

SQA Advanced Unit specification

General information for centres

Unit title: Applied Industrial Plant Maintenance

Unit code: HT7Y 48

Unit purpose: This Unit has been designed to allow Mechanical Engineering candidates to develop, implement and evaluate a CMSS (Computerised Maintenance Management System) solution to a plant maintenance schedule for a new or existing plant installation. In order to achieve this, candidates will require to develop a knowledge and understanding of general approaches to plant maintenance and the factors associated with devising a maintenance schedule.

On completion of the Unit the candidate should be able to:

- 1 Explain general approaches to plant maintenance.
- 2 Explain the factors associated with devising a maintenance strategy.
- 3 Develop a computerised maintenance schedule for a new or modified installation.

Credit points and level: 1 SQA Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Recommended prior knowledge and skills: Candidates should have a basic knowledge and understanding of mechanical and electrical plant. This may be evidenced by possession of SQA Advanced Units: Plant Systems and Electrical Machine Principles.

Core skills: There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Using Information Technology	SCQF level 6
Critical Thinking	SCQF level 6

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

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Assessment: Outcomes 1 and 2 should be assessed by one assessment paper. This paper should be taken by candidates at one single assessment event that should last 1 hour and 30 minutes and should be attempted after the delivery of Outcomes 1 and 2 are completed. This assessment should be conducted under controlled, supervised conditions. Candidates should not be allowed to bring any notes, text books or other materials into the assessment.

The assessment for Outcome 3 should consist of the development of a computerised maintenance schedule for a given installation comprising mechanical plant or electromechanical plant being supplied with a minimum of electrical services. This assessment should take the form of an assignment in which the candidate develops a computerised maintenance schedule, using CMMS software, and produces appropriate documentation. Candidates will also be required to produce a report (1,000 words) in which they justify the selection of the CMSS software.

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SQA Advanced Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain general approaches to plant maintenance.

Knowledge and/or skills

- ◆ Reactive Maintenance (RM)
- ◆ Planned Preventative Maintenance (PPM)
- ◆ Total Productive Maintenance (TPM)
- ◆ Reliability Centred Maintenance (RCM)
- ◆ Condition Monitoring (CM)
- ◆ Advantages and disadvantages of each approach

Outcome 2

Explain the factors associated with devising a maintenance strategy.

Knowledge and/or skills

Strategic factors:

- ◆ Health and Safety at Work Act or marine equivalent
- ◆ Risk assessment
- ◆ COSHH, Noise-related health and safety regulations, PPE or marine equivalent
- ◆ Permit to work procedures

Organisational factors:

- ◆ Workforce skills and qualifications
- ◆ Methods of working (individual, squad, sub-contract)
- ◆ Methods of recording (plant records, critical path analysis, bar charts)
- ◆ Availability issues (spares, continuously operated plant, expert help, training)

Evidence requirements for Outcomes 1 and 2

Evidence for the knowledge and/or skills in Outcomes 1 and 2 will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that she/he can answer correctly questions based on a sample of the items shown under the knowledge and skills above. In the assessment of Outcome 1, **four out of six** knowledge and/or

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skills items should be sampled while in Outcome 2 **six out of eight** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of four out of six knowledge and/or skills items from Outcome 1 and six out of eight knowledge and/or skills items for Outcome 2 are required each time the Unit is assessed.

Where sampling takes place in Outcome 1 a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain what is meant by Reactive Maintenance (RM)
- ◆ explain what is meant by Planned Preventative Maintenance (PPM)
- ◆ explain what is meant by Total Productive Maintenance (TPM)
- ◆ explain what is meant by Reliability Centred Maintenance (RCM)
- ◆ explain what is meant by Condition Monitoring (CM)
- ◆ identify the advantages and disadvantages of the maintenance approaches in the previous five bullet points

Where sampling takes place in Outcome 2 a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain the duties of employees and employers under the Health and Safety at Work Act, particularly in relation to the safe running of plant or marine equivalent
- ◆ outline the procedure involved in conducting a risk assessment
- ◆ explain specific legislation relating to COSHH, Noise and PPE or marine equivalent
- ◆ outline a typical permit to work system
- ◆ explain the importance of having a skilled and qualified workforce when planning and implementing an industrial maintenance programme
- ◆ identify different types of organisational structures and staff qualification profiles used to implement an industrial maintenance programme
- ◆ identify different types of records that can be used in an industrial plant maintenance programme
- ◆ outline the necessary availability issues that need to be considered when planning and implementing a maintenance programme

Assessment guidelines for Outcomes 1 and 2

Outcomes 1 and 2 should be assessed by means of one single assessment paper taken at a single assessment event that should last 1 hour and 30 minutes. This assessment should be conducted under closed-book, controlled, supervised conditions. Candidates should not be allowed to bring any notes text books or other materials into the assessment.

The assessment paper should be composed of a suitable balance of short answer, restricted response and structured questions.

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Outcome 3

Develop a computerised maintenance schedule for a new or modified installation

Knowledge and/or skills

- ◆ analyse paper-based maintenance schedule to identify variables and processes
- ◆ evaluate a range of CMSS (Computerised Maintenance Management System) software
- ◆ select CMSS software solution to meet maintenance schedule requirements
- ◆ implement a software solution
- ◆ evaluate the effectiveness of solution in meeting maintenance requirements

Evidence requirements

Evidence for all the items listed in the knowledge and/or skills items in Outcome 3 is required to be produced. The candidate will compile a computerised maintenance schedule suitable for a given industrial installation. The installation should consist of mechanical plant or electromechanical plant with a minimum of electrical services and should be appropriate to the candidates' own industrial experience and/or area of study. CMMS software must be employed in completing the assignment.

A candidate's response can be judged satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ analyse a paper-based maintenance schedule for a new or modified installation to identify the variables and processes in the schedule
- ◆ evaluate a range of CMMS software and from the evaluation select a software solution which best meets the needs of the industrial plant maintenance schedule of the new or modified installation
- ◆ use CMMS software to set up, run and generate a **minimum of two** documents relevant to plant maintenance operation
- ◆ evaluate the effectiveness of the computerised maintenance schedule in meeting the maintenance requirements of the new or modified installation

Assessment guidelines

The assessment for Outcome 3 will take the form of an assignment involving the development of a CMMS solution to the maintenance schedule and a 1,000 word report which will contain an evaluation of the effectiveness of the software solution in meeting the maintenance requirements of the new or modified installation. The assignment will involve analysing an existing paper-based maintenance plan (for a new or modified installation), specifying a CMMS software package and using this software to control maintenance operations.

A suggested format for the evaluation report is as follows:

- ◆ introduction
- ◆ description of plant operation
- ◆ description of existing maintenance plan
- ◆ evaluation of CMSS software (eg in tabular format)
- ◆ justification of software solution
- ◆ evaluation
- ◆ conclusions

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Candidates in employment may choose to select a maintenance scenario from their workplace.

Whilst it is not possible to specify precisely the type of installation that would be acceptable for the assignment in Outcome 3, it is important to emphasise that the installation must involve several items of plant. Such an installation could be, for example, the complete installation for a small site or a single line in a large site. The installation must be provided with a minimum of electrical services but can also be supplied with air, water and other services.

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Administrative information

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SQA Advanced Unit specification: support notes

Unit title: Applied Industrial Plant Maintenance

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit has been written in order to allow candidates to develop their knowledge, understanding and skills in the following areas:

- 1 General approaches to plant maintenance.
- 2 Factors associated with devising a plant maintenance strategy.
- 3 Develop a computerised maintenance schedule for a new or modified installation.

It is recommended that candidates have studied the Unit Plant Systems before taking this Unit.

In designing this Unit, the writers have identified the range of topics they would expect to be covered by lecturers. The writers have also given recommendations as to how much time should be spent on each Outcome. This has been done to help lecturers to decide what depth of treatment should be given to the topics attached to each of the Outcomes. Whilst it is not mandatory for centres to use this list of topics it is strongly recommended that they do so to ensure continuity of teaching and learning, and because the assessment exemplar pack for this Unit is based on the knowledge and/or skills and list of topics in each of the Outcomes.

The list of topics is as follows:

1 Explain general approaches to plant maintenance. (8 hours)

- ◆ RM, advantages/disadvantages, where applicable.
- ◆ PPM: Highlight where PPM is applicable. Discuss advantages such as: more even spread of maintenance work, better budgetary control, fewer emergency breakdowns, extension of working life of plant, scheduling of maintenance at organisationally convenient or economically beneficial time.
- ◆ TPM: Advantages. Highlight the importance of staff training/cooperation. Discuss overall equipment effectiveness (OEE).
- ◆ RCM: Explain how this stresses the maintenance of items critical to the continued reliable operation of plant. Attempts to maximise reliability. Seeks to eliminate unnecessary preventative maintenance.
- ◆ Condition Monitoring: Explain CM, Monitoring vibration, temperature, thermal imaging, allows recording of trends and comparisons with initial base line measurements. Allows remedial measures to be taken before breakdown. Give examples such as monitoring of steam generators and turbines, printing machines, bearings and power consumption. Explain that conditions are monitored according to the most likely failure modes expected. CM Software allows viewing of history in graphs, charts etc and publishing of reports.

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2 Explain the factors associated with devising a maintenance strategy (9 hours)

- ◆ Highlight the necessity of being informed of, and complying with, all statutory health and safety requirements.
- ◆ Responsibilities for personnel under Health and Safety at Work Act 1974, Management of Health and Safety at Work Regulations 1999 or marine equivalent eg, COSWP. Explain hazard and risk and give typical examples. Explain the rudiments of sensible risk assessment procedure.
- ◆ Explain provisions of COSHH regulations or marine equivalent. The need to protect personnel from potentially dangerous substances either through removal of substance or provision of appropriate PPM. Explain noise hazards. Noise related health and safety regulations.
- ◆ Explain the purpose of the permit to work procedure and the need to identify all potentially hazardous work activities to be carried out and the measures required to minimise any risks. Highlight the need for an operational plan involving safe isolation and locking off.
- ◆ Organisational requirements of a maintenance policy, administrative structures, staff qualifications, analysis of particular industrial scenarios so that appropriate maintenance strategies are employed.
- ◆ Recording of information and updating plant records, spares inventories and standard operating procedures for plant.
- ◆ Value of using charts and graphs in analysing the history of particular systems and planning of plant maintenance.
- ◆ Importance of employing cost effective strategies for maintenance.
- ◆ Importance of ensuring skills and qualifications of workforce are adequate (eg diagnostic skills, fitting skills, electrical engineers, plant servicing skills, etc vocational qualifications and experience.)
- ◆ Value of critical path network analysis techniques.

3 Develop a computerised maintenance schedule for a new or modified installation (23 hours)

- ◆ establish the requirements of a given maintenance operation
- ◆ decide/confirm measurable conditions useful to establishing plant condition
- ◆ plan/confirm plan
- ◆ match requirements with given CMMS software
- ◆ use software effectively
- ◆ evaluate the use of CMMS software in the management of plant maintenance operations

This Outcome should provide the candidate with an opportunity to apply the principles of plant maintenance learned to a given industrial installation.

Guidance on the delivery and assessment of this Unit

Delivery of this Unit should relate to current codes of practice and legislation, for example:

- ◆ Health and Safety at Work Act, 1974 (HASWA)
- ◆ The Management of Health and Safety at Work Regulations 1999
- ◆ Control of Substances Hazardous to Health Regulations 2002 (COSHH)
- ◆ Electricity at Work Regulations (1989)

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Useful sources of Computerised Maintenance management systems (CMMS):

<http://www.>

ez-maintenance.com/index.php

maintenancesoftware.co.uk

fixed-asset-tracking-software.co.uk/planned-maintenance/planned-maintenance.htm

The single assessment paper should take place after Outcomes 1 and 2 have been completed and the Assignment would normally be undertaken following the written test.

Opportunities for developing Core Skills

There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Using Information Technology

SCQF level 6

Critical Thinking

SCQF level 6

Open learning

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regards to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessment, whether done at a single or multiple events, was conducted under controlled, supervised conditions.

To keep administrative arrangements to a minimum, it is recommended that for distance learning candidates the assessment paper is taken at a single assessment event

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Applied Industrial Plant Maintenance

This Unit has been designed to allow you to develop the knowledge, understanding and skills to write a computerised industrial plant maintenance schedule. Before you can do this you will need to learn about general plant maintenance approaches and the factors that can affect the development of a maintenance schedule such as safety regulations pertaining to plant maintenance systems, permit to work systems, risk assessment and responsibilities of employers and employees under the Health and Safety at Work Act or marine equivalent. In addition, you may also have to consider local company issues that affect plant maintenance planning. During the delivery of Outcome 3 you will have the opportunity to develop a knowledge and understanding of modern Computerised Maintenance Management System software used in plant maintenance scheduling. You will also be given the opportunity to apply what you have learnt in this Outcome by undertaking an assignment involving you in the development of a computerised maintenance schedule. The particular industrial setting will be drawn as closely as possible from your own industrial experience or area of study.

Assessment will be in the following two parts.

- (i) A written paper taken at the end of Outcome 2 and lasting 1.5 hours based on what you have learnt in the first two Outcomes.
- (ii) Successful completion of a computerised plant maintenance schedule assignment and report based on Outcome 3.