



Safety at granulators

Plastics Processing Sheet No 10

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 granulators and details safeguarding standards, checklists and safety precautions needed during feeding operations and when gaining access into the cutting chamber.

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 granulators 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 Granulator accidents reported under RIDDOR 1992/93-1995/96

Year	92/93	93/94	94/95	95/96
All	27	35	42	30
Major	3	8	4	3

Causes of accidents

Nearly 40 accidents involving granulators were investigated by HSE inspectors from 1986-1996. Table 2 summarises the parts of the machine and the circumstances involved.

The vast majority of the failings can be reduced to one of the following:

- unsafe systems of work, both when gaining access to the cutting chamber and when feeding materials;
- inadequate safeguarding; or
- the safeguarding provided had fallen into disrepair.

Table 2 Causes of accidents

Part causing injury		Cause/reason		
Blade	25	Powered motion	10 Access to blade for cleaning/blockage clearance. Hopper removed. Machine not isolated and locked off and started by third party.	3
			Operator removed bolted guard to clear blockage.	2
			Fail to danger interlock.	2
			Rundown device inoperative/faulty.	2
			Access to blade via feed hopper to clear blockage with machine left running.	1
		Unpowered movement of the blade	13 Safe access, unpowered movement of the blade - often when the blockage was removed.	13
		Blade stationary	2 Safe access, cut on sharp edge of the stationary blade.	2
Feed material		4	Entanglement or jarring when feeding long lengths of material into the granulator.	4
Feed rolls		4	Non-interlocked flapdoor at feed opening.	3
			No guard at feed rolls, just a tripwire.	1

Part causing injury		Cause/reason	
Hopper	2	Fell into hopper. Machinery stationary.	1
		Trapped as hopper lid was being closed under power.	1
Ejected material	1	No ejection restraint.	1
Motor cooling fan	1	Guard vibrated loose and fell off.	1
Transmission machinery	1	Transmission machinery not securely fenced.	1

Guarding standards for production

The standards outlined in Table 3 describe commonly accepted and practicable safeguards needed for the significant hazards on granulators supplied before the publication of European Standard prEN 12012-1. This standard, when published, will specify safety requirements for new blade granulators.

Table 3

Hazard	Safeguard
Access to blades when rotor is under powered motion or running down	<p>Reaching through feed opening and hopper By design, ie size of feed opening in hopper and its position, to prevent the operator reaching the blades when standing at the highest operating position.</p> <p>Reaching into cutting chamber with hopper removed When the hopper can be removed or hinged out of position before the rundown period is completed, then a time-delayed interlock should be fitted to prevent access until the dangerous parts have come to rest.</p> <p>Reaching through any other openings in the feed hopper, eg inspection covers <i>Either:</i></p> <ul style="list-style-type: none"> ● fixed guarding positioned to comply with safety distances; <i>or</i> ● a time-delayed interlock. <p>Reaching through the discharge area <i>Either:</i></p> <ul style="list-style-type: none"> ● a fixed mesh guard, positioned to comply with safety distances, used in conjunction with a safe system of work whenever it is removed; <i>or</i> ● a removable mesh guard with a time-delayed interlock.
Unpowered movement of blades	A safe system of work, including rotor restraint where necessary.
Ejection of process material or machine parts from: <ul style="list-style-type: none"> ● feed hopper opening; <i>or</i> ● chamber. 	<p><i>Either:</i></p> <ul style="list-style-type: none"> ● by design of the feed hopper, eg restraining plates, dog-legs etc; <i>or</i> ● by protective flaps at the feed hopper. <p>Chamber to be strong enough to withstand the impact of breaking or loosening of a blade during rotation.</p>
Entanglement with flexible feed material	<p><i>Either:</i></p> <ul style="list-style-type: none"> ● use of mechanical feeding device; <i>or</i> ● feeding of pre-cut, shredded, baled or bagged material ideally fed in as a ball. Maximum length of pre-cut material to be 1.5 m.
Falling through feed hopper opening	If feed openings are large enough to allow whole body entry then the hopper opening should be at least 1.2 m above the working platform.

<i>Hazard</i>	<i>Safeguard</i>
Movement of power-operated devices such as feed hopper, screen plate cradle or other enclosing equipment	<p>A time-delayed interlock to prevent such devices being operated until all movement of the rotor and feed rolls has stopped.</p> <p>If movement of such a device creates a danger in itself then use <i>either</i>:</p> <ul style="list-style-type: none"> ● a two-hand control device; <i>or</i> ● a hold-to-run control device <p>positioned in either case to give a clear view of the relevant danger area.</p>
In-running nips of feed rolls	Fixed guarding, or by distance guarding positioned taking into account safety distances to prevent the operator reaching the danger zone.
In-running nips of vee-belt and pulley drives	Fixed guarding, or by distance guarding positioned taking into account safety distances to prevent the operator reaching the danger zone.
Unpowered feed hopper falling under gravity	<p><i>Either</i>:</p> <ul style="list-style-type: none"> ● the centre of gravity at the fully open position to be well beyond its pivot point; <i>or</i> ● held in the open position by a mechanical constraint device <p>to prevent inadvertent closure.</p>

Safety checks

About 60% of accidents at granulators occur because of unsafe systems of work either when gaining access into the cutting chamber or during feeding of material. The remainder are due to safeguards that are inadequate or have fallen into disrepair. 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)

- Are all fixed and interlocked guards in place and secure?
- If fitted, are:
 - the protective flaps or restraining plates in the feed hopper intact and unbroken; or
 - any deflecting screens fitted to feed devices intact and unbroken?
- If used, are rotor restraint devices readily available?

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?

- Are all interlocks and time delay arrangements operating correctly?
- Does operation of the emergency stop(s) remove all power to the machine?
- Is it possible to operate any dangerous parts after activation of the emergency stop(s) before the machine is reset?
- Are control unit enclosures closed, locked and the keys removed?
- Are any rotor restraints used readily available and working effectively?
- Do the safety control devices (ie two-hand control, hold-to-run) for any power-operated equipment, eg hopper, screen plate cradle, function correctly?
- Do hoppers *either*:
 - hinge back beyond their pivot point; *or*
 - where held open by a mechanical constraint device, is this device in good condition and functioning correctly?
- If fitted are:
 - the protective flaps or restraining plates in the feed hopper intact and unbroken; or

- any deflecting screens fitted to feed devices intact and unbroken?

- Are any crossbars fitted to the material feed entry secure and in position?
- From a visual inspection is any of the exposed electrical wiring showing any signs of damage?

Safe systems of work during maintenance

Accidents often occur because safe systems of work are not being followed, for instance when maintenance staff need to gain access into the cutting chamber.

To ensure safety in these circumstances a lock-off procedure must be included in the safe system of work.

Lock-off procedures usually involve:

- isolating the machine from the mains supply by locking off power;
- using a padlock with only one key;
- using a multiple hasp padlock where several people are working on the machine, so each can fit their own lock; and
- putting a warning notice on the isolator.

After following these procedures, and before gaining access to the cutting chamber, those working on the machine should check by both looking and listening that motion has stopped. Parts giving access to the cutting chamber should be secured in the open position.

When the blades need to be handled, suitable gloves should be worn.

Further reading

prEN 12012-1, July 1998: *Rubber and plastics machines - Size reduction machines - Pt 1: Safety requirements for blade granulators*

BPF *Code of Practice: Safety in the use and construction of granulators for work in plastics 279/1*. Available from: British Plastics Federation, 6 Bath Place, Rivington Street, London EC2A 3JE, Tel: 0171 457 5000 Fax: 0171 457 5045

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>

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

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