

Level 3 Diploma in Food and Drink Engineering Maintenance (1255-01)

August 2021 Version 2.2

Qualification Handbook

Qualification at a glance

Subject area	Engineering
City & Guilds number	1255-01
Age group approved	16-18, 19+
Entry requirements	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.
Assessment	Short answer question tests Assignments Online multiple choice test (to be taken through qualification 2382 and claimed by proxy)
Approvals	Full qualification approval required.
Support materials	Centre handbook
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates.

Title and level	GLH	TQT	City & Guilds number	Accreditation number
Level 3 Diploma in Food and Drink Engineering Maintenance	1320	2495	1255-01	603/0355/4

Version and date	Change detail	Section
1.0 August 2016	Final	All
1.1 September 2017	Added TQT details	Qualification at a glance and Structure
	Deleted QCF	Throughout
2.0 April 2019	Grading table contents	Assessment
	Various LO and AC content	Units
2.1 August 2021	Changes made to Unit 317	Structure Assessment Units
2.2 August 2021	Changes made to Unit 317	Structure Assessment Units

Contents

Qualification at a glance	2
Introduction	5
Structure	6
Total Qualification Time	7
2 Centre requirements	8
Approval	8
Internal quality assurance	8
Resource requirements	9
Learner entry requirements	9
3 Delivering the qualification	10
Initial assessment and induction	10
Support materials	10
4 Assessment	11
Summary of assessment methods	11
Grading	13
Test specifications	14
5 Units	16
Unit 301 Food and drink engineering maintenance compliance	17
Unit 302 Food and drink engineering maintenance best practice	21
Unit 303 Materials science	25
Unit 304 Mechanical maintenance in food and drink operations	27
Unit 305 Producing replacement components for food and drink operations	30
Unit 306 Fluid power systems for food and drink operations	34
Unit 307 Welding technologies for food and drink operations	37
Unit 308 Electrical maintenance in food and drink operations	41
Unit 309 Services and utilities within food and drink operations	45
Unit 310 Thermodynamics	48
Unit 311 Maths for food and drink engineering maintenance	51
Unit 312 Monitoring mechanical maintenance for food and drink operations	55
Unit 313 Repairing and producing replacement components in food and drink operations	58
Unit 314 Welding skills for food and drink operations	61
Unit 315 Electrical maintenance and testing in food and drink operations	64
Unit 316 Automation in food and drink operations	69
Unit 817 Understand the requirements of electrical installations BS7671:2018	72
Appendix 1 Sources of general information	76

Introduction

This document tells you what you need to do to deliver the qualifications:

Area	Description
Who is are the qualifications for?	This Diploma qualification is for learners taking a Food and Drink Maintenance Engineer apprenticeship.
What do the qualifications cover?	The qualification covers the knowledge, understanding and skills required of an apprentice Food and Drink Maintenance Engineer.
What opportunities for progression are there?	It allows learners to progress into following: <ul style="list-style-type: none">• Higher Apprenticeship in Advanced Manufacturing Engineering• Foundation Degrees in Engineering• City and Guilds Level 4 Diploma in Engineering
Who did we develop the qualification with?	The qualification was developed in conjunction with Food and Drink Maintenance Engineer employers.
Is it part of an apprenticeship framework or initiative?	This qualification is a mandatory requirement of the Food and Drink Engineering Maintenance Apprenticeship.

Structure

To achieve the **Level 3 Diploma in Food and Drink Engineering Maintenance** learners must achieve 11 mandatory units 301-311. In addition, learners must achieve the relevant pathway units:

Mechanical pathway units 312-314

Multi-skilled pathway units 315, 316 and Proxy unit 817.

Level 3 Diploma in Food and Drink Engineering Maintenance (1255-01)

UAN	City & Guilds unit number	Unit title	GLH
Mandatory			
K/507/9800	301	Food and drink engineering maintenance compliance	70
M/507/9801	302	Food and drink engineering maintenance best practice	95
T/507/9802	303	Materials science	70
A/507/9803	304	Mechanical maintenance in food and drink operations	80
F/507/9804	305	Producing replacement components for food and drink operations	210
J/507/9805	306	Fluid power systems for food and drink operations	95
L/507/9806	307	Welding technologies for food and drink operations	95
R/507/9807	308	Electrical maintenance in food and drink operations	120
Y/507/9808	309	Services and utilities within food and drink operations	95
D/507/9809	310	Thermodynamics	80
R/507/9810	311	Maths for food and drink engineering maintenance	100
Mandatory		Mechanical pathway	
Y/507/9811	312	Monitoring for mechanical maintenance in food and drink operations	70
D/507/9812	313	Repairing and producing replacement components in food and drink operations	60
H/507/9813	314	Welding skills for food and drink operations	80
Mandatory		Multi-skilled pathway	
K/507/9814	315	Electrical maintenance and testing in food and drink operations	145
T/507/9816	316	Automation in food and drink operations	120
	817	Understand the requirements of electrical installations BS7671 (Proxy Unit)	40

Total Qualification Time

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 3 Diploma in Food and Drinks Maintenance (Mechanical pathway)	1320	2495	2473-02	603/0355/4
Level 3 Diploma in Food and Drinks Maintenance (Multi-skilled pathway)	1415	2560		

2 Centre requirements

Approval

To offer this qualification existing centres will need to gain full qualification approval. New centres will need to gain both centre and qualification approval. Please refer to the *City & Guilds Centre Manual* for further information.

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

Internal quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications.

Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance.

Internal Quality Assurance requirements

Staff must:

- have experience in quality management/internal verification
- or
- hold or be working towards an appropriate internal quality assurance qualification
- and
- be familiar with the occupation and technical content covered within the qualification
- be familiar with the Engineering Technician (UK spec) requirements where delivering/assessing Level 3, they will be required to provide a signed declaration confirming they have read and understood the Engineering Technician UK spec and the evidence requirements to meet the engineering technician (UK spec) criteria.

Teacher/Trainer/Lecturer/Assessor requirements

Staff must:

- have relevant experience in teaching/training/assessing
- or
- hold or be working towards an appropriate teaching/training/assessing qualification
- and
- be technically knowledgeable in the area(s) for which they are delivering training/assessing, with appropriate qualifications
- be familiar with the Engineering Technician (UK spec) requirements where delivering/assessing Level 3, they will be required to provide a signed declaration confirming they have read and understood the Engineering Technician UK spec and the evidence requirements to meet the engineering technician (UK spec) criteria.

Full details and guidance on the internal and external quality assurance requirements and procedures are provided in the *Centre Manual – Supporting Customer Excellence*, which can be found on the centre support pages of **www.cityandguilds.com**. This document also explains the tasks, activities and responsibilities of quality assurance staff.

Resource requirements

Centre staffing

Staff delivering the qualification must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Learner entry requirements

City & Guilds does not set entry requirements for the qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualifications successfully.

Age restrictions

City & Guilds cannot accept any registrations for candidates under 16 as these qualifications are not approved for under 16s.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualifications
- any units they have already completed, or credit they have accumulated which is relevant to the qualifications
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for these qualifications:

Description	How to access
Recording documents	www.cityandguilds.com

Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems, including our own, **Learning Assistant**, an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualifications. Further details are available at: www.cityandguilds.com/eportfolios.

4 Assessment

Summary of assessment methods

Candidates must successfully complete the designated assessment for each unit.

There are **three** assessment methods used for this qualification.

Assessment method	Description
Assignment	<p>These are set by City & Guilds and marked internally. Centres will be allowed to amend the assignment within certain parameters to ensure it is appropriate to the organisation where the apprentice works.</p> <p>Units 302 and 309 are assessed using this method and graded Fail/Pass. All other units assessed using this method will be graded Fail/Pass/Merit/Distinction.</p>
Short answer question tests	<p>City & Guilds externally set SAQs. These are internally marked by the centre.</p> <p>Units assessed using this method will be graded Fail/Pass/Merit/Distinction.</p>
Online multiple choice test	<p>City & Guilds externally set and mark online multiple choice tests. These are available on demand through the Electrical Installations (2382) qualification.</p> <p>This assessment is graded Pass/Fail.</p>

Assessment Types

Unit	Title	Assessment method	Grading	Where to obtain assessment materials
301	Food and drink engineering maintenance compliance	Short answer question test	PMDX	www.cityandguilds.com
302	Food and drink engineering maintenance best practice	Assignment	PX	www.cityandguilds.com
303	Materials science	Short answer question test	PMDX	www.cityandguilds.com
304	Mechanical maintenance in food and drink operations	Assignment	PMDX	www.cityandguilds.com
305	Producing replacement components for food and drink operations	Assignment	PMDX	www.cityandguilds.com
306	Fluid power systems for food and drink operations	Assignment	PMDX	www.cityandguilds.com
307	Welding technologies for food and drink operations	Assignment	PMDX	www.cityandguilds.com
308	Electrical maintenance in food and drink operations	Assignment	PMDX	www.cityandguilds.com
309	Services and utilities within food and drink operations	Assignment	PX	www.cityandguilds.com
310	Thermodynamics	Short answer question test	PMDX	www.cityandguilds.com
311	Maths for food and drink engineering maintenance	Short answer question test	PMDX	www.cityandguilds.com
312	Monitoring for mechanical maintenance in food and drink operations	Assignment	PMDX	www.cityandguilds.com
313	Repairing and producing replacement components in food and drink operations	Assignment	PMDX	www.cityandguilds.com
314	Welding skills for food and drink operations	Assignment	PMDX	www.cityandguilds.com
315	Electrical maintenance and testing in food and drink operations	Assignment	PMDX	www.cityandguilds.com
316	Automation in food and drink operations	Assignment	PMDX	www.cityandguilds.com
817	Understand the requirements of electrical installations BS7671 (Proxy Unit)	Online multiple choice test	PX	e-volve online platform

Grading

All assessment must be achieved at a minimum pass for the qualification to be awarded. Grades above Pass are only considered when all units are achieved at Pass. The grades awarded for the units are converted to points. The points available for each assessment are shown in the following table:

	Pass	Merit	Distinction
Short answer question test (301, 303, 310-311)	4	6	8
Online multiple choice test (817 proxy unit)	4	-	-
Assignment (302, 309)	4	-	-
Assignment (305 – 308, 312 – 316)	4	6	8

The candidate's points for each assessment are added together, and the overall grade of the **Level 3 Diploma in Food and Drink Engineering Maintenance** will then be determined using the following criteria.

Mechanical Pathway

Multi-skilled Pathway

Qualification Grade	Minimum points	Qualification Grade	Minimum points
Distinction	100	Distinction	96
Merit	76	Merit	74
Pass	56	Pass	56

Test specifications

The way the knowledge is covered by each test is laid out in the tables below:

Test: 301		
Duration: 2 hours		
Outcome	Number of questions	%
1 understand health and safety requirements	6	21
2 understand environmental requirements	5	21
3 understand safe working practices and procedures	8	36
4 understand how to use engineering information to ensure compliance	5	22
Total	24	100

The grade boundaries for this test will be approximately:

Pass: 60%

Merit: 70%

Distinction: 80%

Test: 303		
Duration: 2 hours		
Outcome	Number of questions	%
1 understand the properties of materials used in food and drink operations	7	37.5
2 understand why engineering materials fail	6	30
3 understand suitability of engineering materials for food and drink operations	6	32.5
Total	19	100

The grade boundaries for this test will be approximately:

Pass: 50%

Merit: 69%

Distinction: 87%

Test: 310		
Duration: 2 hours and 30 minutes		
Outcome	Number of questions	%
1 understand the principles of heat transfer and energy conservation	8	28
2 understand the operation of heat exchange equipment	7	28
3 understand principles of fluid flow	4	16
4 understand the operation of systems transporting and controlling fluids in a pipeline system	7	28
Total	25	100

The grade boundaries for this test will be approximately:

Pass: 50%

Merit: 60%

Distinction: 70%

Test: 311		
Duration: 2 hours		
Outcome	Number of questions	%
1 be able to use arithmetic methods to solve engineering problems	6	26
2 be able to use algebra to solve engineering problems	7	28
3 be able to use trigonometry to solve engineering problems	7	31
4 be able to use statistical methods to display data	3	15
Total	23	100

The grade boundaries for this test will be approximately:

Pass: 40%

Merit: 58%

Distinction: 75%

These boundaries may be subject to slight variation to ensure fairness should any variations in the difficulty of the test be identified.

5 Units

Availability of units

All units relating to this qualification can be found in this document.

Unit 301

Food and drink engineering maintenance compliance

UAN:	K/507/9800
Level:	Level 3
GLH:	70
Aim:	This unit is concerned with the requirements that are essential to enable food and drink engineering maintenance activities to be carried out safely and effectively in compliance with organisational, national and international standards, where appropriate. It includes dealing with statutory and organisational requirements in accordance with approved regulations, codes of practice and procedures and the use of engineering information and covers responsibilities relating to accident reporting and the identification of hazards and risks.

Assessment type Short answer question test

Learning outcome:

The learner will:

1. understand health and safety requirements

Assessment criteria

The learner can:

- 1.1 describe the health and safety **regulations** applicable to food and drink engineering maintenance operations
- 1.2 state the roles, responsibilities and powers of **health and safety personnel**
- 1.3 explain **employers' responsibilities** to maintain health and safety
- 1.4 explain how the **management of health and safety** regulations are implemented
- 1.5 state the general rules for the observance of **safe practices**
- 1.6 explain the implications of documentary requirements
- 1.7 explain the Reportable Diseases and Dangerous Occurrences Regulations (**RIDDOR**) relevant to food and drink engineering maintenance
- 1.8 explain the procedures for **reporting accidents**
- 1.9 describe the Manual Handling Operations Regulations as they apply to engineering industries.

Range

Regulations

Health and Safety at Work Act, Control of Substances Hazardous to Health Regulations (COSHH), Provision and Use of Work Equipment Regulations (PUWER), Electricity at Work Regulations, Control of Major Accident Hazards Regulations (COMAH), Control of Noise at Work Regulations, Lifting Operations and Lifting Equipment Regulations (LOLER), Manual Handling Operations Regulations

Health and safety personnel

Health and Safety Advisors, Health and Safety Representatives, Health and Safety Executive Inspectors, Environmental Health Officers

Employers' responsibilities

Safe: place of work, plant and equipment, system of work, working environment, methods of handling, storing and transporting goods and materials; to employees, to visitors

Management of Health and Safety

Including the four C's of positive health and safety (Competence, Control, Co-operation, Communication)

Safe practices

Be alert, maintain personal hygiene, protect yourself and other people, know emergency procedures, report all hazards

RIDDOR

Information, instruction, training and supervision of employees, a health and safety policy

Reporting accidents

Summary of accident, name of victim(s), summary of events prior to accident, details of witnesses, information on injury or loss sustained, conclusions, recommendations, supporting material (photographs, video), diagrams, date, signature of person(s) responsible for report

Learning outcome

The learner will:

2. understand environmental requirements

Assessment criteria

The learner can:

- 2.1 analyse the relationship between the **human and environmental conditions** in the workplace
- 2.2 explain how risks from **human and environmental conditions** are **controlled** in the workplace
- 2.3 analyse the implications of Environmental Management Systems standard ISO 14001 to food and drink operations
- 2.4 analyse the implications of **environmental legislation** to food and drink operations
- 2.5 identify the **signs and nomenclature** used for environmental issues.

Range

Human conditions: lack of management control, carelessness; improper behaviour and dress; lack of training, supervision and experience; fatigue; drug-taking and alcohol intake

Environmental conditions: unguarded or faulty machinery or tools; inadequate ventilation; untidy, dirty, overcrowded workplace; inadequate lighting

Controlled

Eliminate the hazard, replace the hazard with something less dangerous, guard the hazard, personal protection, health and safety education and publicity

Environmental legislation

Environmental Protection Act, Pollution Prevention and Control Act, Clean Air Act, Radioactive Substances Act, Controlled Waste Regulations, Dangerous Substances and Preparations and Chemicals Regulations, Hazardous Waste Regulations

Signs and nomenclature

Warning, prohibition, mandatory, information

Learning outcome

The learner will:

3. understand safe working practices and procedures

Assessment criteria

The learner can:

- 3.1 describe the range of Personal Protective Equipment (PPE) available and relate its use to the operations that will be undertaken
- 3.2 explain the Respiratory Protective Equipment (RPE) used when undertaking tasks involving exposure to **hazardous substances**
- 3.3 **assess health and safety risks**
- 3.4 explain the purpose and methods of use of **accessories** to lifting gear
- 3.5 explain the necessity of a **permit to work** procedure
- 3.6 describe the **safety systems** in place on machinery
- 3.7 describe isolation procedures
- 3.8 state situations in which it is unadvisable or unsafe to **work in isolation**
- 3.9 explain the **health and safety procedures** that prevent injury or discomfort to skin, eyes, hands and limbs
- 3.10 explain **extraordinary hazards** that lead to an emergency situation in a food and drink operations
- 3.11 describe the statutory requirements for **maintenance of equipment** in food and drink operations.

Range

Hazardous substances

Chemicals and solvents, fumes, dust or harmful particulates, heat

Assess health and safety risks

Identify hazards, evaluate risk, control measures to mitigate risk

Accessories

Hooks, slings, eyebolts, shackles, chains, rings, special-to-purpose equipment, rules for the use of slings

Permit to work

Purpose, description, content, types (including: 'hot working', electrical, maintenance operations, pressure testing), procedure for use

Safety systems

Guards, emergency stops, safety relays, interlocks and switches

Work in isolation

In confined spaces, above ground or in trenches, in close proximity to unguarded machinery, when a fire risk exists, with toxic or corrosive substances, on site

Health and safety procedures

Personal hygiene, skin protection and care, care of eyes, use of eye and face protectors which are to current EN specifications, use of respirators, dangers of hair and loose clothing getting caught in machinery, means of avoiding such dangers, benefits and use of protective clothing, use of safety guards, screens and fences

Extraordinary hazards

Ammonia, terrorist threat (trespass, exploding devices, poisons, cyber), sabotage, drowning, hypoxia

Maintenance of equipment

Specialist equipment (eg xray machines, metal detector and checkweigher), limits of own authority to carry out certain activities (eg working with electrical equipment)

Learning outcome

The learner will:

4. understand how to use engineering information to ensure compliance

Assessment criteria

The learner can:

- 4.1 describe the **sources** of standards
- 4.2 explain how **engineering information** is used for food and drink engineering maintenance activities
- 4.3 analyse implications of **information management** to food and drink operations
- 4.4 explain the importance of analysing all compliant **engineering information** before decisions are made
- 4.5 explain **procedures** for dealing with **issues** associated with engineering information.

Range

Sources

Legal, company, manufacturers', industry, customer

Engineering information

Drawings, change control documentation, risk assessments, engineering product data sheets, manufacturers' manuals, production schedules, inspection and calibration requirements, permits to work, standard operating procedures, reference charts, method statements, Critical Control Points (CCP)

Information management

Physical security, change control, storage, access authorisation, data protection, commercial confidentiality, security rating, cyber risks, ensuring validity

Procedures

Reporting, change control, authorisation and archiving

Issues

Discrepancies, loss, damage, currency

UAN:	M/507/9801
Level:	Level 3
GLH:	95
Aim:	This unit develops in learners the understanding of engineering maintenance best practice in food and drink operations. It includes an understanding of different types of maintenance and how to plan maintenance of equipment for food and drink operations. It also includes an understanding of fault finding and measurement.
Assessment type	Assignment

Learning outcome:

The learner will:

1. understand types of maintenance used in food and drink operations

Assessment criteria

The learner can:

- 1.1 describe different **types of maintenance**
- 1.2 explain the **purpose** of maintenance
- 1.3 describe types of **engineered systems** used in food and drink operations
- 1.4 describe the **plant and equipment** used in food and drink operations
- 1.5 explain how frequency of maintenance affects **production**
- 1.6 explain the **costs** of maintenance for an engineered system
- 1.7 calculate maintenance costs for an engineered system
- 1.8 justify planned maintenance for a specified **engineered system**
- 1.9 describe factors affecting reliability of components and equipment
- 1.10 explain how the use of **technology** leads to efficiency and quality in maintenance
- 1.11 explain how to set up a line.

Range

Types of maintenance

Planned, total preventative (TPM), breakdown, scheduled, shutdown, reactive, preventative, corrective, emergency, post fault, scheduled, modification, condition-based

Purpose

Plant reliability and availability, improved quality of output, cost effectiveness, improved safety, legal requirements, reduced environmental damage, food safety

Engineered systems

Process monitoring and control, mechanical, fluid power, electrical, environmental

Plant and equipment

Gearboxes, pumps, engines, machine tools, lifting and handling equipment, valves, mechanical structures, motors, starters, switchgear, distribution panels

Production

Downtime, operating performance, product quality, customer service, effects on related equipment, systems and plant, secondary damage

Costs

As a proportion of total expenditure, use of frontline maintenance, maintenance contracting, lost production, financial penalties, stock control, equipment hire, safety and environmental costs

Technology

Administrative eg Computerised Maintenance Management Systems (CMMS), process eg sensors, testing eg self diagnosis

Learning outcome

The learner will:

2. be able to plan maintenance for engineered systems in food and drink operations

Assessment criteria

The learner can:

- 2.1 explain the **content** of a maintenance plan
- 2.2 explain the requirements for communicating maintenance plans
- 2.3 describe planning techniques
- 2.4 describe **monitoring techniques**
- 2.5 explain the use of **monitoring data**
- 2.6 analyse monitoring data
- 2.7 calculate failure rates for components and equipment
- 2.8 interpret manufacturers' manuals for maintenance requirements of system components.

Range

Content

Tools and equipment, timelines, waste disposal, safety requirements, activities required, food safety requirements and considerations, communication, reporting and documentation, permissions, costs, handover

Monitoring techniques

Condition, scheduled overhaul, routine servicing, hazard studies, failure mode effect analysis (FMEA), self-diagnosis

Monitoring data

Operational characteristics, output quality, throughput, environmental conditions, collection points, laboratory testing data

Learning outcome

The learner will:

3. understand fault finding techniques

Assessment criteria

The learner can:

- 3.1 explain the importance of root cause identification and analysis in fault finding
- 3.2 describe models of root cause analysis
- 3.3 explain the risks of running equipment with faults
- 3.4 explain fault investigation procedures
- 3.5 describe how **information** is used for fault finding
- 3.6 assess the suitability of **fault-finding techniques** in **engineered systems**
- 3.7 describe procedures for use of **aids** with fault diagnosis
- 3.8 describe procedures for use of **equipment** with fault diagnosis
- 3.9 explain processes used to assess equipment when fault finding.

Range

Information

From operators, monitoring equipment, recording devices, sensory, plant and/or machinery records, condition of the end product, laboratory data

Fault finding techniques

Half-split, emergent problem sequence, six point, equipment self diagnostics, function/performance testing, injection and sampling, input/output, unit substitution, automation

Engineered systems

Mechanical, electrical/electronic, fluid power

Aids

Manufacturers' manuals, algorithms, probability charts/reports, equipment self diagnostics, circuit diagrams/specifications, logic diagrams, flow charts, fault analysis charts, troubleshooting guides

Equipment

Mechanical measuring instruments, electrical/electronic measuring instruments, fluid power test equipment

Learning outcome

The learner will:

4. understand the importance of measurement in maintenance

Assessment criteria

The learner can:

- 4.1 describe the purposes of measurement
- 4.2 describe the effects of the environment on measurement
- 4.3 describe the effect of datum selection on measurement
- 4.4 describe the applications of **measuring equipment**
- 4.5 assess the suitability of **measuring equipment** for the required measurement
- 4.6 describe the importance of measuring equipment **condition**
- 4.7 explain the importance of sampling in measurement.

Range

Measuring equipment

Micrometers, Verniers, gauges, dial test indicators, coordinate measurement machines, multimeters, electrical test equipment, insulation tester

Condition

Damage, calibration, safe, useable

UAN:	T/507/9802
Level:	Level 3
GLH:	70
Aim:	This unit develops in learners an understanding of the behaviour of materials. This supports the learner in selecting the most appropriate material to satisfy requirements for different types of food and drink operations.

Assessment type Short answer question test

Learning outcome:

The learner will:

1. understand the properties of materials in food and drink operations

Assessment criteria

The learner can:

- 1.1 describe the **properties** of **materials**
- 1.2 describe the **structure** of **materials**
- 1.3 explain how the materials' structures create their **properties**
- 1.4 explain the effects of **processing** on the **properties** of **materials**
- 1.5 explain how processing of materials affects **food and drink operations**.

Range

Properties

Strength (compressive, tensile), hardness, toughness, ductility, malleability, elasticity, plasticity, conductivity, absorption (shock, sound), density, melting temperature, permeability, viscosity, thermal expansion, corrosive, resistivity

Materials

Low carbon steel, high carbon steel, stainless steel, aluminium, brass, bronze, specialist steels, alloys, plastic/synthetics, composites, lubricants, ceramics, copper

Structure

Periodic table, atomic structure, molecular structure, bonding mechanisms, structure (lattice, grain, crystals)

Processing: heat, alloying, cutting, joining, forming, welding, moulding, injection, sintering, cooling, coating, heat treatments

Food and drink operations: food safety, final product quality

Learning outcome

The learner will:

2. understand why engineering materials fail

Assessment criteria

The learner can:

- 2.1 explain the **causes** of engineering materials **failure**
- 2.2 explain the symptoms of engineering materials **failure**
- 2.3 explain how **methods of testing** show engineering materials **failure**
- 2.4 evaluate the results of tests on engineering materials.

Range

Causes: chemical, physical, design

Failure: fracture, fatigue, creep

Methods of testing: destructive (tensile, shear, hardness, toughness), non-destructive (visual, penetrant, radiographic, magnetic powder)

Learning outcome

The learner will:

3. understand the suitability of engineering materials for food and drink operations

Assessment criteria

The learner can:

- 3.1 describe the food and drink production applications of engineering **materials**
- 3.2 explain how **properties** of engineering **materials** support their application
- 3.3 explain **factors** affecting selection of engineering **materials**
- 3.4 identify criteria from **engineering information** for assessing the suitability of engineering materials for an application
- 3.5 select engineering **materials** for specific food and drink operations applications.

Range

Materials: carbon steel, stainless steel, aluminium, brass, bronze, specialist steels, alloys, plastic/synthetics, composites, lubricants, ceramics, copper

Properties: strength (compressive, tensile), hardness, toughness, ductility, malleability, elasticity, plasticity, conductivity, absorption (shock, sound), density, melting temperature, permeability, viscosity, thermal expansion, corrosive, resistivity

Factors: application, properties, environment, availability, costs, food safety

Engineering information: standard specifications (British Standards (BS), European Standards (EN), International Standards (ISO)), manufacturers' information (data sheets, catalogues, websites)

UAN:	A/507/9803
Level:	3
GLH:	80
Aim:	The aim of this unit is for learners to develop the knowledge and skills required to maintain mechanical systems and equipment in food and drink operations. They will learn the importance of maintaining health and safety and food safety throughout the process and the requirements, processes and equipment available to ensure they work safely throughout all maintenance activities. They will learn to use a range of maintenance techniques and procedures and how to apply these in different food and drink operations. They will also learn about how to record maintenance activities, and how to refer issues beyond their authority to the relevant personnel.

Assessment type Assignment

Learning outcome

The learner will:

1. understand the operation of mechanical equipment for food and drink operations

Assessment criteria

The learner can:

- 1.1 explain methods used to **control hygiene** food safety risks when undertaking mechanical maintenance activities
- 1.2 explain the **implications** of carrying out mechanical maintenance activities within a food and drink operation
- 1.3 explain the methods used to transmit movement between different **types of motion**
- 1.4 explain the methods used to change direction of transmitted movement
- 1.5 explain the application of **mechanical systems**
- 1.6 explain the function of **mechanical components**
- 1.7 explain the relationship between mechanical and electrical components in a system
- 1.8 describe maintenance **checks**
- 1.9 describe organisational procedures for safe disposal of **waste**.

Range

Control

Prevent, eliminate, reduce

Implications

For food safety, production efficiency

Types of motion

Rotary, linear, reciprocating, oscillating

Mechanical systems

Gears and gear drives, valves, pumps, cams and followers, chain and belt drives, clutches and brakes, transmission shafts

Mechanical components

Gears, shafts, bearings, seals, permanent fasteners, temporary fasteners, springs, cams, followers, casings

Checks

Fault reports, visual checks, measuring, movement and alignment checks, testing

Waste

Parts, lubricants, product, packaging, disposables, consumables

Learning outcome

The learner will:

2. be able to prepare for mechanical maintenance activities

Assessment criteria

The learner can:

- 2.1 interpret **engineering information**
- 2.2 follow maintenance schedules
- 2.3 plan mechanical maintenance activities to minimise disruption to food and drink production operations
- 2.4 communicate planned activities to relevant stakeholders to meet organisational requirements
- 2.5 plan how food safety risks will be **controlled** when carrying out mechanical maintenance activities
- 2.6 **plan** mechanical maintenance activities
- 2.7 assess hazards and associated risks
- 2.8 ensure the safe isolation of **equipment**
- 2.9 prepare work area for mechanical maintenance activities
- 2.10 select equipment and materials for mechanical maintenance activities
- 2.11 assess condition of equipment and materials for mechanical maintenance activities
- 2.12 prepare equipment and materials for mechanical maintenance activities
- 2.13 select consumables for mechanical maintenance activities
- 2.14 **document** preparation activities.

Range

Engineering information

Drawings, specifications, schematics, manufacturers' manuals, data sheets, retailers' standards, operational records, standard operating procedures

Controlled

Prevent, eliminate, reduce

Plan

Location, date and time, parts to be used, tests required, testing points, checks to be made, permits to work required, tools and equipment required, sequence of operations, provision for waste, communications required

Equipment

Mechanical, electrical, fluid

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

3. be able to maintain mechanical equipment

Assessment criteria

The learner can:

- 3.1 control food safety risks when carrying out mechanical maintenance activities
- 3.2 apply safe working practices when carrying out mechanical maintenance activities
- 3.3 use **maintenance procedures** on **mechanical systems**
- 3.4 comply with **requirements** for maintenance activities
- 3.5 **record** completed maintenance activities
- 3.6 handover equipment for operation.

Range

Maintenance procedure

Draining, dismantling, setting, lubricating, replacing, checking, marking/labelling, functional testing, validation

Mechanical systems

Levers and linkage mechanisms, gears and gear drives, valves, pumps, cams and followers, chain and belt drives, clutches and brakes, transmission shafts

Requirements

Company guidelines and codes of practice, equipment manufacturers' operation range, BS, ISO and/or BSEN standards

Record

Job cards, permits to work/formal risk assessment and/or sign on/off procedure, maintenance log or report, company specific documentation, issues with completion of maintenance activities

Unit 305

Producing replacement components for food and drink operations

UAN:	F/507/9804
Level:	Level 3
GLH:	210
Aim:	This unit develops the understanding and skills required to produce mechanical components. This will involve the development of skills associated with milling, turning, fitting and grinding to produce components for maintenance of food and drink operations.
Assessment type	Assignment

Learning outcome:

The learner will:

1. understand producing replacement component activities

Assessment criteria

The learner can:

- 1.1 explain the **implications** of carrying out machining activities for a food and drink operation
- 1.2 explain methods used to **control** food safety risks when producing replacement components
- 1.3 describe the **operation of equipment**
- 1.4 explain methods used to prevent damage to **equipment**
- 1.5 assess the suitability of **tools** for an application
- 1.6 explain how **tools** achieve desired outcomes
- 1.7 explain how to prevent damage to **tools**
- 1.8 describe **principles** of cutting tool geometry
- 1.9 assess the suitability of work holding devices for the material used
- 1.10 explain the methods used to produce a **thread**
- 1.11 describe the purpose of different **types of thread**
- 1.12 explain the **factors** that affect cutting feeds and speeds and depth of cut that can be taken
- 1.13 **calculate** speeds and feeds
- 1.14 explain how different **types of repair** affect the lifecycle of components
- 1.15 explain the application of cutting fluids for different **materials** and **processes**
- 1.16 explain the types of **fit** required for different activities
- 1.17 explain how abrasive wheels regulations apply to grinding activities
- 1.18 describe types and applications of grinding wheels
- 1.19 explain when wheels require balancing
- 1.20 analyse causes of defects in components
- 1.21 explain how emerging technologies contribute to producing replacement components in food and drink operations.

Range

Implications

For food safety, production efficiency

Control

Prevent, eliminate, reduce

Operation

Features, application

Equipment

Lathes, milling machines, grinders (pedestal, universal, portable, hand), power saws

Tools

Work holding devices, cutting tools, milling tools, grinding wheels, saws, files, chucks, drills, taps, reamers

Principles

Planes, angles, vector analysis

Thread

Internal, external

Types of thread

Vee form, square, acme, multi-start

Factors

Rigidity, machine conditions, type and size of tooling used, type of materials

Calculate

Based on type of materials, based on type of tool

Types of repair

Reforming surface by adding metal, rework surface finish, sleeving worn components, cutting new keyways, bushing worn holes, replacement of internal threads, shimming, plugging holes, filling cracks

Materials

Non-metallic, non-magnetic, steel

Processes

Milling, turning, fitting, grinding

Fit

Clearance, transition, interference

Learning outcome:

The learner will:

2. be able to prepare for producing replacement components in food and drink operations

Assessment criteria

The learner can:

- 2.1 interpret **engineering information**
- 2.2 establish maintenance requirements
- 2.3 plan machining and fitting activities to minimise disruption to food and drink production operations
- 2.4 communicate planned activities to relevant stakeholders to meet organisational requirements
- 2.5 plan how machining and fitting activities will be undertaken to **control** food safety risks
- 2.6 **plan** maintenance work to be carried out
- 2.7 produce working sketch of components
- 2.8 assess hazards and associated risks
- 2.9 prepare work area for machining and fitting activities
- 2.10 select **materials, tools and equipment** for machining and fitting activities
- 2.11 assess condition of **materials, tools and equipment** for machining and fitting activities
- 2.12 **prepare work holding devices and equipment** for machining and fitting activities
- 2.13 **document** preparation activities.

Range

Engineering information

Drawings, sketches, sample or damaged component to be replaced, manufacturers' specifications, company policies and procedures for repair, maintenance log, asset register, standard operating procedures

Control

Prevent, eliminate, reduce

Plan

Location, date and time, parts to be used, tests required, testing points, checks to be made, permits to work required, tools and equipment required, sequence of operations, provision for waste, communications required

Materials

Non-metallic, non-magnetic, steel

Tools

Work holding devices, cutting tools, milling tools, grinding wheels, saws, files, chucks, drills, taps, reamers

Equipment

Lathes, milling machines, grinders (pedestal, hand), power saws, measuring equipment

Prepare work holding devices and equipment

Set work holding device, set tooling, calibrate measuring equipment, calculate speeds and feeds, sharpen tools

Document

Risk assessment, production plan

Learning outcome

The learner will:

3. be able to produce components in food and drink operations

Assessment criteria

The learner can:

- 3.1 **control** food safety risks when carrying out machining and fitting activities
- 3.2 apply **machining and fitting processes**
- 3.3 apply safe working practices when carrying out machining and fitting activities
- 3.4 produce **features** in components to **required standard**
- 3.5 select appropriate measuring instruments
- 3.6 measure **accuracy** of component features
- 3.7 use machine controls in line with operational procedures
- 3.8 adjust machine tools and feeds
- 3.9 use **hand fitting methods**
- 3.10 produce components in **different materials**
- 3.11 **record** completed maintenance activities
- 3.12 handover equipment for operation.

Range

Machining and fitting processes

Milling, turning, drilling, grinding

Features

External diameters, internal diameters, flat faces, parallel faces, steps/shoulders, angular/tapered surfaces, threads, slots/recesses, drilled holes, bored holes, reamed holes

Required standards

Components to be free from false tool cuts, burrs and sharp edges, general dimensional tolerance of $\pm 0.25\text{mm}$ (0.004"), reamed holes within H8, surface finish $63\mu\text{in}$ or $1.6\mu\text{m}$

Accuracy

Dimensions, geometric features

Hand fitting methods

Filing, sawing, drilling, marking out

Different materials

Non-metallic, non-magnetic, steel

Record

Job cards, permits to work/formal risk assessment and/or sign on/off procedure, maintenance log or report, company specific documentation, issues with completion of maintenance activities

UAN:	J/507/9805
Level:	Level 3
GLH:	95
Aim:	This unit enables the learner to develop the skills and understanding required for the maintenance of pneumatic, hydraulic and electro-pneumatic fluid power systems. It covers the procedures and techniques involved assembling, testing and maintaining fluid power systems.
Assessment type	Assignment

Learning outcome:

The learner will:

1. understand the function of fluid power systems**Assessment criteria**

The learner can:

- 1.1 explain methods used to **control** food safety risks when maintaining fluid power systems
- 1.2 explain the **implications** of carrying out fluid power systems maintenance within a food and drink operation
- 1.3 explain the advantages and disadvantages of different types of **fluid power systems**
- 1.4 explain **types of fluid power equipment**
- 1.5 describe the applications of different types of **fluid power systems**
- 1.6 explain how **components** interrelate to create a fluid power system
- 1.7 explain the relationships between force, pressure and area
- 1.8 explain procedures to minimize pressure changes in fluid power systems
- 1.9 explain the causes and effects of contamination in fluid power systems
- 1.10 identify standard symbols of **components** in fluid power systems
- 1.11 interpret schematics
- 1.12 explain changes in energy throughout a system
- 1.13 explain causes of common system faults
- 1.14 explain the need for safe isolation
- 1.15 describe procedures used to test the release of stored energy
- 1.16 explain the importance of fluid hygiene in food and drink operations.

Range

Control

Prevent, eliminate, reduce

Implications

To food safety, to production efficiency

Fluid power systems

Hydraulic, pneumatic, electro-pneumatic

Types of fluid power equipment

Activators, cylinders, reactors, restrictors, reservoirs, filters

Components

Compressors, motors, valves, sensors and actuators, pumps, static and dynamic seals

Calculate

Force, pressure, area, temperature

Learning outcome

The learner will:

2. be able to prepare for maintenance of fluid power systems in food and drink operations

Assessment criteria

The learner can:

- 2.1 interpret **engineering information**
- 2.2 determine the **maintenance work** required for **fluid power systems**
- 2.3 plan required activities to minimise disruption to food and drink production operations
- 2.4 communicate planned activities to relevant stakeholders to meet organizational requirements
- 2.5 plan how fluid power system maintenance activities will be undertaken to **control** food safety risks
- 2.6 **plan** maintenance work to be carried out
- 2.7 assess hazards and associated risks
- 2.8 prepare work area for fluid power system maintenance
- 2.9 select equipment and consumables for fluid power system maintenance
- 2.10 **prepare** equipment and consumables for fluid power system maintenance
- 2.11 **document** preparation activities.

Range

Engineering information

Work requisition, manufacturers' specifications, system schematics, standard operating procedures

Maintenance work

Assembly, testing, servicing, monitoring

Fluid power systems

Hydraulic, pneumatic, electro-pneumatic

Control

Prevent, eliminate, reduce

Plan

Location, date and time, parts to be used, tests required, testing points, checks to be made, permits to work required, tools and equipment required, sequence of operations, provision for waste, communication required

Prepare

Check for damage, calibration, suitability for task

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

3. be able to carry out maintenance tasks

Assessment criteria

The learner can:

- 3.1 **control** food safety risks when carrying out fluid power systems maintenance
- 3.2 safely isolate fluid power systems
- 3.3 safely release stored energy
- 3.4 apply safe working practices when carrying out fluid power maintenance activities
- 3.5 apply **maintenance activities** to fluid power systems
- 3.6 identify faults in fluid power systems
- 3.7 **record** completed maintenance activities
- 3.8 handover equipment for operation.

Range

Control

Prevent, eliminate, reduce

Fluid power systems

Hydraulic, pneumatic, electro-pneumatic

Maintenance activities

Dismantle: Releasing stored energy, supporting components, draining and removing fluids, disconnecting hoses and pipes, removing components, proof marking removed components

Replacing components: setting, aligning, adjusting

Assemble: Check components for serviceability, position equipment, align pipework, dress and secure pipes and hoses, set, align and adjust components, secure using mechanical fixings, apply screw fastener locking devices, tighten fastenings to required torque, apply hose/cable clips and fasteners, make de-energised checks, fill system, pressurise system, secure components, use specified connectors and securing devices, priming, bleeding, recharging, pressurising the system, cleaning

Validation: dimensions within specification parameters, components correctly positioned, components correctly aligned, direction and flow indicators on components are correct, components are securely held in place, connections to components are tightened to the required torque, pipework is free from ripple and creases, electrical connections are correctly made, system is leak free, functional testing of whole system (leak test, line pressure test, speed, sequence, fluid contamination, operational performance)

Record

Job cards, permits to work/formal risk assessment and/or sign on/off procedure, maintenance log or report, company specific documentation, issues with completion of maintenance activities

UAN:	L/507/9806
Level:	Level 3
GLH:	95
Aim:	This unit sets out the requirements for welding and cutting in food and drink operations. It is concerned with the technology associated with different types of welding: Metal Active Gas (MAG), Tungsten Inert Gas (TIG), Manual Metal Arc (MMA). Learners will develop an understanding of each method and develop practical skills to use one of them.

Assessment type Assignment

Learning outcome:

The learner will:

1. understand the principles of cutting and welding in food and drink operations

Assessment criteria

The learner can:

- 1.1 explain methods used to **control** food safety risks when carrying out cutting and welding activities
- 1.2 explain the **implications** of carrying out cutting and welding activities within a food and drink operation
- 1.3 describe the **principles** of different **welding processes**
- 1.4 assess the suitability of welding processes for different **applications**
- 1.5 describe changes required to equipment as a result of **different applications**
- 1.6 describe typical **hazards** associated with different **welding processes**
- 1.7 explain **safety control measures** needed to minimise risk for different types of **welding processes**
- 1.8 describe the **features** of welded joints
- 1.9 explain the **consumables** required for different **welding processes**
- 1.10 explain the purpose of shield gases in welding
- 1.11 explain how electrode coatings contribute to weld quality
- 1.12 evaluate the **metallurgical effects** of welding processes on **materials**
- 1.13 explain the **techniques** used to determine the **integrity** of welded joints
- 1.14 explain the **techniques** used to control **distortion**
- 1.15 analyse the causes of **welding defects**
- 1.16 explain how to rectify **welding defects**
- 1.17 describe typical **hazards** associated with cutting processes
- 1.18 describe **gases** used in thermal cutting
- 1.19 describe British Compressed Gas Association (BCGA) codes of practice for use of thermal equipment
- 1.20 describe the principles of thermal cutting
- 1.21 explain procedures for cutting specific materials

- 1.22 describe problems that can occur with cutting
- 1.23 explain the causes of cutting defects
- 1.24 explain the effect of **external agents** on the cutting process.

Range

Control

Prevent, eliminate and reduce

Implications

Food safety, production efficiency, gases

Principles

Equipment used, how equipment is used, weld sequence, welding technique

Hazards (welding)

Fumes, electricity, arc radiation, hot metals

Welding processes

MIG, TIG, MMA

Applications

Different types of metal, different thicknesses of materials, different joint configurations

Safety control measures

PPE, handling, storage, safe working area, use of equipment, closing down of equipment, earthing arrangements

Features

Toe, face, root (gap, face), HAZ, fillet profiles, throat thickness, leg length, fusion zone, penetration

Consumables

Gases, wires, electrodes, composition, size/amount

Metallurgical effects

Hardness, toughness, ductility, strength, stability, malleability, resistance to wear and corrosion

Techniques (integrity)

Non-destructive: Penetrant testing, magnetic particle testing, radiography, ultrasonic, mechanical, container

Destructive: Macrosection, nick break, bend test, tensile test

Integrity

Uniformity, alignment, position, weld size, profile, fusion, penetration

Techniques (distortion)

Jigging, clamping, offsetting, tack weld

Distortion

Transverse, angular, longitudinal

Welding defects

Inclusions, porosity, cracks (internal, surface), lack of fusion, lack of penetration, undercut, overlap, lack of continuity

Hazards (cutting)

Trailing hoses, naked flames, fumes and gases, explosive gas mixtures, oxygen enrichments, spatter, hot metal, enclosed spaces

Gases

Gas identification and colour codes, characteristics, safety procedures

External agents

Oil, grease, scale, dirt

Learning outcome

The learner will:

2. be able to prepare for cutting and welding in food and drink operations

Assessment criteria

The learner can:

- 2.1 interpret **engineering information**
- 2.2 assess welding requirements
- 2.3 establish **welding technique** required
- 2.4 plan required activities to minimise disruption to food and drink production operations
- 2.5 communicate planned activities to relevant stakeholders to meet organisational requirements
- 2.6 plan how cutting and welding activities will be undertaken to **control** food safety risks
- 2.7 **plan** maintenance work to be carried out
- 2.8 assess hazards and associated risks for cutting and welding activities
- 2.9 prepare work area for cutting and welding activities
- 2.10 select equipment and consumables for cutting and welding activities
- 2.11 assess condition of equipment and consumables for cutting and welding activities
- 2.12 prepare equipment and consumables for cutting and welding activities
- 2.13 use marking out **techniques**
- 2.14 mark out materials
- 2.15 **document** preparation activities.

Range

Interpret engineering information

Work requisition, manufacturers' specifications, standard operating procedures

Welding technique

Slope and tilt angles, arc length

Control

Prevent, eliminate, reduce

Plan

Location, date and time, parts to be used, tests required, testing points, checks to be made, permits to work required, tools and equipment required, sequence of operations, provisions for waste, communications required

Techniques

Direct marking, templates, tracing/transfer

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

3. be able to perform welding activities in food and drink operations

Assessment criteria

The learner can:

- 3.1 **control** food safety risks when carrying out welding activities
- 3.2 produce welded **joints** in a range of **positions** in accordance to BS4872 part 1 standard or equivalent
- 3.3 use **distortion control techniques**
- 3.4 apply **post welding activities**
- 3.5 perform **visual checks** on welded joints
- 3.6 perform **thermal cutting operations** to **quality standards**
- 3.7 apply safe working practices when performing welding operations
- 3.8 **record** completed maintenance activities
- 3.9 handover outputs for use in food and drink operations

Range

Control

Prevent, eliminate, reduce

Joints

Plate: Fillet joints (lap, tee, corner), butt joints (open, closed, single vee)

Positions

Flat, horizontal vertical, horizontal, vertical upwards

Distortion control techniques

Jigging, clamping, offsetting, tack weld

Post welding activities

Cleaning, slag removal, spatter removal, wiring brushing, removal of excess weld

Visual checks

Magnification, illumination, weld gauges

Thermal cutting operations

Straight cuts, square/rectangular shapes, round holes, square holes

Quality standards

Clean and smooth with minimal drag lies, dimensional accuracy to tolerance specified on drawing or specification or within +/- 2mm, angled cut to within specification requirements for angularity and perpendicularity

Record

Job cards, permits to work/formal risk assessment and/or sign on/off procedure, maintenance log or report, company specific documentation, issues with completion of maintenance activities

UAN:	R/507/9807
Level:	Level 3
GLH:	120
Aim:	This unit enables learners to understand the underlying principles that apply across electrical maintenance engineering. The unit covers the theory of electrical technology and the requirements for electrical maintenance in food and drink operations. Through this unit, learners will develop skills needed to carry out maintenance activities on electrical components of machines.

Assessment type Assignment

Learning outcome:

The learner will:

1. understand electrical technology

Assessment criteria

The learner can:

- 1.1 explain methods used to **control** food safety risks when carrying out electrical maintenance activities
- 1.2 explain the **implications** of carrying out electrical maintenance activities within a food and drink operation
- 1.3 explain **scientific terms**
- 1.4 perform **electrical calculations** for d.c. networks
- 1.5 explain electricity **supply systems**
- 1.6 describe **magnetism**
- 1.7 explain the application of **electrical components**
- 1.8 explain the application of different **circuit types**
- 1.9 describe the types of **cabling** used for electrical maintenance activities
- 1.10 explain the types of **earthing systems**
- 1.11 explain different **types of motors**
- 1.12 describe types of **wiring enclosures and containment systems** used in electrical maintenance
- 1.13 explain the isolation and lock-off procedure for a 3 phase system
- 1.14 explain how to deal with **system problems**
- 1.15 explain procedures used to assess that components meet **required specifications**
- 1.16 describe types of **luminaires**
- 1.17 describe the application of **electrical measuring instruments**
- 1.18 explain **techniques** used to dismantle and assemble electrical equipment
- 1.19 explain the application of programmable logic control (plc) systems
- 1.20 explain the application of PLC controlled input/output (I/O) devices
- 1.21 describe the techniques used to **connect** PLC equipment

- 1.22 describe the devices and systems for storing programs
- 1.23 explain how ladder logic is used in plc equipment
- 1.24 describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
- 1.25 explain procedures used to identify system **faults** from displayed symptoms
- 1.26 explain the extent of authority in dealing with electrical maintenance.

Range

Control

Prevent, eliminate, reduce

Implications

For food safety, production efficiency

Scientific terms

Resistance, inductance, capacitance, voltage, current, units, sub multiples

Electrical calculations

Ohm's law, resistance, power, energy, current, voltage

Supply systems

From generation to utilisation, generation, transmission and distribution voltages, star and delta connections, single and 3 phase power

Magnetism

Fields and flux paths, relationship between flux, area and flux density

Electrical components

Contactors, relays, locking and retaining devices, capacitors, resistors, rectifiers, encoders or resolvers, inverter or servo controllers, circuit boards, thermistors or thermocouples, lighting fixtures, batteries, switches and sensors, solenoids, transformers, actuators

Circuit types

Ring, radial

Cabling

Single core, multi-core, steel wire armoured (SWA), mineral insulated (MI), screened, data/communication, fibre-optic

Earthing systems

TT, TN-C-S, TN-S, TN-C

Types of motor

Induction, synchronous, series universal, split phase, servo

Wiring enclosures and containment systems

Conduit, trunking, tray, basket

System problems

Error messages, non-responsive peripherals, faulty connecting leads and equipment

Required specifications

Value, tolerance, current carrying capacity, voltage rating, power rating, working temperature range

Luminaires

Tungsten, sodium, mercury vapour, fluorescent, LED

Electrical measuring instruments

Ammeter, voltmeter, insulation resistance tester, phase rotation meter, approved voltage indicator

Techniques

Plugs and sockets, soldering/de-soldering, screw fixing, clamped and crimped connections, marking, polarity

Connect

Ethernet: RS232

Faults

Earth fault, short circuit, open circuit, overload, under-voltage, earth leakage, insulation breakdown

Learning outcome

The learner will:

2. be able to prepare for electrical maintenance activities

Assessment criteria

The learner can:

- 2.1 interpret **engineering information**
- 2.2 plan electrical maintenance activities to minimise disruption to food and drink production operations
- 2.3 communicate planned activities to relevant stakeholders to meet organisational requirements
- 2.4 plan how electrical maintenance activities will be undertaken to **control** food safety
- 2.5 assess hazards and associated risks
- 2.6 ensure the safe isolation of equipment
- 2.7 select required **tools and equipment** for specified maintenance tasks.
- 2.8 select required **materials** for specified maintenance tasks
- 2.9 prepare work area for electrical maintenance activities
- 2.10 check condition of equipment and materials for electrical maintenance activities
- 2.11 **document** preparation activities.

Range

Engineering information

Drawings, specifications, schematics, manufacturers' manuals, data sheets, retailers' standards, operational records, standard operating procedures

Control

Prevent, eliminate, reduce

Tools and equipment

Hand tools, power tools, access systems, test equipment, safety equipment

Materials

Cables, terminations, replacement components, fixings

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

3. be able to carry out electrical maintenance activities

Assessment criteria

The learner can:

- 3.1 **control** food safety risks when carrying out electrical maintenance activities
- 3.2 apply safe working practices when carrying out electrical maintenance activities
- 3.3 apply electrical **maintenance activities** to a range of **electrical equipment**
- 3.4 ensure maintenance activities comply with **requirements**
- 3.5 inspect and test functionality of maintained electrical equipment
- 3.6 **record** completed maintenance activities
- 3.7 handover equipment for operation.

Range

Control

Prevent, eliminate, reduce

Maintenance activities

Disconnect and reconnect cables and wires, attach identification markers, remove electrical units/components, check components for serviceability, replace damaged/defective components, remove and replace damaged wires and cables, remove and replace wiring enclosures, set and adjust replaced components, prove PLC operation

Electrical equipment

Single-phase power supplies, direct current power supplies, single phase motors and starters, switchgear and distribution panels, control systems and components, electrical plant, wiring enclosures, luminaires

Requirements

Company guidelines and codes of practice, equipment manufacturers' operation range, BS, ISO and/BSEN standards

Record

Job cards, permits to work, maintenance log or report, company specific documentation, issues with completion of maintenance activities

UAN:	Y/507/9808
Level:	3
GLH:	95
Aim:	The aim of this unit is for learners to develop an understanding of the distribution of services within food and drink operations. Learners will gain knowledge of utilities and how they are identified from visual checks and scrutiny of distribution plans. They will learn about the characteristics of different types of utility and how they contribute to the creation of heating, lighting and power.

Assessment type Assignment

Learning outcome

The learner will:

1. know services and utilities in food and drink operations

Assessment criteria

The learner can:

- 1.1 identify **coding requirements** for **utility** pipelines and services
- 1.2 describe the **characteristics** of different **types of gas**
- 1.3 describe the differences between **electrical supply systems** in food and drink operations
- 1.4 describe the condition of **compressed air** required for food and drink operations
- 1.5 explain the safety requirements for handling compressed gas cylinders
- 1.6 describe the characteristics of different **types of water system**
- 1.7 describe the **risks** associated with legionella in food and drink operations pipework systems
- 1.8 interpret **services** installation drawings.

Range

Coding

BS1710 or updated current equivalent

Requirements

Identification colours, size, banding, location of banding

Utility

Water, oil, gas, compressed air, steam, electrical, drainage

Characteristics

Ignition temperature, flammability range, specific gravity, flame speed, calorific values

Types of gas

Natural, LPG

Electrical supply systems

Single phase, three phase, extra low voltage

Compressed air

Individual compressor, compressed cylinder, distributed compressed air

Types of water system

Drinking, cooling, heating, waste, hydraulic power, hot water, grey water

Risks

To individuals, effects on food and drink operations, precautions, signs of legionella, causes, effects

Services

Gas, water, electric, waste

Learning outcome

The learner will:

2. understand the operation of plant for generating services

Assessment criteria

The learner can:

- 2.1 describe the sources of hot water in food and drink operations
- 2.2 describe the local **methods of generating electricity** used in food and drink operations
- 2.3 explain how steam is produced in food and drink operations
- 2.4 explain the operation of different **types of boiler**
- 2.5 explain the operation of a compressor
- 2.6 explain the **operation** of refrigeration/chiller units
- 2.7 describe the legislation for dealing with refrigerant gases
- 2.8 explain the operation of ventilation systems in food and drink operations
- 2.9 explain limits of own authority for dealing services in food and drink operations.

Range

Methods of generating electricity

Gas fired, combined heat and power units, renewable technologies

Types of boiler

Low temperature hot water, high temperature hot water, steam

Operation

Vapour compression cycle, absorption

Learning outcome

The learner will:

3. understand energy management in food and drink operations

Assessment criteria

The learner can:

- 3.1 show the **combustion process** as an equation
- 3.2 explain causes of incomplete combustion
- 3.3 explain **risks** associated with incomplete combustion
- 3.4 identify fuel types that can be used for heating or power generation
- 3.5 explain the need for ventilation for the combustion process
- 3.6 describe the potential greenhouse gases generated as a result of food and drink operations
- 3.7 categorise the waste generated from food and drink operations
- 3.8 explain the process used for waste disposal in food and drink operations
- 3.9 describe the legal requirements related to waste
- 3.10 explain the environmental impact of food and drink operations
- 3.11 describe the energy audit process within a food and drink operation
- 3.12 explain the sources of energy losses on a food and drink operations building
- 3.13 describe the methods used to reduce energy losses
- 3.14 describe methods used to monitor **energy loss and consumption**
- 3.15 explain the financial impact of inefficient systems.

Range

Combustion process

Incomplete combustion, complete combustion

Risks

To individuals, to food and drink operations, control measures

Energy loss and consumption

On individual pieces of equipment, on a building

UAN:	D/507/9809
Level:	3
GLH:	80
Aim:	This unit provides the essential knowledge required for an understanding of the way in which the principles of heat transfer are applied to problems associated with the heating and cooling of process fluids in industry and the way in which the basic principles of fluid flow are used to solve problems associated with the transport and control of fluids in pipeline systems.

Assessment type Short answer question test

Learning outcome:

The learner will:

1. understand the principles of heat transfer and energy conservation

Assessment criteria

The learner can:

- 1.1 explain the modes of **heat transfer**
- 1.2 explain how different **factors** affect rates of **heat transfer**
- 1.3 describe the differences between natural and forced convection
- 1.4 explain the importance of restricting heat losses from surfaces of industrial processing equipment
- 1.5 describe **methods** of minimizing heat losses from hot surfaces
- 1.6 explain the principle of energy conservation in a thermodynamic system
- 1.7 describe Boyle's law
- 1.8 describe the ideal gas law
- 1.9 calculate heating and cooling rates associated with different **equipment**
- 1.10 calculate **latent heat energy**
- 1.11 calculate the insulation required for a thermodynamic system
- 1.12 explain the insulation properties of common **lagging materials**
- 1.13 identify the thermal capacity of a material.

Range

Heat transfer

By conduction, by convection, by radiation

Factors

Area through which heat is transferred, thickness of material, temperature difference across the medium, thermal conductivity of material, surface temperature, temperature of surroundings, nature of surface (emissivity/absorptivity), layers of lagging, static layers of fluid, fouling deposits on surfaces

Methods

Use of lagging, use of surfaces which reduce radiation, air gaps and vacuum, restriction of convection currents

Lagging materials

Magnesia, slag wool, fibre glass, aluminium foil, sheet and paint

Equipment

Pressure vessels, pipes, cooling units

Latent heat energy

Absorbed, released

Learning outcome

The learner will:

2. understand the operation of heat exchange equipment

Assessment criteria

The learner can:

- 2.1 describe the **construction** of heat exchangers
- 2.2 describe the operating principles of heat exchangers
- 2.3 compare the function of different **types of heat exchangers**
- 2.4 explain **factors** that affect the efficient operation of heat exchangers
- 2.5 describe how **heat exchange fluids** are applied in a heat exchange system
- 2.6 explain the principles of **water cooling systems**
- 2.7 describe the **management of water** used in water cooling systems
- 2.8 explain the principles of refrigeration
- 2.9 explain the function of primary and secondary refrigerants.

Range

Construction

Double pipe, shell and tube, single and multiple pass, hairpin types, floating head types, air fin types, reboilers

Types of heat exchangers

Heaters, coolers, condensers, reboilers, pre-heaters, space heaters, boilers, waste heat boilers

Factors

Scaling, fouling, corrosion

Heat exchange fluids

Water, steam, superheated steam, oils, gases, liquefied gases, molten salts, molten metals, solutions

Water cooling systems

Open evaporative, forced air

Management of water

Algae and bacteria removal, removal of dissolved solids, removal of suspended solids, pH control

Components

Compressor, condenser, expansion valve, evaporator, oil filter

Learning outcome

The learner will:

3. understand principles of fluid flow

Assessment criteria

The learner can:

- 3.1 explain how different **factors** affect the flow of fluids in pipes and tubes
- 3.2 describe the significance of Reynold's numbers in pumping and heat transfer operations
- 3.3 use Bernouilli's equation to solve **problems** relating to fluids flowing in pipes
- 3.4 explain the effect of cavitation on the efficiency of a pump.

Range

Factors

Fluid viscosity, fluid temperature, pressure head, pressure difference, cross-sectional area of tube, fluid density, bends, contractions and constrictions in pipes, obstructions and fittings in pipework, pump capacity, volumetric efficiency

Problems

Changes in height, changes in cross-sectional area, power and energy requirements

Learning outcome

The learner will:

4. understand operation of systems transporting and controlling fluids in a pipeline system

Assessment criteria

The learner can:

- 4.1 describe the application of different **types of pump**
- 4.2 describe the application of **shaft seals**
- 4.3 explain the need for lubrication in systems transporting fluids
- 4.4 describe **equipment** used for lubrication of seals and bearings
- 4.5 describe the application of **pumps** used for transferring gases
- 4.6 describe **methods of preventing deposition** of solid materials in pipelines
- 4.7 describe **methods of cleaning pipelines**.

Range

Types of pump

Centrifugal, displacement

Shaft seals

Simple stuffing box/packed seal, lantern ring, mechanical seal, liquid and gas seals

Equipment

Oil pots, slinger/oil rings, pumped lubrication

Pumps (transferring gases)

Reciprocating piston types, rotary blowers (vane, lobe), centrifugal blowers, radial flow fans, axial flow fans, multi-stage units

Methods of preventing deposition

Steam tracing, electrical tracing, steam/water jackets

Methods of cleaning pipelines

High pressure jet cleaning, rotary brushes, pigging, use of solvents

UAN:	R/507/9810
Level:	Level 3
GLH:	100
Aim:	This unit develops in learners an ability to apply mathematical techniques to solve engineering problems. Learners will be able to use arithmetic, algebra trigonometry and statistical techniques to solve problems typically encountered by food and drink maintenance engineers.

Assessment type Short answer test

Learning outcome:

The learner will:

1. Be able to use arithmetic methods to solve engineering problems

The learner can:

- 1.1 define mathematical **terms**
- 1.2 convert numbers between **bases**
- 1.3 use mathematical operations in different **bases**
- 1.4 express decimal fractions in standard form
- 1.5 calculate approximations and estimations
- 1.6 evaluate numerical expressions containing combined positive, negative and fractional indices
- 1.7 construct **mathematical tables**
- 1.8 calculate areas of **shapes**
- 1.9 calculate **volumes**
- 1.10 calculate flow rates.

Range

Terms

Base, index, power, root, reciprocal, logarithms

Bases

Denary, binary, hexadecimal

Mathematical tables

Imperial units to metric and vice versa, Fahrenheit to Celsius and vice versa, mass and volume using density values

Shapes

Triangle, square, rectangle, parallelogram, circle, trapezium

Volume

Cylinders, spheres, cones

Learning outcome:

The learner will:

2. Be able to use algebra to solve engineering problems

The learner can:

- 2.1 determine a logarithm as a power applied to a base number
- 2.2 use **logarithms** to simplify calculations
- 2.3 **analyse** straight line graphs
- 2.4 **evaluate** linear simultaneous equations
- 2.5 solve quadratic equations
- 2.6 determine the root of an equation
- 2.7 transpose terms with indices
- 2.8 transpose engineering formulae.

Range

Logarithms

Log, anti-log, log linear, log-log

Analyse

Rectangular and Cartesian coordinate points, gradient, slope, ratio of change, points of intercept

Evaluate

Graphical methods, using substitution rule

Learning outcome

The learner will:

3. Be able to use trigonometry to solve engineering problems

Assessment criteria

The learner can:

- 3.1 perform calculations involving trigonometric ratios for the four quadrants
- 3.2 apply the **sine rule** to practical problems
- 3.3 apply the **cosine rule** to practical problems
- 3.4 use trigonometry to determine **properties**
- 3.5 differentiate between different **trigonometric identities**
- 3.6 evaluate **complex numbers**
- 3.7 explain the graphical representation of different types of **quantities**.

Range

Sine rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Cosine rule

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

Properties

non right-angled triangles, angles between lines, true length of lines, true angle between planes

Trigonometric identities

$\tan = \sin/\cos$, $\cot = 1/\tan$, $\sec = 1/\cos$, $\operatorname{cosec} = 1/\sin$

Complex numbers

Rectangular, Argand

Quantities

Vector (complex numbers, modulus, argument), polar (complex numbers, argand diagrams, rotating vector, polar to Cartesian form and vice versa)

Learning outcome

The learner will:

4. Be able to use statistical methods to display data

Assessment criteria

The learner can:

- 4.1 define **statistical terms**
- 4.2 calculate the standard deviation for a sample of engineering components
- 4.3 interpret **statistical diagrams**.

Range

Statistical terms

Probability, dependent and independent events, addition and multiplication laws of probability, permutations and combinations applied to probability, normal probability distribution, confidence limits, statistical testing, average (mean, median, mode), sample, population, frequency, standard deviation

Statistical diagrams

Bar charts, pie charts, frequency distributions, frequency tables, histograms, cumulative frequency curves

UAN:	Y/507/9811
Level:	3
GLH:	70
Aim:	The aim of this unit is for learners to develop the skills required to maintain systems and equipment in food and drink operations. They will learn to use a range of maintenance techniques and procedures including fault finding and condition monitoring.
Assessment type	Assignment

Learning outcome

The learner will:

1. be able to prepare for mechanical maintenance activities in food and drink operations

Assessment criteria

The learner can:

- 1.1 interpret **engineering information**
- 1.2 apply maintenance schedules
- 1.3 plan mechanical maintenance activities to minimise disruption to food and drink production operations
- 1.4 communicate planned activities to relevant stakeholders to meet organisational requirements
- 1.5 plan how mechanical maintenance activities will be undertaken to **control** food safety risks
- 1.6 assess hazards and associated risks
- 1.7 ensure the safe isolation of **equipment**
- 1.8 prepare work area for mechanical maintenance activities
- 1.9 select equipment and materials for mechanical maintenance activities
- 1.10 assess condition of equipment and materials for mechanical maintenance activities
- 1.11 prepare equipment and materials for mechanical maintenance activities
- 1.12 select consumables for mechanical maintenance activities
- 1.13 **document** preparation activities.

Range

Engineering information

Drawings, specifications, schematics, manufacturers' manuals, data sheets, retailers' standards, operational records, standard operating procedures

Control

Prevent, eliminate, reduce

Equipment

Mechanical, electrical, gas, fluids

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

2. be able to maintain mechanical equipment in food and drink operations

Assessment criteria

The learner can:

- 2.1 **control** food safety risks when carrying out mechanical maintenance activities
- 2.2 apply safe working practices when carrying out mechanical maintenance activities
- 2.3 apply planned **maintenance procedures** to **mechanical equipment**
- 2.4 comply with **requirements** for maintenance activities
- 2.5 **record** completed maintenance activities
- 2.6 handover equipment for operation.

Range

Maintenance procedure

Sealing, aligning, tensioning, fitting, refitting, bending

Mechanical equipment

Levers and linkage mechanisms, gears and gear drives, valves, pumps, cams and followers, chain and belt drives, clutches and brakes, transmission shafts

Requirements

Company guidelines and codes of practice, equipment manufacturers' operation range, BS, ISO and/or BSEN standards

Record

Job cards, permits to work/formal risk assessment and/or sign on/off procedure, maintenance log or report, company specific documentation, issues with completion of maintenance activities

Handover

Check hygiene, no components

Learning outcome

The learner will:

3. be able to monitor mechanical equipment

Assessment criteria

The learner can:

- 3.1 **measure** mechanical components
- 3.2 identify issues from **operational information**
- 3.3 identify faults in **mechanical equipment**
- 3.4 assess **serviceability** of **mechanical equipment**
- 3.5 apply condition monitoring techniques to mechanical systems.

Range

Measure

For wear, tool locations and positions, size, temperature, movement

Operational information

Output records, wastage records, maintenance records, asset register, lubricant usage, tool change frequencies

Mechanical equipment

Levers and linkage mechanisms, gears and gear drives, cams and followers, chain and belt drives, clutches and brakes, transmission shafts

Serviceability

Correct operation of moving parts, correct working clearance of parts, backlash in gears, belt/chain tension, bearing loading, torque loading, operational performance, shaft alignment, overheating

Unit 313

Repairing and producing replacement components in food and drink operations

UAN:	D/507/9812
Level:	Level 3
GLH:	60
Aim:	This unit develops the skills required to produce and repair mechanical components. This will involve the development of skills associated with milling, turning, fitting and grinding to produce and repair components for maintenance of food and drink operations. Learners will use techniques relate to fault finding and condition monitoring.
Assessment type	Assignment

Learning outcome:

The learner will:

1. be able to prepare for producing replacement components

Assessment criteria

The learner can:

- 1.1 interpret **engineering information**
- 1.2 plan machining and fitting activities to minimise disruption to food and drink production operations
- 1.3 communicate planned activities to relevant stakeholders to meet organisational requirements
- 1.4 plan how machining and fitting activities will be undertaken to **control** food safety risks
- 1.5 produce working sketches of component
- 1.6 assess hazards and associated risks
- 1.7 prepare work area for machining and fitting activities
- 1.8 select **materials, tools and equipment**
- 1.9 assess condition of **materials, tools and equipment** for machining and fitting activities
- 1.10 **prepare work holding devices and equipment**
- 1.11 prepare components for repair
- 1.12 **document** preparation activities.

Range

Engineering information

Drawings, sketches, sample or damaged component to be replaced, manufacturers' specifications, company policies and procedures for repair, maintenance log, asset register, standard operating procedures

Control

Prevent, eliminate, reduce

Materials

Non-metallic, non-magnetic, steel

Tools

Work holding devices, cutting tools, milling tools, grinding wheels, saws, files, chucks, drills, taps, reamers

Equipment

Lathes, milling machines, grinders (pedestal, surface, universal, hand), power saws, measuring equipment

Prepare work holding devices and equipment

Set work holding device, set tooling, calibrate measuring equipment, calculate speeds and feeds, sharpen tools

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

2. be able to produce components to meet specifications

Assessment criteria

The learner can:

- 2.1 **control** food safety risks when carrying out machining and fitting activities
- 2.2 apply safe working practices when carrying out machining and fitting activities
- 2.3 produce **features** in components to **required standard**
- 2.4 select appropriate measuring instruments
- 2.5 measure **accuracy** of component features
- 2.6 use machine controls in line with operational procedures
- 2.7 adjust machine tools and feeds
- 2.8 use **hand fitting methods**
- 2.9 produce components in **different materials**
- 2.10 **repair** components to **required standard**
- 2.11 inspect components for fitness for purpose
- 2.12 measure accuracy of component features
- 2.13 **record** completed maintenance activities
- 2.14 handover components for use in food and drink operations.

Range

Features

External diameters, internal diameters, flat faces, parallel faces, steps/shoulders, angular/tapered surfaces, threads, slots/recesses, drilled holes, bored holes, reamed holes

Required standards

Components to be free from false tool cuts, burrs and sharp edges, dimensional tolerance of $\pm 0.05\text{mm}$ or (0.002"), reamed holes within H8, surface finish $32\mu\text{in}$ or $0.8\mu\text{m}$, bench fitting $\pm 0.05\text{mm}$ or (0.002")

Repair

Welding: Reform component surface by adding metal, plugging holes, dealing with cracks (stopping runs, filling)

Machining and fitting: making stepped dowels or studs, cutting new keyways, making new or stepped keys, replacement of internal threads, rework surface finish, sleeve worn components, bushing worn holes, rework fit (shimming)

Different materials

Non-metallic, non-magnetic, steel

Record

Job cards, permits to work/formal risk assessment and/or sign on/off procedure, maintenance log or report, company specific documentation, issues with completion of maintenance activities

UAN:	H/507/9813
Level:	Level 3
GLH:	80
Aim:	This unit develops in learners the skills to use three different welding techniques in food and drink operations: Metal Active Gas (MAG), Tungsten Inert Gas (TIG), Manual Metal Arc (MMA). Skills developed will enable learners to carry out complex welding activities. They will also develop skills to cut shapes using thermal cutting equipment.
Assessment type	Assignment

Learning outcome

The learner will:

1. be able to prepare for cutting and welding in food and drink operations

Assessment criteria

The learner can:

- 1.1 interpret **engineering information**
- 1.2 assess welding requirements
- 1.3 establish **welding technique**
- 1.4 plan required activities to minimise disruption to food and drink production operations
- 1.5 communicate planned activities to relevant stakeholders to meet organisational requirements
- 1.6 plan how cutting and welding activities will be undertaken to **control** food safety risks
- 1.7 **plan** maintenance work to be carried out
- 1.8 assess hazards and associated risks for cutting and welding activities
- 1.9 prepare work area for cutting and welding activities
- 1.10 select equipment and consumables for cutting and welding activities
- 1.11 assess condition of equipment and consumables for cutting and welding activities
- 1.12 prepare equipment and consumables for cutting and welding activities
- 1.13 use marking out **techniques**
- 1.14 mark out materials
- 1.15 **document** preparation activities.

Range

Interpret engineering information

Work requisition, manufacturers' specifications, standard operating procedures

Welding technique

Slope and tilt angles, arc length

Plan

Location, date and time, parts to be used, tests required, testing points, checks to be made, permits to work required, tools and equipment required, sequence of operations, provisions for waste, communications required

Techniques

Direct marking, templates, tracing/transfer)

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

2. be able to perform cutting and welding activities in food and drink operations

Assessment criteria

The learner can:

- 2.1 **control** food safety risks when carrying out welding activities
- 2.2 produce complex welded **joints** in a range of **positions** in accordance to BS4872 part 1 standard or equivalent
- 2.3 weld with different materials
- 2.4 use **distortion control techniques**
- 2.5 perform **visual checks** on welded joints
- 2.6 perform **thermal cutting operations** to **quality standards**
- 2.7 apply safe working practices when performing welding operations
- 2.8 **record** completed maintenance activities.

Range

Control

Prevent, eliminate and reduce

Metals

Carbon steel, stainless steel

Joints

Plate/sheet: Fillet joints (lap, tee, corner), butt joints (open, closed, single vee)

Pipe: Branch connection, butt joints (closed, single vee)

Positions

Horizontal vertical, horizontal, vertical upwards, vertical downwards, overhead, inclined

Distortion control techniques

Jigging, clamping, offsetting, tack weld

Thermal cutting operations

Freehand straight cuts, track guided straight cuts, radial cuts, angled cuts, bevelled edges

Quality standards

Clean and smooth without adhering dross and with minimal drag lies, dimensional accuracy to tolerance specified on drawing or specification or within +/- 2mm, angled cut to within specification requirements for angularity and perpendicularity

Record

Job cards, permits to work/formal risk assessment and/or sign on/off procedure, maintenance log or report, company specific documentation, issues with completion of maintenance activities

Learning outcome

The learner will:

3. be able to review welded activities

Assessment criteria

The learner can:

- 3.1 assess **quality** of welded joints against specification requirements
- 3.2 **test** welded joints
- 3.3 apply **post welding activities**
- 3.4 **document** maintenance activities
- 3.5 handover outputs for use in food and drink operations.

Range

Quality

Dimensional accuracy, alignment/squareness, size and profile of weld, number of runs

Tests

Visual, dye penetrant, macroscopic examination, nick break tests, bend tests

Post welding activities

Cleaning, slag removal, spatter removal, wiring brushing, removal of excess weld

Document

Equipment maintained, type of maintenance, repairs, replaced parts and consumables, time, outstanding issues

UAN:	K/507/9814
Level:	Level 3
GLH:	145
Aim:	This unit enables learners to understand the underlying principles that apply across three phase motors and speed drives in electrical maintenance engineering. It also covers the principles associated with the testing of electrical circuits. Learners will develop the skills needed to apply their understanding to the maintenance and testing of electrical components of machines in food and drink operations.
Assessment type	Assignment

Learning outcome:

The learner will:

1. understand the principles of electrical machines

Assessment criteria

The learner can:

- 1.1 explain the operating principle of **d.c. machines**
- 1.2 state the **applications** of d.c. machines
- 1.3 explain the operating principle of **single phase a.c. machines**
- 1.4 state the applications of single phase a.c. machines
- 1.5 explain the operating principle of **three phase a.c. machines**
- 1.6 state the **applications** of three phase a.c. machines
- 1.7 calculate values of **voltage** and **current** in **configured systems**
- 1.8 determine the **neutral current** in a three phase and neutral supply
- 1.9 calculate the **characteristics** of three phase motors
- 1.10 explain **methods** used for starting motors
- 1.11 explain levels of **motor protection** required
- 1.12 explain types of **protection devices**
- 1.13 describe different types of **control systems**
- 1.14 explain the application of **electrical control components**
- 1.15 explain the integration of servo motors into a typically industrial automation system
- 1.16 understand the **factors** effecting the location of servo systems
- 1.17 explain the **applications** of variable speed drives
- 1.18 explain how to use intelligent test equipment to determine the nature and position of faults.

Range

d.c machines

d.c generator, series motor, shunt motor, compound motor

Applications (d.c machines)

Generation, motors for domestic, commercial, industrial applications

Single phase a.c machines

a.c. generator, split phase induction motor, capacitor start induction motor, capacitor start and run induction motor, universal motor

Three phase a.c machines

a.c generator, cage induction motor, wound rotor motor, synchronous

Voltage

Line voltage, phase voltage

Current

line current, phase current

Configured systems

Star, delta

Neutral current

Balanced load, unbalanced load

Characteristics

Poles, speed, torque, power, efficiency, slip

Methods

Direct on – line, Star – Delta, rotor resistance, soft start, variable frequency, inverters, Programmable Logic Converters.

Motor protection

Thermal overload, vibration, noise

Protection devices

Fuses, circuit breakers, residual current devices (RCDs), residual current breakers with overload (RCBO),

Control systems

Supervisory control and data acquisition (SCADA), distributive control system (DCS), proportional integral derivative (PID)

Electrical control components

Diodes, diacs, triacs, thyristors, rectifiers, transistors, invertors solenoids

Factors

Degree of protection (IP), installation in hazardous areas, supply voltages, type of construction (IM B3 mounting IMB5 flange mounting), maximum torque from the load cycle profile and average torque

Application

Integration into intelligent network, energy regeneration, safety

Learning outcome

The learner will:

2. understand the principles of testing electrical equipment and circuits

Assessment criteria

The learner can:

- 2.1 describe the **procedures** that apply to electrical testing activities
- 2.2 describe the specific safety precautions to be taken when carrying out formal inspection and testing of electrical equipment
- 2.3 assess the suitability of different **types of test equipment** for different types of tests
- 2.4 explain how to connect the appropriate test equipment for the **measurement**
- 2.5 describe the various testing methods and procedures for **parameters**, as recommended in approved electrical codes of practice
- 2.6 explain the operation of testing methods in different operating conditions
- 2.7 describe the **problems** that may occur and which could affect the test results, and how they can be avoided
- 2.8 describe the extent of their own authority in testing electrical equipment and circuits.

Range

Procedures

Equipment isolation and lock-off procedure or permit-to-work

Types of test equipment

Low resistance ohmmeter, insulation resistance tester, approved voltage indicator, earth fault loop impedance tester, phase rotation meter, prospective fault current tester

Measurement

Resistance, current, voltage, power, capacitance, inductance, frequency, power factor, protective device disconnection/trip times

Parameters

Continuity, insulation resistance, polarity, earth fault loop impedance, prospective fault current, RCD operation, phase sequence

Problems

Parallel paths, voltage sensitive devices, uncalibrated equipment, defective equipment, contact resistance

Learning outcome

The learner will:

3. be able to prepare for electrical maintenance activities

Assessment criteria

The learner can:

- 3.1 interpret **engineering information**
- 3.2 determine electrical maintenance activities required
- 3.3 plan electrical maintenance activities to minimise disruption to food and drink production operations
- 3.4 communicate planned activities to relevant stakeholders to meet organisational requirements
- 3.5 plan how electrical maintenance activities will be undertaken to **control** food safety
- 3.6 assess hazards and associated risks
- 3.7 ensure the safe isolation of **equipment**
- 3.8 select required **tools and equipment** for specified maintenance tasks.
- 3.9 select required **materials** for specified maintenance tasks
- 3.10 prepare work area for electrical maintenance activities
- 3.11 assess condition of equipment and materials for mechanical maintenance activities
- 3.12 **document** preparation activities.

Range

Engineering information

Drawings, specifications, schematics, manufacturers' manuals, data sheets, retailers' standards, operational records, IET wiring regulations, standard operating procedures

Control

Prevent, eliminate, reduce

Equipment

Mechanical, electrical, fluid power

Tools and equipment

Hand tools, power tools, access systems, test equipment, safety equipment

Materials

Cables, terminations, replacement components, fixings

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

4. Be able to carry out electrical maintenance activities

Assessment criteria

The learner can:

- 4.1 **control** food safety risks when carrying out electrical maintenance activities
- 4.2 apply safe working practices when carrying out electrical maintenance activities
- 4.3 apply electrical **maintenance activities** to a range of **electrical equipment**
- 4.4 ensure maintenance activities comply with **requirements**
- 4.5 inspect and **test** functionality of maintained electrical equipment
- 4.6 use techniques to diagnose **faults**
- 4.7 apply condition monitoring to **electrical equipment**
- 4.8 **record** completed maintenance activities
- 4.9 **handover** equipment for operation.

Range

Control

Prevent, eliminate, reduce

Maintenance activities

Disconnect and reconnect cables and wires, attach identification markers, remove electrical units/components, check components for serviceability, replace damaged/defective components, remove and replace damaged wires and cables, remove and replace wiring enclosures, set and adjust replaced components, prove PLC operation

Electrical equipment

Single-phase power supplies, three-phase power supplies, direct current power supplies, three phase motors and starters, switchgear and distribution panels, control systems and components, electrical plant, wiring enclosures, servos, variable speed/frequency drives, PLC systems, sensors, actuators

Requirements

Company guidelines and codes of practice, equipment manufacturers' operation range, BS, ISO and/BSEN standards

Test

Protective conductor resistance values, insulation resistance values, load current, voltage levels, impedance, continuity, polarity, power rating, resistance, capacitance, frequency values, RCD disconnection time, specialised tests (such as speed, sound, light, temperature)

Faults

Loss of supply, overload, short-circuit and earth fault, transient voltage, loss of phase/line, incorrect phase rotation, high resistance joints, component, accessory or equipment faults

Record

Job cards, permits to work, maintenance log or report, company specific documentation

UAN:	T/507/9816
Level:	Level 3
GLH:	120
Aim:	Through this unit, the learner will develop an understanding of process controller equipment working in an integrated system involving two or more interactive technologies. They will develop skills required to carry out maintenance on process controller systems in food and drink operations.
Assessment type	Assignment

Learning outcome:

The learner will:

1. Understand the operation of process controllers within an engineered system

Assessment criteria

The learner can:

- 1.1 explain the procedures used to eliminate electrostatic discharge hazards
- 1.2 explain how process controllers function
- 1.3 describe the **procedures** used to maintain programs
- 1.4 explain the applications of different types of interface cards
- 1.5 explain how to search a program within a programmable logic controller (plc)
- 1.6 describe the numbering system and codes used for identification of inputs and outputs in a given plc
- 1.7 describe the **programming techniques** used in plcs
- 1.8 describe the **techniques** involved in working with lines of logic
- 1.9 describe the procedure to follow for off line and on line programming
- 1.10 explain the operation of **instrumentation systems**
- 1.11 explain **signal transmission** methods
- 1.12 describe the equipment used to measure **product variables**
- 1.13 explain logic functions performed by basic plc instructions
- 1.14 explain how to address input and outputs of plcs
- 1.15 identify the range of input/output (i/o) modules available
- 1.16 explain the principles of **process control systems**
- 1.17 identify the capabilities of controllers from their exterior markings
- 1.18 explain the limitations of auto tuning
- 1.19 explain the difference between analogue digital i/o devices
- 1.20 explain the purpose of industrial instrument buses.

Range

Procedures

Storage, backing up

Programming techniques

Interlocking, timers, counters, sub-routines

Techniques

Editing, entering, removing

Instrumentation systems

Electrical, hydraulic, pneumatic, electro-pneumatic

Signal transmission

Electric 4 to 20mA, Pneumatic 0.2 to 1.0 bar

Product variables

Temperature, pressure, levels, flow, conductivity, pH, turbidity, compressed air, refrigeration

Process control systems

MES, SCADA, PID

Learning outcome

The learner will:

2. Be able to prepare for automation maintenance activities

Assessment criteria

The learner can:

- 2.1 interpret **engineering information**
- 2.2 identify automation maintenance activities required
- 2.3 plan automation maintenance activities to minimise disruption to food and drink production operations
- 2.4 communicate planned activities to relevant stakeholders to meet organisational requirements
- 2.5 plan how automation maintenance activities will be undertaken to **control** food safety
- 2.6 assess hazards and associated risks
- 2.7 ensure the safe isolation of **equipment**
- 2.8 Select required tools and equipment for specified maintenance tasks.
- 2.9 Select required materials for specified maintenance tasks
- 2.10 prepare work area for automation maintenance activities
- 2.11 assess condition of equipment and materials for automation maintenance activities
- 2.12 **document** preparation activities.

Range

Engineering information

Drawings, specifications, schematics, manufacturers' manuals, data sheets, retailers' standards, operational records, ladder logic, statement lists, system flowcharts, standard operating procedures

Control

Prevent, eliminate, reduce

Equipment

Mechanical, electrical, fluid power

Document

Risk assessment, method statement, permit to work

Learning outcome

The learner will:

3. Be able to carry out automation maintenance activities

Assessment criteria

The learner can:

- 3.1 **control** food safety risks when carrying out automation maintenance activities
- 3.2 apply safe working practices when carrying out electrical maintenance activities
- 3.3 carry out **program maintenance activities**
- 3.4 apply **maintenance activities** to a range of automation **equipment**
- 3.5 ensure maintenance activities comply with **requirements**
- 3.6 inspect and test serviceability of maintained automation equipment components
- 3.7 identify faults in automation equipment
- 3.8 carry out condition monitoring of automation equipment
- 3.9 **record** completed maintenance activities
- 3.10 **handover** equipment for operation.

Range

Control

Prevent, eliminate, reduce

Program maintenance activities

Force contacts on and off, edit, enter and remove contacts from lines of logic, alter counter and timer settings, use 'on' and 'off-line' programming, carry out on-line monitoring of programs, load, read and save programs, produce back-ups of completed programs, programme by computer based authoring (to include sub-routines), use single-step mode of operation, modify program parameters

Maintenance activities

Calibrate sensors, use program full-run modes of operation, change or add circuit boards, replace power supplies, replace peripherals (such as sensors, actuators, relays, switches), replace process controller units, replace back-up batteries, functionally test the system, manually tune electronic controllers, connect, commission and maintain measuring devices

Equipment

Electrical, mechanical, fluid power

Requirements

Company guidelines and codes of practice, equipment manufacturers' operation range, BS, ISO and/BSEN standards

Record

Job cards, permits to work, maintenance log or report, company specific documentation, issues with completion of maintenance activities

Unit 817

Understand the requirements of electrical installations BS7671:2018

Level:	Level 3
GLH:	40
Aim:	This unit gives the learner an understanding of the full content of BS7671, and how this applies to electrical installations within its scope.
Assessment type	This unit is assessed by Multiple choice test through the Electrical Installations (2382) qualification. Unit no 817 should be used as a proxy to claim under 1255 once this has been achieved.

Learning outcome:

The learner will:

1. Understand the scope, object and fundamental principles of BS7671.

Assessment criteria

The learner can:

- 1.1 identify the scope of BS7671
- 1.2 identify the object of BS7671
- 1.3 identify the fundamental principles of BS7671.

Learning outcome

The learner will:

2. Understand the definitions used within BS7671

Assessment criteria

The learner can:

- 2.1 interpret the definitions used within BS7671
- 2.2 relate the definitions to the regulations and appendices of BS7671.

Learning outcome

The learner will:

3. Understand how to assess the general characteristics of electrical installations

Assessment criteria

The learner can:

- 3.1 interpret the requirements of assessing the general characteristics of electrical installations within the scope of BS7671, including;
 - Chapter 31 Purpose, supplies and structure
 - Chapter 32 Classification of external influences

- Chapter 33 Compatibility
 - Chapter 34 Maintainability.
 - Chapter 35 Safety services Chapter
 - Chapter 36 Continuity of service
-

Learning outcome:

The learner will:

4. Understand requirements of protection for safety for electrical installations

Assessment criteria

The learner can:

- 4.1 identify the requirements of protection for safety within the scope of BS7671 including;
 - Chapter 41 Electric shock
 - Chapter 42 Thermal effects
 - Chapter 43 Overcurrent
 - Chapter 44 Voltage disturbances and EMI
 - Chapter 46 Isolation and switching
 - 4.2 interpret how this applies to electrical installations within the scope of BS7671 to include:
 - protection against electric shock
 - protection against thermal effects
 - protection against overcurrent
 - protection against voltage disturbances and electromagnetic disturbances
 - Isolation and switching.
-

Learning outcome

The learner will:

5. Understand the requirements for selection and erection of equipment for electrical installations

Assessment criteria

The learner can:

- 5.1 identify the requirements for selecting and erecting equipment and interpret how this applies to wiring systems
 - 5.2 interpret how this applies to electrical installations within the scope of BS7671 to include:
 - Common rules
 - Wiring systems
 - Protection, isolation, switching, control and monitoring
 - Earthing arrangements and protective conductors
 - Other equipment
 - Safety services
-

Learning outcome

The learner will:

6. Understand the requirements of Inspection and testing of electrical installations

Assessment criteria

The learner can:

- 6.1 identify the requirements for inspection and testing
- 6.2 interpret how this applies to electrical installations including;
 - Chapter 64 Initial verification
 - Chapter 65 Periodic inspection and testing.

Learning outcome:

The learner will:

7. Understand the requirements of Special installations or locations as identified in BS7671

Assessment criteria

The learner can:

- 7.1 identify the requirements for special installations including;
 - Section 700 General
 - Section 701 Locations containing a bath or shower
 - Section 702 Swimming pools and other basins
 - Section 703 Rooms and cabins containing sauna heaters
 - Section 704 Construction and demolition site installations
 - Section 705 Agricultural and horticultural premises
 - Section 706 Conducting locations with restricted movement
 - Section 708 Electrical installations in caravan / camping parks and similar locations
 - Section 709 Marinas and similar locations
 - Section 710 Medical locations
 - Section 711 Exhibitions, shows and stands
 - Section 712 Solar photovoltaic (PV) power supply systems
 - Section 714 Outdoor lighting installations
 - Section 715 Extra-low voltage lighting installations
 - Section 717 Mobile or transportable units
 - Section 721 Electrical installations in caravans and motor caravans
 - Section 722 Electric vehicle charging installations
 - Section 729 Operating and maintenance gangways
 - Section 730 Onshore units of electrical connections for inland navigation vessels
 - Section 740 Temporary electrical installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses
 - Section 753 Heating cables and embedded heating systems
- 7.2 interpret how these effect the general requirements of the regulations.

Learning outcome

The learner will:

8. Understand the information contained within the appendices of BS 7671.

Assessment criteria

The learner can:

- 8.1 identify the information in the appendices of BS7671
- 8.2 specify how the information contained in the appendices is used to support electrical installation activities.

Appendix 1 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.

City & Guilds Centre Manual 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, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

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 on such things as:

Walled Garden: how to register and certificate candidates on line

Events: dates and information on the latest Centre events

Online assessment: how to register for e-assessments.

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.

Linking to this document from web pages

We regularly update the name of documents on our website, therefore in order to prevent broken links we recommend that you link to our web page that the document resides upon, rather than linking to the document itself.

Useful contacts

UK learners

General qualification information

T: +44 (0)844 543 0033

E: learnersupport@cityandguilds.com

International learners

General qualification information

T: +44 (0)844 543 0033

F: +44 (0)20 7294 2413

E: intcg@cityandguilds.com

Centres

Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

F: +44 (0)20 7294 2404 (BB forms)

E: singlesubjects@cityandguilds.com

International awards

Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: intops@cityandguilds.com

Walled Garden

Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: walledgarden@cityandguilds.com

Employer

Employer solutions including, Employer Recognition: Endorsement, Accreditation and Quality Mark, Consultancy, Mapping and Specialist Training Delivery

T: +44 (0)207 294 8128

E: business@cityandguilds.com

Publications

Logbooks, Centre documents, Forms, Free literature

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

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.

If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: **feedbackandcomplaints@cityandguilds.com**

About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Licence to Practice (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).

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 (see the City & Guilds 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. Published by City & Guilds, a registered charity established to promote education and training

City & Guilds

1 Giltspur Street

London EC1A 9DD

T +44 (0)844 543 0000

F +44 (0)20 7294 2413

www.cityandguilds.com
