# On Your Guard

## A Designer's Guide to Machinery Guarding Standards

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## Machine Safety

The UK's leading machine guarding specialist

# On Your Guard

A Designer's Guide to
Machinery Guarding Standards

## Introduction

There is no hiding from the fact that guarding is a crucial element of a machine or production line, yet the guarding design is often left until last and not given as much thought as the aspects that are seen to relate directly to productivity. Nevertheless, guards usually control the interaction between operator and machine, so it should be remembered that their design can be a significant factor in optimising a machine's performance.

A perceived difficulty with designing guards is that there are numerous regulations and standards that must be complied with. In fact, as the designer becomes more familiar with the 'rules', the 'game' becomes easier. Alternatively, specialists such as Procter Machine Safety can be employed to undertake the complete design, manufacture and installation, including electrical aspects.

This guide seeks to direct the reader towards the main standards for machine guarding and machinery safety in general, as well as providing some advice on how the standards can be applied. At the end there are lists of useful resources and sources of additional information.

Machine guarding is a matter of life and death…

- In 2017/18 there were 15 fatal injuries in manufacturing industries.
- In 2017/18, across all industries, contact with machinery caused 13 fatal injuries.
- Between 2013/4 and 2015/16, in the manufacturing industries there were an average of 66,000 self-reported non-fatal workplace injuries, of which 12% (approximately 8000) were due to contact with machinery.

*Source: HSE*

## The importance of guarding

Most employers today have at least a basic understanding of safety issues and accept that their employees are one of the company's biggest assets. But many still see machine guarding expenditure as a necessary evil rather than a key investment that can really help deliver improved productivity.

If guards are well designed they will not interfere with efficient operation; ill-considered guards invariably do. Worse than that, poorly designed guards encourage operators, maintenance staff and management to bypass them, which can compromise quality and significantly increase risks.

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## Machinery safety regulations

Machinery safety in the UK is driven by two main sets of regulations: The Supply of Machinery (Safety) Regulations 2008 as amended (the UK implementation of the European Machinery Directive 2006/42/EC, requiring all machines placed on the market in the European Economic Area (EEA), Switzerland and Turkey to carry a CE mark) and The Provision and Use of Work Equipment Regulations 1998 (PUWER 98). In addition, there are The Health and Safety at Work etc Act 1974 and The Management of Health and Safety at Work Regulations 1999.

To comply with the requirements of The Supply of Machinery (Safety) Regulations 2008, a machine needs to pass these tests:

- The machine must comply with the EHSRs (Essential Health and Safety Requirements) of the Supply of Machinery Safety Regulations.
- The machine must have been assessed as complying with the EHSRs.
- There must be a Declaration of Conformity.
- The supplier must assemble a Technical File.
- The supplier must provide the information necessary to operate the machinery safely, such as instructions.
- The supplier must have followed one of the prescribed conformity assessment procedures.
- The machine must carry a CE mark.
- The machine must 'in fact' be safe.

For partly completed machinery, the requirements are simpler:

- The supplier must prepare the technical documentation.
- The supplier must prepare the assembly instructions.
- There must be a Declaration of Incorporation.

Unlike The Supply of Machinery Safety Regulations 1992, and the 1994 and 2005 amendments, the new Regulations (which came into force on 29 December 2009 to implement the Machinery Directive 2006/42/EC) stipulate that safety components must also be CE marked. In certain circumstances, therefore, machine guards need to be CE marked. See 'Useful Resources' below for a *Guide to the New Machinery Directive,* a White Paper *CE Marking of Guards*, and the European Commission has published both a *Guide to application of the Machinery Directive 2006/42/EC* and a report *Safety fences as safety component under the Machinery Directive 2006/42/EC*. Alternatively, contact Procter Machine Safety if in doubt whether or not there is a need to CE mark guards or, indeed, other components for which guarding is a secondary function such as covers, lids and acoustic enclosures.

## Guarding standards

In practice, the way suppliers and users of machines can most easily meet their legal obligations is to ensure that their machines, guards and other safety devices conform to harmonised European standards (Euronorms). These standards have been developed to ensure an equally high standard of machine safety across the EU. The good news for users of machines in the UK is that these standards incorporate most of the principles of BS 5304:1975 and 1988 (the Code of practice for safety of machinery), which served British industry well for a long period and, although no longer current, is now available from BSI as a Published Document, PD 5304:2014.

The main standards and published documents applying to machine safety and machine guarding are shown in the tables below. Machinery Directive Harmonised Standards are classed as A-type, B-type and C-type standards, so the list below has been divided the same way, with non-harmonised standards and other documents shown at the end. The list below focuses on the main standards; readers should use the 'Useful resources' section of this present guide to check whether any other standards need to be applied to the machinery or equipment in question. In the tables below the 'BS' designation is for the British Standard, which is the UK implementation of the European (EN) or International (ISO or IEC) standard where applicable.

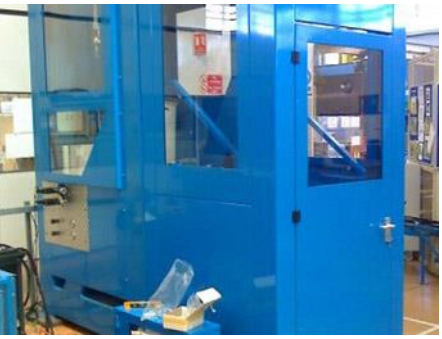
**A-type standard:** this specifies basic concepts, terminology and design principles applicable to all categories of machinery.

| | |
|---|---|
| BS EN ISO 12100:2010 | Safety of machinery. General principles for design. Risk assessment and risk reduction |

**B-type standards:** these deal with specific aspects of machinery safety or specific types of safeguard that can be used across a wide range of categories of machinery (NB the following list is not exhaustive).

| | |
|---|---|
| BS EN 349:1993+A1:2008 | Safety of machinery - Minimum gaps to avoid crushing of parts of the human body |
| BS EN 547-1:1996+A1:2008 | Safety of machinery. Human body measurements. Principles for determining the dimensions required for openings for whole body access into machinery |
| BS EN 547-2:1996+A1:2008 | Safety of machinery. Human body measurements. Principles for determining the dimensions required for access openings |
| BS EN 547-3:1996+A1:2008 | Safety of machinery. Human body measurements. Anthropometric data |
| BS EN 574:1996+A1:2008 | Safety of machinery. Two-hand control devices. Functional aspects. Principles for design |
| BS EN 614-1:2006+A1:2009 | Safety of machinery. Ergonomic design principles. Terminology and general principles |
| BS EN 614-2:2000+A1:2008 | Safety of machinery. Ergonomic design principles. Interactions between the design of machinery and work tasks |
| BS EN 842:1996+A1:2008 | Safety of machinery. Visual danger signals. General requirements, design and testing |
| BS EN 894-1:1997+A1:2008 | Safety of machinery. Ergonomics requirements for the design of displays and control actuators. General principles for human interactions with displays and control actuators |
| BS EN 894-2:1997+A1:2008 | Safety of machinery. Ergonomics requirements for the design of displays and control actuators. Displays |

| | |
|---|---|
| BS EN 894-3:2000+A1:2008 | Safety of machinery. Ergonomics requirements for the design of displays and control actuators. Control actuators |
| BS EN 894-4:2010 | Safety of machinery. Ergonomics requirements for design of displays and control actuators. Location and arrangement of displays and control actuators |
| BS EN 981:1996+A1:2008 | Safety of machinery. System of auditory and visual danger and information signals |
| BS EN 1005-1:2001 +A1:2008 | Safety of machinery. Human physical performance. Terms and definitions |
| BS EN 1005-2:2003 +A1:2008 | Safety of machinery. Human physical performance. Manual handling of machinery and component parts of machinery |
| BS EN 1005-3:2002 +A1:2008 | Safety of machinery. Human physical performance. Recommended force limits for machinery operation |
| BS EN 1005-4:2005 +A1:2008 | Safety of machinery. Human physical performance. Evaluation of working postures and movements in relation to machinery |
| BS EN 1672-2:2005 +A1:2009 | Food processing machinery. Basic concepts. Hygiene requirements |
| BS EN 1837:1999+A1:2009 | Safety of machinery. Integral lighting of machines |
| BS EN ISO 3744:2010 | Acoustics. Determination of sound power levels and sound energy levels of noise sources using sound pressure. Engineering methods for an essentially free field over a reflecting plane |
| BS EN ISO 4413:2010 | Hydraulic fluid power. General rules and safety requirements for systems and their components |
| BS EN ISO 4414:2010 | Pneumatic fluid power. General rules and safety requirements for systems and their components |
| BS EN ISO 4871:2009 | Acoustics. Declaration and verification of noise emission values of machinery and equipment |
| BS EN ISO 7010:2012 +A7:2017 | Graphical symbols. Safety colours and safety signs. Registered safety signs |
| BS EN ISO 7731:2008 | Ergonomics. Danger signals for public and work areas. Auditory danger signals |
| BS EN ISO 9614-1:2009 | Acoustics. Determination of sound power levels of noise sources using sound intensity. Measurement at discrete points |



| | |
|---|---|
| BS EN ISO 9614-3:2009 | Acoustics. Determination of sound power levels of noise sources using sound intensity. Precision method for measurement by scanning |
| BS EN ISO 11161:2007 +A1:2010 | Safety of machinery. Integrated manufacturing systems. Basic requirements |
| BS EN ISO 11200:2014 | Acoustics. Noise emitted by machinery and equipment. Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions |
| BS EN ISO 11201:2010 | Acoustics. Noise emitted by machinery and equipment. Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections |
| BS EN ISO 11202:2010 | Acoustics. Noise emitted by machinery and equipment. Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections |
| BS EN ISO 11203:2009 | Acoustics. Noise emitted by machinery and equipment. Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level |
| BS EN ISO 11204:2010 | Acoustics. Noise emitted by machinery and equipment. Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections |
| BS EN ISO 11205:2009 | Acoustics. Noise emitted by machinery and equipment. Engineering method for the determination of emission sound pressure levels in situ at the work station and at other specified positions using sound intensity |
| BS EN ISO 11688-1:2009 | Acoustics. Recommended practice for the design of low-noise machinery and equipment. Planning |
| BS EN 12198-1:2000 +A1:2008 | Safety of machinery. Assessment and reduction of risks arising from radiation emitted by machinery. General principles |
| BS EN 12198-2:2002 +A1:2008 | Safety of machinery. Assessment and reduction of risks arising from radiation emitted by machinery. Radiation emission measurement procedure |

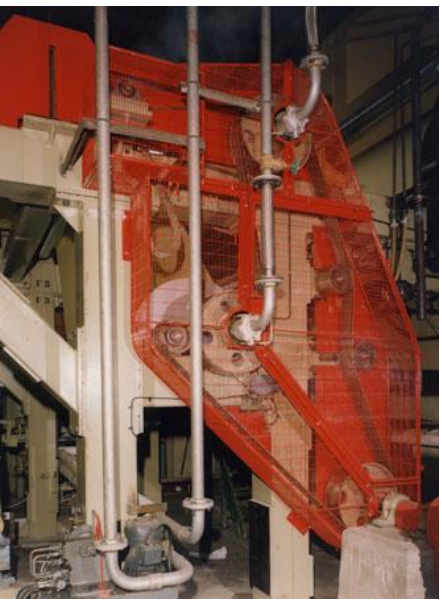
| | |
|---|---|
| BS EN 12198-3:2002 +A1:2008 | Safety of machinery. Assessment and reduction of risks arising from radiation emitted by machinery. Reduction of radiation by attenuation or screening |
| BS EN ISO 13732-1:2008 | Ergonomics of the thermal environment. Methods for the assessment of human responses to contact with surfaces. Hot surfaces |
| BS EN ISO 13732-3:2008 | Ergonomics of the thermal environment. Methods for the assessment of human responses to contact with surfaces. Cold surfaces |
| BS EN ISO 13849-1:2015 | Safety of machinery. Safety related parts of control systems. General principles for design |
| BS EN ISO 13849-2:2012 | Safety of machinery. Safety-related parts of control systems. Validation |
| BS EN ISO 13850:2015 | Safety of machinery. Emergency stop. Principles for design |
| BS EN ISO 13855:2010 | Safety of machinery. Positioning of safeguards with respect to the approach speeds of parts of the human body |
| BS EN ISO 13856-1:2013 | Safety of machinery. Pressure-sensitive protective devices. General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors |
| BS EN ISO 13856-2:2013 | Safety of machinery. Pressure-sensitive protective devices. General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars |
| BS EN ISO 13856-3:2013 | Safety of machinery. Pressure-sensitive protective devices. General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices |
| BS EN ISO 13857:2008 | Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs |
| BS EN ISO 14118:2018 | Safety of machinery - Prevention of unexpected start-up |
| BS EN ISO 14119:2013 | Safety of machinery. Interlocking devices associated with guards. Principles for design and selection |
| BS EN ISO 14120:2015 | Safety of machinery. Guards. General requirements for the design and construction of fixed and movable guards |
| BS EN ISO 14122-1:2016 | Safety of machinery. Permanent means of access to machinery. Choice of a fixed means of access between two levels |
| BS EN ISO 14122-2:2016 | Safety of machinery. Permanent means of access to machinery. Working platforms and walkways |
| BS EN ISO 14122-3:2016 | Safety of machinery. Permanent means of access to machinery. Stairways, stepladders and guard-rails |

| | |
|---|---|
| BS EN ISO 14122-4:2016 | Safety of machinery. Permanent means of access to machinery. Fixed ladders |
| BS EN ISO 14123-1:2015 | Safety of machinery. Reduction of risks to health from hazardous substances emitted by machinery. Principles and specifications for machinery manufacturers |
| BS EN ISO 14123-2:2015 | Safety of machinery. Reduction of risk to health from hazardous substances emitted by machinery. Methodology leading to verification procedures |
| BS EN ISO 14159:2008 | Safety of machinery. Hygiene requirements for the design of machinery |
| BS EN ISO 14738:2008 | Safety of machinery. Anthropometric requirements for the design of workstations at machinery. Anthropometric requirements for the design of workstations at machinery |
| BS EN 60204-1:2018 | Safety of machinery. Electrical equipment of machines. General requirements |
| BS EN 61310-1:2008 | Safety of machinery. Indication, marking and actuation. Requirements for visual, auditory and tactile signals |
| BS EN 61310-2:2008 | Safety of machinery. Indication, marking and actuation. Requirements for marking |
| BS EN 61310-3:2008 | Safety of machinery. Indication, marking and actuation. Requirements for the location and operation of actuators |
| BS EN 61496-1:2013 | Safety of machinery. Electro-sensitive protective equipment. General requirements and tests |
| BS EN 62061:2005 +A2:2015 | Safety of machinery. Functional safety of safety-related electrical, electronic and programmable electronic control systems |

**C-type standards:** these deal with safety requirements for particular types of machine or groups of machine. When a C-type standard deviates from an A-type or B-type standard, the C-type standard takes precedence. NB the following list is not exhaustive.

| | |
|---|---|
| BS EN 415-1:2014 | Safety of packaging machines. Terminology and classification of packaging machines and associated equipment |
| BS EN 415-3:1999 +A1:2009 | Safety of packaging machines. Form, fill and seal machines |
| BS EN 415-5:2006 +A1:2009 | Safety of packaging machines. Wrapping machines |
| BS EN 415-6:2013 | Safety of packaging machines. Pallet wrapping machines |

| | |
|---|---|
| BS EN 415-7:2006 +A1:2008 | Safety of packaging machines. Group and secondary packaging machines |
| BS EN 415-8:2008 | Safety of packaging machines. Strapping machines |
| BS EN 415-10:2014 | Safety of packaging machines. General Requirements |
| BS EN 618:2002 +A1:2010 | Continuous handling equipment and systems. Safety and EMC requirements for equipment for mechanical handling of bulk materials except fixed belt conveyors |
| BS EN 619:2002 +A1:2010 | Continuous handling equipment and systems. Safety and EMC requirements for equipment for mechanical handling of unit loads |
| BS EN 620:2002 +A1:2010 | Continuous handling equipment and systems. Safety and EMC requirements for fixed belt conveyors for bulk materials |
| BS EN 1010-1:2004 +A1:2010 | Safety of machinery. Safety requirements for the design and construction of printing and paper converting machines. Common requirements |
| BS EN 1034-1:2000 +A1:2010 | Safety of machinery. Safety requirements for the design and construction of paper-making and finishing machines. Common requirements |
| BS EN ISO 10218-1: 2011 | Robots and robotic devices. Safety requirements for industrial robots. Robots |
| BS EN ISO 10218-2: 2011 | Robots and robotic devices. Safety requirements for industrial robots. Robot systems and integration |
| BS EN ISO 11553-1: 2008 | Safety of machinery. Laser processing machines. General safety requirements |
| BS EN 12622:2009 +A1:2013 | Safety of machine tools. Hydraulic press brakes |
| BS EN 12717:2001 +A1:2009 | Safety of machine tools. Drilling machines |
| BS EN 13736:2003 +A1:2009 | Safety of machine tools. Pneumatic presses |
| BS EN ISO 16089:2015 | Machine tools. Safety. Stationary grinding machines |
| BS EN ISO 16090-1: 2018 | Machine tools safety. Machining centres, Milling machines, Transfer machines. Safety requirements |
| BS EN ISO 16092-1: 2018 | Machine tools safety. Presses. General safety requirements |
| BS EN ISO 16092-3: 2018 | Machine tools safety. Presses. Safety requirements for hydraulic presses |
| BS EN ISO 16093:2017 | Machine tools. Safety. Sawing machines for cold metal |
| BS EN ISO 23125:2015 | Machine tools. Safety. Turning machines |



**Non-harmonised standards and other documents**

| | |
|---|---|
| BS EN 415-2:2000 | Safety of packaging machines. Pre-formed rigid container packaging machines |
| BS EN 415-4:1998 | Safety of packaging machines. Palletizers and depalletizers |
| BS EN 1005-5:2007 | Safety of machinery. Human physical performance. Risk assessment for repetitive handling at high frequency |
| BS 4163:2014 | Health and safety for design and technology in schools and similar establishments. Code of practice |
| BS 4531:1986 | Specification for portable and mobile troughed belt conveyors |
| BS 5667-1:1979 (ISO 1819-1977) | Specification for continuous mechanical handling equipment - safety requirements. General |
| BS 6753:1986 | Specification for shotbolts (solenoid operated) for guarding machinery |
| BS EN ISO 9614-2: 1997 | Acoustics. Determination of sound power levels of noise sources using sound intensity. Measurement by scanning |
| BS EN ISO/TR 11688-2:2001 | Acoustics. Recommended practice for the design of low-noise machinery and equipment. Introduction to the physics of low-noise design |
| BS EN 13861:2011 | Safety of machinery. Guidance for the application of ergonomics standards in the design of machinery |
| PD ISO/TR 18569:2004 | Safety of machinery. Guidelines for the understanding and use of safety of machinery standards |
| PD ISO/TS 19837:2018 | Safety of machinery. Trapped key interlocking devices. Principles for design and selection |
| PD ISO/TR 23849:2010 PD IEC/TR 62061-1: 2010 | Guidance on the application of ISO 13849-1 and IEC 62061 in the design of safety-related control systems for machinery |
| BS EN 61496-2:2013 | Safety of machinery. Electro-sensitive protective equipment. Particular requirements for equipment using active opto-electronic protective devices (AOPDs) |
| PD IEC/TR 61496-4: 2007 | Safety of machinery. Electro-sensitive protective equipment. Particular requirements for equipment using vision based protective devices (VBPD) |
| PD IEC/TS 61496-4-2: 2014 | Safety of machinery. Electro-sensitive protective equipment. Particular requirements for equipment using vision based protective devices (VBPD). Additional requirements when using reference pattern techniques (VBPDPP) |

| | |
|---|---|
| PD IEC/TS 61496-4-3: 2015 | Safety of machinery. Electro-sensitive protective equipment. Particular requirements for equipment using vision based protective devices (VBPD). Additional requirements when using stereo vision techniques (VBPDST) |
| 17/30356573 DC (BS IEC 62046, draft for public comment) | Safety of machinery. Application of protective equipment to detect the presence of persons |

Other types of machinery, from cranes to sewing machines, also have their own requirements. A full list of standards harmonised to the Machinery Directive is available on the European Commission's website (see 'Useful Resources' below).

Additional information is also available from the HSE's website: from the *I am interested in…* menu select *More topics* then select *Work equipment and machinery*; and from the *I work in…* menu select *More industries* then select *Engineering* and *Manufacturing*.

Do you have questions about machine guarding standards? Contact us:

02920 855 758 info@machinesafety.co.uk https://www.machinesafety.co.uk/contact-us

## Risk assessment and reduction

Today the accepted approach to the design of any machine guarding system is based on risk assessment. BS EN ISO 12100:2010 (which replaced BS EN ISO 14121-1, which itself replaced BS EN 1050) sets out different methods; these must take account of the probability and degree of possible harm relating to any foreseeable injury. More guidance on Risk Assessment can be found in the HSE's leaflet *Risk Assessment - A brief guide to controlling risks in the workplace* INDG163 (rev4), which has replaced the previous publication *Five steps to risk assessment.* Most HSE publications can be downloaded for free, or hard copies can be purchased.

A free *Risk Assessment Calculator* is also available from Procter Machine Safety. This is based on the requirements of the A-type harmonised standard BS EN ISO 12100:2010 and is designed to be simple to use, making extensive use of checklists (see 'Useful Resources' below).

Once a machine has been assessed, if the resultant risk is considered unacceptable, measures should be applied to reduce the risk rating — which often includes guarding. This iterative process is repeated until the measures applied reduce the risk to an acceptable level.

Risk reduction measures should be implemented in a hierarchical, three-step process:

1. Inherently safe design (ie design-out the hazards)
2. Safeguarding and complementary protective measures
3. Information for safe use

Additional measures may also be required such as training, safe working procedures, permit-to-work systems and personal protective equipment.

Contact us if you need help with Risk Assessments, PUWER Assessments or Machine Guarding Compliance Surveys

02920 855 758 info@machinesafety.co.uk https://www.machinesafety.co.uk/contact-us

## Working with the standards

BS EN ISO 14120, which is the main guarding standard (replacing BS EN 953), covers all machinery from simple drive couplings to very complex installations involving robots, conveyors and processing machinery. The standard lists those aspects of machinery, people and the design and construction of guards that need to be considered.

Machine aspects to be considered are, of course, the functions of the machine and the hazards arising from these. Obvious ones include entanglement or impact from moving parts, and less obvious ones are, for example, the potential for ejection of broken tools, hazardous materials and invisible emissions including noise and radiation. Guards should minimise exposure to these hazards by the selection of appropriate materials, construction methods and correct safety distances — as specified in BS EN ISO 13857.

## Before starting the design

The successful design of machine guards needs a clear understanding of all the ways in which people interact with the machine at all phases of its life including commissioning, production and maintenance. Before designing any guarding, the designer should talk to the operators and maintenance staff who will use the machine; if the machine operates for more than one shift per day, the designer needs to talk to the operators and maintenance staff from all shifts because the working practices may not be the same.

Well-designed guards should permit machines to be loaded, unloaded, cleaned and maintained efficiently without exposing people to hazards (remember that around 25-30 per cent of fatal injuries in the manufacturing industries occur while maintenance is being carried out).

## Design guidelines

Machine guarding can be constructed from a variety of materials and the skill of the designer lies in creating a system that will be fully compliant with the regulations and standards, yet will also be user-friendly, cost-effective and aesthetically pleasing. The main choice of infill materials is between sheet steel, welded wire mesh and clear polycarbonate — though sheet steel guards can also be provided with mesh or polycarbonate windows.

On machines where process viewing is necessary, adequate lighting must be provided to ensure compliance with BS EN 1837, *Safety of machinery. Integral lighting of machines*, and to discourage operatives from attempting to bypass the guarding.

If ejected parts are an issue, sheet steel or polycarbonate are typically chosen, while welded wire mesh (weldmesh) is cost-effective for many other applications. In corrosive environments or where frequent washdowns are required, stainless steel is preferred. If heavy use or abuse is anticipated, robust materials and methods of construction should be employed.

Noise reduction is increasingly important today, so acoustic foam or other sound-deadening material can be added to sheet metal panelling. Sealing around guards can also help to reduce noise levels, and sealing is highly beneficial if fluids or dust are present. In some cases the best option is to construct an acoustic enclosure around the machine.

BS EN ISO 14120:2015 requires fixings for fixed guards to remain attached to the guard or the machinery when the guard is removed. While this appears to make the situation clear, in fact designers need to be decide whether or not a guard (or other component with a secondary safety function) is a 'fixed guard' and whether or not it is foreseeable that the guard will be removed for maintenance, cleaning or other reasons (if not, then there is no need to use retained/captive fasteners). More information about fixings for fixed guards is available in a free White Paper from Procter Machine Safety, *How to specify fixings for machine guards* (see 'Useful Resources' below).

When designing either fixed or moving guarding, the designer should refer to the standard that covers safety distances to prevent hazard zones being reached, namely BS EN ISO 13857. A free *Safety Distance Calculator* is available from Procter Machine Safety for establishing the required safety distances and heights of machine guards in accordance with BS EN ISO 13857 (see 'Useful Resources' below).

The new Machinery Directive 2006/42/EC is more explicit in its requirements relating to ergonomics — and there are currently some 20 relevant Harmonised standards. Not all of these standards are required when designing machine guards, but it is clear that ergonomics cannot be ignored. Helpful information is available in a European Commission publication *Guidance on the application of the essential health and safety requirements on ergonomics*.

## Access control

The section of BS EN ISO 14120 covering human aspects addresses the human/machine interaction, including reducing the need for frequent access and ensuring that, where the need for access cannot be eliminated, access is controlled so that the machine can only be approached when it is in a safe condition. This is usually achieved by interlocking the access guards/gates. The need for non-essential access can be reduced by, for example, designing guards with good process viewing and locating lubrication points outside the guarding.

If interlocks are required, it is vital to select components that are suitable for the machine's risks and safety-related control system, depending whether the designer is working to functional safety standard BS EN ISO 13849-1 or BS EN 62061. Typically the interlocks will be of the mechanical type using roller plungers or metal tongues, switches incorporated within hinges, or non-contact types utilising coded magnetic or electronic technologies.

Whichever type is selected, the switches must be installed correctly if they are to perform properly and not start to fail (either to a safe or unsafe condition) when the guard hinges or runners begin to wear. BS EN ISO 14119 gives more information about interlock selection.

For perimeter guards and machinery where whole-body access is possible, key exchange systems are often the most appropriate, as the person entering the guarded area can take a key with them to prevent the machine from being restarted (assuming the safe system of work is followed). If frequent access is required and the machine has a short stopping time, photo-electric guards can be very effective, though care must be taken to observe the correct distance between the guard and hazard (see BS EN ISO 13855). Other options are laser area scanners and pressure-sensitive mats.

Conventional opening guards can be manually operated or powered. In the case of powered guards, it may be necessary to install 'safe edges' on the leading edges of the guards to prevent them becoming hazards themselves.

Two of the changes introduced when BS EN ISO 14120 replaced BS EN 953 relate to the choice of fixed or movable guards *where access is required only for machine setting, process correction or maintenance*.

- first, EN 953 states that movable guards should be used if the frequency of access is *'high (e.g. more than once per shift)'* but now ISO 14120 defines 'high' as *'e.g. more than once per week'*;

- second, in EN 953 fixed guards should only be used *'if the foreseeable frequency of access is low, its replacement is easy, and its removal and replacement are carried out under a safe system of work'*, with no definition provided for 'low', so users were left to assume that 'low' is any frequency that falls outside the scope of 'high'. In contrast, ISO 14120 defines 'low' as *'e.g. less than once per week'*.

There is an ambiguity here regarding whether fixed or movable guards should be used if access is required once per week (not more, not less), as this is a foreseeable situation (maintenance, calibration and checks/adjustments might be scheduled to take place weekly). It could be argued that the machine designer should err on the side of safety and specify (interlocked) movable guards rather than fixed guards that are removed and replaced under a safe system of work. On the other hand, the designer may be tempted to save costs by installing fixed guards that do not require hinges or linear bearings, or the interlock, wiring and additional inputs on the safety-related control system.

The other issue here is that under EN 953 the frequency of access was considered to be high if access was required more than once per shift; in contrast, ISO 14120 redefines 'high' as once per week, which could result in many more machines meeting this criterion and therefore having to be equipped with movable guards rather than fixed guards. The implications for design and manufacturing costs could be considerable.

If you find this document useful, have a look at our other guides and white papers:
https://www.machinesafety.co.uk/free-downloads

## If in doubt, ask

This guide is intended to point machine designers in the right direction for designing safe, cost-effective guards that comply with relevant UK and European regulations and help to optimise the machine's performance.

If further assistance is required, Procter Machine Safety can advise on current regulatory requirements as well as undertake risk assessments and site surveys, and then design, fabricate and install bespoke guarding, including electrical integration, to suit virtually any machine or process.

For perimeter guarding, Procter Machine Safety offers a choice of modular systems in both steel and aluminium. Standard elements include sliding, hinged and lifting guards, as well as fixed panels with infills of welded wire mesh, sheet steel and polycarbonate. Furthermore, the company can also design and manufacture bespoke components to complement the standard elements where these would not be ideal. Customers pay only for what they need because they can select from a choice of modular systems of different strengths and specifications — or use a combination of different specifications for various areas around a machine. All perimeter guards are offered on a supply-on basis or Procter can provide an installation service if required.

## Useful resources

These are all available free of charge on request or to download.
Email: info@machinesafety.co.uk
Download: https://www.machinesafety.co.uk/free-downloads

### Risk Assessment Calculator
Based on the requirements of BS EN ISO 12100 and designed to be simple to use.

### Safety Distance Calculator
Establishes machine guard safety distances and heights in accordance with BS EN ISO 13857.

### Guide to the New Machinery Directive 2006/42/EC
To help companies comply with the Directive that came into force on 29 December 2009.

### White paper: Machinery Directive and Fixings for Fixed Guards
Explaining the requirements for Guard Fixings under the Machinery Directive.

### White paper: CE Marking of Machine Guards
Explaining the requirements relating to CE marking of guards under the Machinery Directive.

### White paper: EN 349, Minimum Gaps to Avoid Crushing
Explaining the requirements of the standard for minimum gaps to prevent crushing.

## White paper: Differences Between BS EN 953 and BS EN ISO 14120

Explaining what changes have been introduced in BS EN ISO 14120, which replaces and supersedes BS EN 953.

## White paper: Conveyor Guarding

Explaining the hazards associated with conveyors, regulations and standards, and how to safeguard conveyors without adversely affecting productivity.

## White paper: The 2014 Edition of PD 5304

Explaining the changes in the latest edition of BSI's *Guidance on safe use of machinery*.

## Guide to Workshop Safety

A guide to guarding small machine tools typically used in workshops.

## Machine Accident Investigation Kit

To help companies meet their statutory obligations and prevent future accidents.

## Ergonomics Guidance

European Commission publication *Guidance on the application of the essential health and safety requirements on ergonomics*.
Download: http://ec.europa.eu/growth/sectors/mechanical-engineering/machinery

# Further information

## Procter Machine Safety

Tel: 02920 855 758
Email: info@machinesafety.co.uk — Website: https://www.machinesafety.co.uk

## SATECH (low-cost modular perimeter guards)

Tel: 02920 855 754
Email: satech@machinesafety.co.uk
Website: https://www.machinesafety.co.uk/satech

## Nelsa (standard machine shop guards from Procter)

Tel: 02920 855 751
Email: nelsa@machinesafety.co.uk — Website: https://www.machinesafety.co.uk/nelsa

## BSI

Tel: 0345 086 9001
Email: cservices@bsigroup.com — Website: https://shop.bsigroup.com

## Health and Safety Executive

Tel: 0300 003 1747
Website: www.hse.gov.uk

## HSE Books

Note: many publications are now available to download for free as PDF files.
Tel: 0333 202 5070
Email: hseorders@tso.co.uk — Website: https://books.hse.gov.uk

## Department for Business, Energy and Industrial Strategy (BEIS)

Tel: 020 7215 5000
Email: enquiries@beis.gov.uk — Website: www.gov.uk/beis

## European Commission

List of standards harmonised to the Machinery Directive 2006/42/EC, official guide to application of the Machinery Directive and guidance on ergonomics and safety fences used as safety components
Website: http://ec.europa.eu/growth/sectors/mechanical-engineering/machinery

## About the author

Steve Allen is a Member of standards committee BSI MCE/3 (Safeguarding of machinery) and is National Sales Manager at Procter Machine Safety. He has been involved with machinery guarding for over 25 years and has an internationally recognised qualification as a Certified Machinery Safety Expert (TÜV NORD). Steve Allen has the benefit of both a detailed knowledge of machinery safety standards and many years' experience of their practical implementation.

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