



Machine Guards

White Paper 1 Fixings for Fixed Guards

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How to specify fixings for machine guards

Jeremy Procter, a Member of BSI's MCE/3 committee, former Convenor of the European Standards Committee responsible for Machine Guards (CEN TC114 WG11), and Managing Director of Procter Machine Guarding, explains how to select the right types of fastener for fixed guards, given the requirements in the Machinery Directive 2006/42/EC, the European Commission's official guidance on the Directive, and the latest version of the guarding standard BS EN 953.

How to specify fixings for machine guards

When it was published in 2009, BS EN 953:1997 +A1:2009, *Safety of machinery. Guards. General requirements for the design and construction of fixed and movable guards*, incorporated amendments to align it with the new Machinery Directive 2006/42/EC that came into force at the end of 2009. Compared with the previous versions of the standard and Machinery Directive, there is now a requirement that fixings for fixed guards shall remain attached to the guard or the machinery when the guard is removed. The underlying logic is that retained (or captive) fasteners will not be lost when the guard is removed - for maintenance, for example - so it is much less likely that the guard will be replaced with insufficient fixings, which could allow hazardous parts of the machinery to be accessed or the guard to be incapable of containing ejected parts.

BS EN 953:1997 +A1:2009 will soon be replaced by a new International Standard ISO 14120. The current draft contains statements about fixings for fixed guards that are almost identical to those in the European Commission's *Guide to application of the Machinery Directive 2006/42/EC*, which is not legally binding but is the closest we have to an authoritative interpretation of the Directive. Once ISO 14120 has been approved and Harmonised to the Machinery Directive as EN ISO 14120, compliance with its requirements will be sufficient for machine builders (and guard manufacturers CE marking guards) to claim that the relevant Essential Health and Safety Requirements of the Machinery Directive have been met.

However, it is not just a simple matter of specifying retained fasteners for parts identified on the manufacturing drawing as 'guards' because the formal definition of a guard needs to be taken into account - and it does not help that the definition differs between the standard and the Machinery Directive.

Defining a 'fixed guard'

BS EN 953:1997 +A1:2009, Clause 3 (Definitions), defines a guard as a "physical barrier, designed as part of a machine, to provide protection" (the definition in the current draft of ISO 14120 is identical). In contrast, item 1.1.1. (f) of the Essential Health and Safety Requirements in the new Machinery Directive defines a guard as "a part of the machinery used specifically to provide protection by means of a physical barrier." This raises the question as to whether other parts of the machine - such as weather-proof covers and chutes - are deemed to be 'guards' and therefore need to be fixed using retained fasteners, as they are not designed 'specifically' to provide protection.

For all practical purposes, machine designers should use the definition of a guard given in BS EN 953:1997 +A1:2009. Indeed, the standard provides additional clarification within the definition of a guard as follows: "Note 2. Depending on its design, a guard may be called eg casing, shield, cover, screen, door, enclosing guard." Interpreting the term 'specifically' from the Directive in order to relax the requirements relating to these parts of the machine would be incorrect, as they often do provide protection, if only as a secondary function.

A sensible approach to take would be to consider whether, if a component were removed, hazardous parts could be accessed. Here it is essential to consult BS EN ISO 13857:2008 *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs*. If the analysis indicates that, say, removing a roof panel will not provide access to hazardous parts of the machinery, then there is no need to use retained fasteners on that panel. But be aware that BS EN ISO 13857:2008 only considers hazards associated with reaching over, under, around and through guards; if there are potential hazards from, say, parts or hazardous substances being ejected from the machine, then those panels will still be classed as guards and will need to be fixed with retained fasteners.

Sub-clause 7.2 (Retained fastenings) of BS EN 953:1997 +A1:2009 states: "Where it is foreseen (eg maintenance) that the fixed guard will be removed then the fastenings shall remain attached to the guard or to the machinery." It therefore follows that if it is not foreseen that the guards will be removed for maintenance, cleaning or other reasons, then there is no requirement to use retained fasteners. This point is further clarified in the European Commission's guide to the Machinery Directive: "The requirement applies to any fixed guards that are liable to be removed by the user with a risk of loss of the fixings, for example, to fixed guards that are liable to be removed during routine cleaning, setting or maintenance operations carried out at the place of use. The requirement does not necessarily apply to fixed guards that are only liable to be removed, for example, when the machinery is completely overhauled, is subject to major repairs or is dismantled for transfer to another site. For the same reason, it may not be necessary to apply the requirement to the casings of machinery intended for use by consumers, where the manufacturer's instructions specify that the repairs requiring removal of these casings are only to be carried out in a specialist repair workshop. In that case, fixing systems should be used that are not easy to remove." Note, however, that the guidance says the application of this requirement depends on the manufacturer's risk assessment.

Design issues

Having identified the parts of the machine that should be treated as fixed guards and which might be removed for maintenance or other purposes, the designer can start selecting suitable fastenings. Unfortunately this cannot be done in isolation, as the type of fastener selected will have a bearing on the design of the guard and/or the structure to which it is attached, and vice versa. Furthermore, retained fastenings are likely to be more expensive to purchase and install than conventional screws, so it might be that minor changes to the design of the assembly can yield benefits. For

example, if a guard panel has previously been manufactured from relatively thin, flat sheet metal, and installed using a number of screws around the periphery, then it might be beneficial to form a small return on one or more edges of the panel to impart stiffness and reduce the number of fasteners required. Alternatively (or additionally) it might be cost-effective to design guards that hook in on one edge and only need fasteners on the opposite edge, though the guard needs to be incapable of remaining in place if it is not correctly secured (the Machinery Directive states 'where possible, guards must be incapable of remaining in place without their fixings').

Further design measures that could be considered include ensuring there is no need to remove guards in order to access lubrication points, adjust conveyor tracking or perform similar maintenance operations. It might also be that a large cover panel protecting a relatively small hazard can be redesigned as two panels, so that only the panel providing protection needs retained fasteners.

Selecting fasteners

The optimum choice of retained fastener for a particular fixed guard will depend on a number of factors. If the machine is a one-off, the production processes may be different from those for a mass-produced machine. This has implications for the tolerances that can be achieved, which, in turn, will make some types of fastener more suitable than others (some require good alignment of the guard and machine structure, whereas others are more tolerant of misalignment). In addition, the designer must assess whether the guard will need to be removed periodically for maintenance or cleaning, or whether it is only to be removed, say, in the event of a motor burning out. If regular maintenance is required, it might be better to specify push-turn or quarter-turn fasteners that are quick to remove and replace, and are tolerant of panel misalignment (depending on the model selected). Beware, however, that there are numerous such fasteners on the market, but not all of them require a 'tool' for removal (fasteners with a straight screwdriver slot are unsuitable for machine guards, as they can be undone using improvised tools such as a steel rule).

An important point to note is that spanners and hexagonal (Allen) keys are classified tools, despite what some machinery safety consultants and guard manufacturers may claim. The EC guide to the Machinery Directive states: "Fixed guards may thus be fixed, for example, by means of bolts, screws or other fasteners that can only be removed by using tools such as keys or wrenches" and gives the underlying reasoning as: "This requirement aims to restrict the removal of fixed guards to competent or authorised persons." As with all aspects of machinery safety, however, the EC guide emphasises the need for a risk assessment: "The choice of fixing system and tools must be considered in light of the risk assessment." In several decades' involvement in machine guarding, the author has never been advised by the UK health and safety authorities that fasteners requiring spanners or Allen keys are unsuitable for machine guards.

Machines often generate vibrations, so it is important to ensure that whatever fasteners are selected will not shake loose. Something else to bear in mind with retained fasteners is that a damaged fastener will be more difficult to replace than a simple screw. While some retained screws are held captive on the panel by, for example, a spring clip in an undercut beneath the head - and can therefore be replaced relatively simply - others are held in place by a clinching process in which the panel material is deformed during fastener installation. Because the material is deformed so as to encroach on an undercut on the fastener, replacement of this type of fastener is likely to be more troublesome. Moreover, it may be impossible to replace the retained fastener with another of the same design.

Depending on the type of fastener selected for a guard, the mating feature on the machine may be a simple threaded hole or an insert that has to be installed in a specially prepared hole. As with the fastener itself, the designer should consider what the course of action would be in the event of the mating feature becoming damaged.

Clearly the requirement for fixed guards to be held in place using retained fasteners (subject to the provisos above) could increase costs for machine builders. However, by considering carefully the requirements for each guard, and by implementing minor changes to the guard or machine design where appropriate, the additional costs can be minimised. Furthermore, one consequence could be that machine maintenance becomes easier and quicker.

A final point to make in relation to fixings for fixed guards is that the aim is to ensure that guards are correctly replaced after maintenance operations in order that they can provide the protection for which they were designed. The machine instructions need to state that only trained persons should be authorised to remove machine guards. In addition, workplaces require a suitable safety culture that does not tolerate anyone 'turning a blind eye' to dangerous practices such as the unauthorised removal of machine guards.

Procter Machine Guarding is the UK's leading machinery guarding specialist, with extensive experience in the design, manufacture and installation of close-fitting machine guards and perimeter guards. With unrivalled knowledge of the applicable standards, as well as a deep understanding of the ergonomic issues relating to machine guarding, Procter can design guards that meet all the necessary safety standards, do not hinder production, and enhance the machine's aesthetics.

To discuss any requirements for machine guarding, please email Procter Machine Guarding at machinesafety@procterbedwas.co.uk or telephone 02920 882222.

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