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# Safe maintenance of equipment (inc. machinery)

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## Principles

### What is this guidance about?

This information document covers safe working procedures associated with equipment maintenance, cleaning, setting and operation, clearing of blockages, and the associated need for electrical isolation. Where equipment uses additional sources of energy, such as hydraulics, pneumatics or mechanical drives, then isolation from these may also be necessary.

Relevant maintenance activity includes that undertaken by electrically competent technicians involving, for example, the dismantling of equipment parts, wiring alterations or testing, which generally require a secure isolation to be performed. It could also be applicable to some operator tasks that do not present a risk of electric shock, and for which it may be possible in some cases to manage the risks by means other than secure isolation.

### How can injuries happen during maintenance?

People carrying out maintenance can be injured by electric shock and burns, and also by inadvertent start-up of equipment. Accidents at machinery often occur when access is required to dangerous parts while work is being carried out, such as:

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| cleaning or clearing blockages | inspection and maintenance |
| lubrication | repair |
| et-up and adjustment | |

### Carrying out a risk assessment

To help identify the precautions that are necessary for carrying out the work safely a risk assessment should firstly be performed.

The risk assessment process is shown in Figure 1, targeting to achieve the lowest Reasonably Practicable risk. More details can be found on the Health and Safety Executive website: http://www.hse.gov.uk/risk/

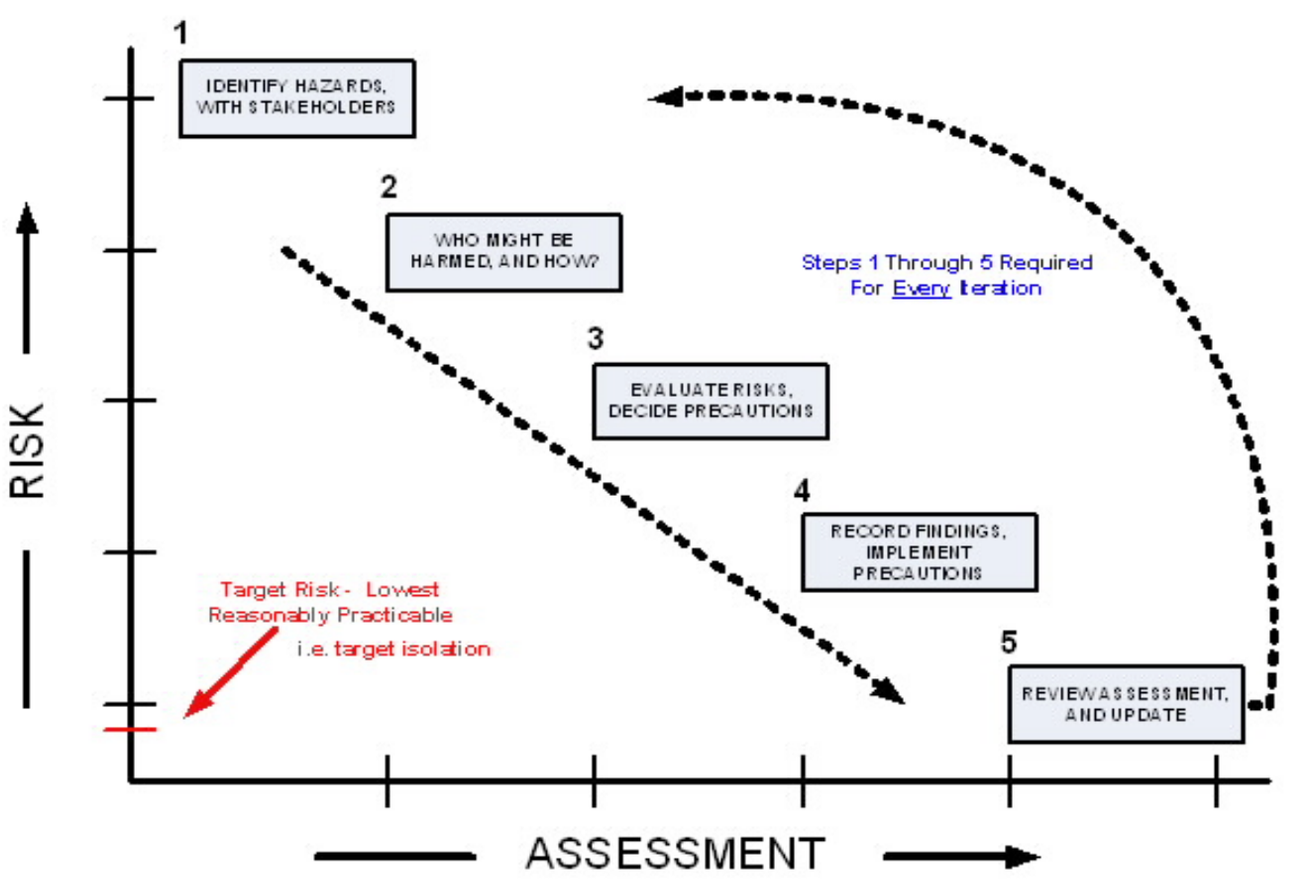


**Figure 1. Risk Assessment Steps**

When carrying out the risk assessment ask yourself the following questions:

- Can the work be done while the equipment is de-energised (i.e. with all sources of energy dead, isolated and discharged)?
- Does somebody have to enter the danger area?
- How often is the procedure necessary?
- What safeguards are built in?
- Are there any formal procedures?
- Is the worker trained to recognise the risks?
- Is there competent supervision?

## What precautions should I take?

Where possible the work should be carried out when all associated sources of energy (e.g. electrical, pneumatic, hydraulic, and mechanical) have been isolated, and any energy stored (e.g. pressure, gravity, inertia etc.) has been dissipated or its effects constrained. If this is not possible then the work should only proceed if alternative precautions identified in the risk assessment can ensure adequate safety.

The following precautions are recommended as part of a safe system of work:

### Work areas

Work areas should be clearly designated and kept clean and tidy.

### Access

Only suitably competent people should be permitted to enter the work area and attempt to enter any equipment.

### Electrical Isolation

By using an appropriate device equipment should be isolated from its supply of electrical energy. This has the dual purpose of protecting against electrical hazards (electric shock and burn), and of preventing an unexpected start-up of electrically-powered moving parts. (All points of isolation should be clearly identified.)

Devices that are suitable for isolation are specifically designed for this purpose. They provide sufficient physical separation between the equipment's electrical circuit and its power supply and also give a positive indication of this separation. Simply stopping the equipment by operating control devices such as stop or emergency stop push buttons, or software controls, will not satisfy the requirements of isolation, even if the device can be secured in the off-state.

The isolation of equipment should remain secure so as to prevent a reconnection of the electrical supply. If an isolator cannot remain continuously under the direct control of the person working on the equipment, then it should be locked off, and an appropriate warning notice posted at the point of isolation. This will ensure that subsequent re-energisation of the supply is under the control of the person working on the equipment, thus averting any electric shock risk and preventing any unauthorised, unintentional or inadvertent start-up. It is essential that the effectiveness of an isolation is verified by a competent person (e.g. by using an approved voltage tester), before work commences on the equipment.

Where an item of equipment has several incoming supplies of electrical energy, associated with its different functional parts for example, then each of these should be securely isolated, where necessary, to prevent danger.

### Isolation from non-electrical energy sources

Any other sources of energy (e.g. hydraulics, pneumatics or mechanical drives) that can cause danger will also need to be isolated.

### Location and Identification of Isolators

As personnel might be reluctant to locate and use a remote means of isolation, a point of isolation should be located conveniently close to the relevant equipment. It should also be easy to recognise, access and operate, again so that personnel will readily use it and can monitor its status. Accessing the point of isolation should not present additional danger, and there should also be adequate working space around it.

Accurate and unambiguous labelling of the equipment and its isolator is essential for aiding identification of the correct point of isolation. This will reduce the possibility of the wrong equipment being isolated or of equipment with multiple electrical supplies being only partially isolated.

## Safe systems of work

The company safety rules should incorporate a written safe system of work based on the results of risk assessments, and this should include requirements for the isolation of equipment. It should highlight the tasks and situations for which secure isolation is required, and detail the appropriate procedures for achieving this.

People required to work on equipment should understand these rules, be appointed, be suitably trained and be capable of undertaking such work safely.

## Switching Off Versus Secure Isolation

Maintenance activities that require, for example, the dismantling of equipment parts, wiring alterations or testing, will generally require a secure isolation to be performed. This will prevent the equipment from being re-energised until all work has been completed, the electrical installation is safe, guards and covers have been replaced, and all workers and their tools are clear of the equipment.

For some frequently occurring, short–duration tasks that are less intrusive and do not present a risk of electric shock, a secure isolation may not always be appropriate. In such cases there will be a requirement to put any hazardous parts of the equipment into a safe state before work can commence and to ensure that this safe state is maintained while the task is being performed. For example, although it will not isolate the equipment, it may be appropriate in some circumstances to switch off using means, such as interlocking, which can automatically stop moving parts of the equipment and **maintain the stopped condition** while a person is carrying out a particular task. An interlocking guard, consisting of a movable guard and an associated interlocking device could be used for this purpose.

When designing an interlocking system, the level of risk that a person will be exposed to during a particular task should be estimated. Any control system that implements the interlocking function should achieve an appropriate level of integrity to mitigate the risk.

It is generally only appropriate to rely upon interlocking to prevent unexpected start-up for short-duration production tasks, rather than more intrusive maintenance tasks. Typical maintenance tasks might include inspections, minor adjustments and some superficial cleaning activity.

Although interlocking can, in appropriate circumstances, offer protection against the unexpected start-up of equipment that is being worked upon, it does not provide protection against electric shock and burn. If the task on the equipment involves exposure to electrical hazards, then a secure electrical isolation must always be performed.

There may be some activities, such as internal cleaning of equipment, for which the requirement for a secure isolation is not clearly determined from the risk assessment. Further confusion might arise if a manufacturer's advice and guidance calls for isolation without defining what it actually means, which might result in it being misinterpreted as simply switching off.

However, the default position should always be to enter a danger area only after performing a secure isolation of all energy supplies, unless alternative measures are supported by a risk assessment. Particular care is required with automated machinery, particularly with linked machines such as those found in industrial robot cells.

The acceptability of alternative measures, such as interlocking, for preventing an unexpected start-up would depend on the:

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| consequences of any unexpected start-up | duration of the task |
| level of control of the operator | nature of the task |
| specific functionality and integrity of an interlocking system | training and experience of the operator |

## UK Legislation and Implementation

## References [including IET Briefing Notes]

Standards:

- **BS EN (IEC) 60204-1:2006 + A1:2009**
  *Safety of machinery - Electrical equipment of machines - General requirements*
- **BS-EN 1037:1995+A1:2008**
  *Safety of machinery - Prevention of unexpected start-up*
- **BS EN (IEC) 60947-3:2009**
  *Low-voltage switchgear and control-gear - Switches, disconnectors, switch-disconnectors, and fuse-combination units*
- **BS EN ISO 13849-1:2008**
  *Safety of machinery - Safety-related parts of control systems - General principles for design*
- **BS EN ISO 12100-1&2:2003 + A1:2009**
  *Safety of machinery - Basic concepts, general principles for design*
- **BS EN 1088: 1995 + A2:2008**
  *Safety of machinery - Interlocking devices associated with guards - Principles for design and selection*

## Further information

Isolation and Permits to work; Health and Safety Executive guidance:

- The safe isolation of plant and equipment, HSG253, ISBN 0717661718
  http://books.hse.gov.uk/hse/public/saleproduct.jsf?catalogueCode=9780717661718
- Guidance on permit-to-work systems, HSG250, ISBN 0717629435
  http://www.hse.gov.uk/pubns/priced/hsg250.pdf
- HSE Safe Maintenance:
  http://www.hse.gov.uk/safemaintenance/index.htm
- Electricity at work: - Safe Working Practices, HSG85, ISBN 9780717621644
  http://www.hse.gov.uk/pubns/priced/hsg85.pdf
- Memorandum of Guidance on the Electricity at Work Regulations 1989. HSR25, ISBN 9780717662289
  http://www.hse.gov.uk/pubns/priced/hsr25.pdf

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