Health and Safety

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ESSENTIALS

AEEU

INTRODUCTION

The AEEU has a proud tradition of upholding policies and systems that are essential in maintaining safe and secure workplaces. Over the years we have published many leaflets and books on various aspects of health and safety. This latest publication is new in both format and approach in dealing with everyday and more complex safety problems.

In this booklet we have included major industries, while not ignoring smaller enterprises that have problems of equal gravity. As time has moved on, much of the older legislation has been repealed and replaced with new regulation. With this in mind, we have put an abbreviated version of the most relevant legislation into this publication. The law is constantly changing and updates are published in the Union News, the AEEU's quarterly journal. Health and Safety Essentials is available for downloading on the AEEU website at www.aeeu.org.uk, or further copies are available from head office on: 020 8462 7755 ext 436.

As your interest broadens, so will your information sources need to expand. Therefore a network of people dedicated to health and safety issues is now in place. The network is responsible for all aspects of safety training, information dissemination, National representation on various official bodies and committees, and most importantly listening to what our safety representatives want, and responding to their wishes.

We hope that you find this book useful. If you need advice remember we are only a phone call, fax, e-mail, or letter away. Keep in touch, together we can make workplaces safer.

Best wishes,

Sir Ken Jackson
General Secretary
AEEU

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Chapter Seven: Maintenance hazards

Safe systems of work are absolutely essential to protect workers who are carrying out maintenance work. The need was highlighted in a special HSE report 'Deadly maintenance', which analysed 106 fatal maintenance accidents involving plant and machinery. This emphasised that maintenance whether emergency repairs, routine servicing or cleaning, usually involves access to hazardous areas not normally approached. Such work is more than likely to be done under pressure and the combination of circumstances can prove fatal if a properly planned approach to safety is not adopted.

Employer responsibility

HSE have concluded that well over 75 per cent of fatal maintenance accidents taking reasonably practicable precautions could have prevented accidents. About two thirds of such accidents occur during breakdowns or scheduled repairs The remainder tend to happen during cleaning operation or during examination, lubrication and painting.

'Deadly Maintenance' states 'It is clear that the main responsibility for reducing the death toll lies with management. If people are not to die in

what, in a lot of cases, are tragic and horrific circumstances, management must plan and control its plant and machinery work.'

Key principles

Many pieces of health and safety legislation contain both general and specific requirements to maintain premises, plant and equipment. The general duty is contained in Section 2(2)(d) of HASAWA, which requires employers to provide and maintain a safe place of work.

The Management of Health and Safety Regulations 1999 state quite clearly that it is the employers responsibility to make sure that work is always done safely and to see that specific precautions apply equally to maintenance operations carried out by a contractor and to those carried out by workers employed directly by a company.

Design:

Good initial design can minimise maintenance problems. The need to approach dangerous parts may be reduced by proximity guards or translucent materials, and the provision of external lubrication points or adjustment devices. Means of isolating hazards are important, such as lockable electrical isolators or props to prevent gravity fall. Safe access and working platforms for maintenance may require permanent walkways, or fixtures for attaching temporary structures. Tanks should be provided with large enough manholes to aid the entry and escape of people, possibly wearing breathing apparatus.

Accidents associated with maintenance

(From 'Deadly Maintenance' HSE)

Accident Type	Number
Machinery	60
Crushed by gravity fall machine parts or residual energy motion:	11
Crushed between fixed and powered moving parts of machines	12
Entanglement in powered moving parts of machines	17
Crushed between moving machines and structure	10
Falls (from)	21
Work platforms	7
Ladders	2
Plant or machinery	8
Plant due to rupture of vessel	2
Fragile roof/ceilings	2
Burns	10
Gassing	9
Electrocution	6
Asphyxiation	5
Struck by falling materials	5
Total	106

Any maintenance system should take account of:

Management

Maintenance needs to be properly managed. High-risk activities require supervision by suitably experienced staff if failure and death are to be

avoided. There will undoubtedly be occasions when specialist assistance is needed. The tendency for maintenance departments to attempt to cope must be avoided.

Information

Clear information about safe procedures should be available to the people doing maintenance work.

Training

Maintenance often involves work in situations where normal production safeguards no longer apply. Training should pay particular attention to safe working practices in hazardous environments.

Risk Assessment

The hazards associated with each maintenance task must be listed and the risks of each considered (frequency of the task and possible consequences of failure to carry it out correctly). The AEEU has found that some employers do not understand the need for assessment for maintenance tasks. Clear and appropriately detailed procedures should be drawn up for all foreseeable maintenance operations. The extent of those plans will obviously vary from a simple manufacturer's manual, to a basic plant isolation procedure or a full permit-to-work procedure. A system should define the extent of the maintenance activity and not only the precautions required to safeguard the people involved, but also any others working in the premises. Whatever system is adopted, it is essential that the hazard remains isolated for the full duration of the work.

Equipment

A wide variety of special purpose testing or maybe safety equipment my be necessary for maintenance operations. Homemade devices can be deadly. Safety equipment should be compatible with the type of work and appropriate to the hazard or it should not be used. If it is to function as designed it must be kept in good working order. It is equally important that personnel are trained in the correct procedures for its use. The correct equipment should be readily available for use so that the temptation to make do is avoided.

Implementation

The benefits of planning can only be gained if procedures are fully implemented. The laid down systems must be applied in every detail and checks made to ensure that safe conditions have been achieved before work commences. If the planned procedures have not isolated the hazards, then work should stop immediately, until the problem is resolved.

Monitoring

People must be protected during maintenance work. Conditions should be monitored periodically, or in some cases continuously. Inspection by experienced management with appropriate authority should be adequate, but more exhaustive checks may be necessary, e.g. atmospheric testing;

Rescue

The meticulous application and monitoring of a planned safe working procedure should make the need for emergency rescue systems

superfluous. But, mistakes happen and the rapid removal of unconscious or badly injured people from still dangerous situations may be needed. If a fatality is to be avoided, the range of possible failures must be considered and plans laid to stabilise the situation, to achieve a rescue without risking further lives. It is essential that training in rescue procedures be given if people are to act calmly when required.

Permit-to-work systems

The use of effective 'permit-to-work systems' is an important part of a planned approach to safe maintenance. Some Statutes and Regulations state specifically that this should be done. A permit-to work system may well be considered an acceptable control measure in certain situations which come under the provisions of COSHH.

Boiler-furnaces: a factory occupier must not allow any work to be undertaken inside a boiler furnace or boiler flue until it has been sufficiently cooled, ventilated or otherwise to make work safe for the persons employed.

Welding, blazing or soldering: No plant, tank or vessel that contains, or has contained, any explosive or flammable substance, may be subjected to any form of welding, brazing or soldering operation, or to any cutting or similar operation involving the applications of heat, until all practical steps have been taken to remove the substance and many fumes arising from it, or to render them non-explosive or non-flammable. Any such tank, plant or vessel must first be allowed to cool before any explosive or

flammable substance is reintroduced. Again, a permit-to-work issued to a responsible person would be a sensible precaution.

Under the Ionising Radiation's Regulations 1985 detailed working arrangements, or systems of work, need to be adopted for any work with ionising radiations – Regulations 6(1) and (2) if the work could result in over-exposure in a few minutes or less (whether under normal or abnormal conditions). It is preferable that the working arrangements be formalised by means of a permit-to-work system involving the issue of a certificate detailing and specifying the method of work and conditions governing both entry to the area and persons permitted to use the certificate. Detailed written systems of work are also necessary to permit the entry of non-classified persons to controlled areas under the requirements of Regulation 8(6).

A permit is usually a form completed by the person in overall charge of maintenance at the workplace or with special knowledge of the hazards. Its purpose is to:

(a) Grant authority to certain individuals to carry out maintenance
(b) Identify plant or equipment and its associated hazards
(c) Identify the nature and extent of work to be carried out
(d) Ensure precautions are taken before work starts
(e) Provide basic information to maintenance staff on safe working procedures

A permit-to-work may stipulate that the following general precautions should be taken before work is started:

(a) Electrical and/or mechanical isolation of plant from all possible sources of danger

(b) Locking off isolating valves and blanking off of steam, acid, water, gas and compressed air supplied and pipework;
(c) Erection of scaffolding or other means required to give safe access to all work areas
(d) Provision of temporary guards or other action required to make the job safe, i.e. guard rails around the holes in floors
(e) Isolation of machine areas, indication of limits of safe working i.e. danger notices on adjacent equipment
(f) An efficient permit-to-work system will include all these precautions, and ideally
(g) The signature of the person authorised to release the plant from production
(h) The time period from which the permit is valid
(i) Details of isolation and other procedures or prerequisites necessary for the job to be done safely to be filled in and signed by the plant engineer responsible
(j) The signature of the person who carried out de-isolation procedures preparatory to the restoration of power supplies after checking that all work has been completed and signed off
(k) The signature of the person authorised to accept the plant back for production

Persons should not issue permits-to-work to themselves unless they are the sole person responsible for carrying out the work. The contents for each permit-to-work should be clearly drawn to the attention of the person receiving it and assurance received that it is understood. No one should be expected to receive permits-to-work if he/she has any

misgivings. If they have, such misgivings should be referred to a higher authority than the person issuing the permit-to-work.

The whole system of permit-to-work is based on a formal document. The format and details of the document will vary according to circumstances. It would be a worthwhile exercise for safety reps to examine any documents used in their own workplace to see if they fulfil the principles outlined above.

Multi key 'locking off'

Where equipment has only one source of power (e.g. a machine driven by a single electric motor), it is often possible to adapt the isolation switch to the motor so that it can be locked in the 'off' position with a multi-key locking device. Each person employed in this equipment is then supplied with a key, which they keep in their possession and the lock cannot be opened until all the keys have been turned. This enables several people to work on equipment without fear of one of them finishing their work and switching in the machine, thus avoiding the need for a full permit-to-work procedure.

However, for this system to be safe it is essential to adhere to the following rules:

(a) Each machine and isolation box must be numbered
(b) The special padlocks and keys should be kept under control, e.g. of the plant engineer and only be issued to people authorised to lock equipment off

(c) Each lock must have only one key, which must be given to the person working on the equipment and each key must be kept by them until the job is finished, when it must be returned to the person in control
(d) Where more than one trade works on equipment, a separate lock must be used for each trade

Overhead cranes

Often maintenance and other work must be carried out near to overhead travelling cranes. In these circumstances, a reliable permit-to-work or lock off system will ensure that the law is sufficiently observed and safe working conditions are achieved.

There are two main ways in which an overhead travelling crane can be prevented from entering a particular zone: complete electrical isolation of both the crane area in which the maintenance work is to be done, and when necessary, of adjacent bays in which cranes operate; and electrical isolation of the zone affected plus the fitting of stop blocks on the crane tracks to restrict any excessive overrun due, for instance, to faulty brakes. However, stop blocks must be used with discretion – the abrupt halting of the crane might endanger people working below.

Records of accidents suggest that to be reliable at all times, the safety system must prevent an overhead travelling crane from entering the 'danger area'. Methods that have failed include use of signallers or lookout men, warning lights or flags, the use of detonators placed on the track to warn of an approaching crane, and the issuing of verbal or written instructions to crane drivers.

Any system of work designed for use during maintenance of overhead cranes must, therefore, make it clear that it is forbidden to approach the crane, under any circumstances, until a permit has been issued or a lock off procedure implemented. All cranes must be kept out of the operation zone and all bare electrical conductors must remain dead until the permit has been cleared and cancelled.

Control

Overseeing and monitoring of maintenance systems throughout a workplace should be in the hands of a suitably experienced person, who should be identified in the safety policy. They should have the authority to coordinate the duties and responsibilities of everyone involved or affected by maintenance activities, and must make sure everyone understands that the permit-to-work system must be followed in every detail.

Occasionally, it may be impossible for one nominated person to be responsible at any given time for all maintenance activities. In this case some other responsible person should be able to assume authority.

Separate people may be needed to deal with different classes of risk (mechanical, electrical, chemical or radiological) so that there is time not only to draw up the safe systems, but also to check that all necessary precautions have been taken and the people controlling the work know exactly what they have to do.

Confined spaces

Entry into confined spaces can be highly dangerous with no outward sign of hazard. Tests are normally carried out to ensure that there are no dangerous gases, explosive atmospheres present or a lack of oxygen. The results decide whether the area is safe, or whether protective equipment must be worn. Such information may be recorded on a permit-to-work.

Section 2 of the Health and Safety at Work Act 1974 (HSW Act) requires employers to ensure the health and safety at work of their employees 'so far as is reasonably practicable'. Work in confined spaces is potentially dangerous and Section 2 clearly requires employers to take appropriate precautions to ensure that employees are not at risk. The HSW Act duties are complemented by the provisions of the Management of Health and Safety at Work Regulations 1992, especially the requirement to carry out a risk assessment associated with the employers (or self-employed persons) activities and undertaking.

The Confined Spaces Regulations 1997 repeal and replace earlier provisions contained in Section 30 of the Factories Act 1961.

The Confined Spaces Regulations 1997

Definition of confined space

This is any enclosed space, where there is a reasonably foreseeable specified risk associated with that enclosed space, and includes chambers, tanks, vats, silos, pits, trenches, pipes, sewers, flues, wells, or other similar spaces.

Free-flowing solid: This is any substance made up of solid particles, which has a flowing or running consistency, and includes flour, grain, sugar, sand or similar materials.

Specified risk: This includes a risk of: serious injury from fire or explosion; increased body temperature resulting in unconsciousness; unconsciousness or asphyxiation resulting from work exposure to gas, fume, vapour, lack of oxygen; drowning from a rising liquid level, and asphyxiation from a free flowing solid, or, entrapment in the free flowing solid which prevents escape to a respirable environment.

System of work: This includes the provision of equipment which is suitable, and maintained in good working order.

Duties (Regulation 3)
Employers must comply with these Regulations with respect to their employees and non-employees, although the duty to non-employees is to the standard of 'so far as is reasonably practicable' and is limited to matters that are within the employers' control. Similar duties are placed on self-employed persons.

Work in confined spaces (Regulation 4)
Work in confined spaces may only be undertaken if it is not reasonably practicable to perform the necessary work in any other way, and so far as is reasonably practicable, where there is a system of work in place to ensure such work is safe and without risks to health.

Emergency arrangements (Regulation 5)

In addition to the duties under Regulation 4, no work in confined spaces may be carried out unless there are suitable and sufficient arrangements in place to rescue workers in an emergency ó such arrangements must be able to be put into immediate operation.

In order to be suitable and sufficient, the arrangements must reduce any risks to the health and safety of the person putting those arrangements into operation, so far as is reasonably practicable, and must include, where necessary, the provision and maintenance of resuscitation equipment.

Maintenance checklist

(a) Make a list of all maintenance activities and hazards.
(b) Who is responsible for safety of maintenance activities? Are they competent? When are specialist maintenance contractors needed?
(c) How can maintenance hazards reduced through design?
(d) How are maintenance activities planned?
(e) Are permits-to-work needed? Do they provide the necessary information and conditions to ensure a safe system of work?
(f) If entry is being made into a confined space, have tests been carried out to find out if the work area is free from fumes and gas?
(g) Is adequate information and adequate training provided for all maintenance staff?
(h) What special safety equipment is required e.g. safety equipment, monitoring equipment etc?
(i) How is maintenance work monitored?

(j) What rescue arrangements are necessary? Have all maintenance staff been trained in rescue techniques?

Hazards from hand tools

Accidents through the use of hand tools run into tens of thousand a year. In factories alone there are over 20,000 a year. These tools include hammers, chisels, drifts, spanners, screwdrivers, knives, files, scrapers and hand tools used on lathes. While it is important that tools are used properly it is extremely difficult to work safely with faulty or worn equipment. Tools that are not in good condition should be returned to the stores or supplier, and the defects pointed out.

A number of Regulations apply to the use of work equipment of which hand tools are a part, such as:

(a) Provision and Use of Work Equipment Regulations PUWER 1998
(b) The Workplace Health, Safety and Welfare Regulations 1999
(c) The PPE Regulations
(d) The Electricity At Work Regulations 1989

Safety precautions

Safe working with hands tools is a mixture of common sense, safe procedures and intelligent observation. These are four golden rules:

(a) Use the correct tool for each type of job
(b) Use only tools which are in good condition
(c) Stow all safely, particularly at heights
(d) Wear eye protectors when provided

Tool and equipment use

(a) Are women using tools designed for men? Tools designed for men are often too large for women or require high activating forces.

(b) Do the tools vibrate, without having a vibration absorbing grip? Vibration at particular frequencies can cause vascular problems and could affect muscle and tendon blood supply, exacerbating force and motion problems.

(c) Do the tools impose shock loading upon the user? If used inappropriately, tools may generate shock loadings, which can increase muscle tension as well as imparting mechanical loads to the wrist and hands.

(d) Do tools need to be held firmly to resist reaction torque's when operated? Having to grip the tool tightly increases the muscular load and prevents smooth operation.

(e) Do the tools have a jerky action? Smooth operations are preferable for ease, muscular movement, strength application and control.

f) Is considerable pressure required to hold or operate the tool? Pressure can cause compression of tissues in the hand or wrist unless handle design is perfect. Pressure also represents an additional static load on the arm muscles.

(g) Are the handles:
- too large or small in diameter to be gripped easily?
- too short to extend across the palm?
- excessively shaped, preventing good contact?
- relying upon the hand grip to oppose motion along the length of the tool?
- excessively slippery?

Tool-handle combination

The tool-handle combination affects static and dynamic muscle loads, freedom of wrist movement, compression of the hand tissues and ease of use. The handle is often the easiest item to change, but the worst designed!

(a) How are the controls on the tool operated? Control operation affects the tension in the flexor muscles and control should probably be used by the thumb in most instances but there are some occasions where use by the fingers is better. Control positioning needs to be examined carefully.

(b) Are the tools traditional or domestic in design? Tools not designed for repeated or prolonged use rarely have suitable characteristics and can give risk to grip, pressure and force problems.

(c) Have the tools been modified by the operators or are improvised tools in use? These are frequently good indicators of problems with the tool design. Improvisation rarely overcomes the fundamental problems, and can sometimes make them worse.

(d) Do operators have to twist and turn to reach frequently needed items? Twisting, turning and arm elevation are often caused by the workspace being poorly laid out.

(e) Do operators wear gloves and, if so, do they affect grip or manual dexterity? A good tool or handle design can be rendered useless by poor gloves.

Tools and equipment design principles

These principles need to be interpreted carefully as, if applied inappropriately, they can cause further problems.

(a) Avoid sharp edges on any equipment or fixtures that come into contact with the body.
(b) Keep repetitive reaching as close as possible to the body and always within 450 mm of the front of the operator.
(c) Tilt the work surface and fixtures towards the operator, particularly those above the elbow height of the individual.
(d) Avoid a pinch grip and use a power grip whenever possible (the pinch grip, between thumb and forefinger, is five times more stressful than the power grip where most of the palm of the hand and fingers can clasp the object).
(e) Minimise hand force requirement.
(f) Make workstation height adjustable if possible.
(g) Avoid repetitive pounding with the palm.
(h) Avoid flexing the wrist (toward or away from the palm) more than about 15 degrees while performing hand activities.
(i) Avoid bending the wrist more than 5 degrees toward the thumb or 15 degrees toward the little finger while performing hand activities.
(j) Avoid raising the elbow above chest height.
(k) Avoid reaching below seat or waist level.
(l) Avoid reaching behind the centre-line of the body.
(m) Avoid repetitively rotating the hand and forearm by more than about 90 degrees.
(n) Design repetitively pushed control buttons to be a nominal 75 mm in diameter and avoid button guards with sharp edges.

(o) Provide adequate spacing between repetitively accessed button (nominal 50 mm clearance) in multiple control situations.
(p) Provide padded body support surfaces when awkward body postures must be maintained for extended periods.
(q) Avoid exposure to cold ambient temperatures or to local cold air sources such as exhaust from a powered tool.
(r) If gloves must be worn, provide adequate sizes to fit all workers' hands.

Avoid equipment and/or tools that transmit vibration to the hands.

(a) Design or select handles, tools or parts of machinery that must be grasped according to the following ergonomic criteria:
(b) The nominal diameter of single handles should be approximately 40mm and if the hand must span two handles, the span should be between 50mm and 75mm
(c) The handle should be made of some material other than metal, which tends to be cold
(d) Handle material should be soft, compliant and textured rather than hard and smooth
(e) The handle should be oriented to prevent excessive wrist bending and torque
(f) For vertically oriented handles, provide a lower support surface to prevent the handle from sliding out of the hand
(g) Tools and surfaces that contact the hand should be thick or long enough so that forces are not concentrated in the centre of the palm

Hammers: The head should be securely attached to the shaft. The head should be in good condition, and the face free from chipped edges and

not rounded from wear. The shaft should be in good condition and, if it is split, broken or loose, the hammer should not be used.

Spanner and wrenches: Do not use set spanners or wrenches with splayed jaws, or box spanners that show signs of splitting. Use a fixed spanner – rigid jawed or ring – of the correct size wherever possible rather than an adjustable one. Do not use a tube to obtain extra leverage, or hammer the end of a spanner, or use a spanner as a hammer. See that the hand will clear any obstructions when the nut turns. Never pack the gap between the spanner and the nut with shims or washers. Never use a spanner as a wedge.

Chisels and drifts: Never use a chisel with a mushroomed head. At the first sign of mushrooming, the chisel head should be correctly dressed on a grinding wheel. Use the chisel to cut away from the body. Cutting edges must always be kept sharp so that the original shape and angle of the cutting edges is maintained. The resharpened chisels should be suitably hardened and tempered.

Screwdrivers: A frequent cause of accidents is holding the workpiece in the palm of the hand while tightening up screws, a slip can result in a serious injury. The piece being worked upon should not be held in one hand and the screwdriver used in the other - work should be secured in a vice or held on other firm support. Never use a screwdriver as a chisel or strike with a hammer. Do not use a screwdriver with a split handle, even if bound with string or tape: scrap the tool or fit a new handle.

Files: Never use a file with an exposed tang: have a handle fitted. Do not use a file as a lever or toggle-bar, as it will easily snap. If filing in a lathe do not place your hand or file near the chuck, it is safer and more efficient to learn to do filing left-handed. Always check that the handle of the file is secure. Using a file on lathe work can often be done more safely and efficiently by a tool mounted in the tool post.

Knives: When used for cutting greasy materials, the handle should be designed to offer a firm grip and a shield should be fitted between the handle and the blade. It may also be necessary to wear a stout apron to protect the abdomen in case the knife should slip. So far as possible, the cut should always be away from the body.

Training and supervision

Adequate training and supervision is needed to ensure:

(a) that hand tools are used correctly
(b) that the correct ones are used for specific work
(c) that they are maintained in a fully serviceable condition
(d) that they are properly guarded and stowed safely when not being used
(e) that they are scrapped and replace when worn

Ergonomic design of hand tools

From an ergonomic point of view a number of basis requirements for the design of an efficient hand tool have been specified:

(a) It should perform its intended function effectively
(b) it should be properly proportioned to the dimensions of the user
(c) It should be appropriate to the strength and endurance of the user
(d) It should minimise user fatigue