

Level 2 Certificate in Rail Engineering Underpinning Knowledge (7597-01)

Qualification handbook for centres
501/2174/1



About City & Guilds

City & Guilds is the UK's leading provider of vocational qualifications, offering over 500 awards across a wide range of industries, and progressing from entry level to the highest levels of professional achievement. With over 8500 centres in 100 countries, City & Guilds is recognised by employers worldwide for providing qualifications that offer proof of the skills they need to get the job done.

City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people and organisations to develop their skills for personal and economic growth. Made up of City & Guilds, City & Guilds Kineo, The Oxford Group and ILM, we work with education providers, businesses and governments in over 100 countries.

Equal opportunities

City & Guilds fully supports the principle of equal opportunities and we are committed to satisfying this principle in all our activities and published material. A copy of our equal opportunities policy statement is available on our website.

Copyright

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute and may not be copied, reproduced or distributed without prior written consent.

However, approved City & Guilds centres and candidates studying for City & Guilds qualifications may photocopy this document free of charge and/or include a PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching candidates working towards a City & Guilds qualification, or for internal administration purposes
- candidates may copy the material only for their own use when working towards a City & Guilds qualification

The *Standard Copying Conditions* (which can be found on our website) also apply.

Please note: National Occupational Standards are not © The City and Guilds of London Institute. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

Publications

City & Guilds publications are available from our website or from our Publications Sales department, using the contact details shown below.

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds' products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

City & Guilds

1 Giltspur Street

London EC1A 9DD

www.cityandguilds.com

centresupport@cityandguilds.com

Level 2 Certificate in Rail Engineering Underpinning Knowledge (7597-01)

Qualification handbook for centres



www.cityandguilds.com
October 2010
Version 1.4

City & Guilds
Skills for a brighter future



www.cityandguilds.com

Contents

1	Introduction to the qualification	5
1.1	Qualification structure	5
1.2	Opportunities for progression	6
1.3	Qualification support materials	6
2	Centre requirements	7
2.1	Resource requirements	7
2.2	Candidate entry requirements	7
3	Course design and delivery	9
3.1	Recommended delivery strategies	9
4	Assessment	10
4.1	Summary of assessment methods	10
5	Units	11
Unit 001	Engineering industry	12
Unit 002	Engineering technology	18
Unit 003	Maintenance technology	23
Unit 004	Maintaining mechanical devices and equipment	27
Appendix 1	Relationships to other qualifications	31
Appendix 2	Sources of general information	32

City & Guilds
Skills for a brighter future



www.cityandguilds.com

1 Introduction to the qualification

This document contains the information that centres need to offer the following qualification:

Qualification title and level	Level 2 Certificate in Rail Engineering Underpinning Knowledge
City & Guilds qualification number	(7597-01)
Qualification accreditation number	501/2174/1
Last registration date	30/09/2014
Last certification date	30/09/2016

This qualification is aimed to apprentices within the Rail Engineering Industry. Its purpose is to provide candidates with sufficient knowledge, understanding and practical skills to introduce them to the industry and prepare them to undertake the NVQs in Rail Transport Engineering successfully.

1.1 Qualification structure

To achieve the Level 2 Certificate in Rail Engineering Underpinning Knowledge learners **must** achieve the 28 credits from the following units:

Unit accreditation number	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
D/602/5873	Unit 001	Engineering industry	Mandatory	7
K/602/5875	Unit 002	Engineering technology	Mandatory	7
T/602/5877	Unit 003	Maintenance technology	Mandatory	7
A/602/5878	Unit 004	Maintaining mechanical devices and equipment	Mandatory	7

This qualification development has been supported by GoSkills.

GoSkills' contact details:

Concorde House, Trinity Park,
Solihull, West Midlands B37 7UQ
Tel: 0121 635 5520
Fax: 0121 635 5521

1.2 Opportunities for progression

On completion of this qualification candidates may progress into employment or to a range of further education and professional body qualifications. For example:

- Advanced Apprenticeship in Rail Transport Engineering.
- Supervisor or team leader roles such as: Leading Track Operative (Maintenance and Renewals).
- Institute of Leadership and Management qualifications.

1.3 Qualification support materials

City & Guilds also provides the following publications and resources specifically for this qualification:

Description	How to access
fast track approval forms	www.cityandguilds.com

2 Centre requirements

This section outlines the approval process for Centres to offer this qualification and any resources that Centres will need in place to offer the qualifications including qualification-specific requirements for Centre staff.

Centres already offering City & Guilds qualifications in this subject area

Centres approved to offer the qualification 7588 NVQs in Railway Engineering may apply for approval for the new Level 2 Certificate in Rail Engineering Underpinning Knowledge using the **fast track approval form**, available from the City & Guilds website.

Fast track approval is available for 12 months from the launch of the qualification. After this time, the qualification is subject to the **standard** Qualification Approval Process. It is the centre's responsibility to check that fast track approval is still current at the time of application.

2.1 Resource requirements

Human resources

All new teachers delivering publicly funded qualifications in the learning and skills sector (all post 16 education – including FE, adult and community learning, work-based learning, offender education) in England are now required to take qualifications which form part of the Qualified Teacher – Learning and Skills (QTLS) framework. City & Guilds offers a range of qualifications within the QTLS framework. Details are available on the QTLS pages of www.cityandguilds.com/QTLS

Staff should be technically competent in the areas for which they are delivering training. It is expected that staff hold a minimum of an appropriate level 3 qualification or equivalent.

The assessment centre will be responsible for maintaining up-to-date information on the staff delivering this qualification.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but must never internally verify their own assessments.

Continuing professional development (CPD)

Centres are expected to support their staff in ensuring that their knowledge remains current of the occupational area and of best practice in delivery, mentoring, training, assessment and verification, and that it takes account of any national or legislative developments.

2.2 Candidate entry requirements

Candidates should not be entered for a qualification of the same type, content and level as that of a qualification they already hold.

There are no formal entry requirements for candidates undertaking this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully.

Age restrictions

This qualification is not approved for use by candidates under the age of 16 and City & Guilds cannot accept any registrations for candidates in this age group.

3 Course design and delivery

3.1 Recommended delivery strategies

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Centres may design course programmes of study in any way which:

- best meets the needs and capabilities of their candidates
- satisfies the requirements of the qualification.

When designing and delivering the course programme, centres might wish to incorporate other teaching and learning that is not assessed as part of the qualification. This might include the following:

- literacy, language and/or numeracy
- personal learning and thinking
- personal and social development
- employability

Where applicable, this could involve enabling the candidate to access relevant qualifications covering these skills.

4 Assessment

4.1 Summary of assessment methods

This qualification has been designed to complement the delivery of the Level 2 NVQs in Railway Engineering to apprentices in the Rail Transport Engineering industry.

Centres will devise the assessment of the qualification ensuring that covers the assessment criteria of the units and present it to the City & Guilds' External Verifier for approval. Once City & Guilds' qualification expert has approved the assessment, the centre will be able to proceed with the delivery of the qualification.

A range of assessment methods are accepted like: practical demonstration, assignments and/or written examination.

This qualification is graded as Pass or Fail.

Centre set and marked assignments

City & Guilds has provided separate guidance for writers of centre based assessments which should be read in conjunction with this document, entitled, '**GM1 - Developing centre devised assessments – guidance for centre based assessment writers**'.

A set of generic recording forms is also provided as follows:

- Assessment tasks (AD1)
- Assessment grading criteria (AD2)
- Assessment sign off form (AD3)
- Evidence recording form (GF1)
- Assessment unit front and mark sheet (GF2)
- Assessment task front sheet (GF3)
- Assessment unit mark sheet (GF4)
- Assessment feedback and action plan form (GF5)
- Qualification assessment tracking form (GF6)
- Group assessment tracking form (GF7)

A full explanation of the use of these forms can be found in the centre devised assessment writing guidance. All of this material is available to download from the City & Guilds website at **<http://www.cityandguilds.com/delivering-our-qualifications/centre-development/quality-assurance/quality-assurance-documents>**.

5 Units

Structure of units

The units in this qualification are written in a standard format and comprise the following:

- City & Guilds' reference number
- unit accreditation number
- title
- level
- credit value
- unit aim
- relationship to NOS, other qualifications and frameworks
- endorsement by a sector or other appropriate body
- learning outcomes which are comprised of a number of assessment criteria
- notes for guidance or range.

Summary of units

City & Guilds unit number	Title	QCF unit number	Credits
001	Engineering industry	D/602/5873	7
002	Engineering technology	K/602/5875	7
003	Maintenance technology	T/602/5877	7
004	Maintaining mechanical devices and equipment	A/602/5878	7

Unit 001

Engineering industry

Level: 2

Credit value: 7

NDAQ number: D/602/5873

Unit aim

This unit will encourage candidates to find out about working in engineering. It will provide them with the underpinning knowledge and basic skills needed to work in the engineering or manufacturing sectors.

This unit covers: the need to recognise and use safe working practices, consideration of the environment and working effectively as part of a team. It also includes the methods of communication that engineers use in their everyday.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

- 1 know the engineering Health and Safety requirements
- 2 be able to demonstrate effective methods of communication
- 3 understand drawings and specifications
- 4 be able to demonstrate an awareness of working in engineering.

Guided learning hours

It is recommended that **70** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the following units of the NVQ in Performing Engineering Operations Level 2:

Unit 1: Working safely in an engineering environment

Unit 2: Working efficiently and effectively in engineering

Unit 3: Using and communicating technical information.

Support of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Assessment

A range of assessment methods are accepted like: practical demonstration, assignments and/or written examination.

Unit 001

Engineering industry

Outcome 1

Know the engineering Health and Safety requirements

Assessment Criteria

The learner can:

1. define the current **Health and Safety regulations** applicable to engineering operations
2. define **employers' responsibilities** to comply with Health and Safety in terms of provision in the workplace
3. describe the Health and Safety **implementation within individual organisation**
4. describe the essential Health and Safety requirements applicable to the **protection of operators and bystanders**
5. classify and define different types of Health and Safety **signs** that are used in an engineering/manufacturing environment
6. define the roles, responsibilities and powers of **Health and Safety personnel**
7. describe the **human and environmental conditions** leading to accidents in the workplace and the means of controlling them
8. describe how to carry out and report **risk assessments**
9. apply the general rules for **safe working practices**
10. demonstrate the need for the provision of **first aid treatment**
11. define what is meant by a **dangerous occurrence**
12. describe methods of **fire** prevention and control
13. describe the methods and procedures necessary to make a **hazardous area** safe before starting work
14. describe the basic principles behind **safety checks**

Range

Health and Safety regulations: Health and Safety regulations; Health and Safety at Work Act; Control of Substances Hazardous to Health Regulations; Personal Protective Equipment at Work Regulations; Reporting of Injuries, Diseases and Dangerous Occurrences Regulations; Manual Handling Operations Regulations; Lifting Operations and Lifting Equipment Regulations; The Control of Noise at Work Regulations

employers' responsibilities: a safe place of work, safe plant and safe working environment equipment; safe methods of handling, storing and transporting goods and materials; reporting of accidents; information, instruction, training and supervision of employees

implementation within individual organisation: safety policies, codes of practice, safe systems of work

protection of operators and bystanders: Personal Protective Equipment (PPE), Respiratory Protective Equipment (RPE), designated safe areas

signs: warning, prohibition, mandatory, information, fire

Health and Safety personnel: Health and Safety Advisors, Health and Safety Representatives, Health and Safety Executive Inspectors

human and environmental conditions: causes of accidents (human error, lack of due care, improper behavior and dress, lack of training, lack of supervision and/or experience, tiredness/fatigue, intoxication, unguarded or faulty machinery or tools, inadequate ventilation, poor housekeeping, dirty, overcrowded and badly-lit workplaces); accident prevention measures (eliminate the hazard, replace the hazard with something less dangerous, guard the hazard, personal protection, Health and Safety education and publicity)

risk assessments: slippery or uneven surfaces, spillages, scrap or waste material, flammable materials, faulty or missing machine guards, faulty electrical connections or damaged cables, dust and fumes, contaminants and irritants, materials handling and transportation

safe working practices: be alert, maintain personal hygiene, protect yourself and other people, know emergency procedures, report all hazards

first aid treatment: location of facilities, location of qualified first aiders

dangerous occurrence: definition, examples

fire: conditions required for combustion and extinction (causes of fire, fire prevention, fire procedures, fire drills, fire fighting equipment for different types of fires [extinguishers, automatic systems, eg sprinklers])

hazardous area: using barriers and/or tapes, placing warning signs in appropriate positions, informing any persons who may be affected, isolating power or pressure sources, obtaining official clearance (Permit to Work)

safety checks: ensuring work area is free from hazards, any required safety procedures are implemented, any necessary personal protective equipment is in a usable condition, tools and equipment are in a safe and usable condition.

Assessment Criteria

The learner can:

1. describe procedures regarding **employment rights and responsibilities**
2. describe the **communication** systems used in the workplace
3. describe the **roles** and responsibilities of various departments and personnel within an engineering organisation
4. use a range of methods of **communication**
5. use a range of **sources** of engineering information
6. use a range of methods of communicating **technical information**
7. illustrate the purpose of a design brief
8. establish where to seek **advice and guidance**
9. describe the **correct approach** when seeking advice and guidance

Range

employment rights and responsibilities: procedures for requesting/recording time off work for: illness, medical/dental reasons, holidays family reasons

communication: verbal, written, drawings, electronic, signs

roles: departments, finance/purchasing, manufacturing/production, quality assurance/control, inspection, despatch, maintenance, human resources, personnel, managers, engineers, supervisors, trainers, inspectors, safety officers, personnel staff, unions

communication: instructions, requests, advice

sources: BS EN standards, instruction manuals, technical handbooks, tables, charts, graphs, data sheets, textbooks, reference materials, computer based, Internet, Intranet

technical information: sketches, drawings, diagrams, test and inspection reports, planning documents and schedules

advice and guidance: mentor, trainer, supervisor

correct approach: politeness, timeliness, attentiveness.

Assessment Criteria

The learner can:

1. describe the purpose of **technical drawings and specifications**
2. interpret technical drawings using **current standards**
3. interpret the **essential information** found on drawings
4. describe the purpose of **standards** in engineering
5. describe the use of **specifications and quality systems**
6. interpret standard **conventions** used on technical drawings
7. interpret and apply other **features** associated with technical information

Range

technical drawings and specifications: characteristics of a product, shape, size, material, features; provide additional product information, materials, manufacturing or installation data, special processes/equipment requirements

current standards: projections: orthographic, isometric, oblique, assembly, schematic, exploded views, sketches

essential information: projection, scale, dimensions, issue number, author, tolerances, symbols, notes, materials, batch requirements, parts list

standards: communicates technical information/data, produced in universal language for all stakeholders, provides the basis for quality assurance

specifications and quality systems: quality assurance, quality control, inspection, conformance/fitness for purpose, customer requirements, reference of standards, safety requirements, quality records, traceability, corrective action procedures, quality circles, method statement

conventions: lines, hatching, symbols, views, layout

features: detailed drawings, manufacturing process(s), product make up (number of components), sequence of operations (operations sheet), quality control requirements, storage and dispatch requirements, use of graphs, tables and charts.

Unit 001

Engineering industry

Outcome 4

Demonstrate an awareness of working in engineering

Assessment Criteria

The learner can:

1. illustrate the **approach** expected within an organisation
2. demonstrate how to work effectively within an engineering workplace by displaying the **conduct expected**
3. describe how to effectively request **advice** from colleagues, trainers or supervisors
4. describe how to deal with **conflict** situations
5. describe how to avoid **conflict** situations
6. Demonstrate how to function effectively within a **workplace team**

Range

approach: timekeeping and absenteeism, observation of rules, regulations and procedures, conduct within the workplace, relationships with colleagues, supervisors and managers, respect for company's property, observing safety policies and regulations

conduct expected: when dealing with: customers, visitors, inspectors.

advice: stating the problem clearly and succinctly, listening to the response attentively, seeking clarification on points not fully understood

conflict: avoid conflict situations by: enquiring politely, timeliness when seeking advice or assistance, knowing when to withdraw from the situation, listening carefully, following reasonable requests from supervisors, offering help when colleagues are in need of assistance

workplace team: the roles and responsibilities of: team leaders and team members; difficulties or situations that can arise due to: differences of opinion, unpopular team leader's decisions, working within time constraints, team members' aspirations and/or ambitions, individual skill levels, personal development, team members' personalities; participation in group discussions and decision making: suggesting solutions to problems, how to give and receive constructive criticism, when to be assertive, when to concede to individual or group pressure.

Level: 2

Credit value: 7

NDAQ number: K/602/5875

Unit aim

This unit is concerned with the basic principles of mathematics and science, along with the materials technology that underpin engineering applications. It covers common applied engineering calculations and materials selection in terms of types, common forms of supply, properties and methods of changing their properties.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

- 1 know requirements for materials in engineering
- 2 know the properties of engineering materials
- 3 be able apply analytical methods to engineering mathematical applications
- 4 be able apply analytical methods to engineering science applications.

Guided learning hours

It is recommended that **70** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the following units of the NVQ in Performing Engineering Operations Level 2:

Unit 1: Working safely in an engineering environment

Unit 2: Working efficiently and effectively in engineering

Unit 3: Using and communicating technical information.

Support of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Assessment

A range of assessment methods are accepted like: practical demonstration, assignments and/or written examination.

Unit 002

Engineering technology

Outcome 1

Know requirements for materials in engineering

Assessment Criteria

The learner can:

1. **select materials** for common engineering applications
2. select **forms of supply** of materials
3. **differentiate between materials** by their physical properties

Range

select materials: ferrous metals: carbon steels (low, medium, high), stainless steels (austenitic, ferritic, martensitic), cast iron; non-ferrous metals: aluminium and aluminium alloys, copper and copper alloys (brass, bronze); non-metallic materials: plastics (thermoplastic, thermosetting), composites (glass fibre, carbon fibre, aramid fibre) rubber

forms of supply: railway infrastructure components such as: sleepers, rail, fastening systems, drainage components including ballast

differentiate between materials: colour, appearance, functions and properties.

Unit 002

Engineering technology

Outcome 2

Know the properties of engineering materials

Assessment Criteria

The learner can:

1. compare the **physical properties** of materials
2. define what is meant by **mechanical properties** of materials
3. compare the **mechanical properties** of materials
4. describe methods of **modifying properties** of materials

Range

physical properties: melting points of metals, density, colour, magnetism, corrosion resistance, conductivity, insulation

mechanical properties: tensile strength, toughness, hardness, elasticity, ductility, malleability

modifying properties: prolonging life or preserving materials, effects of cold working; heat treatment: annealing, normalising, hardening and tempering.

Unit 002

Engineering technology

Outcome 3

Be able to apply analytical methods to engineering mathematical applications

Assessment Criteria

The learner can:

1. apply appropriate **degree of accuracy** to express numbers
2. describe tolerance in terms of limits of size
3. perform calculations to determine the **areas of basic shapes**
4. perform calculations to determine the areas of **compound shapes**
5. perform calculations to determine the **surface areas** of regular shaped solids
6. perform calculations to determine the **volumes** of regular shaped solids
7. perform calculations to determine the value of **angles in a triangle**
8. apply **Pythagoras' Theorem** to right-angled triangle problems
9. interpret straight line graphs using given data
10. apply multiple prefix symbols appropriately

Range

degree of accuracy: decimals places, significant figures, fractions as a decimal quantity

areas of basic shapes: square, rectangle, triangle, circle

compound shapes: squares, rectangles, triangles, circles, semi-circles, quadrants of a circle

surface areas: cube, cylinder (curved surface area only)

volumes: cube, cylinder, rectangular prism

angles in a triangle: right-angled, isosceles, equilateral

Pythagoras' Theorem: definition, apply to solve problems

Unit 002

Engineering technology

Outcome 4

Be able to apply analytical methods to engineering science applications

Assessment Criteria

The learner can:

1. perform calculations to determine the value of a **force**
2. perform calculations to determine **work done** by a simple machine
3. perform calculations to determine **power** used
4. perform calculations to determine **energy** used
5. perform calculations to determine the **efficiency** of a machine
6. perform calculations to determine the turning **moment of a force**
7. perform calculations to determine the **relative density** of engineering materials
8. apply principles to determine simple electrical circuit problems
9. perform calculations to determine the **strength of engineering materials**
10. perform calculations to determine pressure
11. perform calculations to determine apply multiple prefix symbols appropriately

Range

force: definition, solve problems using formulae

work done: definition, solve problems using formulae

power: mechanical power, electrical power

energy: mechanical energy, electrical energy

efficiency: mechanical (power, energy), electrical (power, energy)

moment of a force: levers, torque

relative density: viscosity

strength of engineering materials: yield stress, tensile stress, percentage elongation, force/extension graph, stress/strain graph

Level: 2

Credit value: 7

NDAQ number: T/602/5877

Unit aim

This unit identifies the basic principles and commonly used processes that are required to most maintenance activities such as track renewals and maintenance. It covers routine maintenance requirements, components, tools and equipment that are commonly used and the ways in which they may be used or applied.

Learners are provided with an overview understanding of a wide range of engineering maintenance activities, terminology and practices that are needed as part of routine maintenance work.

Learning outcomes

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

- 1 use safe and effective working practices
- 2 select working methods, tools and equipment
- 3 use dismantling/assembly techniques for components/systems.

Guided learning hours

It is recommended that **70** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the following unit of the NVQ in Performing Engineering Operations Level 2:
Unit 68: General Maintenance Engineering Applications.

Support of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Assessment

A range of assessment methods are accepted like: practical demonstration, assignments and/or written examination.

Unit 003

Maintenance technology

Outcome 1

Use safe and effective working practices

Assessment Criteria

The learner can:

1. describe **safe working practices** and Health and Safety requirements
2. describe the **hazards** associated with maintenance activities
3. describe **information** from **sources**
4. describe types of **maintenance activities**
5. describe the factors to be considered when **planning** a maintenance activity
6. describe the procedures for **cleaning work areas** following a spillage or leakage
7. describe maintenance **diagnostic and fault location techniques** and aids used
8. describe methods and techniques used to **dismantle/re-assemble** equipment
9. describe the information required when completing a **maintenance report**

Range

safe working practices: wearing appropriate protective clothing and equipment, maintaining a clean and tidy work area, use of barriers and/or tapes, post warning signs, informing personnel of maintenance activities, system isolation procedures for power and pressure sources, permit-to-work procedures, preparing the work area, leaving the work area in a safe and clean condition

hazards: handling of oils and grease, misuses of tools, use of damaged or badly maintained tools, not following laid-down maintenance procedures and buried services

information sources: drawings, charts, tables, manufacturer's instructions, service manuals, drawings (orthographic, isometric, exploded views), technical specifications

maintenance activities: routine servicing schedules, planned/preventive maintenance, repair/replacement following breakdowns, monitoring and performance tests

planning: tools and equipment requirements, materials and replacement parts, importance of minimising downtime to avoid production loss, site conditions, component location, provision of services (electricity, water, drainage), method statements

cleaning work areas: approved waste disposal methods, absorbent substances, use of detergents and solvents

diagnostic and fault location techniques: evaluation using sensory information (sight, sound, smell, touch), diagnostic techniques (fault reports, visual checks, measurement, movement and alignment checks, testing), fault location techniques (half-split, input-to-output, function testing, unit substitution, equipment self-diagnostics), diagnostic aids (manuals, flow charts, troubleshooting guides, maintenance records)

dismantle/re-assemble: release of pressure/force, proof marking, extraction, pressing, alignment

maintenance report: description of work undertaken, location(s), date and times (commencement, completion, handover), parts and consumable used, test data, permit to work reference

Unit 003

Outcome 2

Maintenance technology

Select working methods, tools and equipment

Assessment Criteria

The learner can:

1. set-up **access equipment** for safe working
2. demonstrate safe **lifting techniques**
3. move a **heavy equipment** across a flat surface
4. describe types and methods for using **tools and equipment**
5. perform **measurement and alignment** using equipment
6. replace **life determined** items
7. describe the application of **lubricants**

Range

access equipment: equipment for lifting and moving such as: ladders, scaffolding, platforms, mobile hoists, temporary work ways, trolleys

lifting techniques: chains, rope and wire slings, hooks, shackles, eye bolts, methods of sling attachment to prevent damage to sling/machinery (protective padding, wooden blocks) estimation of approximate weight, use of manufacturer's data, centre of gravity of load, angle of splay between two leg sling chains not to exceed 120°, never exceed the safe working load (SWL), inspection records for lifting equipment are current, lifting equipment (screw and hydraulic jacks, overhead gantry cranes, mobile cranes, jib cranes, derricks, fork lift trucks, tripods, shackles, pulley blocks), road rail equipment

heavy equipment: rollers and skates, crowbars, pull-lifts, lubricated plates

tools and equipment: torque/impact wrenches, pipe wrenches, pipe cutting and threading, spanners and socket sets, drifts and wedges, extractors, feeler gauges, screw drivers, pliers, wire cutter/strippers

measurement and alignment: rules/tapes, micrometers, vernier instruments, ammeters, voltmeters, multi-meters, straight edges, squares, feeler gauges, plumb line, spirit level, piano wire, optical instruments, lasers, track gauges

life determined: high tensile bolts and washers, nylon insert nuts, locking devices, split pins, seals and gaskets

lubricants: friction between moving parts, wear, generation of heat, force required to overcome friction, methods of reduction (oils [mineral, synthetic, animal and vegetable] greases, copper compound, graphite), application (total loss, re-circulatory, splash, grease guns and nipples), reasons for oil deterioration (excessive heat, oxidation, contamination, breakdown of structure, poor storage conditions)

Unit 003

Outcome 3

Maintenance technology

Use dismantling/assembly techniques for components/systems

Assessment Criteria

The learner can:

1. **dismantle** an engineering device or system
2. **re-assemble** an engineering device or system
3. **restore the work area**
4. prepare a **report** following maintenance activities

Range

dismantle: procedure for isolation and locking off a device/system, sequence of operations used to dismantle/re-assemble a device/system, proof marking (aid re-assembly), correct storage procedures for removed parts, release of pressure/force, extraction (bearing extractors, hub pullers), diodes/transistors, fuses, printed circuit boards, mandrel presses, drifts, alignment, studs, bolts, screws, pins and dowels, keys, bearings and shafts, gears, couplings, springs, seals and gaskets, circlips, seals, gaskets, rivets; removal and refitting of: seals, gaskets, packings, grommets

re-assemble: laying out components parts in logical sequence to aid re-assembly, tensioning (belts, chains), dimensional accuracy and clearance of component (internal/external micrometers, vernier height gauges, dial test indicator, protractor, feeler gauges), components to discard and replace (high tensile bolts and washers, nylon insert nuts, locking devices, split pins, seals and gaskets), fitting of mating parts (filing, scraping locating, cleaning), need for the use of shims or packing, type and use of mechanical/electrical locking devices, tighten fastenings correctly (correct torque applied, correct tightening sequence)

restore the work area: leave the work area free of unused consumables, cleaning the work area, putting tools and equipment into safe storage, identifying and recording finished work

report: importance of completing a maintenance documentation following maintenance activities

Unit 004

Maintaining mechanical devices and equipment

Level: 2

Credit value: 7

NDAQ number: A/602/5878

Unit aim

This unit identifies the basic principles and commonly used processes that are required to maintain mechanical devices and equipment. It covers basic maintenance requirements, routine inspection, lubrication and service of mechanical devices and equipment. It further deals with dismantling and re-assembly of equipment and the replacement of 'life determined' items.

Learning outcomes

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

- 1 prepare for routine maintenance activities and dismantle devices and equipment
- 2 apply fault finding techniques
- 3 re-assemble mechanical devices and equipment

Guided learning hours

It is recommended that **70** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the following unit of the NVQ in Performing Engineering Operations Level 2:
Unit 19: Maintaining Mechanical Devices and Equipment.

Support of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Assessment

A range of assessment methods are accepted like: practical demonstration, assignments and/or written examination.

Unit 004

Maintaining mechanical devices and equipment

Outcome 1

Prepare for routine maintenance activities and dismantle devices and equipment

Assessment Criteria

The learner can:

10. demonstrate **safe working practices** and procedures for maintenance activities
11. describe the **hazards** associated with maintenance activities
12. produce a **plan** for a maintenance activity for a mechanical device
13. extract **information** from **sources**
14. select **tools and equipment** to undertake a maintenance operation
15. select appropriate **cleaning technique(s)**
16. **disassemble a mechanical devices and equipment**

Range

safe working practices: wearing appropriate protective clothing and equipment, maintaining a clean and tidy work area, use of barriers and/or tapes, post warning signs, informing personnel of maintenance activities, system isolation procedures for power and pressure sources, permit-to-work procedures, preparing the work area, leaving the work area in a safe and clean condition

hazards: handling of oils and grease, misuses of tools, use of damaged or badly maintained tools, not following laid-down maintenance procedures

plan: description of task, location(s), date and times (commencement, completion, handover), parts and consumables to be used, test data requirements, checks to be made, permits to work required, tools and equipment requirements, isolation/barrier requirements, sequence of operations for dismantle/re-assemble components

information sources: drawings, charts, tables, manufacturer's instructions, service manuals, drawings (orthographic, isometric, exploded views), job instructions

tools and equipment: spanners (open-ended, socket sets, ring), hammers and mallets, screwdrivers, pliers and grips, chisels, punches, drifts and wedges, nut splitters, stud extractors, measuring instruments (rules, tapes, micrometers, vernier height gauge and calipers, feeler gauges, dial test indicators), equipment checks (free from damage or defect, in a safe and usable condition, within calibration, configured correctly for the intended purpose), lifting equipment (screw and hydraulic jacks, mobile cranes, jib cranes, derricks, fork lift trucks, tripods, shackles, pulley blocks, estimation of approximate weight, use of manufacturers data, centre of gravity of load, angle of splay between two leg sling chains not to exceed 120°, never exceed the safe working load [SWL], inspection records for lifting equipment are current), methods of moving heavy equipment across flat surfaces (rollers, skates, crowbars, pull-lifts, lubricated plates), road rail equipment

cleaning techniques: dust (blow, vacuum), dirt (brushing, vacuum), grease (degreasing agents, solvents, steam, Health and Safety considerations)

disassemble a mechanical devices and equipment: proof marking (aid re-assembly), correct storage procedures for removed parts, release of pressure/force, extraction (bearing extractors, hub pullers), mandrel presses, drifts, alignment, studs, bolts, screws, pins and dowels, keys, bearings and shafts, gears, couplings, springs, seals and gaskets, circlips, seals, gaskets.

Unit 004 **Maintaining mechanical devices and equipment**

Outcome 2 Apply fault finding techniques

Assessment Criteria

The learner can:

1. assess devices and equipment for **common faults**
2. recognise **wear/damage** to component parts
3. deal with **problems encountered** during maintaining mechanical devices/equipment

Range

common faults: evaluation using sensory information (sight, sound, smell, touch), diagnostic techniques (fault reports, visual checks, measurement, movement and alignment checks, testing), fault location techniques (half-split, input-to-output, function testing, unit substitution, equipment self-diagnostics), diagnostic aids (manuals, flow charts, troubleshooting guides, maintenance records)

wear/damage: bearings and shafts, linkages, drive belts and chains, couplings, clutches, brakes, gearboxes, seals and gaskets, metal fractures, surface cracking, corrosion, excessive movement/clearance, leakage from seals and gaskets, excessive temperature of bearings, breaks and drives, vibration, overheating, out of balance, missing parts, loose fittings and connections

problems encountered: fastenings damaged during dismantling, components not easily parted, correct tools not available, unavailability of spares

Unit 004

Maintaining mechanical devices and equipment

Outcome 3

Re-assemble mechanical devices and equipment

Assessment Criteria

The learner can:

1. **re-assemble mechanical devices and equipment**
2. **restore the work area**
3. prepare a **report** following maintenance activities

Range

re-assemble mechanical devices and equipment: laying out components parts in logical sequence to aid re-assembly) tensioning (belts, chains), dimensional accuracy and clearance of component (internal / external micrometers, vernier height gauges, dial test indicator, protractor, feeler gauges), components to discard and replace (high tensile bolts and washers, nylon insert nuts, locking devices, split pins, seals and gaskets), fitting of mating parts may require filing or scraping, need for the use of shims or packing, type and use of locking devices, tighten fastenings correctly (correct torque applied, correct tightening sequence), lubrication requirements for a device/system (types of oil and grease, methods of application)

restore the work area: leave the work area free of unused consumables, cleaning the work area, putting tools and equipment into safe storage, identifying and recording finished work

report: importance of completing a maintenance documentation following maintenance activities

Appendix 1 Relationships to other qualifications

Literacy, language, numeracy and ICT skills development

This qualification includes opportunities to develop and practise many of the skills and techniques required for success in the following qualifications:

- Functional Skills (England) – see www.cityandguilds.com/functionalskills
- Essential Skills (Northern Ireland) – see www.cityandguilds.com/essentialskillsni
- Essential Skills Wales (from September 2010).

There might also be opportunities to develop skills and/or portfolio evidence if candidates are completing any Key Skills alongside this qualification.

Appendix 2 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on www.cityandguilds.com.

Centre Guide – Delivering International Qualifications contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve ‘approved centre’ status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Providing City & Guilds qualifications – a guide to centre and qualification approval contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve ‘approved centre’ status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Ensuring quality contains updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document contains information on:

- Management systems
- Maintaining records
- Assessment
- Internal verification and quality assurance
- External verification.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information such on such things as:

- ***Walled Garden***

Find out how to register and certificate candidates on line

- **Qualifications and Credit Framework (QCF)**

Contains general guidance about the QCF and how qualifications will change, as well as information on the IT systems needed and FAQs

- **Events**

Contains dates and information on the latest Centre events

Useful contacts

UK learners
General qualification information E: learnersupport@cityandguilds.com

International learners
General qualification information E: intcg@cityandguilds.com

Centres
Exam entries, Registrations/enrolment, Certificates, Invoices, Missing or late exam materials, Nominal roll reports, Results E: centresupport@cityandguilds.com

Single subject qualifications
Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change E: singlesubjects@cityandguilds.com

International awards
Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports E: intops@cityandguilds.com

Walled Garden
Re-issue of password or username, Technical problems, Entries, Results, GOLA, Navigation, User/menu option, Problems E: walledgarden@cityandguilds.com

Employer
Employer solutions, Mapping, Accreditation, Development Skills, Consultancy E: business_unit@cityandguilds.com

Publications
Logbooks, Centre documents, Forms, Free literature

If you have a complaint, or any suggestions for improvement about any of the services that City & Guilds provides, email:
feedbackandcomplaints@cityandguilds.com

**Published by City & Guilds
1 Giltspur Street
London
EC1A 9DD
F +44 (0)20 7294 2413
www.cityandguilds.com**

**City & Guilds is a registered charity
established to promote education
and training**