

Pearson BTEC Levels 4 Higher Nationals in Engineering (RQF)

Unit 18: Maintenance Engineering

Unit Workbook 3

in a series of 4 for this unit

Learning Outcome 3

Hazards in Maintenance

INTRODUCTION

LO3 Illustrate competence in working safely by correctly identifying the hazards and risks associated with maintenance techniques

Working safely:

Life-saving rules for employee safety, such as safety devices and guards, lock out, tag out, electrical work, arc flash, fall protection and permit required confined space working

Development and implementation of safe schemes of work

Lone working

Permit to work (PTW)

Emergency Procedures

Hazard identification and assessment of risk associated with identified hazard

Use of control measures (ERIC SP)

Production of a Risk Assessment & Method Statement for a maintenance procedure

SAMPLE

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SAMPLE

- safe for any work that has to be done when setting up, during normal use, when clearing blockages, when carrying out repairs for breakdowns, and during planned maintenance
- properly switched off, isolated or locked-off before taking any action to remove blockages, clean or adjust the machine

Also, make sure you identify and deal with the risks from:

- electrical, hydraulic or pneumatic power supplies
- badly designed safeguards. These may be inconvenient to use or easily overridden, which could encourage your workers to risk injury and break the law. If they are, find out why they are doing it and take appropriate action to deal with the reasons/causes

Preventing access to dangerous parts

Think about how you can make a machine safe. The measures you use to prevent access to dangerous parts should be in the following order. In some cases it may be necessary to use a combination of these measures:

- Use fixed guards (eg secured with screws or nuts and bolts) to enclose the dangerous parts, whenever practical. Use the best material for these guards – plastic may be easy to see through but may easily be damaged. Where you use wire mesh or similar materials, make sure the holes are not large enough to allow access to moving parts
- If fixed guards are not practical, use other methods, eg interlock the guard so that the machine cannot start before the guard is closed and cannot be opened while the machine is still moving. In some cases, trip systems such as photoelectric devices, pressure-sensitive mats or automatic guards may be used if other guards are not practical
- Where guards cannot give full protection, use jigs, holders, push sticks etc if it is practical to do so
- Control any remaining risk by providing the operator with the necessary information, instruction, training, supervision and appropriate safety equipment

Other things you should consider

- If machines are controlled by programmable electronic systems, changes to any programmes should be carried out by a competent person (someone who has the necessary skills, knowledge and experience to carry out the work safely). Keep a record of such changes and check they have been made properly
- Ensure control switches are clearly marked to show what they do
- Have emergency stop controls where necessary, eg mushroom-head push buttons within easy reach
- Make sure operating controls are designed and placed to avoid accidental operation and injury, use two-hand controls where necessary and shroud start buttons and pedals
- Do not let unauthorised, unqualified or untrained people use machinery – never allow children to operate or help at machines. Some workers, eg new starters, young people or those with disabilities, may be particularly at risk and need instruction, training and supervision

Actions

- Simply turning off the machine, equipment or processes is not enough
- You may be working out of site of the on/off switch or isolator
- In this case, another worker might inadvertently switch the machine back on.

Electrical work

Electricity can kill or severely injure people and cause damage to property. However, you can take simple precautions when working with or near electricity and electrical equipment to significantly reduce the risk of injury to you, your workers and others around you. This section provides a summary of those precautions.

What are the hazards?

The main hazards of working with electricity are:

- electric shock and burns from contact with live parts
- injury from exposure to arcing, fire from faulty electrical equipment or installations
- explosion caused by unsuitable electrical apparatus or static electricity igniting flammable vapours or dusts, for example in a spray paint booth

Electric shocks can also lead to other types of injury, for example by causing a fall from ladders or scaffolds etc.

What do I have to do?

You must ensure an assessment has been made of any electrical hazards, which covers:

- who could be harmed by them
- how the level of risk has been established
- the precautions taken to control that risk

The risk assessment should take into consideration the type of electrical equipment used, the way in which it is used and the environment that it is used in.

You must make sure that the electrical installation and the electrical equipment is:

- suitable for its intended use and the conditions in which it is operated
- only used for its intended purpose

In wet surroundings, unsuitable equipment can become live and make its surroundings live too. Fuses, circuit-breakers and other devices must be correctly rated for the circuit they protect. Isolators and fuse-box cases should be kept closed and, if possible, locked.

Key points to remember

- Ensure that workers know how to use the electrical equipment safely
- Make sure enough sockets are available. Check that socket outlets are not overloaded by using unfused adaptors as this can cause fires
- Ensure there are no trailing cables that can cause people to trip or fall
- Switch off and unplug appliances before cleaning or adjusting them
- Ensure everyone looks for electrical wires, cables or equipment near where they are going to work and check for signs warning of dangers from electricity, or any other hazard. Checks should be made around the job, and remember that electrical cables may be within walls, floors and ceilings (especially when drilling into these locations) etc
- Make sure anyone working with electricity has sufficient skills, knowledge and experience to do so. Incorrectly wiring a plug can be dangerous and lead to fatal accidents or fires
- Stop using equipment immediately if it appears to be faulty – have it checked by a competent person
- Ensure any electrical equipment brought to work by employees, or any hired or borrowed, is suitable for use before using it and remains suitable by being maintained as necessary
- Consider using a residual current device (RCD) between the electrical supply and the equipment, especially when working outdoors, or within a wet or confined place (see HSE's electrical safety at work site)

Overhead electric lines

- Be aware of the dangers of working near or underneath overhead power lines. Electricity can flash over from them, even though machinery or equipment may not touch them
- Don't work under them when equipment (eg ladders, a crane jib, a tipper-lorry body or a scaffold pole) could come within a minimum of six metres of a power line without getting advice. Speak to the line owner, eg the electricity company, railway company or tram operator, before any work begins
- Underground cables
- Always assume cables will be present when digging in the street, pavement and/or near buildings
- Consult local electricity companies and service plans to identify where cables are located

Arc flash

“injury” means death or personal injury from electric shock, electric burn, electrical explosion or **arcing**, or from fire or explosion initiated by electrical energy, where any such death or injury is associated with the generation, provision, transmission, transformation, rectification, conversion, conduction, distribution, control, storage, measurement or use of electrical energy;

Electric burns are different from burns due to fire, arcing or explosion. They are due to the heating effect caused by the passage of electric current through body tissues. They are most commonly associated with

Dos and don'ts of working at height

Do...

- as much work as possible from the ground
- ensure workers can get safely to and from where they work at height
- ensure equipment is suitable, stable and strong enough for the job, maintained and checked regularly
- take precautions when working on or near fragile surfaces
- provide protection from falling objects
- consider emergency evacuation and rescue procedures

Don't...

- overload ladders – consider the equipment or materials workers are carrying before working at height. Check the pictogram or label on the ladder for information
- overreach on ladders or stepladders
- rest a ladder against weak upper surfaces, eg glazing or plastic gutters
- use ladders or stepladders for strenuous or heavy tasks, only use them for light work of short duration (a maximum of 30 minutes at a time)
- let anyone who is not competent (who doesn't have the skills, knowledge and experience to do the job) work at height

Permit required and Permit to Work (PTW)

This Technical Measure Document refers to permit to work systems required to control work such as maintenance activities on chemical plant and so prevent a major accident.

General principles

The following aspects should be considered with respect to Permit to Work Systems:

- Human factors;
- Management of the work permit systems;
- Poorly skilled work force;
- Unconscious and conscious incompetence;
- Objectives of the work permit system;
- Types of work permits required; and
- Contents of the work permits.

The following issues may contribute towards a major accident or hazard:

- Failing of the site safety management system;
- Failure to recognise a hazard before and during maintenance;

Confined space working

Under domestic law (the Health and Safety at Work etc Act 1974) employers are responsible for ensuring the safety of their employees and others. This responsibility is reinforced by regulations.

The Confined Spaces Regulations 1997 apply where the assessment identifies risks of serious injury from work in confined spaces.

These regulations contain the following key duties:

- avoid entry to confined spaces, e.g. by doing the work from the outside
- if entry to a confined space is unavoidable, follow a safe system of work
- put in place adequate emergency arrangements before the work start

The Management of Health and Safety at Work Regulations 1999 require employers and self-employed people to carry out a suitable and sufficient assessment of the risks for all work activities for the purpose of deciding what measures are necessary for safety. For work in confined spaces this means identifying the hazards present, assessing the risks and determining what precautions to take.

Development and implementation of safe schemes of work

Passport schemes for health and safety can be a useful way for employers to check that somebody working on their premises, or elsewhere doing work on their behalf, has received basic health and safety awareness training.

An employer needs to be clear about what any particular passport held by a worker tells them, and whether the training and awareness the passport represents is compatible with the work the passport holder is doing and the environment they are working in.

If an employer is considering setting up a passport scheme, it is important to make sure, as far as possible:

- that the passport genuinely reflects an understanding of the hazards and risks associated with the work that the holder will undertake and
- that they know how to deal with them safely

Carrying out an effective risk assessment will help to do this.

Industries and their people are best placed to decide on the content and type of passports that work best for them.

Organisations should recognise different passport schemes, if they are confident that they represent a level of health and safety awareness needed for the work being carried out. This can help reduce the burden on businesses and people who operate in more than one work environment.

- If you have 25 tonnes or more of dangerous substances, you must notify the fire and rescue service and put up warning signs
- Decide where to go to reach a place of safety or to get rescue equipment. You must provide suitable forms of emergency lighting
- You must make sure there are enough emergency exits for everyone to escape quickly, and keep emergency doors and escape routes unobstructed and clearly marked
- Nominate competent people to take control (a competent person is someone with the necessary skills, knowledge and experience to manage health and safety)
- Decide which other key people you need, such as a nominated incident controller, someone who is able to provide technical and other site-specific information if necessary, or first-aiders
- Plan essential actions such as emergency plant shutdown, isolation or making processes safe. Clearly identify important items like shut-off valves and electrical isolators etc
- You must train everyone in emergency procedures. Don't forget the needs of people with disabilities and vulnerable workers
- Work should not resume after an emergency if a serious danger remains. If you have any doubts, ask for assistance from the emergency services

Hazard identification and assessment of risk associated with identified hazard

One of the most important aspects of your risk assessment is accurately identifying the potential hazards in your workplace. A good starting point is to walk around your workplace and think about any hazards. In other words, what is it about the activities, processes or substances used that could injure employees or harm their health?

When you work in a place every day it is easy to overlook some hazards, so here are some tips to help you identify the ones that matter:

- Check manufacturers' instructions or data sheets for chemicals and equipment as they can be very helpful in spelling out the hazards and putting them in their true perspective
- Look back at your accident and ill-health records - these often help to identify the less obvious hazards
- Take account of non-routine operations (eg maintenance, cleaning operations or changes in production cycles)
- Remember to think about long-term hazards to health (eg high levels of noise or exposure to harmful substances)
- Visit the HSE website. HSE publishes practical guidance on hazards and how to control them

There are some hazards with a recognised risk of harm, for example working at height, working with chemicals, machinery, and asbestos. Depending on the type of work you do, there may be other hazards that are relevant to your business.

- Whether the procedures to ensure quoted proof check periods for safety critical items are adhered to
- Whether the company Safety Management System includes adequate consideration of maintenance of plant, instrumentation and electrical systems
- Whether maintenance staff have been sufficiently trained to recognise plant or equipment failing during maintenance inspections
- Whether maintenance staff have been sufficiently informed, instructed, trained and supervised to minimise a potential human failing during maintenance
- Whether maintenance schedules are managed and regularly inspected and reviewed
- Whether Human factors (stress, fatigue, shift work, attitude) are addressed
- Whether sufficient precautions are taken prior to maintenance of hazardous plant and equipment (isolation, draining, flushing, environmental monitoring, risk assessments, permits to work, communication, time allotted for the work)
- Whether the maintenance staff are aware of the type of environment they are working in (flammable, corrosive, explosive, zones 0, 1 & 2)
- Whether the maintenance staff use the correct equipment in the workplace during re-conditioning, replacement and re-commissioning (static free, intrinsically safe, flameproof, PPE/RPE)
- Whether sufficient maintenance systems are in place during productive assistance, servicing, running of plant, plant shutdown and plant breakdown
- Whether procedures are in place to provide detailed operating instructions for re-commission plant after maintenance, which have been subjected to risk assessments (see Technical Measures Document on Plant Modification / Change Procedures)
- Whether sufficient reporting systems are in place so that corrective maintenance can be applied to mitigate a major accident or hazard.

Major hazards

Major hazards could arise from the following:

- The lack of control of spares such that incorrect materials or items outside specification (e.g. non-flameproof equipment) are used in replacement of plant items leading to increased risk of loss of containment, fire or explosion
- Failure to drain and/or isolate plant prior to dismantling causing release of flammable or toxic substances
- Maintenance being performed incompetently (particularly alarm/action set points on instruments incorrectly set, alignment of couplings on pumps and agitators causing overheating, motors running in wrong direction, safety features left disconnected/dismantled, gaskets left out, bolts torqued incorrectly or bolts missing, non-return valves orientation incorrect, pipework/flexibles incorrectly connected/installed, pipeline spades/orifice plates left in/removed, relief valve springs overtightened, bursting discs orientation incorrect/left out)
- Scheduled maintenance not being undertaken as required or breakdown maintenance inadequate, leading to unrevealed failures of safety critical items
- Lack of knowledge by maintenance staff of the working environment where maintenance is being carried out (i.e. lack of risk assessments, warning signs, method statements, emergency