

Pearson BTEC Levels 4 Higher Nationals in Engineering (RQF)

## Unit 18: Maintenance Engineering

# Unit Workbook 4

in a series of 4 for this unit

Learning Outcome 4

# Inspection and Maintenance Techniques

## INTRODUCTION

### **Maintenance techniques:**

Importance of isolation and making safe before undertaking maintenance

Adherence to PTW process and shift changeover procedures

In-service (live) preventative maintenance e.g. thermographic survey, partial discharge inspection

Compliance with manufacturer's recommended inspection and maintenance procedures, using manufacturer's data as case studies

Look, listen and feel philosophy. Visual inspections

Measurements: electrical and mechanical. Mechanical operations test

Functional tests e.g. exercise switching mechanisms

Recording data and maintenance records

SAMPLE

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**SAMPLE**

of fumes, liquids, steam or gases (included those from fire extinguishant systems); hot work which could cause fire or explosion, and entry into vessels, machines or confined spaces.

A 'confined space' is a place which is substantially (though not always entirely) enclosed, and where there is a risk of death or serious injury from hazardous substances or dangerous conditions (such as a lack of oxygen). These can include storage tanks, silos, reaction vessels, enclosed drains and sewers, open topped chambers, ductwork and poorly ventilated rooms.

Confined spaces are often doubly dangerous and have regularly killed not only the first person - who is overcome by the fumes (or lack of oxygen) - but also a second or third person who have attempted a rescue without the proper equipment.

The shift handover process must ensure effective communication between workers ending a shift and workers beginning a shift.

Use the following checklist to develop handover procedures:

- Do you have a handover policy in place?
- Are your workers trained in the handover procedure?
- Do you allow adequate handover time?
- Do your workers use logbooks or other means of documentation to assist with handover?
- Are shift handovers regularly monitored?
- Are your shift handover procedures regularly reviewed?

It's important that your company conducts a risk assessment to better understand the hazards associated with the shift work schedule you have planned for your workers.

After you have conducted a risk assessment, implement control measures to reduce the risk to your workers, for example:

- design a considered schedule that provides workers with enough rest time between shifts
- manage overtime carefully
- schedule sufficient rest breaks
- train your workers
- monitor and supervise during and between shifts.

## Compliance with manufacturer's recommended inspection and maintenance procedures, using manufacturer's data as case studies

In order to ensure work equipment does not deteriorate to the extent that it may put people at risk, employers, the relevant self-employed and others in control of work equipment are required by PUWER to keep it 'maintained in an efficient state, in efficient order and in good repair'. If you are self-employed and your work poses no risk to the health and safety of others, then health and safety law may not apply to you. HSE has guidance to help you understand if the law applies. Such effective maintenance can not only help in meeting PUWER requirements but can also serve other business objectives, such as improved productivity and reduced environmental impact.

The frequency and nature of maintenance should be determined through risk assessment, taking full account of:

- the manufacturer's recommendations
- the intensity of use
- operating environment (eg the effect of temperature, corrosion, weathering)
- user knowledge and experience
- the risk to health and safety from any foreseeable failure or malfunction

Safety-critical parts of work equipment may need a higher and more frequent level of attention than other aspects, which can be reflected within any maintenance programme. Breakdown maintenance, undertaken only after faults or failures have occurred, will not be suitable where significant risk will arise from the continued use of the work equipment.

The manufacturer's instructions should describe what maintenance is required to keep the equipment safe and how this can be done safely. These instructions should always be followed, unless there are justifiable reasons for not doing so (eg where more frequent maintenance is necessary, due to intense use, adverse environmental conditions or when other experience shows this need). Maintenance on a less frequent basis than the manufacturer's recommendation should be subject to careful risk assessment and the reasons for doing so should be reviewed at appropriate intervals. For example, where there is already an inspection regime, perhaps for lightly used equipment, less frequent maintenance may be justified because of the condition monitoring already provided by the inspection programme.

There is no requirement for you to keep a maintenance log, although it is recommended for high-risk equipment. Maintenance logs can provide useful information for the future planning of maintenance, as

Requirements for visual testing typically pertain to three areas:

- The inspector's vision
- The amount of light falling on the specimen, which is measured using a light meter
- Whether the area being inspected is obstructed from view.

### **Mechanical and Optical Aids Used in VT**

Mechanical or optical aids are often necessary to perform visual testing. These include such items as:

- Boroscopes
- Magnifying glasses
- Micrometers
- Mirrors
- UV Lights

The specimen being tested should be well illuminated and have a clean surface. As specifications and tolerances become closer, mechanical and optical aids can help improve the precision of an inspector's vision.

Despite the advance in NDT technology, visual testing will continue to be a technique many industries rely on to ensure that the highest quality examination takes place.

### **Measurements: electrical and mechanical. Mechanical operations test**

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

- the plug or connector is damaged
- the cable has been repaired with tape, is not secure, or internal wires are visible etc
- burn marks or stains are present (suggesting overheating)

Repairs should only be carried out by a competent person (someone who has the necessary skills, knowledge and experience to carry out the work safely).

Have more frequent checks for items more likely to become damaged (eg portable electrical tools and equipment that is regularly moved, or used frequently or in arduous environments). Less frequent checks are needed for equipment less likely to become damaged (eg desktop computers etc).

Visual checks are not usually necessary for small, battery-powered items, or for equipment that works from a mains-powered adaptor (laptops or cordless phones etc). However, the mains-powered adaptor for such equipment should be visually checked.

Consider whether electrical equipment, including portable appliances, should be more formally inspected or tested by a competent person. Also think about the intervals at which this should be done.

Make arrangements for inspecting and testing fixed wiring installations, ie the circuits from the meter and consumer unit supplying light switches, sockets, wired-in equipment (eg cookers, hairdryers) etc, to be carried out regularly so there is little chance of deterioration leading to danger. This work should normally be carried out by a competent person, usually an electrician

### **When is someone competent to do electrical work?**

In this context, a competent person is someone who has the suitable training, skill and knowledge for the task to be undertaken to prevent injury to themselves and others.

A successfully completed electrical apprenticeship, with some post-apprenticeship experience, is one way of demonstrating technical competence for general electrical work.

More specialised work, such as maintenance of high-voltage switchgear or control system modification, is almost certainly likely to require additional training and experience.

- People can be struck and injured by moving parts of machinery or ejected material. Parts of the body can also be drawn in or trapped between rollers, belts and pulley drives
- Sharp edges can cause cuts and severing injuries, sharp-pointed parts can cause stabbing or puncture the skin, and rough surface parts can cause friction or abrasion
- People can be crushed, both between parts moving together or towards a fixed part of the machine, wall or other object, and two parts moving past one another can cause shearing
- Parts of the machine, materials and emissions (such as steam or water) can be hot or cold enough to cause burns or scalds and electricity can cause electrical shock and burns
- Injuries can also occur due to machinery becoming unreliable and developing faults or when machines are used improperly through inexperience or lack of training

### Functional tests - switching mechanisms

As part of managing the health and safety of your business, you must control the risks in your workplace. If you use switchgear you must assess the risks and manage them to ensure safe operation and minimise the risk of injury. A risk assessment is about identifying and taking sensible and proportionate measures to control the risks in your workplace, not about creating huge amounts of paperwork.

You are probably already taking steps to protect your employees, but your risk assessment will help you decide whether you should be doing more. The following might help:

- Think about how the switchgear could injure or harm the health of your employees and others.
- Ask your employees what they think the hazards are, as they may notice things that are not obvious to you and may have some good ideas on how to control the risks.
- Check manufacturers' instructions or safety data sheets for chemicals and equipment, as they can be very helpful in spelling out the hazards.
- Some workers may have particular requirements; for example, new and young workers, migrant workers, people with disabilities, temporary workers, contractors and lone workers may be at particular risk.

Having identified the hazards, you then have to decide what you need to do to manage them responsibly. Generally, you need to do everything 'reasonably practicable' to protect people from harm. An explanation to what 'reasonably practicable' means is provided at [www.hse.gov.uk/risk/faqs/htm](http://www.hse.gov.uk/risk/faqs/htm). Your strategy for managing the risk should include:

- system information and record-keeping