

Overview

This unit covers a broad range of competences covering the maintenance of process instrumentation and control devices. These competences will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or they will provide a basis for the development of additional skills and occupational competences in the working environment.

You will be expected to prepare for the instrumentation and control maintenance activities by obtaining all the necessary information, documentation, tools and equipment required, and to plan how you intend to carry out the required maintenance activities and the sequence of operations you intend to use.

You will be required to select the appropriate equipment to use, based on the maintenance operations to be carried out and the type of instrumentation and control equipment being maintained, such as pressure, flow, level and temperature instruments, fiscal monitoring equipment, fire and gas detection and alarm systems, industrial weighing systems, speed measurement and control systems, vibration monitoring equipment, nucleonics and radiation measurement, telemetry systems and emergency shutdown systems.

You will be expected to use a variety of maintenance diagnostic techniques and procedures, such as gathering information from fault reports, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment. You will also be expected to cover a range of maintenance activities, such as isolating and locking off, disconnecting, removing and reconnecting instruments and faulty peripheral components, setting and adjusting components, and testing the equipment, using appropriate techniques and procedures.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the instrumentation maintenance activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the maintenance activities, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply safely the appropriate maintenance techniques and

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procedures for process instrumentation and control equipment. You will understand the instrumentation maintenance process, and its application, and will know about the instrumentation and systems being maintained, and the tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when carrying out the maintenance activities, (especially those for ensuring that the equipment is correctly isolated), and when using maintenance tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand your responsibility for taking the necessary safeguards to protect yourself and others in the workplace.

Specific Unit Requirements

In order to prove your ability to combine different process instrumentation and control maintenance operations, at least one of the instrumentation maintenance activities carried out must be of a significant nature, and must cover a minimum of **eight** of the activities listed in scope 4.

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Performance criteria

- You must be able to:*
- P1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
 - P2 plan the maintenance activities before you start them
 - P3 obtain all the information you need for the safe removal and replacement of the instruments and/or sensors
 - P4 obtain and prepare the appropriate tools and equipment
 - P5 apply appropriate maintenance diagnostic techniques and procedures
 - P6 use the appropriate methods and techniques to remove and replace the required instruments/sensors
 - P7 carry out tests on sensing elements and associated instruments
 - P8 deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
 - P9 leave the work area in a safe and tidy condition on completion of the maintenance activities

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Knowledge and understanding

You need to know and understand:

- K1 the health and safety requirements, and safe working practices and procedures required for the instrumentation maintenance activities undertaken
- K2 the isolation and lock-off procedure or permit-to-work procedure that applies to the system and instruments being worked on, and how to check that any stored energy in pipework and instruments has been released
- K3 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
- K4 hazards associated with carrying out instrumentation and control maintenance activities (such as live electrical components, process controller interface, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them
- K5 what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and how to obtain first aid assistance)
- K6 the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD)
- K7 how to obtain and interpret information from job instructions and other documents needed for the maintenance activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, symbols and terminology, BS and ISO wiring regulations)
- K8 the basic principles of operation of the instrumentation being maintained (to include pressure, temperature, level and flow instrument sensors)
- K9 how to identify the various instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)
- K10 the various maintenance diagnostic techniques and aids that can be used (such as flow charts, fault reports, visual checks, measuring, movement and alignment checks, testing)
- K11 the various fault location techniques that can be used, and how they are applied (such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)
- K12 how to select and use a range of fault diagnostic equipment to investigate the problem
- K13 the care, handling and application of instrumentation and control measuring instruments
- K14 the reasons for making sure that control systems are isolated or put into

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- manual control, and that appropriate trip locks or keys are inserted, before removing any sensors or instruments from the system, and the consequences of failing to do this
- K15 the techniques used to dismantle/remove the equipment (such as release of pressures/force, proof marking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
 - K16 methods of attaching identification marks/labels to removed components or cables, to assist with reassembly
 - K17 methods of checking that components are fit for purpose, and the need to replace batteries, boards and other failed items
 - K18 the correct way of re-fitting instruments to avoid faulty readings (such as caused by head correction, poor flow past the sensor, blockages, incorrect wiring, poor insulation or incorrect materials)
 - K19 how to carry out visual checks of the instruments (such as security of joints and physical damage)
 - K20 the need to carry out tests and calibration checks on the various sensing elements and stand alone instruments, and the use of standard calibration charts and tables
 - K21 the types and application of standard test equipment (such as pressure sources, deadweight tester, temperature baths, signal sources and comparators)
 - K22 how to check that tools and equipment are free from damage or defects and are in a safe, calibrated, PAT tested and usable condition
 - K23 the approved methods of carrying out the tests on each type of instrument/sensor; setting instrument zero readings; obtaining instrument readings and comparing them with the circuit parameters; making adjustments to instrument/circuit components
 - K24 the generation of maintenance documentation and/or reports following the maintenance activity
 - K25 the problems that can occur during the maintenance of the instrumentation and control system, and how they can be overcome
 - K26 the organisational procedure to be adopted for the safe disposal of waste of all types of materials
 - K27 when to act on your own initiative and when to seek help and advice from others
 - K28 the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning tools and test equipment to its designated location, cleaning the work area, and removing and disposing of waste)

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Additional Information

Scope/range related to performance criteria

You must be able to:

1. Carry out **all** of the following during the instrumentation maintenance activities:
 - 1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
 - 1.2 where appropriate, ensure the safe isolation of instruments (such as electrical, pneumatic, process)
 - 1.3 follow job instructions, maintenance drawings and procedures
 - 1.4 check that the tools and test instruments are within calibration date and are in a safe and usable condition
 - 1.5 ensure that the equipment/system is kept free from foreign objects, dirt or other contamination
 - 1.6 return all tools and equipment to the correct location on completion of the maintenance activities

2. Carry out maintenance activities on **two** of the following types of instrumentation and control systems:
 - 2.1 pressure
 - 2.2 speed measurement
 - 2.3 fluid level
 - 2.4 noise
 - 2.5 fluid flow
 - 2.6 vibration monitoring
 - 2.7 temperature measurement
 - 2.8 nucleonic and radiation measurement
 - 2.9 fire detection
 - 2.10 telemetry systems
 - 2.11 gas detection
 - 2.12 weight measurement
 - 2.13 emergency shutdown
 - 2.14 alarm systems
 - 2.15 environmental
 - 2.16 other specific system

3. Use **four** of the following maintenance diagnostic techniques, tools and aids:
 - 3.1 fault finding techniques (such as input/output, half-split, unit substitution)
 - 3.2 diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records)
 - 3.3 information gathered from the person who reported the fault
 - 3.4 visual checks (such as signs of damage, leaks, missing parts,

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- wear/deterioration)
- 3.5 movement checks (such as loose fittings and connections)
- 3.6 monitoring equipment or gauges
- 3.7 test instrumentation measurement (such as voltage, resistance, current)
- 4. Carry out **all** of the following instrumentation maintenance activities:
 - 4.1 removing excessive dirt and grime
 - 4.2 replacing all 'lived' items (such as seals, gaskets)
 - 4.3 taking electrostatic discharge (ESD) precautions (where appropriate)
 - 4.4 replacing instruments/devices in the system
 - 4.5 setting, aligning and adjusting components
 - 4.6 disconnecting supply/signal connections
 - 4.7 tightening fastenings to the required torque
 - 4.8 removing instruments from the system
 - 4.9 re-connecting instrumentation pipework and power supply
 - 4.10 dismantling equipment to the required level
 - 4.11 labelling/marking of components
 - 4.12 checking signal transmission is satisfactory
 - 4.13 checking components for serviceability
 - 4.14 replacing or repairing damaged/defective components (such as electrical, mechanical and back-up batteries)
 - 4.15 functionally testing the maintained equipment
- 5. Set up and test sensing elements and/or stand alone instruments, to include **three** of the following:
 - 5.1 pressure (such as bourdon tube gauge, capsule/diaphragm gauge, pressure transducers)
 - 5.2 temperature (such as thermocouple, resistance thermometers, liquid in steel thermometer)
 - 5.3 flow (such as differential pressure systems, balanced flow meters, positive displacement)
 - 5.4 level (such as displacer systems, purged dip leg, capacitance probes, differential pressure systems, ultrasonic probes)
 - 5.5 other instruments/sensing elements (such as fire or gas detection, noise or vibration, speed or weight)
- 6. Use **four** of the following types of instrumentation test and calibration equipment:
 - 6.1 signal sources
 - 6.2 pressure sources
 - 6.3 logic probes
 - 6.4 standard test gauges
 - 6.5 comparators
 - 6.6 temperature baths

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- 6.7 analogue or digital meters
 - 6.8 manometers
 - 6.9 workshop potentiometers
 - 6.10 digital pressure indicators
 - 6.11 current injection devices
 - 6.12 dead weight testers
 - 6.13 calibrated flow meters
 - 6.14 calibrated weights
 - 6.15 insulation testers
 - 6.16 special-purpose test equipment
7. Maintain instrumentation and control systems, in accordance with **one** or more of the following:
- 7.1 organisational guidelines and codes of practice
 - 7.2 equipment manufacturer's operation range
 - 7.3 BS and ISO standards

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