Safety at blow moulding machines

HSE information sheet

Plastics Processing Sheet No 5 (Revision 1)

Introduction

This information sheet is one of a series produced by HSE's manufacturing sector and gives practical advice for owners and users of blow moulding machines. It gives information on commonly accepted and practicable safeguards for significant hazards on blow moulding machines *supplied before* the publication of BS EN 422:1996. This standard was replaced by BS EN 422:2009[1] and represents 'state of the art' for these machines. This guidance can also be used as a check for machines manufactured after 1996 to make sure that they meet the minimum levels of protection required.

The main UK legal requirements covering the safe use of blow moulding machines are the Provision and Use of Work Equipment Regulations 1998.[2]

Since 1995, all new machinery has been subject to the European Machinery Directive, which requires machines to be safe by design and construction. When first placed on the market or first put into service, machinery must meet all relevant Essential Health and Safety Requirements (EHSRs) in the Directive. The machine should be designed to the 'state of the art', and be accompanied by user instructions, a Declaration of Conformity, and bear a CE marking. Further guidance on the Directive and the UK Supply of Machinery (Safety) Regulations is available from HSE's website and in *Buying new machinery*.[3]

Guarding standards

In the tables below are the practical safeguards that you can apply. Current standards are quoted to illustrate acceptable levels of safety. Where the publication date of standards is after the machine manufacturing date you should ensure that standards that were current at the time of manufacturing are met. For pre-1995 machinery, safeguards that meet PD 5304:2005[4] are acceptable alternatives to the more recent BS ENs quoted.

Table 1 Practical safeguards to apply to maintain acceptable levels of safety

Hazard	Safeguard
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	If not protected by the guarding systems specified for the mould area, use: ■ fixed guarding; *or* ■ distance guarding positioned in accordance with the values contained in BS EN ISO 13857[6] 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.

	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 – then the following also applies. You should install a monitored, presence-sensing safety device, eg: ■ a pressure-sensitive mat which extends between the moulds; *or* ■ an electro-sensitive protective device; *or* ■ a mechanical latch which prevents involuntary guard closure and can only be released from outside the mould area. Having triggered such a device, it should be necessary to do the following before initiating another cycle: – reset the safety devices; *and* – close the guards; *and* – actuate an enabling device to confirm the danger area is clear. 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. Accessible emergency stops should be fitted on both sides of the mould. At rotary machines they should be placed at intervals of 2 m or less inside the danger area. Where power-operated guards are fitted, the closing movement should be actuated by a hold-to-run control device that is positioned outside the guarded area and gives a clear view of the danger area.
Dangerous moving parts which can be reached through the delivery aperture	If not protected by the guarding systems specified for the mould area, use: ■ fixed guarding in accordance with BS EN 953;[6] *or* ■ distance guarding positioned in accordance with the values contained in BS EN ISO 13857 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: – dual-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	*Either:* ■ sensitive edges (fitted on both sides of the guard) which arrest or reverse guard closure; *or* ■ a reduced-pressure closing system in line with clause 5.2.5.2 of BS EN 953.
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 1 will exist on all machines and some safeguards will protect more than one hazard, eg one interlocked 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.

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.

Setting operations can encompass a wide range of activities. You should perform as many of the setting operations as possible – or actuation of dangerous parts following a setting adjustment – from outside the closed fixed or interlocking guards.

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

Setting

- If it is not practicable to carry out setting with the fixed or interlocking guards in place then an override facility should be provided for setting, but its use should be restricted by a lockable switch with a removable key.
- 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 should work 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 should only be operable if the lockable switch is in the setting position and its key has been removed.
- Setting speeds should not exceed 25 mm unless there is an integrated more than 3-axis robot on the machine, or it is a rotary machine as these are set with the machine at rest.
- 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, you should carry out a final check on the guard interlocks to ensure they are functioning properly.

Operator safety checklist

Regular checks by the operator are a good way of identifying problems as well as making sure machinery is safe for use. Checks should be carried out at regular intervals, as a suggestion daily or after mould changes. Table 2 contains the recommended minimum checks the operator should carry out on a regular basis. You may also want to consult the manufacturer's instructions to see if the operator should carry out any additional checks.

Table 2 Recommended minimum checks for the operator to carry out

The answer to all questions should be 'yes' or action needs to be taken	**Yes**	**No**
Are all fixed and interlocked guards in place, in good condition and secure?		
Are all interlock devices correctly aligned and securely attached to guards?		
Does opening an interlocked guard immediately stop the parts it protects?		
When an interlocked guard is open do all dangerous parts remain stationary if a start control is pressed?		
Where time-delay interlocks are fitted do they prevent access until rotation of dangerous parts has stopped?		
Are fixed guards held in place with fastenings that require a tool to undo them?		
Where pressure-sensitive mats are fitted does the pressure-sensitive mat indicator work when the mat is stepped on?		
Do all trip devices function correctly?		

Are all control unit enclosures closed, locked and the keys removed?		
Where two-hand controls are provided do both buttons have to be pressed together for the machine to operate?		
Where hold-to-run controls are provided, if you release the button does the machine stop?		
Where fitted, are adjustable guards adjusted correctly?		
Are safety devices, interlocks and guards free from evidence of being tampered with?		
If fitted, and with the machine at rest, does breaking the electro-sensitive curtain with the test piece cause the indicator to change state?		

Monthly machine inspections

Monthly machine inspections are recommended. The checklist in Table 3 provides a suggested minimum list of checks to do, but you should also consult the manufacturer's instruction manual to see if you should carry out any additional maintenance inspections.

Table 3 Suggested minimum checklist

The answer to all questions should be 'yes' or action needs to be taken	**Yes**	**No**
Are all fixed guards held in place with fastenings that need a tool to undo them?		
Are all interlocking devices correctly aligned and securely attached to guards?		
Does opening an interlocked guard immediately stop the parts it protects?		
When an interlocked guard is open do all dangerous parts remain stationary if a start control is pressed?		
Where time-delay interlocks are fitted do they prevent access until rotation of dangerous parts has stopped?		
When an emergency stop button is pressed does it stop all movement of the machine?		
Once an emergency stop button has been pressed does all machine movement remain stopped until the button has been reset?		
Do any trip wires stop the machinery almost instantaneously?		
Are control unit enclosures closed, locked and the keys removed and retained by a designated person?		
From a visual inspection, is all electrical wiring in good condition and free from damage?		
Are safety devices, interlocks and guards free from evidence of being tampered with?		
Where two-hand controls are provided do both buttons have to be pressed together for the machine to operate?		
Where hold-to-run controls are provided, if you release the button does the machine stop?		
Does the movement of the interlocked guards actuate the sensors of the associated hydraulic, pneumatic or electrical mechanisms? (Visual check)		

Are all pressurised flexible hoses in good condition and their fastenings secured in place?		
On power-operated guard(s) do either the sensitive edges or the reduced-pressure closing system operate correctly?		
Where fitted, are the mechanical restraints in good condition, properly adjusted and functioning correctly?		
Is movement of dangerous parts prevented while either a test piece is between the electro-sensitive curtain or an actuating force is 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?		
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?		

References and further reading

References

1 BS EN 422 *Plastics and rubber machines. Blow moulding machines. Safety requirements* British Standards Institution

2 *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance* L22 (Fourth edition) HSE Books 2014 www.hse.gov.uk/pubns/books/l22.htm

3 *Buying new machinery: A short guide to the law and your responsibilities when buying new machinery for use at work* Leaflet INDG271(rev1) HSE Books 2011 www.hse.gov.uk/pubns/indg271.htm

4 PD 5304 *Guidance on safe use of machinery* British Standards Institution

5 BS EN ISO 13857 *Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs* British Standards Institution

6 BS EN 953 *Safety of machinery. Guards. General requirements for the design and construction of fixed and movable guards* British Standards Institution

Further reading

Providing and using work equipment safely: A brief guide Leaflet INDG291(rev1) HSE Books 2013 www.hse.gov.uk/pubns/indg291.htm

For health and safety in plastics manufacturing premises see HSE's plastics webpages: www.hse.gov.uk/plastics/

For PUWER and CE marking see HSE's work equipment/machinery webpages: www.hse.gov.uk/work-equipment-machinery/

Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.gov.uk/. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

British Standards can be obtained in PDF or hard copy formats from BSI: http://shop.bsigroup.com or by contacting BSI Customer Services for hard copies only Tel: 020 8996 9001 email: cservices@bsigroup.com.

This leaflet is available at www.hse.gov.uk/pubns/ppis5.htm.