



Safety at window frame manufacturing machines

Plastics Processing Sheet No 8

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 with window frame manufacturing machines, and details safeguarding standards and checklists.

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

Because of the way that the reports of accidents at window frame manufacturing machinery have been coded under the Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations (RIDDOR), it is not possible to provide figures of the total number of such accidents reported to HSE. Data is available on the numbers investigated however (see Tables 1 and 2), but the numbers quoted must be recognised as being only a small proportion of those that will have occurred.

Table 1 Accidents investigated by HSE from 1986-1996

Type of machine	Saws	Routers/slotters	Corner cleaning machines	Welding machines	End milling machines	Other
All	93	17	8	7	3	7
Major	28	4	3	1	0	1

Causes of accidents

Table 2 provides additional data on these investigated accidents and summarises both the parts of machinery involved and the circumstances.

Table 2 Causes of accidents

Machine Part	Saws	Routers/slotters	Welding machines	Corner cleaning machines	End milling machines	Other
Clamp			7	4		2
Blade/cutter: normal operation	76	11		2	2	2
Blade/cutter: setting/maintenance	5	2		1		1
Blade/cutter: cleaning (eg swarf)	10	4		2	1	
Other dangerous part			1	1		1

More detailed analysis identifies the following common failures:

- safeguarding provided had been removed or fallen into disrepair, especially spring returns on 'self-adjusting' saw guards;
- unsafe systems of work during production and maintenance;
- poor adjustment of guards or safety devices;
- safeguarding had been provided but was inadequate, especially at welder clamps and routers/slotters;
- inadequate clamping or securing of the workpiece; or
- poor instruction, training and supervision.

Guarding standards for production

The standards outlined in Table 3 describe commonly accepted and practicable safeguards for the significant hazards on machinery used for manufacturing window frames, both new and second-hand.

Table 3

<i>Hazard</i>	<i>Safeguard</i>
Accessible powered clamps (all types of machinery)	Either restricted stroke (6 mm or less), two-hand control, guarding of the clamps or low pressure approach to within 6 mm of the workpiece: in this case, the clamp should retract if an obstruction is detected during descent. The approach pressure on the clamp should not be adjustable by the user.
Workpiece movement	Where practicable, clamping or other means of restraint should be provided if there is a risk of the workpiece moving and causing injury during machining, particularly at saws (including bead saws), routers/sloters and end millers. Where sequencing is automatic, the blade/cutter should be interlocked with the clamping mechanism, so that blade/cutter cannot be presented to the workpiece until it is clamped.
Contact with the blades of the following types of saw: pivoting single- and double-head mitre, cut-off/pull-up, cross-cut/draw, bead and snip	<p>Fixed guarding (eg a tunnel guard) should be provided, which encloses the saw blade in both its cutting and retracted position.</p> <p>Where this is not practicable, the teeth of the saw blades should be fully enclosed by a self-adjusting guard (with mechanical linkages, not reliant on gravity alone) when in the rest position. Where cutting is automatically initiated, and the blades not fully enclosed during the cutting process, this should be by controls which require the operator to use both hands.</p> <p>Where it is not practicable to fit a self-adjusting guard (as described above), then a fixed or gravity-operated adjustable guard should be provided with a hold-to-run button or trigger switch on the operating handle. The button or switch should be arranged so that, when the button is released, power to the saw blade spindle is removed.</p> <p>Where it is possible to stand between the powered moveable saw-blade carriages and there is a risk of crushing, hold-to-run operating controls should be located in a position which prevents the operator being injured. There should be a clear view of the working area from the operator's position.</p>
Contact with mitre saw blades where blade movement is lateral	<p>One of the following safeguarding combinations should be provided:</p> <p><i>Either:</i></p> <ul style="list-style-type: none"> ● fixed or interlocked guards which prevent access to the blades in their cutting <i>and</i> retracted positions; or ● automatic blade guards which move into the forward position in advance of the blades and cover the blade to the greatest extent practicable during the cutting process. In their retracted position the blades should be fully enclosed in their housing. <p>Neither of these options may be practicable on some older machines. In these cases, the minimum acceptable standard for the cutting/clamping risk is the provision of hold-to-run controls which require the operator to use both hands. In their retracted position the blades should still be fully enclosed in their housing.</p> <p>Where it is possible to stand between the powered moveable saw-blade carriages and there is a risk of crushing, hold-to-run operating controls should be located in a position which prevents the operator being injured. There should be a clear view of the working area from the operator's position.</p>
Contact with saw blades at v-notch and bench circular saws	<p>For v-notch saws, an adjustable bridge guard over the blade(s) should be provided to enclose as much of the blade(s) as possible when cutting. It should be strong, not easily deflected to expose the blade(s) during cutting, wide enough to prevent access to the blade from the sides and easily adjustable without the use of a tool.</p> <p>Circular saw benches should be guarded below the table so as to completely enclose the blade. Above the table, an adjustable guard should be provided; the bottom should be not more than 12 mm above the workpiece. Means should also be provided to prevent the need for the operator's hand to pass close to the blade when feeding.</p>
Contact with tools on multiple-cutter machinery (eg routers/sloters/drilling machines)	These machines should be fitted with controls which require the operator to use both hands on separate hold-to-run devices (eg push buttons or trigger grips). Removing either hand from the control should bring the cutters to rest promptly. Where a prompt rundown time is not practicable, there should be an adjustable guard which covers the tools in the retracted position.

<i>Hazard</i>	<i>Safeguard</i>
Contact with hot parts (welding plates) at welding machines and/or trapping as plates move on both single and in-line machines	<p><i>Either:</i></p> <ul style="list-style-type: none"> ● provision of fixed guards or automatic guards that move into position before welding; or ● two-hand controls. <p>Where clamping initiates an automatic sequence, not requiring the continuous use of the two-hand control, fixed or automatic guards should be provided.</p>
Contact with knives and cutters at cabinet enclosed corner cleaning machines and transom grooving machines	<p>Fixed or distance guards at the front of the machine should prevent access to the knives and cutters.</p> <p>Side or rear doors giving access for cutter block changing should be interlocked so that the cutter spindle motion stops when the door is opened. If run-down time exceeds the time needed to gain access, then guard locking or time delay interlocking will be needed.</p>
Contact with cutters at end milling machines	<p>Access to the cutters through the feed opening should be prevented by restricting the size of the opening (including by the use of spring-loaded/lever-operated self-adjusting guards) or by interlocked guarding.</p>
Large automated equipment (eg cutting and welding centres)	<p>Equipment of this kind should be safeguarded by fixed guarding or perimeter fencing. Access doors in the perimeter fencing should be interlocked to machine operation. Person-sensing devices, limited movement devices and/or other appropriate safeguards should be deployed within the perimeter fencing if access is needed with the machine under power.</p>

Safety checks

A large number of accidents (over 75% at saws) happen because of inadequate or damaged guarding; a further proportion were due to interlocks or two-hand controls having been defeated. The following minimum checks should be made to ensure that safety is maintained (although you may also wish to refer to the manufacturer's own recommendations in machinery manuals).

Operational checks (suggested frequency: daily)

- Are all fixed and interlocked guards in position and secure?
- Do self-adjusting (eg saw-blade) guards move freely and fully enclose the blade or other dangerous part? Does the adjustable part of the guard enclose all the blade on return to the rest position?
- Do return springs on saw-blade guards and at end millers work effectively? (ie do they return adjustable or moveable guards to a position where the dangerous parts are fully enclosed?)
- Are the safety devices at clamps working correctly?
- Are two-hand/hold-to-run controls working correctly?
- Are circular saw blade guards set to no more than 12 mm above the height of the material being cut?
- Are push-sticks provided at circular saws?

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 stopped dangerous parts be started with the guard still open?
- Do time-delay interlocks prevent access until rotation of dangerous parts has stopped?
- Do return springs on saw-blade guards and at end millers work effectively? (ie do they return adjustable or moveable guards to a position where the dangerous parts are fully enclosed?)
- Do hold-to-run controls at routers stop the cutters promptly (or if not are the tools guarded in the retracted position)?
- Do any emergency stops fitted prevent all continued movement of the machine? Is it then possible to operate dangerous parts without resetting?
- Are hot surfaces on in-line welders protected by two-hand controls or fixed guards?

- Is there any evidence of interlocks or low pressure settings being tampered with?
- Where applicable, is movement of dangerous parts prevented while *either* a test piece is between the electro-sensitive curtain *or* a weight is applied to a pressure-sensitive mat?

Further reading

Safety at manually-fed pivoting-head metal-cutting circular saws Engineering Information Sheet EIS12
HSE Books 1998

Circular saw benches - safe working practices HSE Woodworking Information Sheet WIS16 HSE Books 1992

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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