into effect for new blow moulding machines.

Table 3

<i>Hazard</i>	<i>Safeguard</i>
Dangerous moving parts in the mould area	Guarding interlocked with the drive(s) (pneumatic, hydraulic or electrical) for the dangerous parts and sufficient fixed guarding to complete the enclosure. The interlocking system should be dual channel and both channels should be monitored to prevent any further dangerous movement if a fault is detected.
Other dangerous moving parts	<p>If not protected by the guarding systems specified for the mould area, use:</p> <ul style="list-style-type: none"> ● fixed guarding; or ● distance guarding positioned to take account of safety distances to prevent the operator reaching the danger zone; or ● single-channel interlocked guarding, monitored to prevent any further dangerous movement if a fault is detected. <p>... and for large machines**</p> <p>A monitored, person-sensing safety device should be installed, eg:</p> <ul style="list-style-type: none"> ● a pressure-sensitive mat which extends between the moulds; or ● an electro-sensitive device; or ● a mechanical latch which prevents involuntary guard closure and which can only be released from outside the mould area. <p>Having triggered such a device, it should be necessary to do one of the following before initiating another cycle:</p> <ul style="list-style-type: none"> ● reset the safety devices; ● close the guards; and ● actuate an enabling device to confirm the danger area is clear. <p>Reset and enabling device actuation positions should provide a clear view of the danger areas. It should not be possible to actuate the enabling device from the danger area.</p> <p>Accessible emergency stops should be fitted on both sides of the mould. At <i>large rotary machines</i> they should be placed at intervals of 2 m or less inside the danger area.</p>
Dangerous moving parts* which can be reached through the delivery aperture	<p>If not protected by the guarding systems specified for the mould area, use:</p> <ul style="list-style-type: none"> ● fixed guarding; or ● distance guarding positioned to take account of safety distances to prevent the operator reaching the danger zone; or ● interlocked product delivery systems, monitored to prevent any further dangerous movement if a fault is detected. Such product delivery systems would include: <ul style="list-style-type: none"> - single-channel interlocked guarding, consisting of outward opening doors which are activated to let articles out but otherwise act as an interlocked guard; or - two electro-sensitive sensing units arranged so they let articles out but prevent access; or - other equally effective means, eg pressure-sensitive mats built into the delivery system or scanning devices.
Power-operated guards	<p><i>Either:</i></p> <ul style="list-style-type: none"> ● sensitive edges (fitted on both sides of the guard) which arrests or reverses guard closure; or ● a reduced-pressure closing system.

	. . . and for large machines**
	Where the additional safety devices required at large machines are fitted in conjunction with guards closing under power, the closing movement should be actuated by a hold-to-run control device. This should be positioned outside the guarded area and give a clear view of the danger area.
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.

Not all the hazards in Table 3 will exist on all machines and some safeguards will protect more than one hazard, eg one interlocking guard with associated fixed guarding could prevent access to the mould area, cutting area, blowing station, cooling station, finishing station etc. If this is the case, the standard of protection needed for the most highly rated hazard should be applied to the whole safeguarding system.

* 'Dangerous parts' for the purpose of this sheet includes the following where they are present on a given machine: moulds and associated drive mechanisms, cutting devices, blowing nozzle or mandrel, elongation rods, cooling moulds and associated drive mechanisms, cooling mandrel, any dangerous parts at the finishing station, apparatus for handling preforms at the heating area, devices for taking off or rejecting parisons, injection unit movement, withdrawal apparatus and transfer devices, preform feeding devices and transport mechanisms.

** A 'large machine' is one where a person can gain bodily entry between the guards and the machine *and* where that person cannot be seen in all positions from the operator's panel.

Safety checks

About 50% of accidents at blow moulding machines happen because of inadequate or damaged safeguarding and about another 25% are because of defeated safeguards. The following minimum checks should be made to ensure that safety is maintained (you may also want to refer to the manufacturer's manual for additional detail).

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

- Are all fixed and interlocked guards in place and secure?
- Are all control unit enclosures closed, locked and the keys removed?
- If fitted, and with the machine at rest, does breaking the electro-sensitive curtain with the test piece cause the indicator to change state?
- If a pressure-sensitive mat is fitted then, with the power on and the machine at rest, does the pressure-sensitive mat indicator work when the mat is stepped on?

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 door immediately stop the dangerous parts it protects?

- Can the dangerous parts so stopped be started with the guards open?
- On power-operated guard(s), do either the sensitive edges or the reduced-pressure closing system operate correctly?
- Does operation of the emergency stop(s) halt all 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, are the mechanical restraints in good condition, properly adjusted and functioning correctly?
- Are control unit enclosures closed, locked and the keys removed and retained by a designated person?
- Is movement of dangerous parts prevented while *either* a test piece is between the electro-sensitive curtain *or* an actuating force applied to the pressure-sensitive mat sensing area?
- Does removal of power to the electro-sensitive device *and/or* pressure-sensitive mat prevent further operation of the machine and reactivation until power is restored and the device reset?
- From a visual inspection, is any of the exposed electrical wiring showing any signs of damage?
- Are all the hot surfaces, including hot connecting hoses of the temperature control circuit, that are external to guarded areas of the machine, protected by fixed guards or insulation?

Safety during setting

Accidents often occur during setting because safe systems of work are not followed and either interlocked guarding arrangements are overridden, legitimately or otherwise, or fixed guards are removed.

It is recognised that setting operations can encompass a wide range of activities. As many of the setting operations as possible, or actuation of dangerous parts following a setting adjustment, should be performed from outside the closed guards.

Where setting activities cannot be done with the machine isolated from its power supply, a written safe system of work should be provided for your setters based on the following.

Setting

- A guard override facility should be provided for setting but its use should be restricted by a lockable switch.
- When guard override is selected, dangerous movements of the machine should only be permitted via additional safety systems such as hold-to-run or limited movement (inch) which should be engaged automatically.
- If the additional safety device is fitted to a portable control unit which can be taken into the danger area, then an enabling device and an additional emergency stopping device should be fitted on the control unit. The emergency stopping device shall act on all dangerous movements associated with the setting operations.
- If the additional safety device is not on a portable unit it should be permanently fixed in a position which gives the operator a clear view of the danger area.
- Additional safety devices shall only be operable if the lockable switch is in the setting position and its key has been removed.
- Setting speeds shall not exceed 25 mm/s.
- If falls under gravity of any part are a recognised hazard, mechanical restraint devices should be in position.

After setting

- Before returning the machine to the operator, a final check on the guard interlocks should be carried out to ensure they are functioning properly.

Further reading

- 1 BS EN 422:1996 *Rubber and plastics. Machines. Safety. Blow moulding machines intended for the production of hollow articles. Requirements for the design and construction*
- 2 British Polymer Training Association *Blow 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.

British Standards are available from BSI Customer Services, 389 Chiswick High Road, London W4 4AL Tel: 0181 996 7000 Fax: 0181 996 7001.

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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