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# ide guide to Electrical Safety

Electricity is a familiar and necessary part of everyday life, but electricity can kill or severely injure people and cause damage to property.

There are simple precautions when working with, or near electricity that can be taken to significantly reduce the risk of electrical injury to you and others around you.

## Work near electricity

- Do a risk assessment for the work you are planning, and make sure this covers electrical hazards.
- Learn how to recognise electrical wires. These may be overhead power lines, electrical wiring in a workplace, or cables buried under the ground.
- Get an up-to-date map of the services in the area and use it.
- Look for electrical wires, cables or equipment near where you are going to work and check for signs warning of dangers from electricity, or any other hazard. Remember to look up, down, and around you.
- If you will be digging or disturbing the earth or cutting into surfaces, use a cable locator to find buried services and permanently mark the position of services you do find.
- Work away from electrical wiring wherever possible. If you have to work near electrical wiring or equipment, ask for the electrical supply to be turned off. Make sure the power is off, and cannot be turned on again without you agreeing.
- If the electrical supply cannot be turned off, consult a competent person who should be able to advise you on the best way to proceed.
- Identify where it is safe to work. Put up danger notices where there are still live electrical circuits, and warn your co-workers where it is safe to work and where it is not safe. Remember to remove notices at the end of the work.

## *Information*

The booklet 'Electricity at work, safe working practices' provides general guidance on working near electricity. Many electricity supply companies will provide advice on how to work safely near electrical distribution equipment. You should contact them directly.

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### *Electrical danger signs*


Signs warning of electrical danger may not always be easy to see, or may have been removed, so even if you see no signs, electrical cables may still be nearby. Stay vigilant.

When you see signs warning of electrical danger it is highly likely there is electricity present. Remember, you don't need to touch a high voltage cable to get an electric shock and even low voltage cables can be dangerous.


If you cannot work out where the electricity is, ask a competent person to do it for you.

The Department for Energy and Climate change (DECC) enforces the use of electrical safety signs on electrical distribution equipment such as substations and electricity poles.

### *Electrical wiring*

You may not see electrical wires near where you plan to work but this doesn't mean there aren't any. Even if you do see wires, there may be others you cannot see. Electrical wiring may sometimes look like pipes, and may be a range of colours.

Before you drill or start cutting into surfaces:

- look for electrical wires and any other hazards such as asbestos. Remember to look on both sides of walls;
- ask to see plans of the electrical installation, and use these to find electrical wiring;

- If you are competent, use a suitable cable detector, or get a competent person to do it for you. Remember that some cable detectors won't find a wire carrying a small current – consult the user guide.
- look for nearby electrical equipment or installations and find where the wiring runs to these.
- use equipment that will minimise the risks during the work.
- wear suitable protective clothing.

If you are in doubt **STOP WORK** and consult a competent person.

### *Cable colours*

Many electrical cables are coloured to show their purpose and the voltage they are carrying. However, there are many standards used around the world, and you should never assume that a cable of a particular colour is at a particular voltage. The colours used for wiring in Britain changed in 2004. It is very important that you identify what voltages are present on an installation you are not familiar with.

### *Making sure the power is off*

If you are not competent to check if the power is off, ask a competent person to do it for you, and watch them doing it. If you have any doubts about the method they have used, ask someone you know is competent.

When checking that power is off the competent person should be SURE that:

1. The device being used is suitable for the purpose of isolation.
2. The isolator being used to turn off the power is working correctly and reliably.
3. The switch being used is the only way that the circuit can be fed with electrical power.
4. The switch being used is locked in the off position and cannot easily be turned on again.
5. The equipment and method being used to check for voltage works and is reliable.
6. The isolation has been successful by confirming the circuit is no longer 'live'.

Some electrical systems and equipment must be earthed before it is safe to work near them. Check whether this is necessary, and if it is, ensure that this is done properly.

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## *Making sure the power stays off (Secure Isolation)*

If the electrical power has been turned off to allow you to do work safely, it is essential that the power stays off until you have finished work. Make sure YOU are in control and STAY in control. A good way is to have the only key to the switch or a locked room or cabinet containing the switch. Remember, if you remove a fuse, another one could be inserted in its place, and people ignore notices. If you have any doubts that the electricity may be turned on again without you agreeing, STOP WORK.

### Work on electrical equipment, machinery or installations

Work on electrical equipment, machinery or installations should be:

- thoroughly planned;
- done by people who can demonstrate competence;
- done by applying suitable equipment and work standards.

### *Planning*

It is essential that equipment, machinery or installations are prepared for the work to be carried out. This includes the isolation and release of all sources of energy (electrical, mechanical, hydraulic, pneumatic, etc), and may also involve additional work such as decontamination or the construction of a safe working platform. Isolation of energy sources should be secure, meaning that energy cannot be inadvertently re-introduced into the equipment, machinery or installation.

All work should be thoroughly planned so that it can be done safely and so that the completed installation or equipment is safe. HSE booklet Electricity at work, safe working practices provides information on how to plan electrical work in a wide range of industries. HSE guidance Electrical safety on construction sites provides information on how to plan electrical installations on construction sites. Particular care should be taken when repairing equipment that is safety related such as equipment in a potentially explosive atmosphere, or which guards against contact with moving machinery. You should make sure that the repair will not prevent the correct operation of the equipment or adversely affect its safety in any way.

### *Competence*

People working on electrical equipment, machinery or installations must be competent to do so. The level of competence required to do a task is dependent upon the complexity of that task and the amount of knowledge required. Assessing the suitability of an individual to do a task requires evidence of:

- Training to an appropriate level in the area of work
- Experience of achieving a suitable standard in similar work.
- Regular re-assessment.

People who cannot demonstrate competence should not be allowed to work unless they are supervised by someone who is.

The Memorandum of guidance on the Electricity at Work Regulations 1989 provides information on competence.

### *Equipment and work standards*

Equipment that is installed should be suitable for the task it will perform and the environment within which it will be expected to work. A wide range of electrical equipment and work is covered by recognised standards that offer guidance on good engineering practice. For example, BS 7671:2001 Requirements for electrical installations, IEE Wiring Regulations, Seventeenth edition offers guidance on the requirements for the construction and testing of electrical installations. There is a list of some of the more common electrical standards on this web site. Most British and European standards can be purchased from British Standards Online
A European Directive, the Low Voltage Directive (2006/95/EC ), places duties on the design, manufacture and supply of electrical equipment within the voltage ranges 50 - 1000 volts ac or 75 - 1500 volts dc. This Directive is implemented in Great Britain by the Electrical Equipment (Safety) Regulations 1994 . These require electrical equipment to be safe and to conform to certain essential safety requirements. Department for Business, Innovation and Skills (BIS) has responsibility for policy on these regulations. Enforcement is undertaken by HSE for equipment intended for use in the workplace, and Local Authority Trading Standards departments for equipment intended for use elsewhere.

## Electricity in potentially explosive atmospheres

### *Areas which may have explosive atmospheres*

The use of electricity can generate hot surfaces or sparks which can ignite an explosive atmosphere. An explosive atmosphere could be present in a variety of different places including paint spray booths, near fuel tanks, in sumps, or many places where aerosols, vapours, mists, gases, or dusts exist.

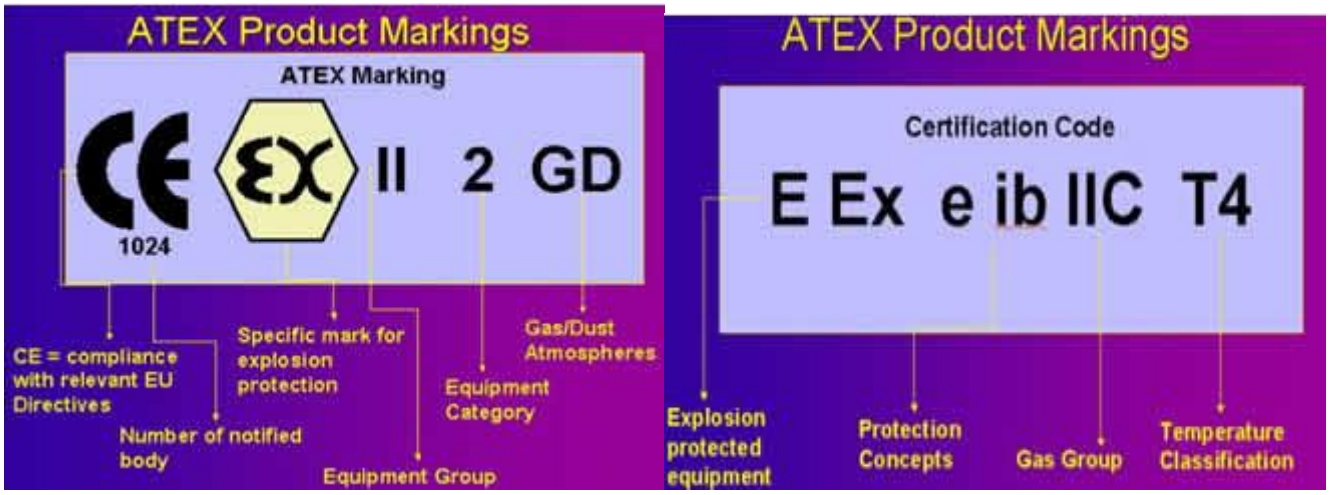
Areas where it is possible that an explosive atmosphere may exist must be treated differently from other areas. The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) requires that such areas be risk assessed before any new work is carried out in them and that measures be taken to

control the risks. HSE has produced guidance on DSEAR that explains how the Dangerous Substances and Explosive Atmospheres Regulations 2002 can be complied with.
Care should be taken to prevent static discharges in potentially explosive atmospheres. Measures such as earth bonding and the selection of antistatic work clothing and footwear can help to reduce the risk of static discharges.

### *Equipment and explosive atmospheres*

Electrical and non electrical equipment and installations in potentially explosive atmospheres must be specially designed and constructed so that the risks of ignition are eliminated or reduced. Techniques to do this include sealing electrical equipment so that the explosive atmosphere cannot come into contact with electrical components, reducing the power of electrical equipment, and de-energising electrical equipment where a fault or an explosive atmosphere is detected.

Recently installed equipment should be marked with an 'Ex' to show it is suitable for use in potentially explosive atmospheres. All new equipment must comply with The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996 that implements the European ATEX Directive. This requires it to be assessed as suitable for a particular explosive atmosphere type and for this to be marked on the equipment along with CE and ATEX markings. Most new equipment being sold in the UK for use in potentially explosive atmospheres must have an ATEX certificate.




Equipment for use in explosive atmospheres should be regularly inspected and maintained to ensure it does not pose an increased risk of causing a fire or explosion. Maintenance of the equipment should only be carried out by people who are competent to do so. BS EN 60079 part 17: Explosive atmospheres. Electrical installations inspection and maintenance offers guidance as to the frequency and scope of maintenance required.

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## Work using electrically powered equipment

You should make sure that electrical equipment used for work is safe. Here are a list of actions that should be taken to ensure this is so:

1. Perform a risk assessment to identify the hazards, the risks arising from those hazards, and the control measures you should use.
2. Check that the electrical equipment is suitable for the work and way in which it is going to be used.
3. Check that the electrical equipment is in good condition. The HSE booklet 'Maintaining portable and transportable electrical equipment' will help you do this.
4. Check that the equipment is suitable for the electrical supply with which it is going to be used, and the electrical supply is safe.
5. It is often beneficial to use a Residual Current Device (RCD) between the electrical supply and the equipment.
6. Make sure that the user of the equipment is trained to use it safely and can keep others safe.
7. Make sure the user knows which personal protective equipment to wear, how to use it, and make sure they do.

### *Check that the electrical equipment is suitable*

- The equipment should be physically capable of doing the job, and designed and constructed so that mechanical and electrical stresses do not cause the equipment to become unsafe.
- If the environment is damp you may choose to use battery or air powered equipment, or equipment that operates at a reduced voltage such as that supplied by a transformer with an output that is centre tapped to earth (this halves the voltage between a live wire and earth). These are used in the construction industry and are readily available from hire shops.
- If the environment is conductive with restricted movement (e.g. inside a metal tank) additional precautions are necessary. BS7671 'Requirements for Electrical Installations', IEE Wiring Regulations, Seventeenth edition, Section 706, gives guidance on this.
- If there is the chance that there is an explosive atmosphere (containing flammable aerosols, vapours, gases or dusts) nearby you should ensure the work can be carried out safely and that the right equipment is chosen.

### *Check that the electrical equipment is in good condition*

Many faults with work equipment can be found during a simple visual inspection:

- Switch off and unplug the equipment before you start any checks.

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- Check that the plug is correctly wired (but only if you are competent to do so).
- Ensure the fuse is correctly rated by checking the equipment rating plate or instruction book.
- Check that the plug is not damaged and that the cable is properly secured with no internal wires visible.
- Check the electrical cable is not damaged and has not been repaired with insulating tape or an unsuitable connector. Damaged cable should be replaced with a new cable by a competent person.
- Check that the outer cover of the equipment is not damaged in a way that will give rise to electrical or mechanical hazards.
- Check for burn marks or staining that suggests the equipment is overheating.
- Position any trailing wires so that they are not a trip hazard and are less likely to get damaged.

If you are concerned about the safety of the equipment you should stop it from being used and ask a competent person to undertake a more thorough check.

Additional information on the visual inspection of electrical equipment is in the free guidance note Homeworking .
Additional regular inspections may be required where a risk assessment indicates this is necessary (such as where equipment is used in a harsh environment). These inspections should be performed by a competent person using suitable equipment, and often enough to ensure equipment does not become unsafe between the inspections.

The table below gives a list of suggested initial inspection intervals for different types of equipment. The combined inspection and test could be a Portable Appliance Test (PAT), or a detailed test with a more sophisticated instrument. You should make sure that the person carrying out the tests is trained and competent to do so. See the guidance booklet Maintaining portable and transportable electrical equipment for more information.
You may need to change how often inspections are being carried out if there are indications that equipment may become unsafe before the next inspection.

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| Type of business | User checks | Formal visual inspection | Combined inspection and test |
|---|---|---|---|
| Equipment hire | N/A | Before issue/after return | Before issue |
| Construction (see Electrical safety on construction sites for more detail) | 110 V – Weekly 230 V mains – Daily/every shift | 110 V – Monthly 230 V – weekly | 110 V – Before first use on site then 3 monthly 230 V mains – Before first use on site then monthly |
| Light industrial | Yes | Before initial use, then 6 monthly | 6 months to 1 year |
| Heavy industrial/high risk of equipment damage | Daily | Weekly | 6 months to 1 year |
| Office information technology e.g. desktop computers, photocopiers, fax machines | No | 1 to 2 years | None if double-insulated, otherwise up to 5 years |
| Double insulated equipment not hand-held, e.g. fans, table lamps | No | 2 to 3 years | No |
| Hand-held double insulated (Class II) equipment, e.g. some floor cleaners, kitchen equipment and irons | Yes | 6 months to 1 year | No |
| Earthed (Class I) equipment, e.g. electric kettles, some floor cleaners | Yes | 6 months to 1 year | 1 to 2 years |
| Equipment used by the public, e.g. in hotels | By member of staff | 3 months | 1 year |

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|---|---|---|---|
| Cables and plugs, extension leads | Yes | 1 year | 2 years |

### *Check that the electrical equipment is suitable for the electrical supply*

Make sure that the electrical equipment you are intending to use is suitable for the electrical supply to which you are connecting it. Check the voltage is correct and that the supply can deliver the current required by the equipment (the power requirements of the equipment will be shown on its rating plate).

### *Check the electrical supply is safe to use*

You should be sure that the electrical supply is safe to use. Regular tests performed by a competent person, using suitable equipment are a good way of reducing risks. Where there is evidence that the supply may not be safe, such as damaged equipment or wiring, the supply should not be used until work has been done to correct this. Some simple user checks can be carried out on electrical socket outlets using an electrical socket tester, but it is essential that the correct type of tester is used . If any doubt remains regarding the safety of the electrical supply, a competent person should be consulted.

### *Use a Residual Current Device (RCD)*

A Residual Current Device (RCD) can reduce the likelihood of an electrical injury but a shock can still cause very serious or fatal injuries, so an RCD should only be used as a secondary means of reducing the risk of people being injured by electricity. RCD's are not designed to prevent the ignition of an explosive atmosphere and should not be used for this purpose.
The best place for an RCD is built into the main switchboard, as this means that the electrical supply is permanently protected. If this is not possible, an electrical socket outlet incorporating an RCD, or a plug in RCD adaptor, can also provide additional safety.

If an electrical socket outlet incorporating an RCD, or a plug in RCD adaptor is used it should be tested, by the user, prior to use by operating the Test button. Faulty RCDs should not be used and either removed for use or labelled as faulty.

An RCD detects some, but not all, faults in the electrical system and rapidly switches off the supply, reducing the potential for injury caused by a common type of electric shock. To reduce the likelihood of injury to people the RCD should have a tripping current of not more than 30 milliamps (mA). RCDs with a higher tripping current are used to protect against fire.

**Remember:**

An RCD is a valuable safety device, never bypass it; if the RCD trips, it is a sign there is a fault. Check the system before using it again; if the RCD trips frequently and no fault can be found in the system, consult the manufacturer of the RCD; the RCD has a test button to check that its mechanism is free and functioning. Use this regularly.

If lighting circuits are protected by the same RCD that also protects other equipment, a fault that causes the RCD to trip will also result in the loss of lighting that could give rise to a number of risks (such as trips and falls or the dangers from moving machinery). You should perform a risk assessment to identify the effect of fitting an RCD to electrical circuits.

**Electrical standards and approved codes of practice**

Listed below are some commonly used electrical standards and approved codes of practice. Additional standards and codes of practice would generally be needed to satisfy a specific application - it is the responsibility of the specifier to select and apply these. You should ensure that the standard you use is the current one.

The standards are organised into a number of topic areas and are ordered with the lowest number at the top of each table:

- Electrical and Power
- Electrical Appliances
- Electromagnetic Compatibility
- Flammable Atmospheres
- Machinery

***Electrical and Power***

| Standard | Year | Description |
|---|---|---|
| BS 5266 Parts 1 to 10 also BS EN 50172 | 1999 - 2008 | Code of practice for emergency lighting |
| BS 5424 Parts 2 and 3, also IEC 60158 part 3 | 1985 - 1988 | Specification for low voltage control gear |
| BS EN 60422 | 2008 | Monitoring and maintenance guide for mineral insulating oils in electrical equipment |
| BS 5839 Parts 1 - 11, also | 1988 - | Fire detection & alarm systems for buildings |

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|---|---|---|
| PD6531:2010 | 2010 | |
| BS EN 60079-30-2 | 2007 | Electric surface heating |
| BS 6423 | 1983 | Code of practice for maintenance of electrical switchgear and controlgear for voltages up to and including 1 kV |
| BS 6626 | 2010 | Code of practice for maintenance of electrical switchgear and controlgear for voltages above l kV and up to and including 36 kV |
| BS EN 62305, 4 parts | 2006-2011 | Code of practice for protection of structures against lightning |
| BS 7375 | 2010 | Code of practice for distribution of electricity on construction and building sites |
| BS 7430 | 1998 | Code of practice for earthing |
| BS 7671 | 2008 - 2011 | Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition |
| BS 7909 | 2008 - 2011 | Code of practice for temporary electrical systems for entertainment and related purposes. |
| BS EN 50110 Parts 1 and 2 | 2004 - 2010 | Operation of electrical installations |
| IEC 60479 Parts 1-4, also PD6519 | 1994-2005 | Guide to effects of current on human beings and livestock. |
| BS EN 60529 | 1992 | Specification for degrees of protection provided by enclosures (IP code) |
| BS EN 60947 Parts 1-8 | 2001 - 2011 | Specification for low voltage switch gear and control gear |

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### *Electrical Appliances*

| Standard | Year | Description |
|---|---|---|
| BS 1362 | 1973 | Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs) |
| BS 1363 Parts 1 -5 | 1995 - 2008 | 13 A plugs, socket-outlets and adaptors. |
| BS EN (IEC) 60309, Parts 1,2, 4 | 1999 - 2007 | Plugs, socket-outlets and couplers for industrial purposes. |
| BS EN 60320, Parts 1, 2 | 1999 - 2009 | Appliance couplers for household and similar general purposes. |
| BS EN 60335, Many parts | | Specification for safety of household and similar electrical appliances |

### *Electromagnetic Compatibility*

| Standard | Year | Description |
|---|---|---|
| BS EN 61000-6-3,4 | 2007 - 2011 | Electromagnetic compatibility. Generic emission standard. |
| BS EN 61000-6-1,2 | 2005 - 2007 | Electromagnetic compatibility. Generic immunity standard. |
| BS EN (IEC) 60801, Part 2 | 1993 | Electromagnetic compatibility for industrial-process measurement and control equipment. Electrostatic discharge requirements |

### *Flammable Atmospheres*

| Standard | Year | Description |
|---|---|---|
| EEMUA 181 | 1995 | Guide to risk based assessments of in-situ large Ex e & Ex n |

| | | |
|---|---|---|
| | | machines |
| EEMUA 186 | 1997 | A Practitioners handbook – electrical installation & maintenance in potentially explosive atmospheres |
| BS EN 1127, Parts 1,2 | 2007 - 2008 | Explosive atmospheres. Explosion prevention and protection.<br><br>Basic concepts and methodology for mining |
| PD CLC/TR 50404: | 2003 | Code of practice for avoidance of hazards due to static electricity. |
| BS EN 61241 | 2004, 2005 | Electrical apparatus with protection by enclosure for use in the presence of combustible dusts. |
| PD CLC/TR 50427 | 2004 | Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation. Guide |
| BS EN ISO 10497 | 2004 | Testing of valves. Specification for fire type-testing requirements |
| BS 7535 | 1992 | Guide to the use of electrical apparatus complying with BS 5501 or BS 6941 in the presence of combustible dusts |
| BS EN 60079, many parts | 2004 | Electrical apparatus for potentially explosive atmospheres. Replaced by BS EN 60079, but remains current. |
| BS EN 60079-6 | 2007 | Explosive atmospheres. Equipment protected by oil immersion "o" |
| BS EN 60079-2 | 2007 | Explosive atmospheres. Equipment protected by pressurized enclosures"p" |
| BS EN 60079-5 | 2007 | Explosive atmospheres. Equipment protected by powder filling "q" |
| BS EN 60079-1 | 2007 | Explosive atmospheres. Equipment protected by flameproof enclosures 'd' |
| BS EN 60079-7 | 2007 | Explosive atmospheres. Equipment protected by increased safety 'e' |
| BS EN 60079-11 | 2007 | Explosive atmospheres. Equipment protected by intrinsic safety 'i' |
| BS EN 60079-22-2 | 2007 | Explosive atmospheres. Gas detection. Selection, installation, use and maintenance of detectors for flammable gases or oxygen |

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|---|---|---|
| Energy Institute Model Code Of Safe Practice, Part 1 (IP1) | 2010 | Electrical Safety Code |
| Energy Institute Model Code Of Safe Practice, Part 15 (IP15) | 2005 | Area classification code for installations handling flammable fluids |
| Energy Institute Model Code Of Safe Practice, Part 21 (IP21) | 2002 | Guidelines for the control of hazards arising from static electricity |

***Machinery***

| Standard | Year | Description |
|---|---|---|
| BS EN ISO 13850 | 2006 | Safety of machinery. Emergency stop. Principles for design. |
| BS EN 953 | 1997 - 2009 | Safety of machinery. Guards. General requirements for the design and construction of fixed and movable guards |
| BS EN 13849 | 2008 | Safety of machinery. Safety related parts of control systems. General principles for design |
| BS EN 982 | 1996 - 2008 | Safety of machinery. Safety requirements for fluid power systems and their components. Hydraulics |
| BS EN 983 | 1996 - 2008 | Safety of machinery. Safety requirements for fluid power systems and their components. Pneumatics |
| BS EN 1037 | 1996 - 2008 | Safety of machinery. Prevention of unexpected start-up |
| BS EN ISO 12100 | 2010 | Safety of machinery. General principles for design. Risk assessment and risk reduction. |
| BS EN 1088 | 2008 | Safety of machinery. Interlocking devices associated with guards. Principles for design and selection. |
| PD 5304 | 2005 | Safe use of machinery |
| BS EN 60204 | | Safety of machinery. Electrical equipment of machines. |

| | | |
|---|---|---|
| many parts | | |
| BS EN 61069, Parts 1-8 | 1991-1999 | Industrial-process measurement and control. Evaluation of system properties for the purpose of system assessment. |
| BS EN 61310, Parts 1,2,3 | 2008 | Safety of machinery. Indication, marking and actuation. |
| BS EN 61496, 3 parts | 2004 - 2008 | Safety of machinery. Electro-sensitive protective equipment. |
| PIAC | 1988 | Printing industry advisory committee - safety at power operated paper cutting guillotines |