

## Unit 220

## Quality and reliability engineering

### Unit summary

This unit is about the design process that leads to reliable systems with built-in quality. It enables measurement of effectiveness and repeatability.

### Aims

The unit aims to develop in the candidate an awareness of artifact quality, reliability, safety, and maintainability by measurement and planning.

### Prerequisites

It is expected that candidates will have a working knowledge of the materials in the four compulsory papers of the Certificate examinations. In particular knowledge of statistics and probability mathematics is needed.

### Learning outcomes

There are **three** outcomes to this unit. The candidate will be able to:

- Describe the importance of quality and reliability
- Use methods for measuring and improving quality and reliability
- Develop quality and reliability programme plans

### Guided learning hours

It is recommended that 300 hours should be allocated for this unit. 120 of those hours are actual taught hours. This may be on a full time or part time basis.

### Key Skills

No Key Skills were identified for this unit.

## **Occupational Standards**

This unit has been mapped to the following National Occupational Standards:

- 1.1.1 Identify the requirements of clients for engineering products or processes
- 1.1.2 Produce specifications for engineering products or processes
- 2.1.1 Determine the production requirements of engineering products and processes
- 2.1.2 Specify production methods and procedures to achieve production requirements
- 2.3.1 Monitor the production process
- 2.3.2 Evaluate the production process
- 4.1.1 Determine the operational requirements of engineering products or processes
- 4.1.2 Specify operational methods and procedures to achieve operational requirements
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- 4.1.2 Specify operational methods and procedures to achieve operational requirements
- 6.1.1 Analyse the risks arising from engineering products and processes
- 6.1.2 Specify methods and procedures to reduce risks
- 6.2.1 Assure the quality of engineering products or processes
- 6.2.2 Identify the reasons for quality assurance problems
- 6.2.3 Implement improvements to the quality of engineering products or processes
- 8.1.1 Maintain and develop own engineering expertise

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### Outcome 1

Describe the importance of quality and reliability

#### Knowledge requirements

##### The candidate knows how to:

- 1 define
  - a quality control and assurance
  - b specifications of quality
  - c engineering reliability
- 2 explain the principles of Total Quality Control (TQC)
  - a measurement techniques for
    - i quality control
    - ii improvement
  - b Quality Function Deployment
  - c Quality Circles and improvement groups
  - d economics of quality
  - e Zero Defects concepts and mistakes proofing
  - f product liability
- 3 define reliability, maintainability and availability
- 4 determine reliability specifications
- 5 explain the effects on safety of engineering quality and reliability by
  - a accident avoidance using
    - i design aspects
    - ii human factors
  - b risk analysis
  - c event tree analysis
  - d fault tree analysis
  - e redundancy
  - f common mode and common cause failures
  - g reliability block diagrams and risk matrices
  - h quality, environmental, health and safety integration (QUENSH)

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### Outcome 2

Use methods for measuring and improving quality and reliability

#### Knowledge requirements

##### The candidate knows how to:

- 1 state the general principles of metrology
- 2 measure and test
  - a length
  - b angle
  - c form
  - d surface finish
  - e roundness
  - f gauging
- 3 use co-ordinate measuring machines
- 4 undertake on-line inspection and testing using
  - a non-destructive techniques
  - b vision systems
  - c electrical, mechanical and radiological methods
- 5 inspect and evaluate the quality of raw materials
  - a for purchasing purposes
  - b use supplier evaluation and rating methods
- 6 use statistical methods for quality and reliability
  - a acceptance sampling
  - b control charts
  - c tests of significance and confidence limits
  - d sampling schemes
  - e Seven Quality Tools
  - f and determine control system choice

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### Outcome 3

### Develop quality and reliability programme plans

#### Knowledge requirements

#### The candidate knows how to:

- 1 assess designs for reliability and safety
  - a institute reliability and safety development programmes
  - b implement testing and evaluate failure modes by
    - i statistical analysis
    - ii physical characteristics
    - iii test design
- 2 assess testing and evaluate failure modes using
  - a Weibull hazard and probability plotting
  - b Lognormal probability plotting
  - c Duane analysis
  - d accelerated testing
- 3 investigate the economics of reliability process improvement and the consequences of catastrophic failure
- 4 develop checklists for plant design and installation
- 5 understand Failure Mode, Effect and Criticality Analysis (FMECA) for
  - a design
  - b process
  - c system
- 6 understand availability, maintainability and life cycles when referring to reliability and safety
- 7 understand the application of designed experimentation
  - a sources of extent of variability
  - b process optimisation
    - i improvement by monitoring
    - ii improvement by rectification
- 8 apply the following to the above
  - a Exploratory Data Analysis
  - b design of experiments
  - c Analysis of Variance (ANOVA)
  - d Taguchi methods

- 9 apply data, collection systems, information feedback and control
  - a fault detection and trend control
  - b automated testing systems
    - i design
    - ii application
  - c expert systems for fault diagnosis in process plant
  - d condition monitoring techniques

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### Recommended reading list

<b>Core texts</b>	<b>Author(s)</b>	<b>Publisher</b>	<b>ISBN</b>
Managing Quality	Dale	Blackwell	0631236147
Practical Approach to Quality Control	Caplen	Random House	0091735815
Practical Reliability Engineering	O'Connor	John Wiley	0470844639
Statistical Methods for Quality Improvement	Ryan	John Wiley	0471197750
Taguchi Techniques for Quality Engineering	Ross	McGraw Hill	0070539588
The Capability Maturity Model for Software	Paulk, Weber, Curtis, Chrissis	Addison-Wesley	0201546647
Total Quality Management	Oakland	Butterworth-Heinemann	0750609931
ZQC: Source Inspection and the Poka-Yoke System	Shingo	Productivity Press Inc.	0915299070
Metrology for Engineers	Gayler, Shotbolt		0304306126 o/p
Quality Management for Software	Daily	Blackwell NCC	1855540827 o/p
<b>Other useful texts</b>			
Statistical Tables	Murdoch, Barnes	Palgrave	0333558596