



# Machine Guards

## White Paper 4 PD 5304:2014

January 2015

### Changes in the 2014 edition of PD 5304

Jeremy Procter, a Member of standards committees ISO/TC 199/WG 6 (Safety distances and ergonomic aspects) and BSI MCE/3 (Safeguarding of machinery), and Managing Director of Procter Machine Guarding, outlines the changes in the 2014 edition of BSI's Published Document PD 5304, *Guidance on safe use of machinery*.

## Introduction

BSI has updated **PD 5304, Guidance on safe use of machinery**, to reflect changes in legislation and machinery safety standards. Although much of PD 5304 remains substantially unchanged, there are revisions in the new edition relating to risk assessments, guards, interlocking and control systems, and safety distances (reach distances).

Machine builders operating in the European market are today expected to conform with the Essential Health and Safety Requirements (EHSRs) of the Machinery Directive, with the simplest route to conformance being compliance with the relevant transposed harmonised standards. However, BSI recognises that there is a need for practical measures and techniques that can be adopted by users of existing machinery, as well as people modifying, refurbishing, upgrading or changing the use of machinery – though it should be noted that beyond a certain point it is necessary to CE mark the machine to the Machinery Directive 2006/42/EC as if it were new. PD 5304:2014, which has evolved from CP 3004 (1964) to BS 5304 (1975) and PD 5304 (2000 and 2005), was published on 31 December 2014 and replaces PD 5304:2005. It does not have the same status as a British Standard but it does contain comprehensive guidance to help protect machine users including operatives and maintenance personnel.

This present White Paper seeks to highlight the main changes between PD 5304:2005 and PD 5304:2014. A clause-by-clause analysis of the changes is provided, but readers should be aware that not every last detail is covered.

## General comments

### Redrafting

Throughout the document text has been redrafted for clarity and to bring it into line with current machinery safety standards. In addition, some paragraphs have been reordered, and some subclauses have been reordered and renumbered accordingly.

### Terminology

In the 2005 edition phrases such as *'Machinery is supposed to have been designed'* and *'The controls ought to have been positioned'* were used; in contrast, the 2014 edition uses *'Machinery should be designed'* and *'Stations should be positioned'* ('should' is used when a recommendation is being made).

## Clause-by-clause changes

### Responsible committee

PD 5304:2014 was prepared by BSI Technical Committee MCE/3 on which a number of bodies are represented. Compared with the 2005 edition, there have been changes to the bodies represented: BARA, Machinery Safety Equipment Manufacturers Association, IEE (now known as the IET) and IOSH are no longer represented, while the Food and Drink Federation is now represented.

### Introduction

The Introduction to PD 5304:2014 is written by Dave Bench, Director of Science at the Health and Safety Executive (HSE). Compared with the introduction to the 2005 edition, there are some changes. In particular, the introduction no longer refers to the Machinery Directive, though it still refers to PUWER 98 and modifications, refurbishment or change of use.

### Foreword

In the redrafted Foreword it is stated that PD 5304:2014 came into effect on 31 December 2014 and supersedes PD 5305:2005, which is withdrawn. There is also a new reminder that users of machinery need to make themselves aware of new codes of practice, etc that may be published from time to time due to developments in machinery safeguarding. A useful addition to the Foreword is a clear explanation of the usage of *should*, *may* and *can* (*should* is used for recommendations, *may* expresses permissibility such as an alternative to the primary recommendation, and *can* expresses possibility such as a consequence of an event or action).

## Section 1: General

### 1.1 Scope

This now refers to the safe use of machinery '*including*' that supplied prior to the implementation of the Supply of Machinery (Safety) Regulations 1992 (the 2005 edition implied that PD 5304 was **only** applicable to pre-1992 machinery).

### 1.2 Normative references

Given the number of changes to International standards and Harmonised European standards since 2005, partly as a result of the new Machinery Directive 2006/42/EC that became applicable on 29 December 2009, the list of normative references contains many revisions.

### **1.3 Terms and definitions**

Throughout this subclause there are minor changes to the text, but the following are worth highlighting:

#### **1.3.8 intensification**

This is a new definition.

#### **1.3.10 interlocking guard**

This is a new definition and it is identical to that found in BS EN ISO 12100:2010.

### **Section 2: Strategy for selecting protective measures**

The introductory text from subsection 2.1 of the 2005 edition, relating to application and objective of the guidance, has been removed, though some of the material contained therein is now included within the redrafted Foreword.

A new illustration (Figure 1, *Enclosed tools at a power press*) is provided as an example of inherently safe design.

### **Section 3: Risk assessment**

#### **3.1 General**

3.1.1 – There is a new reminder that risk assessment is a requirement of the Management of Health and Safety Regulations 1995, and a new reference to ‘users’ also contributing to risk assessments by drawing on their experience.

The rest of Section 3 has been redrafted to clarify when a new risk assessment is necessary. It also makes it clear that risk assessments should be reviewed periodically, and there are detailed references to BS EN ISO 12100:2010 with respect to risk assessment and risk reduction. Also included is a useful flow chart (Figure 2, *Iterative process to reduce risk*), which is essentially the ‘risk assessment’ portion of the risk reduction flow chart shown in BS EN ISO 12100:2010.

#### **3.5 Documentation**

This is a new subsection that emphasises the need for thorough record-keeping when undertaking risk assessments.

### **Section 4: Identification of hazards**

#### **4.1 Hazards at machinery**

This subsection has been partly rewritten, recognising that readers of PD 5304 are largely working on existing machinery, so there is little scope for designing-out hazards; it is therefore likely that safeguards and complementary protective measures will have to be applied.

#### **4.3 Non-mechanical hazards**

3.1.1 Hygiene – This new subclause is aimed primarily at machine users in the food and pharmaceutical processing industries.

## **Section 5: Aspects of machine design to eliminate or reduce risks**

### **5.1 Design for safe use**

This new subsection refers to BS EN 12100 and, in particular, the three-step method of risk reduction:

- 1) inherently safe design measures;
- 2) safeguarding and/or complementary protective measures; and
- 3) information for use.

In addition, readers are reminded about type-B and type-C standards and the need for users to perform certain checks.

### **5.2 Checks by user**

This subsection was numbered 5.1 in the 2005 edition but, in the 2014 edition, it is expanded considerably.

### **5.4 Controls**

This subsection contains a new reference to the use of presence-sensing devices when it is not practicable to position the controls such that any person in the hazardous area is visible.

5.4.4 Controls for machinery setting or adjustment and for feeding material – this subclause contains a new statement: *‘As far as practicable, tasks requiring manual intervention should be performed from outside the safeguarded space.’*

The subclause also contains an expanded list of protective measures for use when setting or adjustment need to take place with the machine in motion and guards displaced or removed. There is also a new note containing examples of reduced speeds from unspecified published standards.

### **5.6 Unexpected/unintended start-up**

This subsection has been redrafted and expanded considerably.

### **5.7 Measures for the escape and rescue of trapped persons**

This subsection now includes an additional item *‘escape doors in guards’* in the examples of measures that should be provided where necessary.

### **5.13 Feeding and take-off devices**

This subsection has been partially redrafted and now mentions the need for a new risk assessment and, if required, guarding if automatic feeding and removal devices are installed.

## **Section 6: Selection of safeguards**

### **6.2 Where access to the hazard zone is not required during normal operation**

This subsection now refers only to *fixed enclosing guards* and *fixed distance guards*. References to the following have been deleted (but see 6.3 below): *interlocking guard with or without guard locking*; *self-adjusting (self-closing) guard*; and *sensitive protective equipment*.

### **6.3 Where access to the hazardous area can be required during normal operation**

This is a new subsection incorporating the three items deleted from 6.2.

### **6.4 Where access to the hazardous area is required during normal operation**

The term '*trip device*' has been deleted, though the same point still exists, covering sensitive protective equipment.

### **6.5 Access to the hazardous area for infrequent operation**

This is a new subsection relating to operations such as setting, process correction or maintenance. It refers to safe systems of work, isolation/immobilisation procedures and lockout/tagout safeguards.

## **Section 7: Guard design and construction**

### **7.2 Types of guard**

#### **7.2.1 Fixed guard**

Figure 28, *Fixed guards for chains and chain wheels*, has been improved to make it clearer that one of the guard types illustrated is unsatisfactory.

The illustration of a fixed enclosing guard for a band resawing machine has been deleted.

There is a new Figure 37, *Transparent tunnel guard with conveyor belt*.

7.2.1.1 General – This subclause benefits from a better description of a fixed guard that is all but identical to the definition given in BS EN ISO 12100. In addition, whereas PD 5304:2005 only stated a preference for the use of captive fasteners, PD 5304:2014 states that '*fastenings should be of the captive type*'.

#### **7.2.2 Movable guard**

This is a new subclause. Note that it states '*Movable guards, where practicable, should be interlocking guards.*'

## **Section 8: Protective devices**

In PD 5304:2005 there was a subsection 8.1 *General*. This was essentially a list of the contents of Section 8 and has been deleted, so the remaining subsections in Section 8 have been renumbered accordingly.

### **8.1 Trip devices**

#### **8.1.1 General**

This subclause adds a reference to trip devices being unsuitable for machinery that cannot be stopped part-way through a cycle, such as a full revolution mechanical power press.

## **Section 9: Interlocking**

### **9.3 Interlocking methods for power interruption**

This subsection has been redrafted and now includes two new subclauses:

9.3.3 Interlocking guard without guard locking

9.3.5 Mechanical trapped-key guard interlock

One subclause has been deleted, namely 9.4.3.5 Combination of devices.

### **9.6 Electrical interlocking devices**

From the list of interlocking devices, '*inductive proximity switches*' has been deleted and new additions are:

- uncoded non-contact switches;
- coded non-contact switches;
- power interlocking.

There is also a new reference to functional safety characteristics of electrical interlocking devices.

9.6.3.2 Interlocking switch with solenoid-operated guard locking – a new paragraph has been added to this subclause to explain that interlocking switches with solenoid-operated guard locking should be of the '*power to unlock*' or '*power to lock and power to unlock*' type unless a risk assessment shows this is not appropriate. Other methods can be used but they should provide an equivalent level of protection.

9.6.6 Uncoded non-contact switches – this is a new subclause for uncoded devices using operating principles including inductive, magnetic, capacitive, ultrasonic and optical. It states that these are not generally suitable for interlocking duties unless additional measures are taken to prevent their defeat.

9.6.7 Coded non-contact switches – this is a new subclause for coded devices using operating principles including magnetic, radio frequency identification (RFID) and optical. It explains that different levels of coding are available and this type of device is suitable for use in applications requiring high integrity, protection from liquids and dusts, and tolerance of guard misalignment and movement. The corresponding illustration, Figure 89, has been reused but with a new caption (previously the figure illustrated the application of a magnetic switch).

## **9.7 Mechanical interlocking devices**

9.7.2 Design – within this subclause the following sentence was included in the previous edition of PD 5304 but has been deleted from the 2014 edition: *'An approximation to power interlocking methods might be achieved when the link between the guard and the power interruption device is direct.'* One illustration of a pinned threaded connecting rod has been deleted, but the caption's references to adjustable components and provision for maintenance have now been incorporated within the text.

## **9.8 Pneumatic interlocking devices**

9.8.1 General – this subclause includes a list of devices used for interlocking guard movement, from which jet detection valves has been deleted (hence there is no equivalent to subclause 9.8.5 Jet detection valve).

# **Section 10: Safety-related control systems**

## **10.2 Architectural considerations**

10.2.1.1 General – this subclause has been partly redrafted to remove references to *dual-control* systems and introduce the terms *fault-tolerant*, *dual-channel control* and *zero fault-tolerant*.

Subsequent subclauses have been rewritten to improve clarity and take account of the newer terminology.

10.2.2.2 Types of failure – this subclause from the 2005 edition has been deleted, but the content has been moved and expanded considerably to create the new Annex B in the 2014 edition.

10.2.5.1 General – this subclause (under *Electrical considerations*) now lists *'logic-solving devices, e.g. programmable controllers'* as one of the main items for consideration in terms of failures that could result in hazardous situations.

10.2.5.5.2 Single-control system interlocking – this subclause (under *Electrical interlocking control systems*) no longer contains the following: *'interposed electromechanical relays and/or solid-state switching devices, if any. Reducing the number of these components lessens the probability of failure to danger'*.



10.2.5.7.2 Electronic control systems – this subclause (under *Systems incorporating solid-state devices or components*) was previously titled *Input and fixed logic stages* and has been redrafted. It no longer refers to pulse width modulation but now refers to unpredictability of failure modes and the need for dynamic fault-detection techniques and/or dual-channel systems in order to achieve adequate safety performance.

10.2.5.7.3 Programmable logic stages – this subclause now refers to the need to avoid software errors and alteration of stored programs that could cause incorrect operation.

### **10.3 Safety-related control systems**

This subclause has been redrafted and is simplified, shorter and now refers readers to BS EN 62061 and BS EN ISO 13849. In particular, PD 5304:2014 cautions *‘The approach adopted to the design of safety-related electrical control systems of machinery in previous editions of BS 5304 and PD 5304 differs from that in BS EN 62061 and BS EN ISO 13849’* (which is similar to the caution provided in the previous edition of PD 5304).

## **Section 12: Maintenance and safe working practices**

### **12.1 General**

This subsection now acknowledges that *‘operation’* is a phase of the machine’s life in which it is not always possible to eliminate all hazards or design safeguards to protect people against all risks.

12.5.3 Installation, operation and maintenance instructions – this subclause no longer lists *‘transport’*, though the next point now includes *‘moving’* alongside *‘lifting’* (and *‘unloading’* has been deleted). Similarly, *‘commissioning and installation’* have been deleted, even though *‘installation’* remains in the subclause heading. A new item *‘emergency procedures’* has been added.

The following text has also been deleted from this subclause: *‘For machinery supplied without tooling, the supplier ought to have indicated that the user might need to provide additional safeguards to the standard guarding in certain circumstances.’*

## **Annex A: Ergonomic data**

### **A.2.2 Reaching over**

Slight changes have been made to the examples of *‘reaching over’*.

## **Annex B: Common types of failures associated with safety-related interlocking control systems**

This is a new annex, taking the content previously found in 10.2.2 and considerably expanding it. Although the annex is only informative, this is one of the most substantive changes to PD 5304 and will undoubtedly be very helpful to machine designers and those modifying or assessing existing machinery.

The Annex B from the previous edition of PD 5304, *Use and selection of interlocking systems*, has been deleted. This contained a graphical method for selecting interlocking systems, which is no longer felt to be appropriate. Instead, more rigorous approaches should be adopted based on risk assessment and the relevant standards.

## **Bibliography**

This has been updated as appropriate but no longer includes a full list of transposed harmonised standards for the Machinery Directive; rather it quotes the address for the page on the European Commission website where the current list can be found.

## **In conclusion**

PD 5304:2014 contains extensive revisions to bring this thoroughly useful document up to date and align it with current machinery safety standards and legislation. While it is aimed primarily at users of existing machinery, as well as people modifying, refurbishing, upgrading or changing the use of machinery, it will also be of significant benefit to designers of new machinery.

Procter Machine Guarding is the UK's leading machinery guarding specialist. The company has published numerous guides and White Papers relating to machine guarding and machinery safety standards, all of which can be downloaded free of charge from the website at [www.machinesafety.co.uk](http://www.machinesafety.co.uk). Alternatively, contact Procter Machine Guarding to discuss specific machine guarding requirements by telephoning 02920 855758 or emailing [guards@procterbedwas.co.uk](mailto:guards@procterbedwas.co.uk)

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