SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 5/7 (5310-25/27)

December 2019 Version 1.0

Qualification Handbook

Qualification at a glance

Subject area	**Heavy Vehicle Maintenance and Repair**
City & Guilds number	5310
Age group approved	16-18, 19+
Assessment	Portfolio of Evidence Online Multiple Choice Tests
Approvals	Fast track approval available.
Support materials	Centre handbook
Registration and certification	See online catalogue/Walled Garden for last dates

Title and level	City & Guilds number	Accreditation number
SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 5	5310-25	GL85 45
SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 7	5310-27	GL86 47

Version and date	Change detail	Section

Contents

1 Introduction

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

Area	Description
Who are the qualifications for?	These qualifications in Heavy (Commercial) Vehicle Maintenance and Repair are for anyone developing a career in the motor industry. These practical qualifications demonstrate your skills on the job, in your own workplace, showing that you meet national standards for automotive workers. Their structure and assessment strategy have been produced by the Institute of the Motor Industry, who are the Sector Skills Council for the Automotive Industry.
What do the qualifications cover?	Candidates cover areas such as heavy vehicle maintenance, removal and replacement of vehicle units and components and diagnosis and rectification of vehicle faults. They are assessed in the workplace by using the following methods: • workplace observation • witness testimony • verbal questioning of essential knowledge • City & Guilds' online multiple choice test
Are the qualifications part of a framework or initiative?	These qualifications are part of the Scottish Automotive Maintenance and Repair Modern Apprenticeship Frameworks.
What opportunities for progression are there?	Once they complete this qualification candidates will have the skills and knowledge to become/ operate as a competent heavy vehicle technician.

Structure

To achieve the **SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 5**, learners must achieve **8 mandatory units** and a minimum of **1 optional unit**. Some units require learners to successfully complete an online multiple choice test or assignment. Details can be found in Section 4 of this handbook and in the assessment requirements section of each individual unit.

City & Guilds unit number	Unit title	SCQF level	SCQF credit value
Mandatory			
5310-001	Contribute to Housekeeping in Motor Vehicle Environments	5	5
5310-002	Reduce Risk(s) to Health & Safety in the Motor Vehicle Environment	5	5
5310-004	Use of Tools and Equipment in Motor Vehicle Engineering	5	11
5310-009	Maintain Working Relationships in the Motor Vehicle Environment	6	7
5310-221	Carry out Routine Commercial Vehicle Maintenance	5	13
5310-222	Remove and Replace Commercial Vehicle Engine Units and Components	5	17
5310-223	Remove and Replace Commercial Vehicle Electrical Auxiliary Units and Components	5	17
5310-224	Remove and Replace Commercial Vehicle Chassis Units and Components	5	20
Optional			
5310-008	Identify and Agree the Motor Vehicle Customer Needs	6	10
5310-214	Remove and Replace Commercial Vehicle Transmission and Driveline Units and Components	5	18
5310-219	Remove and Fit Basic Motor, Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Motor Vehicle Body Panels	5	7
5310-407	Carry out Non High Energy Electrical System Work on or Near Electric and Hybrid Vehicles	4	3

To achieve the **SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 7**, learners must achieve **8 mandatory units** and a minimum of **1 optional unit**. Some units require learners to attain an online multiple choice test or assignment. Details can be found in Section 4 of this handbook and in the assessment requirements section of each individual unit.

City & Guilds unit number	Unit title	SCQF level	SCQF credit value
Mandatory			
5310-001	Contribute to Housekeeping in Motor Vehicle Environments	5	5
5310-002	Reduce Risk(s) to Health & Safety in the Motor Vehicle Environment	5	5
5310-004	Use of Tools and Equipment in Motor Vehicle Engineering	5	11
5310-009	Maintain Working Relationships in the Motor Vehicle Environment	6	7
5310-226	Inspect Commercial Vehicles	6	12
5310-227	Diagnose and Rectify Commercial Vehicle Engine and component faults	7	17
5310-228	Diagnose and Rectify Commercial Vehicle Chassis System faults	7	18
5310-406	Diagnose and Rectify Motor Vehicle Electrical Unit and Component Faults	7	16
Optional			
5310-006	Facilitate Individuals Learning and Development	8	11
5310-008	Identify and Agree the Motor Vehicle Customer Needs	6	10
5310-211	Overhaul Commercial Vehicle Mechanical Units	7	24
5310-215	Diagnose and Rectify Commercial Vehicle Transmission and Driveline System Faults	7	20
5310-219	Remove and Fit Basic Motor, Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Motor Vehicle Body Panels	5	7
5310-407	Carry out Non High Energy Electrical System Work on or Near Electric and Hybrid Vehicles	4	3
5310-408	Service and Repair Non-Live Electric and Hybrid Vehicle Systems	7	3

2 Centre requirements

Approval

Centres approved to offer the current SVQs in Maintenance and Repair may apply for approval for these new qualifications using the fast track approval form available from the City & Guilds' website.

It is important that centres inform us via the fast track form whether they intend to deliver the new optional units for hybrids and electric vehicles, as this will inform the approval process.

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

For any other cases, centres will need to gain both centre and qualification approval. Please refer to the Centre Manual - Supporting Customer Excellence for further information. Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

Resource requirements

Physical resources and site agreements

Centres must have access to sufficient equipment in the college, training centre or workplace centre or workplace to ensure candidates have the opportunity to cover all of the practical activities.

Centre staffing

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

- be occupationally competent or technically knowledgeable in the areas 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.

Assessors and internal verifiers

All assessors must:

- have sufficient and relevant technical/occupational competence in the Unit, at or above the level of the Unit being assessed.
- have in depth knowledge of the qualification or SVQ unit evidence requirements.
- hold or be working towards a relevant assessors' award as specified by the Sector Skills Council. This will include, but not be limited to the Assessor qualifications, Level 3 Award in Understanding the Principles and Practices of Assessment, Level 3 Award in Assessing Competence in the Work Environment, Level 3 Award in Assessing Vocationally Related Achievement, Level 3 Certificate in Assessing Vocational Achievement (and by implication legacy Assessor units A1, A2 and D32/33 unit) but may be an appropriate equivalent as defined by IMI, the SSC).
- assessors working towards a relevant assessor qualification must achieve their qualification within 12 months.
- demonstrate knowledge and understanding of the competencies that a learner is required to demonstrate for the qualification that they are undertaking
- provide evidence of completing 5 days working/job shadowing in industry within their professional area in a 24 month period.
- provide evidence of 30 hours of technical/qualification related CPD within a 12 month period. (This is in addition to working/job shadowing).

All internal verifiers must:

- have in-depth knowledge of the occupational standards and SVQ unit evidence requirements.
- be occupationally aware of the relevant industry sector being internally verified.
- hold or be working towards a relevant verifier award as specified by the Sector Skills Council. This will include, but not be limited to the Quality Assurance qualifications Level 4 Award in Understanding the Internal Quality Assurance of Assessment Processes and Practice, Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practice, Level 4 Certificate in Leading the Internal Quality Assurance of Assessment Processes and Practice, (and by implication legacy Internal Verifier unit V1 D34 unit) but may be an appropriate equivalent as defined by IMI, the Sector Skills Council.

  verifiers working towards a relevant qualification must achieve their qualification within 12 months.
- provide evidence of CPD totalling not less than 30 hours from within their professional area within a 12 month period.

Continuing professional development (CPD)

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification is in line with best practice, and that it takes account of any national or legislative developments.

Candidate entry requirements

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

Age restrictions

There is no age restriction for these qualifications unless this is a legal requirement of the process or the environment.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each learner 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 learner fully understands the requirements of the qualifications, their responsibilities as a learner, 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
Learning and Support Materials	www.cityandguilds.com/automotive
SmartScreen	www.smartscreen.co.uk
Exam Success book TL024290	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**.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate. *Recording forms* are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external quality assurer, before they are used by candidates and assessors at the centre. Amendable (MS Word) versions of the forms are available on the City & Guilds website.

4 Assessment

Summary of assessment methods

Candidates must complete a portfolio of evidence for each unit (for all competence aspects of the unit).

Where stipulated, candidates must also attain an online multiple-choice test, graded as Pass, Merit, Distinction for particular units. The test will cover all or part of the knowledge aspects of the unit. Where the test does not cover all of the essential knowledge, the criterion must be assessed in one of the following ways:

- oral or written questioning
- professional discussion.

Time constraints

There are no time constraints applied to the assessment of this qualification. If centres have queries regarding the length of time required to complete a particular task, they should contact their external quality assurer in the first instance who will advise accordingly and feed this information back to City & Guilds where appropriate.

Recognition of prior learning (RPL)

Recognition of prior learning means using a learner's previous experience, or qualifications which have already been achieved, to contribute to a new qualification.

RPL is allowed and is also sector specific.

Assessment Types			
City & Guilds unit	**SCQF Level**	**Unit title**	**Assessment method**
5310-001	Level 5	Contribute to Housekeeping in Motor Vehicle Environments	Portfolio
5310-002	Level 5	Reduce Risk(s) to Health & Safety in the Motor Vehicle Environment	Portfolio
5310-004	Level 5	Use of Tools and Equipment in Motor Vehicle Engineering	Portfolio
5310-006	Level 5	Facilitate Individuals Learning and Development	Portfolio
5310-008	Level 6	Identify and Agree the Motor Vehicle Customer Needs	Portfolio
5310-009	Level 6	Maintain Working Relationships in the Motor Vehicle Environment	Portfolio
5310-211	Level 7	Overhaul Commercial Vehicle Mechanical Units	Portfolio
5310-261	Level 7	Overhaul Commercial Vehicle Mechanical Units	Multiple choice on-line test
5310-214	Level 5	Remove and Replace Commercial Vehicle Transmission and Driveline Units And Components	Portfolio
5310-264	Level 5	Remove and Replace Commercial Vehicle Transmission and Driveline Units And Components	Multiple choice on-line test
5310-215	Level 7	Diagnose and Rectify Commercial Vehicle Transmission and Driveline System Faults	Portfolio
5310-265	Level 7	Diagnose and Rectify Commercial Vehicle Transmission and Driveline System Faults	Multiple choice on-line test
5310-219	Level 5	Remove and Fit Basic Motor, Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Motor Vehicle Body Panels	Portfolio
5310-269	Level 5	Remove and Fit Basic Motor, Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Motor Vehicle Body Panels	Multiple choice on-line test
5310-221	Level 5	Carry Out Routine Commercial Motor Vehicle Maintenance	Portfolio
5310-231	Level 5	Carry Out Routine Commercial Motor Vehicle Maintenance	Multiple choice on-line test
5310-222	Level 5	Remove and Replace Commercial Vehicle Engine Units and Components	Portfolio
5310-232	Level 5	Remove and Replace Commercial Vehicle Engine Units and Components	Multiple choice on-line test
5310-223	Level 5	Remove and Replace Commercial Vehicle Electrical Auxiliary Units and Components	Portfolio

5310-233	Level 5	Remove and Replace Commercial Vehicle Electrical Auxiliary Units and Components	Multiple choice on-line test
5310-224	Level 5	Remove and Replace Commercial Vehicle Chassis Units and Components Units and Components	Portfolio
5310-234	Level 5	Remove and Replace Commercial Vehicle Chassis Units and Components Units and Components	Multiple choice on-line test
5310-226	Level 6	Inspect Commercial Vehicles	Portfolio
5310-236	Level 6	Inspect Commercial Vehicles	Multiple choice on-line test
5310-227	Level 7	Diagnose and Rectify Commercial Vehicle Engine and Component Faults	Portfolio
5310-237	Level 7	Diagnose and Rectify Commercial Vehicle Engine and Component Faults	Multiple choice on-line test
5310-228	Level 7	Diagnose and Rectify Commercial Vehicle Chassis System Faults	Portfolio
5310-238	Level 7	Diagnose and Rectify Commercial Vehicle Chassis System Faults	Multiple choice on-line test
5310-406	Level 7	Diagnose And Rectify Motor Vehicle Electrical Unit And Component Faults	Portfolio
5310-456	Level 7	Diagnose And Rectify Motor Vehicle Electrical Unit And Component Faults	Multiple choice online test
5310-407	Level 4	Carry Out Non High Energy Electrical Systems Work on or Near Electric and Hybrid Vehicles	Portfolio
5310-408	Level 7	Service And Repair Non-Live Electric And Hybrid Vehicle Systems	Portfolio

Time constraints

The following must be applied to the assessment of this qualification:

- Candidates must finish their assessment within six months of starting it.
- Assignments should take no longer than 8 hours. If they do, centres should consider why this is, and make sure that they are not trying to gather too much evidence.

Assessment strategy

Simulation

The IMI SVQ units are work/competency based and therefore candidates are to be assessed under normal working conditions. It is recognised however, that there are situations where the workplace may not be appropriate or that waiting for naturally occurring evidence is impractical. In these situations centres will be allowed to set up or devise assessment situations. For example, it may not be possible to diagnose and rectify faults because they do not occur frequently, in which case a simulated environment could be used. In addition, dealing with fire and other emergencies such as recovering overturned vehicles, might be better assessed through a simulated environment because this would be a safer approach. Simulations can only be set up after:

- all possible routes of naturally occurring evidence have been exhausted
- the exact make up and content of the centre devised assessment has been agreed and approved by the external quality assurer
- the assessor can assure that the simulation will provide evidence that is valid, reliable and authentic.

Any simulation must be carried out using actual vehicles; the use of engine rigs or electrical boards is not permitted. Simulated environments must not be used for the assessment of entire units.

Realistic Work Environment (RWE)

The use of approved simulation means that RWE is not to be used.

Expert witness

The use of witness testimony and expert witness testimony are appropriate methods for assessors to collect supplementary evidence on candidates' performance. Witness testimonies may be obtained from people that are occupationally competent and whom may be familiar with the NOS, such as the candidate's line manager.

The assessor must judge the validity of the witness testimony and these may vary depending on the source. Witness testimonies can only support the assessment process and may remove or reduce the need to collect supplementary evidence; however City & Guilds quality assurance requirements must be met. The person or persons providing the witness testimony must also be available to the external quality assurer for confirmation of evidence validity if required.

Health and safety

The requirement to follow safe working practices is an integral part of all City & Guilds qualifications and assessments, and it is the responsibility of centres to ensure that all relevant health and safety requirements are in place before candidates start practical assessments.

Should a candidate fail to follow health and safety practice and procedures during an assessment, the assessment must be stopped. The candidate should be informed that they have not reached the standard required to successfully pass the assessment and told the

reason why. Candidates may retake the assessment at a later date, at the discretion of the centre. In case of any doubt, guidance should be sought from the external quality assurer.

Data protection and confidentiality

Centres offering this qualification may need to provide City & Guilds with personal data for staff and candidates. Guidance on data protection and the obligations of City & Guilds and centres are explained in the *Centre Manual - Supporting Customer Excellence*.

Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification.

RPL is allowed and is also sector specific.

5 Units

Availability of units

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

- City & Guilds reference number
- title
- SCQF level
- SCQF credit value
- unit aim
- unit content
- unit range

Unit 001 Contribute to housekeeping in motor vehicle environments

Level:	**5**
Credit value:	5
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about the routine maintenance of the workplace, carrying out basic, non-specialist checks of relevant workplace equipment, cleaning the work area and using resources economically.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures	
1.1	the scope of their job responsibilities for the use and maintenance of equipment and their work area
1.2	workplace policies and legislation and schedules for **housekeeping activities** and **equipment maintenance**
1.3	the manufacturer's requirements for the cleaning and general, non-specialist maintenance of the equipment for which they are responsible
1.4	the regulations and information sources applicable to workshop cleaning and maintenance activities for which they are responsible
1.5	the importance of reporting faults quickly to the relevant person
1.6	the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Equipment maintenance	
2.1	how to select and use equipment appropriate for task for basic hand tool maintenance activities
2.2	how to store equipment safely and accessibly
2.3	how to report faulty or damaged equipment
2.4	how to work safely when cleaning and maintaining equipment.

3. General work area housekeeping	
3.1	how to select and use cleaning equipment
3.2	how to clean and maintain the **equipment** and work areas for which they are responsible
3.3	how to dispose of unused cleaning agents, materials and debris to comply with relevant legal, environmental and workplace requirements
3.4	the properties and hazards associated with the use of cleaning agents and materials
3.5	the importance of wearing personal protective equipment
3.6	the importance of using resources as directed and for their intended purpose only.

Performance objectives

To be competent the learner must:

1. select and use suitable personal protective equipment throughout all **housekeeping** and **equipment maintenance activities**
2. select and use cleaning equipment which is:
    - of the right type
    - suitable for the task
3. use resources as directed and for their intended purpose only, following workplace procedures
4. follow workplace policies, schedules and manufacturers' instructions when cleaning and maintaining equipment
5. ensure their equipment maintenance activities keep your equipment fit for purpose
6. clean the work area(s), for which they are responsible, at the specified time and frequency
7. store their equipment in a safe manner which permits ease of access and identification for use
8. carry out **housekeeping activities** safely and in a way which minimises inconvenience to customers and staff
9. ensure their **housekeeping activities** keep their work area clean and free from debris and waste materials
10. dispose of used cleaning agents, materials and debris to comply with relevant legal, environmental and workplace requirements
11. report any faulty or damaged equipment to the relevant person(s) clearly and promptly
12. report any anticipated delays in completion to the relevant person(s) promptly.

Unit 001 Contribute to housekeeping in motor vehicle environments

Supporting information

Scope of this unit:

Equipment maintenance covers:

a. routine checks on equipment
b. cleaning equipment
c. visual inspection of electrical equipment.

Housekeeping activities cover:

a. day to day work area cleaning
b. clearing away
c. dealing with spillages
d. disposal of waste used materials and debris taking into account relevant environmental factors.

Motor Vehicle could include:

a. Light vehicles
b. Heavy vehicles/commercial vehicles
c. Motorcycles
d. Lift trucks
e. Heavy vehicle trailers
f. Caravan and motorhomes.

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Economic use of Resources

a. Consumable materials e.g. grease, oils, split pins, locking and fastening devices.

Requirement to maintain work area effectively

a. Cleaning tools and equipment to maximise workplace efficiency.
b. Requirement to carry out the housekeeping activities safely and in a way that minimises inconvenience to customers and staff.
c. Risks involved when using solvents and detergents.
d. Advantages of good housekeeping.

Spillages, leaks and waste materials

a. Relevance of safe systems of work to the storage and disposal of waste materials.
b. Requirement to store and dispose of waste, used materials and debris correctly.
c. Safe disposal of special / hazardous waste materials.
d. Advantages of recycling waste materials.
e. Dealing with spillages and leaks.

Basic legislative requirements

a. Provision and Use of Work Equipment Regulations 1992
b. Provision and Use of Work Equipment Regulations 1998 as applied to power presses
c. Pressure Systems and Transportable Gas Containers Regulations 1989
d. Electricity at Work Regulations 1989
e. Noise at Work Regulations 1989
f. Manual Handling Operations Regulations 1992
g. Health and Safety (Display Screen Equipment) Regulations 1992
h. Abrasive Wheels Regulations 1970
i. The Lifting Operations and Lifting Equipment Regulations 1998
j. Work at Height Regulations 2005.

Routine maintenance of the workplace

a. Trainees' personal responsibilities and limits of their authority with regard to work equipment.
b. Risk assessment of the workplace activities and work equipment.
c. Workplace person responsible for training and maintenance of workplace equipment.
d. When and why safety equipment must be used.
e. Location of safety equipment.
f. Particular hazards associated with their work area and equipment.
g. Prohibited areas.
h. Plant and machinery that trainees must **not** use or operate.
i. Why and how faults on unsafe equipment should be reported.
j. Storing tools, equipment and products safely and appropriately.
k. Using the correct PPE.
l. Following manufacturers' recommendations.
m. Location of routine maintenance information e.g. electrical safety check log.

Legislation relevant to Health and Safety

a. Health And Safety At Work Act 1974
b. Control of Substances Hazardous to Health Regulations 2002
c. Environmental Protection Agency
d. Manual Handling Operations Regulations 1992
e. Personal Protective Equipment Regulations 1992.

General regulations to include an awareness of:

a. Health and Safety (Display Screen Equipment) Regulations 1992
b. Health and Safety (First Aid) Regulations 1981
c. Health and Safety (Safety Signs and Signals) Regulations 1996
d. Health and Safety (Consultation with Employees) Regulations 1996
e. Employers Liability (Compulsory Insurance) Act 1969 and Regulations 1998
f. Confined Spaces Regulations 1997
g. Noise at Work Regulations 1989
h. Electricity at Work Regulations 1989
i. Electricity (Safety) Regulations 1994
j. Fire Precautions Act 1971
k. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985
l. Pressure Systems Safety Regulations 2000
m. Waste Management 1991
n. Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002
o. Control of Asbestos at Work Regulations 2002.

Legislative duties

a. The purpose of a Health and Safety Policy.
b. The relevance of the Health and Safety Executive.
c. The relevance of an initial induction to Health and Safety requirements at your workplace.
d. General employee responsibilities under the HASAWA and the consequences of non-compliance.
e. General employer responsibilities under the HASAWA and the consequences of non-compliance.
f. The limits of authority with regard to Health and Safety within a personal job role.
g. Workplace procedure to be followed to report Health and Safety matters.

Precautions to be taken when working with vehicles, workshop materials, tools and equipment including electrical safety, pneumatics and hydraulics

a. Accessing and interpreting safety information.
b. Seeking advice when needed.
c. Seeking assistance when required.
d. Reporting of unsafe equipment.
e. Storing tools, equipment and products safely and appropriately.
f. Using the correct PPE.
g. Following manufacturers' recommendations.
h. Following application procedures e.g. hazardous substances.
i. The correct selection and use of extraction equipment.

PPE to include:

a. Typical maintenance procedures for PPE equipment to include:
    i typical maintenance log
    ii cleaning procedures
    iii filter maintenance
    iv variation in glove types
    v air quality checks.
b. Choice and fitting procedures for masks and air breathing equipment.
c. Typical workplace processes which would require the use of PPE to include:
    i welding
    ii sanding and grinding
    iii filling
    iv panel removal and replacement
    v drilling
    vi cutting
    vii chiselling
    viii removal of broken glass
    ix removal of rubber seals from fire damaged vehicles
    x removal of hypodermic needles
    xi servicing activities
    xii roadside recovery
    xiii unserviceable PPE.
d. PPE required for a range automotive repair activities. To include appropriate protection of:
    i eyes
    ii ears
    iii head
    iv skin
    v feet
    vi hands
    vii lungs

Fire and extinguishers

a. Classification of fire types.
b. Using a fire extinguisher effectively.
c. Types of extinguishers:
    i foam
    ii dry powder
    iii CO2
    iv water
    v fire blanket.

Action to be taken in the event of a fire to include:

The procedure as:

    i raise the alarm
    ii fight fire only if appropriate
    iii evacuate building
    iv call for assistance.

Product warning labels to include:

a. Reasons for placing warning labels on containers.
b. Warning labels in common use:
    i toxic
    ii corrosive
    iii poisonous
    iv harmful
    v irritant
    vi flammable
    vii explosive.

Warning signs and notices

a. Colours used for warning signs:
    i red
    ii blue
    iii green.
b. Shapes and meaning of warning signs:
    i round
    ii triangular
    iii square.
c. The meaning of prohibitive warning signs in common use.
d. The meaning of mandatory warning signs in common use.
e. The meaning of warning notices in common use.
f. General design of safe place warning signs.

Hazards and risks to include:

a. The difference between a risk and a hazard.
b. Potential risks resulting from:
    i the use and maintenance of machinery or equipment
    ii the use of materials or substances
    iii accidental breakages and spillages
    iv unsafe behaviour
    v working practices that do not conform to laid down policies
    vi environmental factors
    vii personal presentation
    viii unauthorised personnel, customers, contractors etc entering work premises
    ix working by the roadside
    x vehicle recovery.
c. The employee's responsibilities in identifying and reporting risks within their working environment.
d. The method of reporting risks that are outside own limits of authority.

e. Potential causes of:
   i fire
   ii explosion
   iii noise
   iv harmful fumes
   v slips
   vi trips
   vii falling objects
   viii accidents whilst dealing with broken down vehicles.

Personal responsibilities

a. The purpose of workplace policies and procedures on:
   i the use of safe working methods and equipment
   ii the safe use of hazardous substances
   iii smoking, eating , drinking and drugs
   iv emergency procedures
   v personal appearance.
b. The importance of personal appearance in the control of health and safety.

Action to be taken in the event of colleagues suffering accidents

a. The typical sequence of events following the discovery of an accident such as:
   ii make the area safe
   iii remove hazards if appropriate i.e. switch off power
   iv administer minor first aid
   v take appropriate action to re-assure the injured party
   vi raise the alarm
   vii get help
   viii report on the accident.
b. Typical examples of first aid which can be administered by persons at the scene of an accident:
   i check for consciousness
   ii stem bleeding
   iii keep the injured person's airways free
   iv place in the recovery position if injured person is unconscious
   v issue plasters for minor cuts
   vi action to prevent shock i.e. keep the injured party warm
   vii administer water for minor burns or chemical injuries
   viii wash eyes with water to remove dust or ingress of chemicals (battery acid)
   ix need to seek professional help for serious injuries.
c. Examples of bad practice which may result in further injury such as:
   i moving the injured party
   ii removing foreign objects from wounds or eyes
   iii inducing vomiting
   iv straightening deformed limbs.

Evidence requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of use of personal and vehicle protection, cleaning the work environment and disposal of waste on **3** separate **occasions.**
5. be observed by their assessor on at least **1** occasion carrying out the above.
6. produce evidence of identifying risks which may result from at least **2** of the items listed below:
    - the use and maintenance of machinery or equipment
    - the use of materials or substances
    - working practices which do not conform to laid down policies
    - unsafe behaviour
    - accidental breakages and spillages
    - environmental factors
7. be observed by their assessor on at least **1** occasion carrying out the above.
8. produce evidence of following at least **4** of the workplace policies listed below:
    - the use of safe working methods and equipment
    - the safe use of hazardous substances
    - smoking, eating, drinking and drugs
    - what to do in the event of an emergency
    - personal presentation
9. be observed by their assessor following workplace policies on at least **1** occasion.

Unit 002 Reduce risk(s) to health and safety in the motor vehicle environment

Level:	**5**
Credit value:	5
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit covers the basic, legally required health and safety duties of everyone in the workplace. It describes the competence required to ensure that: • own actions or lack of actions do not create any health and safety risk(s) • the learner does not ignore an identifiable risk(s) in their workplace • the learner takes sensible action to put things right, including reporting situations which pose an identifiable risk(s) to people in the workplace, and seeking advice from others. When the learner has completed this unit, they will have demonstrated they can: • identify hazards and evaluate risk(s) in their workplace • reduce the risk(s) to health and safety in their workplace.

Essential knowledge

The learner will need to know and understand:

1.	**Health and safety legislation and workplace policies**
1.1	the current health and safety legislation, regulations and workplace policies that govern your working practices
1.2	their duties and responsibilities for current health and safety as defined by any specific legislation covering their job role and where to access the information
1.3	agreed **workplace policies** relating to controlling risk(s) to health and safety
1.4	the responsible person(s) to whom they report health and safety concerns.

2. **Risk(s) to health and safety**	
2.1	what hazards may exist in their workplace
2.2	health and safety risk(s) which may be present in their own job role and the precautions they must take
2.3	the importance of remaining alert to the presence of hazards in the whole workplace
2.4	how to deal with and report risk(s)
2.5	the requirements and guidance on the precautions
2.6	the specific workplace policies including safe working practices covering their job role
2.7	suppliers' and manufacturers' instructions for the safe use of equipment, materials and products
2.8	working practices for their own job role
2.9	the importance of personal presentation in maintaining health and safety in the workplace
2.10	the importance of personal conduct in maintaining the health and safety of themselves and others
2.11	the importance of personal protective equipment, when and where it should be used and the importance of maintaining it correctly
2.12	their scope and responsibility for rectifying risk(s)

Performance objectives

To be competent, the learner must:

1. carry out their working practices in accordance with relevant legislative requirements
2. identify the correct personal and vehicle protective equipment required to correctly carry out their workplace practices
3. carry out their workplace practices and policies using the correct personal protective equipment
4. rectify health and safety **risk(s)** that are within their capability and scope of their job responsibilities
5. pass on any suggestions for reducing **risk(s)** to health and safety within their job role to the responsible persons
6. ensure their personal conduct in the workplace does not endanger the health and safety of themselves or other persons
7. follow the **workplace policies** and suppliers' or manufacturers' instructions for the safe use of equipment, materials and products and report any differences identified
8. ensure their personal presentation at work:
   - ensures the health and safety of themselves and others
   - meets any relevant legislative duties and is in accordance with workplace policies
   - is in accordance with workplace policies.

Unit 002 Reduce risk(s) to health and safety in the motor vehicle environment

Supporting information

Scope of this unit:

Risks resulting from:

a. use of tools and equipment relevant to the task
b. the use of materials or substances
c. working practices which do not conform to laid down policies
d. unsafe behaviour
e. accidental breakages and spillages
f. environmental factors
g. working at height
h. lifting operations and manual handling
i. incorrect use of personal protective equipment.

Workplace policies covering:

a. the use of safe working methods and equipment
b. the safe use of hazardous substances
c. smoking, eating, drinking and drugs
d. what to do in the event of an emergency
e. personal presentation
f. personal protective equipment
g. lifting operations and manual handling
h. working at heights
i. mobile phones and personal stereo equipment.

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Economic use of Resources

a. Consumable materials e.g. grease, oils, split pins, locking and fastening devices.

Requirement to maintain work area effectively

a. Cleaning tools and equipment to maximise workplace efficiency.
b. Requirement to carry out the housekeeping activities safely and in a way that minimises inconvenience to customers and staff.
c. Risks involved when using solvents and detergents.
d. Advantages of good housekeeping.

Spillages, leaks and waste materials

a. Relevance of safe systems of work to the storage and disposal of waste materials.
b. Requirement to store and dispose of waste, used materials and debris correctly.
c. Safe disposal of special / hazardous waste materials.

d. Advantages of recycling waste materials.
e. Dealing with spillages and leaks.

Basic legislative requirements

a. Provision and Use of Work Equipment Regulations 1992
b. Provision and Use of Work Equipment Regulations 1998 as applied to power presses
c. Pressure Systems and Transportable Gas Containers Regulations 1989
d. Electricity at Work Regulations 1989
e. Noise at Work Regulations 1989
f. Manual Handling Operations Regulations 1992
g. Health and Safety (Display Screen Equipment) Regulations 1992
h. Abrasive Wheels Regulations 1970
i. The Lifting Operations and Lifting Equipment Regulations 1998
j. Work at Height Regulations 2005.

Routine maintenance of the workplace

a. Trainees' personal responsibilities and limits of their authority with regard to work equipment.
b. Risk assessment of the workplace activities and work equipment.
c. Workplace person responsible for training and maintenance of workplace equipment.
d. When and why safety equipment must be used.
e. Location of safety equipment.
f. Particular hazards associated with their work area and equipment.
g. Prohibited areas.
h. Plant and machinery that trainees must **not** use or operate.
i. Why and how faults on unsafe equipment should be reported.
j. Storing tools, equipment and products safely and appropriately.
k. Using the correct PPE.
l. Following manufacturers' recommendations.
m. Location of routine maintenance information e.g. electrical safety check log.

Legislation relevant to Health and Safety

a. Health And Safety At Work Act 1974
b. Control of Substances Hazardous to Health Regulations 2002
c. Environmental Protection Agency
d. Manual Handling Operations Regulations 1992
e. Personal Protective Equipment Regulations 1992.

General regulations to include an awareness of:

a. Health and Safety (Display Screen Equipment) Regulations 1992
b. Health and Safety (First Aid) Regulations 1981
c. Health and Safety (Safety Signs and Signals) Regulations 1996
d. Health and Safety (Consultation with Employees) Regulations 1996
e. Employers Liability (Compulsory Insurance) Act 1969 and Regulations 1998
f. Confined Spaces Regulations 1997
g. Noise at Work Regulations 1989
h. Electricity at Work Regulations 1989
i. Electricity (Safety) Regulations 1994
j. Fire Precautions Act 1971
k. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985
l. Pressure Systems Safety Regulations 2000
m. Waste Management 1991
n. Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002
o. Control of Asbestos at Work Regulations 2002.

Legislative duties

a. The purpose of a Health and Safety Policy.
b. The relevance of the Health and Safety Executive.
c. The relevance of an initial induction to Health and Safety requirements at your workplace.
d. General employee responsibilities under the HASAWA and the consequences of non-compliance.
e. General employer responsibilities under the HASAWA and the consequences of non-compliance.
f. The limits of authority with regard to Health and Safety within a personal job role.
g. Workplace procedure to be followed to report Health and Safety matters.

Precautions to be taken when working with vehicles, workshop materials, tools and equipment including electrical safety, pneumatics and hydraulics

a. Accessing and interpreting safety information.
b. Seeking advice when needed.
c. Seeking assistance when required.
d. Reporting of unsafe equipment.
e. Storing tools, equipment and products safely and appropriately.
f. Using the correct PPE.
g. Following manufacturers' recommendations.
h. Following application procedures e.g. hazardous substances.
i. The correct selection and use of extraction equipment.

PPE to include:

a. Typical maintenance procedures for PPE equipment to include:
    i typical maintenance log
    ii cleaning procedures
    iii filter maintenance
    iv variation in glove types
    v air quality checks.
b. Choice and fitting procedures for masks and air breathing equipment.
c. Typical workplace processes which would require the use of PPE to include:
    i welding
    ii sanding and grinding
    iii filling
    iv panel removal and replacement
    v drilling
    vi cutting
    vii chiselling
    viii removal of broken glass
    ix removal of rubber seals from fire damaged vehicles
    x removal of hypodermic needles
    xi servicing activities
    xii roadside recovery
    xiii unserviceable PPE.
d. PPE required for a range automotive repair activities. To include appropriate protection of:
    i eyes
    ii ears
    iii head
    iv skin
    v feet
    vi hands
    vii lungs

Fire and extinguishers

a. Classification of fire types.
b. Using a fire extinguisher effectively.
c. Types of extinguishers:
    i foam
    ii dry powder
    iii CO2
    iv water
    v fire blanket.

Action to be taken in the event of a fire to include:

a. The procedure as:
    ii raise the alarm
    iii fight fire only if appropriate
    iv evacuate building
    v call for assistance.

Product warning labels to include:

a. Reasons for placing warning labels on containers.
b. Warning labels in common use:
    i toxic
    ii corrosive
    iii poisonous
    iv harmful
    v irritant
    vi flammable
    vii explosive

Warning signs and notices

a. Colours used for warning signs:
    i red
    ii blue
    iii green.
b. Shapes and meaning of warning signs:
    i round
    ii triangular
    iii square
c. The meaning of prohibitive warning signs in common use.
d. The meaning of mandatory warning signs in common use.
e. The meaning of warning notices in common use.
f. General design of safe place warning signs.

Hazards and risks to include:

a. The difference between a risk and a hazard.
b. Potential risks resulting from:
    i the use and maintenance of machinery or equipment
    ii the use of materials or substances
    iii accidental breakages and spillages
    iv unsafe behaviour
    v working practices that do not conform to laid down policies
    vi environmental factors
    vii personal presentation
    viii unauthorised personnel, customers, contractors etc entering work premises
    ix working by the roadside
    x vehicle recovery.
c. The employee's responsibilities in identifying and reporting risks within their working environment.
d. The method of reporting risks that are outside own limits of authority.

e. Potential causes of:
   i fire
   ii explosion
   iii noise
   iv harmful fumes
   v slips
   vi trips
   vii falling objects
   viii accidents whilst dealing with broken down vehicles.

Personal responsibilities

a. The purpose of workplace policies and procedures on:
   i the use of safe working methods and equipment
   ii the safe use of hazardous substances
   iii smoking, eating , drinking and drugs
   iv emergency procedures
   v personal appearance.
b. The importance of personal appearance in the control of health and safety.

Action to be taken in the event of colleagues suffering accidents

a. The typical sequence of events following the discovery of an accident such as:
   i make the area safe
   ii remove hazards if appropriate i.e. switch off power
   iii administer minor first aid
   iv take appropriate action to re-assure the injured party
   v raise the alarm
   vi get help
   vii report on the accident.
b. Typical examples of first aid which can be administered by persons at the scene of an accident:
   i check for consciousness
   ii stem bleeding
   iii keep the injured person's airways free
   iv place in the recovery position if injured person is unconscious
   v issue plasters for minor cuts
   vi action to prevent shock i.e. keep the injured party warm
   vii administer water for minor burns or chemical injuries
   viii wash eyes with water to remove dust or ingress of chemicals (battery acid)
   ix need to seek professional help for serious injuries.
c. Examples of bad practice which may result in further injury such as:
   i moving the injured party
   ii removing foreign objects from wounds or eyes
   iii inducing vomiting
   iv straightening deformed limbs.

Evidence requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of use of personal and vehicle protection, cleaning the work environment and disposal of waste on **3** separate **occasions.**
5. be observed by their assessor on at least **1** occasion carrying out the above.
6. produce evidence of identifying risks which may result from at least **2** of the items listed below:
    - the use and maintenance of machinery or equipment
    - the use of materials or substances
    - working practices which do not conform to laid down policies
    - unsafe behaviour
    - accidental breakages and spillages
    - environmental factors
7. be observed by their assessor on at least **1** occasion carrying out the above.
8. produce evidence of following at least **4** of the workplace policies listed below:
    - the use of safe working methods and equipment
    - the safe use of hazardous substances
    - smoking, eating, drinking and drugs
    - what to do in the event of an emergency
    - personal presentation
9. be observed by their assessor following workplace policies on at least **1** occasion.

Unit 004 Use of tools and equipment in motor vehicle engineering

Level:	**5**
Credit value:	11
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about the basic use of tools, materials and fabrications relevant to the Automotive Sector. This unit is about: • interpreting information • adopting safe and healthy working practices • selecting materials and equipment. This unit is for those working in technical support roles. It is also appropriate for workshop planners.

Essential knowledge

The learner will need to know and understand:

1. the relevant organisational procedures developed to report and rectify inappropriate information and unsuitable resources, and how they are implemented
2. the types of information, their source and how they are interpreted
3. the relevant organisational procedures to solve problems with the information and why it is important they are followed
4. the relevant legislation and official guidance and how it is applied
5. what the accident reporting procedures are and who is responsible for making the reports
6. why and when personal protective equipment (PPE) should be used
7. the relevant requirements for the disposal of waste, used materials and debris taking into account relevant environmental factors
8. material properties relevant to the task and their appropriate applications
9. the appropriate use of materials for fabrication and repair
10. how to file, fit, tap, thread, cut and drill plastics and metals
11. how to select and use gaskets, sealants, seals, fittings and fasteners.

Performance objectives

The learner must be able to:
1. select and use suitable personal protective equipment appropriate to the task 2. interpret the information relating supplied relating to the task 3. carry out pre-start preparation inspections on **tools and equipment** in accordance with approved procedures 4. carry out operations using tools and equipment in accordance with safe working practices to achieve the work outcome 5. highlight and identify problems associated with tools and equipment to the relevant person 6. demonstrate work skills to manufacture and repair components using: • measure • mark out • file • fit • tap • thread • cut • drill • finish • position and secure 7. use and maintain relevant tools and equipment 8. dispose of waste in accordance with relevant legislation including environmental to maintain a clean work space 9. carry out checks in accordance with manufacturer's/operator's guidance, schedules, relevant legislation and official guidance and organisational requirements 10. demonstrate correct selection of materials for manufacture or repair 11. inspect, clean and store tools and equipment after use.

Unit 004 Use of tools and equipment in motor vehicle engineering

Supporting information

Scope of this unit:

Tools and equipment

a. Hand tools
b. Electrical
c. Mechanical
d. Pneumatic
e. Hydraulic

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Common types of hand tools used for fabricating and fitting in the automotive workplace, to include:

a. Files.
b. Hacksaws and snips.
c. Hammers.
d. Screwdrivers.
e. Pliers.
f. Spanners.
g. Sockets.
h. Punches.
i. Types of drill and drill bits.
j. Taps and dies.
k. Stud removers.
l. Marking out tools.

Common measuring devices used for fabrication and fitting in the automotive workplace, to include:

a. Rule or tape.
b. Callipers.
c. Feeler gauge.
d. Volume measures.
e. Micrometer.
f. Dial gauges.
g. Torque wrenches.
h. Depth gauges.

Common electrical measuring tools used in the repair of vehicles and components, to include:

a. Ammeter.
b. Voltmeter.
c. Ohmmeter.
d. Multi-meter.

Common electrical terms when measuring:

a. Voltage.
b. Current.
c. Resistance.

Workshop equipment (including appropriate PPE) to include:

a. Hydraulic jacks.
b. Axle stands.
c. Pillar drills.
d. Air tools.
e. Vehicle lifts.
f. Cranes.
g. Hoists.
h. Electrical power tools.

Properties, application and limitations (to include safe use) of ferrous and non-ferrous metals used when constructing, modifying and repairing vehicles and components. Materials to include:

a. Carbon steels.
b. Alloy steels.
c. Cast iron.
d. Aluminium alloys.
e. Brass.
f. Copper.
g. Lead.

Properties, application and limitations (to include safe use) of non-metallic materials used when constructing, modifying and repairing vehicles and components. Materials to include:

a. Glass.
b. Plastics (inc GRP).
c. Kevlar.
d. Rubber.

Terms relating to the properties of materials, to include:

a. Hardness.
b. Toughness.
c. Ductility.
d. Elasticity.
e. Tenacity.
f. Malleability.
g. Plasticity.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence that they have interpreted information, adopted safe and healthy working practices using hand tools and equipment and correctly selected materials and equipment
5. produce evidence of the following work skills listed below:
    - measure, mark out, file, fit, tap, thread, cut, drill, finish, position and secure.

Unit 006 Facilitate individuals learning and development

Level:	**8**
Credit value:	11
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about demonstrating skills and methods to learners and instructing learners in procedures and processes. These include; demonstrating how equipment is used, showing a learner how to do something, giving learners instructions on what to do or how to carry out a particular activity, deciding when to use demonstration or instruction to encourage learning, reviewing the potential use of technology-based learning, checking on the progress of learners and giving feedback to learners.

Essential knowledge

The learner will need to understand:

1.	**The nature and role of demonstrations and instruction**
1.1	the separate areas of demonstrations which encourage learning
1.2	which types of learning are best achieved and supported through demonstrations
1.3	how to identify and use different learning opportunities
1.4	how to structure demonstrations and instruction sessions
1.5	how to choose from a range of demonstration techniques.

2.	**Principles and concepts**
2.1	how to put learners at their ease and encourage them to take part
2.2	how to choose between demonstration and instruction as learning methods
2.3	how to identify individual learning needs
2.4	which factors are likely to prevent learning and how to overcome them
2.5	how to check learners' understanding and progress
2.6	how to put information in order and decide whether the language they will be using is appropriate
2.7	how to choose and prepare appropriate materials, including technology based materials
2.8	the separate areas of instructional techniques which encourage learning
2.9	which types of learning are best achieved and supported through instruction.

3.	**External factors influencing human resource development**
3.1	how to make sure everybody acts in line with health, safety and environmental protection legislation and best practice
3.2	how to analyse and use developments in learning and new ways of delivery, including technology-based learning.

Performance objectives

To be competent, the learner must:

1.	**Demonstrate skills and methods to learners**
1.1	base the demonstration on an analysis of the skills needed and the order they must be learned in
1.2	ensure that the demonstration is accurate and realistic
1.3	structure the demonstration so the learner can get the most out of it
1.4	encourage learners to ask questions and get explanation at appropriate stages in the demonstration
1.5	give learners the opportunities to practise the skill being demonstrated and give them positive feedback
1.6	give extra demonstrations of the skills being taught to reinforce learning
1.7	ensure that demonstrations take place in a safe environment and allow learners to see the demonstration clearly
1.8	respond to the needs of learners during the demonstration
1.9	reduce distractions and disruptions as much as possible.

2.	**Instruct learners**
2.1	match instruction to the needs of the learners
2.2	identify which learning outcomes will be achieved through instruction
2.3	ensure that the manner, level and speed of the instruction encourages learners to take part
2.4	regularly check that learners understand and adapt instruction as appropriate
2.5	give learners positive feedback on the learning experience and the outcomes achieved
2.6	identify anything that prevents learning and review this with the learners.

Unit 006 Facilitate individuals learning and development

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Separate areas of demonstration which encourage learning, to include:

a. Demonstration is particularly applicable to learning manual skills.
b. Learning to do something usually involves:
    i. purpose – the aim or objective
    ii. procedure – the most effective way of completing the task
    iii. practice – all skills require practice to improve.
c. Practical tasks are more quickly learnt through demonstration.
d. Emphasis to body movements is required when demonstrating.
e. The demonstrator should encourage learners to ask questions.
f. Emphasis should be placed upon key points whilst demonstrating.
g. Any demonstration should ensure that all safety aspects are covered.

Types of learning which are best achieved and supported through demonstrations, to include:

a. Types of learning:
    i. psychomotor – measurement of manual skill performance
    ii. cognitive – learning involving thought processes
    iii. affective – demonstration of feelings, emotions or attitudes
b. Demonstration – involves learning to do something (Psychomotor Domain).
c. Combination of instruction and practical demonstrations are very effective means of learning practical skills.

How to structure demonstration and instruction sessions, to include:

a. Before the demonstration and/or instruction ensure that the following good practice is recognised:
   i. identify key points
   ii. relate theoretical underpinning knowledge to key points
   iii. rehearse to ensure that all equipment is working
   iv. ensure all students can see even small equipment and processes
   v. time the demonstration
   vi. consider how to make students participate
   vii. consider how to emphasise safe working practices.
b. During the demonstration and/or instruction good practice is to:
   i. give a clear introduction
   ii. identify any tools/equipment
   iii. determine the current audience level of knowledge
   iv. complete the demonstration correctly (do not show how not to do it)
   v. stress key points and show links between them
   vi. monitor safety aspects
   vii. check learner understanding.
c. After the demonstration (if possible):
   i. enable the audience to practice the techniques
   ii. provide feedback on their performance.

How to identify individual learning needs

a. Diagnose the learning needs of your audience to include:
   i. what competencies they already have
   ii. what experience they have of the subject area
   iii. what competencies they need to achieve
   iv. what demonstration techniques are best suited to their needs
   v. how to assess their needs have been met.

What factors are likely to prevent learning to include:

a. Language barriers.
b. Physical barriers.
c. Specialist knowledge.
d. Pace of learning.
e. Method of delivery.
f. Environmental factors.
g. Teaching styles.
h. Dyslexia.

How to check learners understanding and progress

a. Questionnaires.
b. Verbal questioning.
c. Observation.
d. Assessment.
e. Role play.
f. Projects/assignments.
g. Multi-choice questions.
h. Simulation.
i. Tests.

How to organise information and prepare materials

a. Identify the course aim.
b. Identify the subject aim.
c. Identify the lesson aim.
d. Complete a lesson plan – plan the teaching.
e. Identify a series of 'cues' to be used during the lesson.
f. Logically organise the information.
g. Use suitable resources and equipment to maximise learning opportunities.
h. Assess the learner's progress and understanding.

Instructional techniques

a. Lectures.
b. Handouts.
c. Team teaching.
d. Peer teaching.
e. Discussion – individual, group and peer.
f. Question and answer.
g. Multimedia.
h. Seminars.
i. Case studies.
j. Project/assignments.

Environmental factors that affect learning

a. Environmental factors that should be considered before demonstration/instruction to include:
    i. loud noises
    ii. bright colours
    iii. bright lights
    iv. strong smells
    v. atmosphere
    vi. temperature
    vii. classroom seating
    viii. classroom layout.

Health and safety factors that affect learning

a. Health and safety factors that should be considered before demonstration/instruction to include:
    i. assessment of risk and hazards
    ii. condition of electrical/electronic equipment
    iii. position of cables and wires
    iv. safety of equipment used in demonstration/instruction
    v. condition of classroom equipment/furniture/structure
    vi. suitable protective clothing/equipment.

Analysis of demonstration/instruction to include:

a. Feedback from students.
b. Feedback from colleagues.
c. Organisational quality assessment.
d. Feedback from external organisations.
e. Awarding body requirements.

Developments in learning to include:

a. Multimedia based materials.
b. Web based materials.
c. Interactive materials.

How to choose and prepare appropriate materials, to include:

a. Putting information in order.
b. Deciding whether the language used is appropriate.
c. Type of material i.e. paper and technology based.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy **or** by a witness who has been previously agreed with the assessor prior to the observation taking place.
4. provide at least **1 record** of an activity which has been demonstrated.
5. provide records of at least **2 observations, 1** of which **must be** by their assessor, which cover at least **1 demonstration** and **1 instruction or a combination of both.**

   It is expected that the **records** must include evidence to show how they:

   - decided on the sequence of the demonstration
   - ensured that the demonstration was accurate and realistic
   - identified which learning outcomes were achieved
   - ensured a safe environment for the demonstration and allowed all learners to see the demonstration clearly.

   In preparing the records they should consider:

   - which types of learning are best achieved and supported through demonstrations
   - how to choose between instruction and demonstration as learning methods
   - how to identify individual learning needs
   - which factors are likely to prevent learning and how to overcome them
   - how to choose and prepare appropriate materials, including technology based materials
   - which types of learning are best achieved through instruction
   - how to make sure everybody acts in line with health, safety and environmental protection legislation and best practice
   - how to analyse developments in learning and new ways of delivery, including technology based learning.

   It is also expected that evidence from their observations **will show** how they:

   - structured the demonstration so that the learner got the most out of it
   - encouraged learners to ask questions and get explanations at appropriate stages in the demonstration
   - gave learners the opportunities to practice the skill being demonstrated
   - gave learners positive feedback
   - reinforced learning by repeating demonstration
   - responded to the needs of learners during the demonstration
   - reduced distractions and disruptions as much as possible
   - matched instruction to the needs of learners
   - ensured that the manner, level and speed of the instruction encourages learners to take part
   - regularly check that learners understand and adapt instruction as appropriate
   - gave learners positive feedback on the learning experience and the outcome achieved
   - identified anything that prevented learning and reviewed this with the learner.

Unit 008 Identify and agree the motor vehicle customer needs

Level:	**6**
Credit value:	10
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about: gaining information from customers on their perceived needs; giving advice and information and agreeing a course of action; contracting for the agreed work and completing all necessary records and instructions.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures	
1.1	the relevant legal requirements of consumer legislation and the consequences of their own actions in respect of these
1.2	the different types of company and product warranties that you deal with within your organisation
1.3	the limits of their own responsibility for accepting and returning vehicles
1.4	the importance of keeping customers informed and managing their expectations
1.5	their workplace requirements for the completion of records and documentation.

2. Customer communication and care	
2.1	how to communicate effectively with, and listen to, customers
2.2	how to adapt their language when explaining technical matters to non-technical customers
2.3	how to extract the relevant information to identify and agree the motor vehicle customer needs
2.4	how to care for customers and achieve customer satisfaction.

3. Company products and services	
3.1	the range of options available to meet customer needs
3.2	the range and type of services offered by their organisation
3.3	the effect of non- availability of resource upon the receipt of customer vehicles and for the completion of the work
3.4	where and how to access costing and work completion time information.

Performance objectives

To be competent the learner must:
1. obtain sufficient, relevant information from the customer to make an assessment of their own and perceived vehicle needs 2. provide customers with accurate, current and relevant advice and information on: • suitable vehicle inspection, repair and/or service procedures • potential courses of action • the implications of courses of action • the estimated costs 3. provide advice and information clearly and in a form and manner which the customer will understand 4. actively encourage customers to ask questions and seek clarification during their conversation 5. support the accurate identification and clarification of customer and vehicle needs, by referring to: • vehicle data • operating procedures 6. before accepting the vehicle, agree with the customer and record: • the extent and nature of the work to be undertaken • the terms and conditions of acceptance • the cost • the timescale 7. confirm their customer's understanding of the agreement they have made 8. ensure their recording systems are complete, accurate, in the format required and signed by the customer where necessary 9. pass all completed records to the next person in the process promptly 10. gain further customer approval where the contracted agreement is likely to be exceeded.

Unit 008 Identify and agree the motor vehicle customer needs

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Organisational requirements

a. Explain the organisation's terms and conditions applicable to the acceptance of customer vehicles.
b. Explain the content and limitations of vehicle and component warranties for the vehicles dealt with by your organisation.
c. Detail what, if any, limits there are to the authority for accepting vehicles.
d. Detail why it is important to keep customers advised of progress and how this is achieved within the organisation.
e. Detail the organisation's procedures for the completion and processing of documentation and records, including payment methods and obtaining customer signatures as applicable.

Principles of customer communication and care

a. First impressions.
b. Listening skills – 80:20 ratio.
c. Eye contact and smiling.
d. Showing interest and concern.
e. Questioning techniques and customer qualification.
f. Giving clear non-technical explanations.
g. Confirming understanding (statement/question technique, reflective summary).
h. Written communication – purpose, content, presentation and style.
i. Providing a high quality service – fulfilling (ideally exceeding) customer expectations within agreed time frames.
j. Obtaining customer feedback and corrective actions when dissatisfaction expressed.
k. Dealing with complaints.

Company products and services

a. Service standards:
    i. national
    ii. manufacturer
    iii. organisational.
b. The range and type of services offered by the organisation:
    i. diagnostic
    ii. servicing
    iii. repair
    iv. warranty
    v. MOT testing
    vi. fitment of accessories/enhancements
    vii. internal.
c. The courses of action available to resolve customer problems:
    i. the extent and nature of the work to be undertaken
    ii. the terms and conditions of acceptance
    iii. the cost
    iv. the timescale
    v. required payment methods.
d. The effect of resource availability upon the receipt of customer vehicles and the completion of work:
    i. levels and availability of equipment
    ii. levels and availability of technicians
    iii. workshop loading systems.
e. How to access costing and work completion time information:
    i. manuals
    ii. computer based.

Vehicle information systems, servicing and repair requirements

a. Accessing technical data including diagnostics.
b. Servicing to manufacturer requirements/standards.
c. Repair/operating procedures.
d. MOT standards/requirements.
e. Quality controls – interim and final.
f. Requirements for cleanliness of vehicle on return to customer.
g. Handover procedures.

Consumer legislation to include:

a. Consumer protection.
b. Sale of goods.
c. Data protection.
d. Product liability.
e. Health and safety.
f. Discrimination.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work you have carried out on real vehicles in your normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in your normal workplace or when safety is at risk.
3. be observed by an assessor as defined by the IMI SVQ Assessment Strategy.
4. produce evidence, including records, to show that they have dealt with **3 different customers.**
5. be observed by their assessor in your normal workplace dealing with **at least 1 customer**

Unit 009 Maintain working relationships in the motor vehicle environment

Level:	**6**
Credit value:	7
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about maintaining good working relationships with all colleagues in the working environment by using effective communication and support skills.

Essential knowledge

The learner will need to understand:

1. Their responsibilities and constraints	
1.1	their own and their colleague's job role and limits of responsibility for giving advice and support
1.2	the operational constraints which may affect interaction with colleagues
1.3	lines of communication within their workplace.

2. Communication skills and working relationships	
2.1	how to use suitable and effective communication skills when responding to and interacting with others
2.2	how to adapt communication methods to satisfy the needs of colleagues
2.3	how to report problems using appropriate methods of communication
2.4	the importance of developing positive working relationships with colleagues – the effect on morale, productivity, and company image
2.5	the importance of acknowledging other peoples' views and opinions
2.6	the importance of making and honouring realistic commitments to colleagues
2.7	the implications of inappropriate communication.

Performance objectives

To be competent, the learner must:
1. contribute actively to team working by initiating ideas and co-operating with colleagues 2. respond promptly and willingly to requests for assistance from **colleagues** which fall within the limits of their own job responsibilities and capabilities 3. where requests fall outside their responsibility and capability, refer colleagues to the relevant person(s) 4. give colleagues sufficient, accurate information and support to meet their work needs 5. make **requests for assistance** to **colleagues** clearly and courteously 6. use methods of communication which meet the needs of colleagues 7. treat colleagues in a way which shows respect for their views and opinions and promotes goodwill 8. make and keep achievable commitments to **colleagues** 9. inform colleagues promptly of any problems or information likely to affect their own work.

Unit 009 Maintain working relationships in the motor vehicle environment

Supporting information

Scope of this unit:

Colleagues are:

a. immediate work colleagues
b. supervisors and managers.

Requests for assistance covering:

a. technical assistance
b. personal assistance.

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Sections within a typical vehicle repair business

a. How these areas relate to each other within the business
    i Reception.
    ii Body shop.
    iii Service repair workshop.
    iv Valeting.
    v Parts.
    vi Sales.
    vii Administration.

Different sources of information in an automotive work environment:

a. Other staff.
b. Manuals.
c. Parts lists.
d. Computer software and the internet.
e. Manufacturer.
f. Diagnostic equipment.

Locating and using correct documentation and information for:

a. recording vehicle maintenance and repairs
b. vehicle specifications
c. component specifications
d. oil and fluid specifications
e. equipment and tools
f. identification codes

Alternative methods of communication

a. verbal
b. signs and notices
c. memos
d. telephone
e. electronic mail
f. vehicle job card
g. notice boards
h. SMS text messaging

Communication with a Supervisor

a. referral of problems
b. reporting delays
c. additional work identified during repair or maintenance
d. keep others informed of progress

Agreed timescales

a. relationship between time and cost

Evidence requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence that they have worked well with others in the automotive industry
5. be observed by their assessor on at least **3** occasions carrying out the above whilst performing their normal work duties.

Unit 211 Overhaul commercial vehicle mechanical units

Level:	**7**
Credit value:	24
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about the bench-based overhaul of mechanical units, involving dismantling, assessment, repair, replacement or adjustment of internal components together with re-assembly and testing.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-261 online multiple choice test, to cover the **essential knowledge** element of this unit.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures

1.1 the legal requirements applicable to the units and assemblies overhauled (including road safety requirements)

1.2 the legislation and workplace procedures relevant to:

- health and safety
- the environment (including waste disposal)
- appropriate personal and vehicle protection equipment

1.3 their workplace procedures for:

- recording overhaul activities
- the referral of problems
- reporting delays to the completion of work

1.4 the importance of, documenting repair information

1.5 the importance of working to agreed timescales and keeping others informed of progress

1.6 the importance of reporting any anticipated delays to the relevant person(s) promptly.

2. Equipment
2.1 how to prepare, and assess the accuracy and operation of all the overhauling and testing equipment required
2.2 how to use all the overhauling and testing equipment required.

3. Mechanical unit overhauling activities
3.1 how to find, interpret and use sources of information on overhauling procedures and statutory requirements
3.2 how vehicle mechanical units and assemblies operate
3.3 how mechanical units and assemblies are constructed, dismantled and reassembled
3.4 the possible causes of faults in mechanical units and assemblies
3.5 vehicle operating specification for limits, fits and tolerances and where this information can be sourced
3.6 how to assess the condition evident within unit sub-assemblies and components
3.7 the cost-benefit relationship between the reconditioning, repair and replacement of components within units
3.8 how to carry out **overhauling activities** for the type(s) of unit worked upon
3.9 the relationship between test methodology and the faults repaired– the use of appropriate testing methods
3.10 how to test and evaluate the performance of overhauled units against the operating specification
3.11 how to interpret test results
3.12 how to identify the types and causes of mechanical unit and assembly failure
3.13 how to make suitable adjustments to components and units
3.14 how to work safely avoiding personal injury, damage to components leakage and hazardous substances.

Performance objectives

To be competent the learner must:
1. wear suitable personal protective equipment throughout all overhauling activities
2. use suitable sources of technical information to support their overhauling activities
3. assess and prepare all the equipment required, following manufacturers' instructions, prior to use
4. use the tools and equipment required correctly and safely throughout all overhauling activities
5. carry out all overhauling activities following: • the manufacturer's instructions • workplace procedures • health and safety requirements • environmental requirements
6. work in a way which minimises the risk of: • damage to other components • leakages • contact with hazardous substances
7. ensure their assessment of the dismantled unit identifies accurately its condition and suitability for overhaul
8. inform the relevant person(s) promptly where an overhaul is uneconomic or unsatisfactory to perform
9. use testing methods which comply with the manufacturer's requirements
10. when necessary, adjust the unit's components correctly to ensure that they operate to meet the vehicle operating requirements
11. ensure the overhauled units and assemblies conform to the vehicle operating specification and any legal requirements
12. ensure their overhaul records are accurate, complete and passed to the relevant person(s) promptly in the format required.
13. complete all overhauling activities within the agreed timescale
14. report any anticipated delays in completion to the relevant person(s) promptly.

Unit 211 Overhaul commercial vehicle mechanical units

Supporting information

Key words and phrases

Adjustments

Examples include, adjustments made to clearances, gaps, settings, pressures, tensions, pre-load and speeds.

Agreed timescales

Examples include manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Assessments

Examples include those for wear, damage, alignment, corrosion, leakage, distortion and balance.

Equipment

Examples include hand tools, pullers and presses, measuring instruments, refurbishment tools, general workshop equipment and special service tools.

Functional testing

This refers to any applicable functional tests carried out after overhaul.

Mechanical units

Examples are: engines, gear boxes, final drives, steering, suspension, chassis assemblies.

Testing methods

As prescribed by the appropriate technical literature.

Scope of this unit

Overhaul activities are:

a. dismantling
b. assessment
c. repair
d. replacement
e. adjustment of internal components
f. re-assembly
g. functional testing.

Unit range

How the units and assemblies being overhauled operate

a. Identify unit components.
b. Understand unit construction.
c. Describe unit operation.

How units are dismantled and reassembled

a. The dismantling procedure.
b. Tools and equipment used for stripping and rebuilding units and assemblies.
c. Methods of safe storage for removed components during overhaul activities.
d. The process for assessing the condition of sub-assemblies including:
    i fit
    ii tolerances
    iii permitted limits.
e. The rebuild procedure for units and assemblies.
f. Adjustment procedures during re-assembly.

Unit and assembly testing and evaluation procedures

a. Appropriate testing and evaluation procedures prior to dismantling units.
b. Appropriate testing and evaluation procedures of components after dismantling units.
c. How to use overhauling and test equipment for the task.
d. The cost-benefit relationship between reconditioning, repair and replacement of components within units.
e. How to test and evaluate the performance of the overhauled units against the operating specification.
f. How to interpret test results.
g. Adjustment procedures during final evaluation.

Faults associated with units and assemblies being overhauled

a. Causes of faults and failures within units and assemblies.
b. The faults associated with units and assemblies.
c. How to make adjustments to meet final specification after testing and evaluation of assembled units and assemblies.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of overhauling units or components from **1** of the **3*** systems listed below. The evidence **must** come from work **in their normal workplace.**
   - Engine - 2 complete engine units to include cylinder head and block
   - Gearbox and Final Drive Units - 1 Gearbox and 1 Final Drive unit
   - Steering and Suspension - 1 steering and 1 suspension units
5. overhaul **1** of the above units **in their normal workplace.**
6. be observed by their assessor overhauling **1 unit.**

Simulated activity **will be** acceptable to assess candidates' competence in overhaul on no more than **1** occasion.

* However, they must prove to their assessor that they have the necessary knowledge and understanding to be able to perform competently in respect of **all** the systems listed above.

Simulated activity **will be** acceptable to assess candidates' competence in overhaul on no more than **1** occasion

Unit 214 Remove and replace commercial vehicle transmission and driveline units and components

Level:	**5**
Credit value:	18
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about removing and replacing commercial vehicle units and components where dismantling and re-assembly of transmission and driveline systems is required. It is also about evaluating the performance of replaced units and components. The units and components concerned are those **outside those replaced as part of normal routine, vehicle maintenance (servicing) activities.**
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-264 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.1** **2.2** **2.3** 3.1 3.2 **3.3** **3.5** **3.6** This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures
1.1 the legal requirements relating to the vehicle (including road safety requirements) 1.2 the legislation and workplace procedures relevant to: • health and safety • the environment (including waste disposal) • appropriate personal and vehicle protection equipment 1.3 their workplace procedures for: • recording removal and replacement information • the referral of problems • reporting delays to the completion of work 1.4 the importance of documenting removal and replacement information 1.5 the importance of working to agreed timescales and keeping others informed of progress 1.6 the relationship between time and costs 1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Use of technical information
2.1 how to find, interpret and use sources of information applicable to unit and component removal and replacement within transmission and driveline systems 2.2 the importance of using the correct sources of technical information 2.3 the purpose of and how to use identification codes.

3. Electrical and electronic principles
3.1 vehicle earthing principles and methods 3.2 electrical and electronic principles associated with chassis and transmission systems, including types of sensors and actuators, their application and operation 3.3 types of circuit protection and why these are necessary. 3.4 electrical safety procedures including High energy systems 3.5 electric symbols, units and terms 3.6 electrical and electronic control system principles.

4. Transmission and driveline system operation and construction
4.1 how commercial vehicle transmission and driveline systems and their related units and components are constructed, removed and replaced 4.2 how commercial vehicle transmission and driveline systems and their related units and components operate.

5. Equipment
5.1 how to prepare, test and use all the removal and replacement **equipment** required.

6. Transmission and driveline system unit and component removal and replacement	
6.1	how to remove and replace commercial vehicle transmission and driveline system mechanical, electrical, hydraulic and pneumatic units and components
6.2	how to test and evaluate the performance of replacement transmission and driveline system units and components and the reassembled system against the vehicle operating specifications and any legal requirements
6.3	the relationship between testing methods and the transmission and driveline system units and components replaced – the use of appropriate test methods
6.4	when replacement units and components must meet the original equipment specification (OES) for warranty or other requirements
6.5	how to work safely avoiding damage to other vehicle systems, components and units and contact with leakage and hazardous substances.

Performance objectives

To be competent the learner must:

1. wear suitable personal protective equipment and use vehicle coverings (where appropriate) throughout all removal and replacement activities
2. support their removal and replacement activities by reviewing:
    - vehicle technical data
    - removal and replacement procedures
    - legal requirements
3. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate)
4. prepare, test and use all the **equipment** required following manufacturers' instructions
5. carry out all removal and replacement activities following:
    - manufacturers' instructions their workplace procedures
    - health and safety requirements
    - environmental requirements
6. work in a way which minimises the risk of:
    - damage to other vehicle systems
    - damage to other vehicle components and units
    - contact with leakage
    - contact with hazardous substances
7. ensure replaced transmission and driveline **units and components** conform to the vehicle operating specification and any legal requirements
8. record and report any additional faults they notice during the course of their work promptly
9. use suitable **testing methods** to evaluate the performance of the reassembled system accurately
10. ensure the reassembled **transmission and driveline system** performs to the vehicle operating specification and meets any legal requirements prior to return to the customer
11. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
12. complete all removal and replacement activities within the agreed timescale
13. report any expected delays in completion to the relevant person(s) promptly.

Unit 214 Remove and replace commercial vehicle transmission and driveline units and components

Supporting information

Key words and phrases

Agreed timescales
Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Commercial vehicles
These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Units and components
Any unit or component from the transmission and driveline systems defined in the Scoping Statement below.

Functional testing
Examples include: dynamometer and transmission stall test.

Scope of this unit:

Equipment is:

a. hand tools
b. special workshop tools
c. general workshop equipment
d. electrical testing equipment.

Testing methods are:

a. visual
b. aural
c. functional.

Units and components are:

a. mechanical
b. electrical
c. hydraulic and fluid
d. pneumatic.

Transmission and driveline systems are:

a. gearbox and power take off
b. hubs and bearings
c. driveline shafts
d. clutch
e. final drive.

Unit range

Key principles related to clutch systems

a. Clutch systems to include:
    i principles of friction
    ii principle of levers
    iii torque transmission

The operation of clutch operating systems

a. Clutch operating mechanisms:
    i pedal and lever
    ii hydraulic operated
    iii air assisted
    iv hydraulic components
    v master cylinder
    vi slave cylinder
    vii hydraulic pipes
    viii electrical and electronic components (fluid level indicators).

The operation of friction clutches

a. The reasons for fitting a clutch.
b. The construction and operation of:
    i coil spring clutches
    ii diaphragm spring clutches
    iii single plate clutches
    iv multi plate clutches
    v clutch/upshift brakes.
a. Types of friction materials used in clutch construction:
    i organic
    ii ceramic

Gearbox systems

a. Construction and operation of gearbox systems including:
    i gearshift control systems
    ii manual gearbox
    iii automatic gearbox

b. Key principles relating to gearbox systems
    i gear ratios
    ii input and output ratios

iii torque multiplication

The operation of manual gearboxes

a. The reasons for fitting gearboxes, to provide neutral, reverse, torque multiplication.
b. Different gearbox types:
    i single layshaft
    ii twin layshaft
    iii range change
    iv splitter
    v twin splitter.
c. The layout and construction of gears and shafts for 5, 6, 8, 12 and 16 speed gearbox designs, constant mesh and synchromesh gearboxes, reverse gear.
d. The construction and operation of:
    i gear selection linkages
    ii elector forks and rods
    iii detents and interlock mechanisms.
e. The construction and operation of synchromesh devices.
f. The arrangements for gearbox bearings:
    i bushes
    ii oil seals
    iii gaskets
    iv gearbox lubrication
    v tachograph drive.
g. The electrical and electronic components including reverse lamp switch.
h. Calculate gear ratios and driving torque for typical gearbox specifications.
i. The need to remove the propshaft before towing a casualty vehicle.

T**he operation of automatic gearboxes**

a. The reasons for using automatic gearboxes over manual (urban use, stop/start applications).
b. The construction and operation of automatic gearboxes to include:
    i epicyclic geartrain
    ii brake bands
    iii fluid couplings and torque converters.
c. Properties of automatic transmission fluid.

The construction and operation of driveline systems and components

a. including:
    i universal couplings
    ii sliding couplings
    iii constant velocity joints
    iv final drive units
    v propshafts
    vi split-propshafts
    vii driveshafts
    viii hub reduction
    ix tandem drive axles

b. Key principles relating to driveline systems including:
    i gear ratios
    ii simple stresses
c. The layout and construction of propshafts and drive shafts used in multi axle drive systems.
d. The reasons for using flexible couplings and sliding joints in transmissions systems.
e. The reason for using constant velocity joints in drive shafts incorporating steering mechanisms.
f. The construction and operation of:
    i universal joints
    ii sliding couplings
    iii constant velocity joints
    iv centre bearings.
g. The simple stresses applied to shafts; torsional, bending and shear.
h. The construction and operation of:
    i final drive units
    ii multi-drive axle arrangements
    iii crown wheel & pinion
    iv bevel, hypoid and helical gears
    v differential gears
    vi lubricants
    vii lubrication bearings and seals
    viii differential locks
    ix epicyclic hub reduction.
i. The reasons for fitting a differential.
j. Calculate final drive gear ratios.
k. Calculate the overall gear ratio from given data (gearbox ratio x final drive ratio).

The construction and operation of gear selector systems

a. including:
    i remote linkages
    ii servo-assistance
    iii range change selection
    iv splitter selection
    v electronic gear selection
b. The layout and operation of gear selector mechanisms used on heavy vehicles:
    i manual shift using rods and levers
    ii manual shift using cables
    iii manual shift using servo assistance
    iv range change selection
    v manual switch (gearstick mounted)
    vi automatic (gearbox mounted)
    vii splitter selection.
c. The layout and operation of electronically controlled gear selector systems:
    i clutch system
    ii gear selection
    iii gear speed synchronisation.

The testing and inspection techniques used for heavy vehicle transmission systems

a. The techniques and procedures used for inspecting and testing clutches and clutch mechanisms including:
   i clearances
   ii pedal and lever settings
   iii cables & linkages
   iv hydraulic system
   v leaks (fluid and air)
   vi adjustments
   vii travel
b. The techniques and procedures used for inspecting and testing gearboxes including:
   i leaks
   ii gear selection
   iii synchromesh operation
   iv abnormal noise
c. The techniques and procedures used for inspecting and testing drive line systems (prop & drive shafts, couplings and centre bearings) including:
   i security
   ii serviceability
   iii leaks
   iv alignment
   v balance weights (where applicable)
d. The basic techniques used when inspecting and testing final drive systems including:
   i fluid levels
   ii leaks
   iii noise

The faults and symptoms associated with vehicle transmissions systems

a. The faults and symptoms associated with transmission systems:
   i clutch faults
   ii gearbox faults
   iii drive line faults (propshaft, drive shaft, universal and constant velocity joints)
   iv universal joint alignment
   v final drive faults
   vi gear selection faults.
b. Faults and symptoms to include mechanical, electrical and hydraulic systems.

The procedures for dismantling, removal and replacement of transmission units and components

a. The preparation, testing and use of tools and equipment, electrical meters and equipment used for dismantling removing and replacing transmission systems and components.
b. Appropriate safety precautions:
    i PPE
    ii vehicle protection when dismantling
    iii removing and replacing transmission systems and components.
c. The importance of logical and systematic processes.
d. The inspection and testing of transmission systems and components
e. The preparation of replacement units for re-fitting or replacement of transmission systems or components.
f. The reasons why replacement components and units must meet the original specifications (OES):
    iv warranty requirements
    v to maintain performance
    vi safety requirements.
g. Refitting procedures.
h. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
i. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
    vii cleanliness of vehicle interior and exterior
    viii security of components and fittings
    ix re-instatement of components and fittings

Evidence requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of removing and **replacing 3 different units or components from 2 different vehicles from the systems listed below**:
    - clutch
    - gearbox and power take-off
    - drive line (shafts, couplings, hubs and bearings)
    - final drive
5. be observed by their assessor in their **normal workplace** on at least **1** occasion removing and replacing units and components from **1** of the following systems

Simulated activity **will be** acceptable to assess candidates' competence in removal and replacement on no more than **1** occasion

Unit 215 Diagnose and rectify commercial vehicle transmission and driveline system faults

Level:	**7**
Credit value:	20
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about diagnosing and rectifying faults occurring within commercial vehicle gearboxes, hubs and bearings, driveline, final drive and clutches.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-265 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.1** 4.1 **2.2** 4.12 **2.4** **2.5** This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures
1.1 the legislation and workplace procedures relevant to: • health and safety • the environment (including waste disposal) • appropriate personal and vehicle protection equipment 1.2 legal requirements relating to the vehicle (including road safety requirements) 1.3 their workplace procedures for: • recording diagnostic and rectification activities • the referral of problems • reporting delays to the completion of work 1.4 the importance of, documenting diagnostic and rectification information 1.5 the importance of working to agreed timescales and keeping others informed of progress 1.6 the relationship between time, costs and profitability 1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Electrical and electronic principles
2.1 electrical and electronic principles associated with commercial vehicle transmission and driveline systems, including types of sensors and actuators, their application and operation 2.2 how commercial vehicle electrical and electronic transmission and driveline systems operate, including electrical component function, electrical inputs, outputs, voltages and oscilloscope patterns, digital and fibreoptics principles 2.3 the interaction between electrical, electronic and mechanical components within commercial vehicle transmission and driveline systems 2.4 electrical symbols, units and terms 2.5 electrical safety procedures including High Energy systems.

3. Use of diagnostic and rectification equipment
3.1 how to prepare diagnostic testing equipment 3.2 how to use diagnostic and rectification **equipmen**t for commercial vehicle transmission and driveline mechanical, electrical, pneumatic, hydraulic and fluid systems, specialist repair tools and general workshop equipment.

4. Transmission and driveline faults, their diagnosis and correction	
4.1	how commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic, hydraulic and fluid systems are constructed, dismantled, reassembled and operate
4.2	the types and causes of commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic, hydraulic and fluid system component and unit faults and failures
4.3	commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic, hydraulic and fluid component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action
4.4	how to find, interpret and use sources of information on commercial vehicle transmission and driveline electrical and electronic operating specifications, diagnostic test procedures, repair procedures and legal requirements
4.5	vehicle operating specifications for limits, fits and tolerances relating to transmission and driveline mechanical, electrical, electronic, pneumatic, hydraulic and fluid systems for the vehicle(s) on which they work
4.6	how to select the most appropriate diagnostic testing method for the symptoms presented
4.7	how to carry out systematic diagnostic testing of commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic, hydraulic and fluid systems using a prescribed process or format
4.8	how to assess the condition evident within commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic, hydraulic and fluid components and units
4.9	how to interpret test results and vehicle data in order to identify the location and cause of vehicle system faults
4.10	how to carry out the **rectification activities** listed in the Scoping Statement for this unit in order to correct faults in commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic and hydraulic and fluid systems
4.11	the relationship between test methodology and the faults repaired
– the use of appropriate testing methods	
4.12	how to make cost effective recommendations for rectification.

Performance objectives

To be competent the learner must:

1. wear suitable personal protective equipment and use vehicle coverings (where appropriate) when using diagnostic methods and carrying out rectification activities
2. support the identification of faults, by reviewing vehicle:
   - technical data
   - diagnostic test procedures
3. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate)
4. prepare, connect and test all the required equipment following manufacturers' instructions prior to use
5. use diagnostic methods which are relevant to the symptoms presented
6. collect diagnostic information in a systematic way relevant to the diagnostic methods used
7. collect sufficient diagnostic information to enable an accurate diagnosis of transmission and driveline system faults
8. identify and record any system deviation from acceptable limits accurately
9. ensure their assessment of dismantled sub-assemblies, components and units identifies their condition and suitability for repair or replacement, accurately
10. inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform
11. use the equipment required, correctly and safely throughout all rectification activities
12. carry out all rectification activities following:
    - manufacturers' instructions
    - workplace procedures
    - health and safety requirements
    - environmental requirements
13. work in a way which minimises the risk of :
    - damage to other vehicle systems
    - damage to other components and units
    - contact with leakages
    - contact with hazardous substances
14. ensure all repaired and replaced components and units conform to the vehicle operating specification and any legal requirements
15. when necessary, adjust components and units correctly to ensure that they operate to meet system requirements
16. record and report any additional faults they notice during the course of work promptly
17. use testing methods which are suitable for assessing the performance of the system rectified
18. ensure the transmission and driveline system rectified performs to the vehicle operating specification and any legal requirements prior to return to the customer
19. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
20. complete all system diagnostic activities within the agreed timescale
21. report any anticipated delays in completion to the relevant person(s) promptly.

Unit 215 Diagnose and rectify commercial vehicle transmission and driveline system faults

Supporting information

Key words and phrases

Agreed timescales
Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Commercial vehicles
These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Transmission and driveline system faults
These are faults that require a two or more step diagnostic activity using a prescribed process or format to identify the cause.

Diagnostic information
This relates to mechanical condition, including wear, run out, pressures, flow, leakage and electrical measurements such as voltage and pulse displays, electronic systems data, including fault codes, sensor measurements and control unit outputs and/or signals.

Functional testing
Examples include dynamometer, performance testing and road testing where relevant.

Hydraulic and fluid systems
These are commercial vehicle transmission and driveline related hydraulic and fluid systems.

Transmission Area
Clutch assemblies, clutch operating systems, manual and automatic gear boxes (including electronic control), drivelines, hubs and final drive assemblies.

Recommendations
Examples include: servicing, dismantling for further inspection and test, repair and replacement.

Scope of this unit

Transmission and driveline systems are:

a. gearbox and power take off
b. hubs and bearings
c. driveline shafts
d. clutch
e. final drive.

Diagnostic methods are:

a. measurement
b. functional testing
c. electrical and electronic systems testing.

Equipment is:

a. diagnostic and rectification equipment for transmission and driveline mechanical systems
b. diagnostic and rectification equipment for transmission and driveline electrical systems
c. diagnostic and rectification equipment for transmission and driveline hydraulic and fluid systems
d. diagnostic and rectification equipment for transmission and driveline pneumatic systems
e. specialist repair tools for general workshop equipment.

Faults are:

a. mechanical
b. electrical and electronic
c. hydraulic and fluid
d. pneumatic.

Rectification activities are:

a. dismantling
b. replacement of units and components
c. adjustment of units and components
d. repairs to wiring and connectors
e. re-programming vehicle systems
f. reassembly
g. functional testing
h. repairs to air line and connectors.

Unit range

The construction and operation of transmission and driveline systems

a. Including**:**
   i friction clutches
   ii fluid couplings
   iii multi-speed gearboxes
   iv fully automatic - including electronic control
   v electronically controlled gearshift systems
   vi hub reduction
   vii final drive units
   viii hubs & shafts
b. Key principles relating to heavy vehicle transmission and driveline systems
   i friction
   ii torque transmission
   iii materials
   iv fluids & energy
   v potential & kinetic energy

Electrical and electronic principles related to heavy vehicle transmission systems

a. The operation of electrical and electronic systems and components related to heavy vehicle transmission systems including:
   i ECU
   ii sensors and actuators
   iii electrical inputs & outputs
   iv voltages
   v oscilloscope patterns
   vi digital and fibre optic principles.
b. The interaction between the electrical/electronic system, hydraulic system and mechanical components of the transmission systems.
c. Electronic and electrical safety procedures.

The operation heavy vehicle clutches and fluid couplings

a. The construction and operation of friction clutches (coil spring, diaphragm) including single and twin clutch designs.
b. The construction and operation of fluid couplings including:
   i fluid flywheel
   ii torque converter (torque multiplication, efficiency)
   iii benefits of fluid couplings
   iv benefits of toque converter over fluid flywheel.

The operation of heavy vehicle transmissions and driveline systems

a. The construction and operation of manual gearboxes:
   i multi-speed gearboxes
   ii gear arrangements
   iii haft and bearing arrangements
   iv synchromesh devices
   v interlock mechanisms
   vi linkages
   vii overdrive
   viii lubrication.

b. The construction and operation of automatic gearboxes including hydraulic and electronic control systems: operations of epicyclic gears (sun, planet, annulus and carrier), method for achieving different gear ratios using epicyclic gearing; hydraulic control systems, components and operation; electronic control system, components and operation.

c. The construction and operation of the electronically controlled gearshift systems

d. The construction and operation of final drive systems including:
   i crown wheel and pinion
   ii differential gears
   iii differential lock.

e. The construction and operation of heavy vehicle tandem drive systems including third differential and differential locks.

f. The operation of heavy vehicle traction control systems and launch control.

g. The construction and operation of heavy vehicle hub arrangements.

h. The construction and operation of:

i drive shafts

ii prop shafts including flexible joints and couplings

iii universal joints

iv constant velocity joints

v sliding joints.

Symptoms and faults in heavy vehicle transmissions and drive-line systems

a. Clutch and coupling faults:
   I. abnormal noises
   II. vibrations
   III. fluid leaks
   IV. slip
   V. judder
   VI. grab
   VII. failure to release.

b. Gearbox faults:
   i abnormal noises
   ii vibrations
   iii loss of drive
   iv failure to engage gear
   v failure to disengage gear
   vi leaks
   vii failure to operate
   viii incorrect shift patterns
   ix electrical and electronic faults.

c. Final drive faults:
   i abnormal noises
   ii vibrations
   iii loss of drive
   iv oil leaks
   v failure to operate
   vi electrical and electronic faults.

d. Drive-lines and couplings:
   i abnormal noises
   ii vibrations
   iii loss of drive.

Faults in heavy vehicle transmission systems

a. Interpret information for diagnostic tests, vehicle and equipment specifications, use of equipment, testing procedures, test plans, fault codes and legal requirements.
b. How to prepare equipment for use in diagnostic testing.
c. How to conduct systematic testing and inspection of transmission system, mechanical, hydraulic, electrical and electronic systems using appropriate tools and equipment including, mullet-meters, oscilloscope and pressure gauges.
d. How to carry out workshop based and road testing of vehicle and transmission system.
e. Evaluate and interpret test results from diagnostic and/or road testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions and incorrect settings.
j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance:

Transmission units and components

i friction clutches
ii fluid couplings
iii multi speed gearboxes
iv fully automatic - including electronic control
v electronically controlled gearshift systems
vi hub reduction
vii final drive units
viii hubs & shafts

Measurements and settings

i settings
ii input and output values
iii voltages
iv current consumption
v resistance
vi output patterns with oscilloscope
vii pressures
viii condition
ix wear and performance.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. use a **2 or more** step diagnostic activity.
5. produce evidence of diagnosing and rectifying at least **3** faults occurring in **2** of **the 4** systems listed*.
   - clutch
   - gearbox
   - drive line (shafts, couplings, hubs and bearings)
   - final drive

   2 pieces of evidence must come from work carried out **in their normal workplace**
6. be observed by their assessor on **at least 1 occasion** carrying out the diagnosis and rectification of a fault in a transmission or drive line system.

*However, they must prove to their assessor that they have the necessary knowledge and understanding to be able to perform competently in respect of faults occurring in all the types of engine systems.

Simulated activity **will be** acceptable to assess candidates' competence in diagnosis and rectification on no more than **1** occasion.

Unit 219 Remove and fit basic motor, mechanical, electrical and trim (MET) components and non permanently fixed motor vehicle body panels

Level:	**5**
Credit value:	7
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about the straightforward removal and fitting of basic mechanical, electrical and trim (MET) components to vehicles. It is also about checking the operation of the components fitted.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-269 on-line multiple choice test, which covers all of the **essential knowledge** within this unit.

Essential knowledge

The learner will need to understand:

1.	**Legislative and organisational requirements and procedures**
1.1	the health, safety and legal requirements relating to the removal and fitting **of basic MET components and non welded non-structural body panels**
1.2	their workplace procedures for: the referral of problems reporting of delays to the completion of work completion of work records
1.3	the work that needs to be done and the standard required
1.4	the requirements for protecting the vehicle and contents from damage before, during and after removing and fitting activities
1.5	the importance of selecting, using and maintaining the appropriate personal protective equipment when removing and fitting **basic MET components and non welded non-structural body panels.**

2.	**Removing and fitting basic MET components**
2.1	how to find, interpret and use sources of information applicable to the removal and fitting of **basic MET components and non welded non-structural body panels**
2.2	how to select, check and use all the tools and equipment required to remove and fit basic MET components and non welded nonstructural body panels
2.3	the correct procedures for removing and fitting basic MET components and non welded non-structural body panels
2.4	the correct procedures for working with supplementary safety systems when fitting and removing **basic MET components and non welded non-structural body panels**
2.5	the correct procedures for working with Gas Discharge headlight systems and when fitting and removing **basic MET components and non welded non-structural body panels**
2.6	the methods of storing removed panels and components and the importance of storing them correctly
2.7	the different types of fastenings and fixings and the reasons for their use
2.8	the need for correct alignment of panels and components and the correct methods used to achieve this
2.9	the types of quality checks that can be used to ensure correct alignment and operation of components to manufacturer's specification and their purpose.

Performance objectives

To be competent the learner must:
1. use the appropriate personal protective equipment when removing and fitting **basic MET components and non welded non-structural body panels**
2. protect the vehicle and its contents effectively when removing and fitting **basic MET components and non welded non-structural body panels**
3. select and use the correct **tools and equipment** for the panels or components they are going to remove or fit
4. ensure that the **tools and equipment** they require are in a safe working condition
5. remove and fit **basic MET components and non welded non-structural body panels** following: • removal and fitting procedures • manufacturers' instructions their • workplace procedures • health, safety and legal requirements
6. avoid damaging other components, units and panels on the vehicle
7. store all removed panels and components safely in the correct location
8. realign the panels and components they have fitted correctly in a way which regains their original manufactured gaps
9. check that the components they have fitted operate correctly following the manufacturer's specification
10. report any additional faults they find during the course of their work to the relevant person(s) promptly
11. report any delays in completing their work to the relevant person(s) promptly
12. remove and fit basic **MET components or non welded non-structural body panels** within the agreed timescale
13. complete work records accurately, in the format required and pass them to the relevant person(s) promptly.

Unit 219 Remove and fit basic motor, mechanical, electrical and trim (MET) components and non permanently fixed motor vehicle body panels

Supporting information

Key words and phrases

Agreed timescales

Examples include: job times set by the company or agreed with a specific customer.

Commercial Vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Components fitted

These can be either replacement or refitted components.

MET

Mechanical, electrical and trim.

Non Permanently Fixed panels

Any cosmetic panel within a vehicle that is fitted by mechanical fastening devices and will be undamaged when removed.

Vehicles

These can be any of the following: light vehicles, commercial vehicles, motorcycles, mopeds and scooters.

Scope of this unit

Basic MET components includes:

a. bumpers
b. headlamp units
c. road wheels
d. batteries
e. bonnet and boot lid trim
f. interior trim components
g. exterior trim components.

Non permanently attached body panels are**:**

a. wings
b. doors
c. bonnets
d. boot lids and tailgates
e. bumper bars, covers and components.

Tools and equipment are**:**

a. spanners
b. socket set
c. screwdrivers
d. manufacturer's specified specialist tools
e. pliers and self locking grips
f. power drill and drill bits
g. trolley jack
h. axle stands
i. vehicle lifts
j. torque wrench.

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Describe procedures to prevent damage to the vehicle, components and contents when removing, storing and refitting basic MET components

a. The methods that can be used to protect undamaged items to ensure they are removed and refitted without causing unnecessary damage:
   i bumpers
   ii headlamp units
   iii road wheels
   iv batteries
   v bonnet and boot trim
   vi interior trim components
   vii exterior trim components.
b. The procedures for the correct storage of vehicle contents.
c. The process for the reporting of extra damage and items that may have broken when removed or refitted.

The processes involved when handling batteries

a. The procedure for the removal, storage and refitting of lead acid batteries.
b. The procedure for the disposal of lead acid batteries.
c. Battery checks:
   i electrolyte
   ii discharge
   iii specific gravity.
d. The charging process and procedures:
   i trickle charge
   ii normal charge
   iii boost / start.
e. The health and safety issues involved when charging (explosive gases).

Types of clips and fixings

a. Identify reasons and limitations for the use of the following types of clips:
   - i speed
   - ii 'c'
   - iii 'd'
   - iv 'j' type captive nut
   - v 'r'
   - vi 'u' type captive nut
   - vii cable clip
   - viii trim clips.

b. Identify reasons and limitations for the use of the following types of fixings:
   - i pop rivet
   - ii plastic rivet
   - iii plastic capture nut
   - iv nut and bolt
   - v soulder bolt
   - vi 'Nyloc' type nuts
   - vii washers
   - viii 'Spring' type washers
   - ix self tapping screws and bolts
   - x quick release plastic trim fastenings
   - xi trim tapes
   - xii adhesives and sealers.

The processes involved when carrying out quality checks

a. describe processes for rectifying items that may have been 'workshop' soiled:
   - i door cards
   - ii seats
   - iii carpets
   - iv boot and bonnet trims.

b. Methods for checking gaps.

c. The process for checking and aligning headlamps:
   - i address handling procedures for halogen bulbs
   - ii address handling and health and safety issues relating to xenon bulbs and systems.

d. Operational checks and rectification methods to include:
   - i lights
   - ii washers and wipers
   - iii SRS systems (checking not rectification)
   - iv charging system (checking not rectification)
   - v horn
   - vi fluid levels
   - vii interior switches
   - viii operation of door lock mechanisms.

Removing and fitting non-structural body panels

a. Find, interpret and use sources of information applicable to the removal and fitting of basic non welded non-structural body panels.
b. Select, check and use all the tools and equipment required to remove and fit basic non welded non-structural body panels including:
    i hinge pin removers
    ii spanners
    iii screwdrivers.
c. The different types of mechanical fixings for non welded non-structural body panels and when and why they should be used including:
    i bolts
    ii self tapping
    iii bolts
    iv speed nuts
    v washers.
d. The correct procedures and processes for removing and fitting of non welded non-structural body panels.
e. The need for correct alignment of panels and methods to achieve this:
    i aperture gaps
    ii alignment of panel features
    iii best fit of components to panels
    iv vehicle geometry
    v operation of openings such as doors, tailgates, bonnets etc.
f. The types of quality control checks that can be used to ensure correct alignment and contour of panels and operation of components to manufacturer's specification.

g. The method of storing removed panels and the importance of storing them correctly.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence from their normal workplace of removing and replacing **6 of the 12 units or components** from the list below on at least 2 occasions.
    - bumpers
    - headlamp units
    - road wheels
    - batteries
    - bonnet fittings
    - interior trim components
    - exterior trim components
    - wings
    - doors
    - bonnets
    - boot lids and tailgates
    - bumper bars, covers and components
5. be observed by their assessor on at **least 2 occasions, each** observation covering the removal and replacement of **different** units.

Evidence from simulated activities is acceptable for this unit on no more than 20% in line with the IMI SVQ Assessment Strategy

Unit 221 Carry out routine commercial vehicle maintenance

Level:	**5**
Credit value:	13
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about conducting routine examination, adjustment and replacement activities as part of the periodic servicing of heavy vehicles.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-231 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **3.1** **3.2** **3.3** **3.4** **3.5** 4.2 4.5 This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures
1.1 the manufacturer's and legal requirements, including O-License criteria, relating to routine maintenance activities for vehicle systems and components
1.2 the legal requirements relating to the vehicle maintenance and auxiliary equipment (including road safety requirements)
1.3 the legislation and workplace procedures relevant to: • health and safety • the environment (including waste disposal) • appropriate personal and vehicle protective equipment
1.4 their workplace procedures for: • recording vehicle maintenance work and any variations from the original vehicle specification • the referral of problems • reporting delays to the completion of work
1.5 the importance of documenting vehicle maintenance information
1.6 the importance of working to agreed timescales and keeping others informed of progress
1.7 the relationship between time and costs
1.8 the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Use of technical information
2.1 how to find, interpret and use sources of technical information for scheduled maintenance activities, including on-board diagnostic displays
2.2 the importance of using the correct sources of technical information
2.3 the purpose of and how to use identification codes.

3. Vehicle system operation
3.1 how engines, cooling systems, air supply and exhaust systems, fuel systems and ignition systems operate for the type(s) of vehicle on which they are working
3.2 how clutch assemblies, clutch operating systems, manual gear boxes, automatic gear boxes, drivelines and hubs (if appropriate) and final drive assemblies operate for the type of vehicle on which they are working
3.3 how suspension systems, steering systems, braking systems, nonelectrical body systems, wheels and tyres operate for the type of vehicle on which they are working
3.4 how batteries, starting systems, charging systems, lighting systems and ancillary equipment operate for the type of vehicle on which they are working
3.5 the operating specifications and tolerances for the type(s) of vehicles on which they are working.

4. Chassis system operation and construction	
4.1	how to conduct scheduled, routine examination methods and assessments against vehicle specifications to identify damage, corrosion, inadequate fluid levels, leaks, wear, security problems and general condition and serviceability
4.2	how to check and make adjustments to clearances, gaps, settings, alignment, pressures, tension, speeds and levels relevant to the engine area, transmission area, chassis area, electrical area and body (including adjustments to valves, ignition, fuel and emissions, brakes, transmission, lights, tyres, steering and body fittings)
4.3	how to replenish and replace routine service components and materials, including filters, drive, belts, wiper blades, brake linings and pads, lubricants and fluids
4.4	how to recognise cosmetic damage to vehicle components and units outside normal service items
4.5	how to identify codes and grades of lubricants
4.6	how to work safely avoiding damage to the vehicle and its systems

Performance objectives

To be competent the learner must:

1. use suitable personal protective equipment and vehicle coverings throughout all vehicle maintenance activities
2. use suitable **sources of technical and legal information** to support all their vehicle maintenance activities
3. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate)
4. use the correct specifications and tolerances for the vehicle when making **assessments** of system and component performance
5. where the customer's vehicle falls outside the manufacturer's original specification, record details accurately and use this adapted specification as the basis for their examination and assessment
6. examine the vehicle's systems and components following:
   - the manufacturer's approved **examination methods**
   - their workplace procedures
   - health and safety requirements
   - environmental requirements
7. ensure their **examination methods** identify accurately any vehicle system and component problems falling outside the servicing schedule specified
8. carry out adjustments, replacement of vehicle components and replenishment of consumable materials following the manufacturer's current specification for:
   - the particular service interval
   - working methods and procedures
   - use of equipment
   - the tolerances for the vehicle
9. where system adjustments cannot be made within the manufacturer's specification, record the details accurately and take action which complies with the customer's instructions
10. work in a way which minimises the risk of damage to the vehicle and its systems
11. use suitable testing methods to evaluate the performance of all replaced and adjusted components and systems accurately, prior to returning the vehicle to the customer/driver
12. report any problems or issues relating to the vehicle's condition or conformity to the relevant person(s) promptly
13. ensure their maintenance records are accurate, complete and passed to the relevant person(s) promptly in the format required
14. complete all vehicle maintenance activities within the agreed timescale
15. report any anticipated delays in completion to the relevant persons(s) promptly.

Unit 221 Carry out routine commercial vehicle maintenance

Supporting information

Key words and phrases

Agreed timescales

Examples include: manufacturer's recommended work times, job times set by their company or a job time agreed with a specific customer.

Adjustments

Examples include: adjustments to clearances, gaps, settings, alignment pressures, tensions, speeds and levels, and adjustments to valves, ignition, fuel and emissions, brakes, transmission, lights, tyres, steering and body fittings.

Commercial Vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Components

Examples include: filters, drive belts, wiper blades, brake linings and pads, lubricants and fluids.

Conformity

Examples include conformity to manufacturer's specifications, UK and European legal requirements where applicable.

Systems testing equipment

Examples include: test instruments, emission test equipment, wheel alignment equipment, tyre tread depth gauges.

Maintenance records

Examples include: records of vehicle inspection, manufacturers', fleet, company or customer job cards.

Major service

As defined by manufacturers' specifications appropriate to the vehicle being working upon.

Routine vehicle maintenance

Examples include: conducting scheduled examinations, adjustments, replacements and replenishment of, or to, components and systems in accordance with manufacturer's instructions for the period and/or mileage interval.

Vehicle technical data

Examples include: hard copy manuals, data on computer and data obtained from on-board diagnostic displays.

Scope of this unit

1 **Sources of technical information are:**

a. vehicle technical data
b. schedules of inspection
c. regulations.

2 **Examination methods are:**

a. aural
b. visual
c. functional
d. measurements.

3 **Assessments** are for:

a. malfunction
b. damage
c. fluid levels
d. leaks
e. wear
f. security
g. condition and serviceability
h. conformity
i. necessity for adjustment(s)
j. corrosion.

Unit range

Vehicle maintenance, adjustment and record findings

a. Vehicle inspection techniques used in routine maintenance including: i aural ii visual and functional assessments on:
   - engine systems
   - chassis systems
   - wheels and tyres
   - transmission system
   - electrical and electronic systems
   - exterior vehicle body
   - vehicle interior

b. The procedures used for inspecting the condition and serviceability of the following:
   i filters
   ii drive belts
   iii wiper blades
   iv brake linings
   v pads
   vi lights.

c. Preparation and appropriate use of equipment to include:
   i test instruments
   ii emission equipment
   iii wheel alignment
   iv beam setting equipment
   v tyre tread depth gauges.

d. Procedures for checking and replenishing where applicable:
   i oil (engine, gearbox, final drive, hub reduction)
   ii water (coolant and screenwash)
   iii hydraulic fluids (brake and clutch)
   iv engine emission additives (Urea)
   v pneumatic systems.

e. Procedures for replacement of lubricants and filters (to include chassis systems):
   i replace oil filters
   ii types of oil
   iii cleanliness
   iv disposal of old oil and filters.

f. Procedures for carrying out adjustments on vehicle systems or components:
   i clearances
   ii settings
   iii alignment
   iv operational performance (engine idle, exhaust gas).

g. Procedures for checking electrical systems:
    i operation
    ii security
    iii performance
h. Importance and process of detailed inspection procedures:
    i following inspection checklists
    ii checking conformity to manufacturer's specifications
    iii legal requirements as applicable.
i. Importance and process of completing all relevant documentation relating to routine maintenance:
    i inspection records
    ii job cards
    iii vehicle repair records
    iv in-vehicle service history.

The need to use vehicle protection prior to repair

a. Requirements and methods used for protecting:
    i vehicle body panels
    ii paint surfaces
    iii seats
    iv interior floor protection.

The need to check the vehicle following routine maintenance

a. The need to inspect the vehicle following routine maintenance:
    i professional presentation of vehicle
    ii customer perceptions.
b. The basic checks of vehicle following routine maintenance:
    i removal of oil and grease marks
    ii body panels
    iii paint surfaces iv seats
    iv interior floor protection
    v re-instatement of components.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of carrying out servicing activities on **at least 3 different vehicles** which **must** collectively cover the Essential Knowledge and Performance Objectives
5. be observed by their assessor **in their normal workplace** carrying out servicing activities on **at least 1 occasion.**
6. Evidence from simulated activities is not **acceptable** for this unit

Unit 222 Remove and replace commercial vehicle engine units and components

Level:	**5**
Credit value:	17
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about removing and replacing commercial vehicle units and components where dismantling and re-assembly of engine systems is required. It is also about evaluating the performance of replaced units and components. The units and components concerned are those outside those replaced as part of normal routine, vehicle maintenance (servicing) activities.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-232 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.1 2.2 2.3 2.4** 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 6.2 6.3 6.6 6.8 This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures	
1.1	the legal requirements (e.g. European Emission Standards) relating to the vehicle (including road safety requirements)
1.2	the legislation and workplace procedures relevant to • health and safety • the environment (including waste disposal) • appropriate personal and vehicle protective equipment
1.3	their workplace procedures for: • recording removal and replacement information • the referral of problems • reporting delays to the completion of work
1.4	the importance of documenting removal and replacement information
1.5	the importance of working to agreed timescales and keeping others informed of progress
1.6	the relationship between time and costs
1.7	the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Use of technical information	
2.1	how to find, interpret and use sources of information applicable to unit and component removal and replacement within engine systems
2.2	the importance of using the correct sources of technical information
2.3	the purpose of and how to use identification codes.

3. Electrical and electronic principles	
3.1	vehicle earthing principles and methods
3.2	electrical and electronic principles associated with vehicle engine systems, including types of sensors, actuators, their application and operation
3.3	types of circuit protection and why these are necessary
3.4	electrical safety procedures
3.5	how warning, charging and starter circuits work
3.6	electric symbols, units and terms
3.7	battery charging
3.8	electrical/electronic control system principles.

4. Engine system operation and construction	
4.1	how engine systems and their related units and components are constructed, dismantled and reassembled for the classification of vehicle worked upon
4.2	how engine systems and their related units and components operate for the classification of vehicle worked upon.

5. Equipment	
5.1	how to prepare, test and use all the removal and replacement **equipment** required.

6. Engine unit and component removal and replacement	
6.1	how to remove and replace engine system mechanical and electrical units and components for the classification of vehicle worked upon
6.2	how to file, fit, tap, thread, cut and drill plastics and metals
6.3	how to select and fit gaskets, sealants, fittings and fasteners
6.4	how to test and evaluate the performance of replacement engine units and components and the reassembled system against the vehicle operating specifications and any legal requirements
6.5	the relationship between testing methods and the engine units and components replaced – the use of appropriate test methods
6.6	the properties of jointing materials and when and where they should be used
6.7	the manufacturer's specification for the type and quality of engine units and components to be used
6.8	how to work safely avoiding damage to other vehicle systems, components and units and contact with leakage and hazardous substances.

Performance objectives

To be competent the learner must:
1. wear suitable personal protective equipment and use vehicle coverings (where appropriate) throughout all removal and replacement activities 2. support their removal and replacement activities by reviewing: • vehicle technical data • removal and replacement procedures • legal requirements 3. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate) 4. prepare, test and use all the **equipment** required following manufacturers' instructions 5. carry out all removal and replacement activities following: • manufacturers' instructions • their workplace procedures • health and safety requirements • environmental requirements 6. work in a way which minimises the risk of: • damage to other vehicle systems • damage to other vehicle components and units • contact with leakage • contact with hazardous substances. 7. ensure replaced engine **units and components** conform to the vehicle operating specification and any legal requirements 8. record and report any additional faults they notice during the course of their work promptly 9. use suitable **testing methods** to evaluate the performance of the reassembled system accurately 10. ensure the reassembled **engine system** performs to the vehicle operating specification and meets any legal requirements prior to return to the customer/driver 11. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required 12. complete all removal and replacement activities within the agreed timescale 13. report any expected delays in completion to the relevant person(s) promptly.

Unit 222 Remove and replace commercial vehicle engine units and components

Supporting information

Key words and phrases

Agreed timescales

Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Commercial vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Units and components

Any unit or component from the engine system as defined in the Scoping Statement below.

Scope of this unit

1. **Equipmen**t is, for example:
   a. hand tools
   b. special workshop tools
   c. general workshop equipment
   d. electrical testing equipment.

2. **Testing methods** are:
   a. visual
   b. aural
   c. functional.

3. **Unit and components** are:
   a. mechanical
   b. electrical.

4. **Engine systems** are:
   a. engine mechanical systems
   b. cooling systems
   c. air supply and exhaust systems
   d. fuel systems
   e. engine electrical systems
   f. lubrication systems.

Unit range

Engines

a. Engine types and configurations:
   i inline
   ii flat
   iii vee
   iv four-stroke cycle for compression ignition engines
   v naturally aspirated, turbo-charged and turbo-charged aftercooled engines
   vi alternative fuel engines
   vii hybrid arrangements where applicable.
b. Key engineering principles related to engine mechanical systems:
   i compression ratios
   ii volumetric efficiency
   iii cylinder capacity
   iv power v torque.
c. Terms used in engine mechanical systems:
   i tdc
   ii bdc
   iii stroke
   iv bore.
d. Relative advantages and disadvantages of different engine types and configurations.
e. Engine components and layouts:
   i side camshaft and overhead camshaft
   ii single and multi cylinder
   iii wet and dry liners
   iv crankshaft dampers.
f. Cylinder head layout and design, combustion chamber and piston design.
g. Calculate compression ratios from given data.
h. The procedures used when inspecting engines.
i. The procedures to assess:
   i serviceability
   ii wear
   iii condition
   iv clearances
   v settings
   vi linkages
   vii joints
   viii fluid systems
   ix adjustments
   x operation and functionality
   xi security.

j. Symptoms and faults associated with mechanical engine operation:
   i poor performance
   ii abnormal or excessive mechanical noise
   erratic running
   iii low power
   iv exhaust emissions
   v abnormal exhaust smoke
   vi unable to start
   vii exhaust gas leaks to cooling system

exhaust gas leaks.

Lubrication

a. Key engineering principles relating to lubrication systems
   i classification of lubricants
   ii properties of lubricants
   iii methods of reducing friction.
b. The advantages and disadvantages of wet and dry systems.
c. Engine lubrication system:
   i splash and pressurised systems
   ii pumps
   iii pressure relief valve
   iv filters
   v oil ways
   vi oil coolers.
d. Terms associated with lubrication and engine oil:
   i full-flow
   ii hydrodynamic
   iii boundary
   iv viscosity
   v multi-grade
   vi natural and synthetic oil
   vii viscosity index
   viii multi-grade.
e. The requirements and features of engine oil:
   i operating temperatures
   ii pressures
   iii lubricant grades
   iv viscosity
   v multi-grade oil
   vi additives (detergents, dispersants, anti-oxidants inhibitors, anti-foaming agents, antiwear)
   vii synthetic oils
   viii organic oils
   ix mineral oils.

f. Symptoms and faults associated with lubrication system:
    i excessive oil consumption
    ii oil leaks
    iii oil in water
    iv low or excessive pressure
    v oil contamination.
g. The procedures used when inspecting lubrication system.
h. The construction and operation of heavy vehicle engine lubrication systems and components, to include:
    i full flow
    ii by pass
    iii wet sump
    iv dry sump.

Cooling, Heating and Ventilation

a. Key engineering principles relating to engine cooling, heating and ventilation systems:
    i heat transfer
    ii linear and cubical expansion
    iii specific heat capacity
    iv boiling point of liquids.
b. Procedures used to remove, replace and adjust cooling system components:
    i cooling fans and control devices
    ii header tanks, radiators and pressure caps
    iii coolant filters
    iv heater matrix's and temperature control systems
    v expansion tanks hoses, clips and pipes
    vi thermostats impellers and coolant
    vii ventilation systems.
c. The preparation and method of use of appropriate specialist equipment used to evaluate system performance following component replacement:
    i system pressure testers
    ii pressure cap testers
    iii anti-freeze testing equipment
    iv chemical tests for the detection of combustion gas
    v supplementary coolant additive.
d. The layout and construction of internal heater systems.
e. The controls and connections within internal heater systems.
f. Symptoms and faults associated with cooling systems:
    i water leaks
    ii water in oil
    iii internal heating system: efficiency, operation, leaks, controls, air filtration, air leaks and contamination
    iv excessively low or high coolant temperature.

g. The procedures used when inspecting:
    i internal heating system
    ii cooling system.

General

a. The preparation, testing and use of tools and equipment used for:
    i dismantling
    ii removal and replacement of engine units and components.
b. Appropriate safety precautions:
    i PPE
    ii vehicle protection when dismantling
    iii removal and replacing engine units and components.
c. The importance of logical and systematic processes.
d. The inspection and testing of engine units and components.
e. The preparation of replacement units for re-fitting or replacement.
f. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance and safety requirements.
g. Refitting procedures.
h. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
i. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
    i cleanliness of vehicle interior and exterior
    ii security of components and fittings
    iii re-instatement of components and fittings.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of removing and replacing units or component from **4** of the **5*** systems listed below. The evidence must come from work **in their normal workplace**
    - engine mechanical systems
    - cooling systems
    - air supply and exhaust systems
    - fuel systems
    - engine electrical systems
    - lubrication systems
5. be observed by their assessor on at least **1** occasion removing and replacing components or units.

*However, they must prove to their assessor that they have the necessary knowledge and understanding to be able to perform competently in respect of **all** the systems listed above.

Evidence from simulated activities is **not** acceptable for this unit.

Unit 223 Remove and replace commercial vehicle electrical auxiliary units and components

Level:	**5**
Credit value:	17
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about removing and replacing commercial vehicle units and components previously identified as faulty, damaged, deteriorated or, where the customer/driver has requested replacement. It is also about evaluating the performance of replaced units and components. The units and components concerned are those outside those replaced as part of normal routine, vehicle maintenance (servicing) activities.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-233 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.2** **2.3** 5.4 6.3 This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1.	Legislative and organisational requirements and procedures
1.1	the legal requirements relating to the vehicle (including road safety and refrigerant handling requirements) • the legislation and workplace procedures relevant to health and safety • the environment (including waste disposal) • appropriate personal and vehicle protective equipment
1.2	their workplace procedures for: • recording removal and replacement information • the referral of problems • reporting delays to the completion of work
1.3	the importance of documenting removal and replacement information
1.4	the importance of working to agreed timescales and keeping others informed of progress
1.5	the relationship between time and costs
1.6	the importance of reporting anticipated delays to the relevant person(s) promptly.

2.	Use of technical information
2.1	how to find, interpret and use sources of information applicable to electrical unit and component removal and replacement
2.2	the importance of using the correct sources of technical information
2.3	the purpose of and how to use identification codes.

3.	Electrical auxiliary system operation and construction
3.1	how electrical auxiliary units and components are constructed, removed and replaced for the classification of vehicle worked upon
3.2	how electrical auxiliary units and components operate for the classification of vehicle worked upon.

4.	Equipment
4.1	how to prepare, test and use all the removal and replacement equipment required.

5.	Electrical and electronic principles
5.1	vehicle earthing principles and earthing methods
5.2	electrical and electronic principles associated with electrical auxiliary systems, including types of sensors and actuators, their application and operation
5.3	types of circuit protection and why these are necessary
5.4	electrical safety procedures
5.5	how lighting, warning, charging and starter circuits work
5.6	electric symbols, units and terms
5.7	electrical/electronic control system principles.

6. Electrical unit and component removal and replacement	
6.1	how to remove and replace electrical **auxiliary units and components** for the classification of vehicle worked upon
6.2	how to test and evaluate the performance of replacement **electrical auxiliary units and components** and the reassembled system against the vehicle operating specifications and any legal requirements
6.3	the relationship between testing methods and the **electrical auxiliary units and components** replaced – the use of appropriate test methods
6.4	the manufacturer's specification for the type and quality of **electrical auxiliary units and components** to be used
6.5	how to work safely avoiding damage to other vehicle systems, components and units and contact with leakage and hazardous substances.

Performance objectives

To be competent the learner must:
1. wear suitable personal protective equipment and use vehicle coverings (where appropriate) throughout all removal and replacement activities
2. support their removal and replacement activities by reviewing vehicle technical data removal and replacement procedures legal requirements
3. prepare, test and use all the **equipment** required following manufacturers' instructions
4. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate)
5. carry out all removal and replacement activities following; • manufacturers' instructions • workplace procedures • health and safety requirements • Environmental requirements
6. work in a way which minimises the risk of: • damage to other vehicle systems • damage to other vehicle components and units • contact with leakage • contact with hazardous substances
7. ensure replaced **electrical auxiliary units and components** conform to the vehicle operating specification and any legal requirements
8. record and report any additional faults they notice during the course of their work promptly
9. use suitable **testing methods** to evaluate the performance of the reassembled system accurately
10. ensure the reassembled system performs to the vehicle operating specification and meets any legal requirements prior to return to the customer/driver
11. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
12. complete all removal and replacement activities within the agreed timescale
13. report any expected delays in completion to the relevant person(s) promptly.

Unit 223 Remove and replace commercial vehicle electrical auxiliary units and components

Supporting information

Key words and phrases

Agreed timescales
Examples include; manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Comfort and convenience systems
Examples are heated seats, electrically adjusted seats, heated screens, electric mirrors, heating, climate control and air conditioning.

Commercial Vehicles
These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Units and components
Any unit or component from the electrical systems defined in the Scoping Statement below.

Scope of this unit

1. **Equipmen**t is, for example:
   a. hand tools
   b. special workshop tools
   c. general workshop equipment
   d. electrical meters.

2. **Testing methods** are:
   a. visual
   b. aural
   c. functional.

3. **Electrical auxiliary units and components** are for:
   a. lighting systems
   b. wiper systems
   c. security and alarm systems
   d. comfort and convenience systems
   e. audio systems
   f. communication systems
   g. electric window systems
   h. monitoring and instrumentation systems.

Unit range

a. Electrical units:

i volt (electrical pressure)
ii ampere (electrical current)
iii Ohm (electrical resistance)
iv watt (power).

b. The requirements for an electrical circuit:

i battery
ii cables
iii switch
iv current consuming device
v continuity.

b. The direction of current flow and electron flow.
c. Series and parallel circuits to include:

i current flow
ii voltage
iii volt drop
iv resistance
v the effect on circuit operation of open circuit component(s).

d. Earth and insulated return systems.
e. Cable sizes and colour codes.
f. Different types of connectors, terminals and circuit protection devices.
g. Common electrical and electronic symbols.
h. The meaning of:

i short circuit
ii open circuit
iii bad earth
iv high resistance
v electrical capacity.

i. The principles of vehicle electronic systems and component.
j. Interpret vehicle wiring diagrams to include:

i vehicle lighting
ii auxiliary circuits
iii indicators
iv starting and charging systems.

k. Function and construction of electrical components including:

i circuit relays
ii bulb types including LED’s and alternative lighting systems
iii fan and heater
iv circuit protection.

l. The safety precautions when working on electrical and electronic systems to include:

i disconnection and connection of battery
ii avoidance of short circuits
iii power surges
iv prevention of electric shock
v protection of electrical and electronic components
vi protection of circuits from overload or damage.

m. The set-up and use of:

i digital and analogue multi-meters
ii voltmeter
iii ammeter
iv ohmmeter
v oscilloscope
vi manufacturer's dedicated test equipment.

n. Electrical and electronic checks for electrical and electronic systems to include:

i connections
ii security
iii functionality
iv performance to specifications
v continuity, open circuit vi short circuit
vi high resistance
vii volt drop
viii current consumption
ix output patterns (oscilloscope).

o. Symptoms and faults associated with electrical and electronic systems to include:

i high resistance
ii loose and corroded connections
iii short circuit
iv excessive current consumption
v open circuit
vi malfunction
vii poor performance
viii battery faults to include flat battery
ix failure to hold charge
x low state of charge
xi overheating
xii poor starting.

Battery and charging

a. The construction and operation of vehicle batteries including:

i low maintenance and maintenance free
ii battery cell construction.

b. The operation of the vehicle charging system:

i alternator
ii rotor
iii stator

iv slip ring
v brush assembly
vi three phase output
vii diode rectification pack
viii voltage regulation
ix phased winding connections
x cooling fan
xi alternator drive system.

Starting

a. The layout, construction and operation of engine starting systems: inertia and pre-engaged principles.

b. The function and operation of the following components:

i axial and pre-engaged starter motor
ii starter ring gear
iii starter solenoid
iv ignition/starter switch
v starter relay
vi one-way clutch (pre-engaged starter motor).

Lighting

a. Function and construction of electrical components including:

i front, tail and number plate lamps
ii main and dip beam headlamps
iii fog and spot lamps
iv lighting switches including main/dip switch
v directional indicators
vi hazard warning.

b. The circuit diagram and operation of components for:

i side tail and marker lamps
ii headlamps
iii interior lamps
iv fog, high-intensity rear and spot lamps
v direction indicators.

c. The statutory requirements for vehicle lighting when using a vehicle on the road.
d. Headlamp adjustment and beam setting.

Auxiliary systems

a. Auxiliary systems to include:

   i lighting
   ii wiper
   iii security and alarm
   iv comfort and convenience
   v information and entertainment
   vi telephone and two way communication
   vii electric window.

b. Function and construction of electrical components including:

   i central door locking
   ii anti theft devices
   iii manual locking and dead lock systems
   iv window winding
   v demisting systems
   vi door mirror operation mechanisms
   vii interior lights and switching.

c. The circuit diagram and operation of components for:

   i central door locking
   ii anti-theft devices
   iii manual locking and dead lock systems
   iv window winding
   v demisting systems
   vi door mirror operation mechanisms.

d. Comfort and convenience systems to include:

   i heated seats
   ii electrically adjusted seats
   iii heated screens
   iv electric mirrors
   v heating
   vi climate control
   vii air conditioning
   viii monitoring and instrumentation.

General

a. The preparation, testing and use of:

   i tools and equipment
   ii electrical meters and equipment used for dismantling
   iii removal and replacement of electrical and electronic systems and components.

b. Appropriate safety precautions:

   i PPE
   ii vehicle protection when dismantling
   iii removal and replacing electrical and electronic components and systems.

c. The importance of logical and systematic processes.

d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.

e. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance, safety requirements.
f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
h. Inspection and re-instatement of the vehicle following repair to ensure:

   i customer satisfaction
   ii cleanliness of vehicle interior and exterior
   iii security of components and fittings
   iv re-instatement of components.

Evidence Requirements

The learner must:

2. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
3. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
4. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
5. produce evidence of removing and replacing **at least 4*** units or components, **each** from a **different** electrical system listed below. At least **3** of these **4** pieces of evidence **must** come from work **in their normal workplace**.
6. be observed by their assessor **on at least 1 occasion in their normal workplace** carrying out the removal and replacement of at least **1** of the following*:
   - engine starting
   - battery charging
7. be observed by their assessor on **at least 1 occasion in their normal workplace** of successfully carrying out the removal and replacement of electrical units and components *****:
   a. lighting
   b. wiper
   c. security and alarm
   d. comfort and convenience
   e. information and entertainment
   f. telephone and two way communication
   g. electric window systems
   h. monitoring and instrumentation systems

*However, they must prove to their assessor that they have the necessary knowledge and understanding to be able to perform competently in respect of all the systems listed above.

Simulated activity **will be** acceptable to assess candidates' removal and replacement competence on no **more than 1** occasion.

Unit 224 Remove and replace commercial vehicle chassis units and components

Level:	**5**
Credit value:	20
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about removing and replacing commercial vehicle units and components where dismantling and re-assembly of chassis systems is required. It is also about evaluating the performance of replaced units and components. The units and components concerned are those outside those replaced as part of normal routine, vehicle maintenance (servicing) activities.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-234 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.1 2.2 2.3 2.4** 3.1 3.2 3.3 3.4 3.6 6.2 6.3 This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures
1.1 the legal requirements applicable to the units and assemblies overhauled (including road safety requirements) 1.2 the legislation and workplace procedures relevant to • health and safety • the environment (including waste disposal) • appropriate personal and vehicle protective equipment 1.3 their workplace procedures for: • recording **overhaul activities** • reporting the results of tests • the referral of problems • reporting delays to the completion of work 1.4 the importance of documenting removal and replacement information 1.5 the importance of working to agreed timescales and keeping others informed of progress 1.6 the relationship between time and costs 1.7 the importance of reporting any anticipated delays to the relevant person(s) promptly.

2. Use of technical information
2.1 how to find, interpret and use sources of information applicable to unit and component removal and replacement within chassis systems 2.2 the importance of using the correct sources of technical information 2.3 the purpose of and how to use identification codes.

3. Electrical and electronic principles
3.1 vehicle earthing principles and methods 3.2 electrical and electronic principles associated with chassis systems, including types of sensors and actuators, their application and operation 3.3 types of circuit protection and why these are necessary 3.4 electrical safety procedures 3.5 electric symbols, units and terms 3.6 electrical and electronic control system principles.

4. Chassis system operation and construction
4.1 how commercial vehicle chassis systems and their related units and components are constructed, removed and replaced 4.2 how commercial vehicle chassis systems and their related units and components operate.

5. Equipment	
5.1	how to prepare, test and use all the removal and replacement equipment required.

6. Chassis system unit and component removal and replacement	
6.1	how to remove and replace commercial vehicle chassis system mechanical, electrical, hydraulic and pneumatic units and components
6.2	how to file, fit, tap, thread, measure and mark out, cut and drill plastics and metals
6.3	how to select and use gaskets, sealants, seals, fittings and fasteners
6.4	how to test and evaluate the performance of replacement chassis system units and components and the reassembled system against the vehicle operating specifications and any legal requirements
6.5	the relationship between testing methods and the chassis system units and components replaced – the use of appropriate test methods
6.6	when replacement units and components must meet the original equipment specification (OES) for warranty or other requirements
6.7	how to work safely avoiding damage to other vehicle systems, components and units and contact with leakage and hazardous substances
6.8	awareness of health and safety aspects of working on loaded vehicles (e.g. HAZCHEM, load type and capacity).

Performance objectives

To be competent the learner must:
1. wear suitable personal protective equipment and use vehicle coverings (where appropriate) throughout all removal and replacement activities 2. support their removal and replacement activities by reviewing: vehicle technical data removal and replacement procedures legal requirements 3. prepare, test and use all the equipment required following manufacturers' instructions 4. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate) 5. carry out all removal and replacement activities following: • manufacturers' instructions • their workplace procedures • health and safety requirements • environmental requirements 6. work in a way which minimises the risk of: • damage to other vehicle systems • damage to other vehicle components and units • contact with leakage • contact with hazardous substances 7. ensure replaced chassis units and components conform to the vehicle operating specification and any legal requirements 8. record and report any additional faults they notice during the course of their work promptly 9. use suitable testing methods to evaluate the performance of the reassembled system accurately 10. ensure the reassembled chassis system performs to the vehicle operating specification and meets any legal requirements prior to return to the customer/driver 11. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required 12. complete all removal and replacement activities within the agreed timescale 13. report any expected delays in completion to the relevant person(s) promptly.

Unit 224 Remove and replace commercial vehicle chassis units and components

Supporting information

Key words and phrases

Agreed timescales

Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Commercial Vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Units and components

Any unit or component from the chassis systems defined in the Scoping Statement below.

Functional testing

Examples include: use of brake roller tester, dynamometer and suspension activation.

Steering and suspension system

For the purposes of this unit, this will also include wheels and tyres.

Scope of this unit

1. Equipment is:

a. hand tools
b. special workshop tools
c. general workshop equipment
d. electrical testing equipment.

2. Testing methods are:

a. visual
b. aural
c. functional.

3. Units and components are:

a. mechanical
b. electrical
c. hydraulic and fluid
d. pneumatic.

4. Chassis systems are:

a. Steering
b. suspension
c. braking.

Unit range

Describe how to remove and replace:

a. Integral
b. semi-integral
c. external
d. 6x2x4
e. 8x4x4
f. rear steered axles
g. self-steered axles.

Steering

Chassis layouts

a. types of chassis
b. axle configurations
c. rear steered axles
d. self-steered axles

1.3 describe how to remove and replace

Steering

a. Key engineering principles related to steering:
    i geometry
    ii angles
    iii damping
    iv stress and strain
b. The construction and operation of steering systems
    i power and non-assisted steering

ii multi axle steering arrangements
iii heavy vehicle steering units and components

c. The action and purpose of steering geometry:
   i castor angle
   ii camber angle
   iii kingpin or swivel pin inclination
   iv negative offset
   v wheel alignment (tracking) (toe in and toe out)
   vi toe out on turns
   vii steered wheel geometry
   viii multi axle steered wheel geometry.
d. The following terms associated with steering:
   i Ackerman principle
   ii slip angles
   iii self-aligning torque oversteer and understeer
   iv neutral steer
   v rear steer
   vi self-steer.
e. The components and layout of hydraulic power assisted steering systems:
   i piston and power cylinders
   ii drive belts and pumps
   iii control valve (rotary, spool and flapper type)
   iv hydraulic fluid.
f. The advantages of power assisted steering.
g. The operation of hydraulic power assisted steering.
h. The principles of electronic power steering systems.
i. The procedures used for inspecting the serviceability and condition of:
   i manual steering
   ii power assisted steering.
j. Steering system defects to include:
   i uneven tyre wear
   ii wear on outer edge of tyre
   iii wear on inner edge of tyre
   iv uneven wear
   v flats on tread
   vi steering vibrations
   vii wear in linkage
   viii damaged linkage
   ix incorrect wheel alignment
   x incorrect steering geometry.

Suspension

a. Types of suspension
   i non independent suspension
   ii independent suspension
   iii air suspension
   iv electronically controlled air suspension (ECAS)
   v steel suspension
   vi lifting axles
b. The layout and components of suspension systems:
   i non-independent suspensions
   ii independent front suspension (IFS)
   iii air suspension
   iv electronically controlled air suspension (ECAS)
   v rubber suspension

vi tandem axle suspension
vii lifting axles.

c. The operation of suspension systems and components:
   i leaf and coil springs
   ii torsion bar
   iii air springs
   iv air suspension levelling mechanism (mechanical and electronic)
   v rubber springs
   vi hydraulic dampers
   vii trailing arms
   viii ball joints
   ix bump stops
   x anti-roll bars
   xi stabiliser bars
   xii swinging arms
   xiii parallel link
   xiv transverse link
   xv 'A' frame axle location.
   xvi suspension damping
   xvii stress and strain
d. The advantages of different systems including:
   i non-independent
   ii independent suspension (IFS)
   iii air suspension (mechanical)
   iv air suspension (electronically controlled)
   v rubber suspension
   vi lifting axles.
e. The principles of electronically controlled air suspensions systems.
f. The forces acting on suspension systems during braking, driving and cornering.
g. The methods of locating the road wheels against braking, driving and cornering forces.
h. The methods of controlling cornering forces by fitting anti-roll torsion members.
i. Suspension terms:
   i rebound bump
   ii yaw
   iii dive
   iv pitch
   v roll
   vi compliance.
j. The procedures used for inspecting the serviceability and condition of the suspension system.
k. Suspension system defects:
   i wheel hop
   ii ride height (unequal and low)
   iii wear
   iv noises under operation
   v fluid leakage
   vi excessive travel
   vii excessive tyre wear
   viii bounce
   ix poor vehicle handling
   x worn dampers
   xi worn joints
   xii damaged linkages
   xiii vehicle "crabbing".

Brakes

a. Key principles relating to braking systems:
    i laws of friction
    ii hydraulics
    iii pneumatics
    iv properties of fluids
    v properties of air
    vi braking efficiency
b. The construction and operation of braking systems
    i air brakes
    ii air-over-hydraulic brakes
    iii electronic brakes including Anti-lock Braking Systems and Anti-Slip Regulation
    iv endurance (retarding) systems
c. The construction and operation of drum brakes:
    i leading and trailing shoe construction
    ii self-servo action
    iii slack adjusters
    iv cam expanders v wedge expanders
    v automatic adjusters
    vi backing plates
    vii parking brake system
    viii wear indicators and warning lamps.
d. The construction and operation of disc brakes:
    i disc pads
    ii calliper
    iii brake disc
    iv ventilated disc
    v disc pad retraction
    vi parking brake system
    vii wear indicators and warning lamps.
e. The construction and operation of the hydraulic braking system:
    i line layout
    ii master cylinders
    iii wheel cylinders
    iv disc brake callipers & pistons v brake pipe
    v brake servo
    vi warning lights
    vii parking brakes
    viii equalising valves.
f. The construction and operation of the air braking system:
    i air compressors
    ii air dryers
    iii air processing units
    iv pressure regulating valves
    v circuit protection valves
    vi air reservoirs
    vii control valves (foot, park and hand)
    viii relay valves
    ix load sensing valves (mechanical and automatic)
    x brake actuators
    xi parking brake mechanisms
    xii trailer control valves
    xiii two-line trailer brake system
    xiv warning light/buzzer systems
    xv air pipes

xvi valve port numbering.

g. The construction and operation of the air-over-hydraulic braking system:
    i air supply and storage
    ii air control valves
    iii conversion from pneumatic pressure to hydraulic pressure
    iv hydraulic control valves.
h. The requirements and hazards of brake fluid:
    i boiling point
    ii hygroscopic action
    iii manufacturer's change periods
    iv fluid classification and rating
    v potential to damage paint surfaces.
i. Terms associated with air and hydraulic braking systems:
    i braking efficiency
    ii brake fade
    iii brake balance.

j The procedures used for inspecting the serviceability and condition of the braking system.

Braking system defects:

a. worn shoes or pads
b. worn or scored brake surfaces
c. abnormal brake noises
d. brake judder
e. fluid contamination of brake surfaces
f. fluid/air leaks
g. pulling to one side
h. poor braking efficiency
i. lack of servo assistance
j. loss of air pressure
k. brake drag
l. brake grab
m. brake fade.

Endurance Brakes

a. The construction and operation of heavy vehicle endurance (retarder) brakes:
    i exhaust brake
    ii compression (engine) brake
    iii hydraulic retarder
    iv electro-magnetic retarder.

ABS and ASR

a. The construction and operation of heavy vehicle ABS systems:
    i category one (2S/2M)
    ii category two (2S/1M)
    iii category three (1S/1M)
    iv wheel speed sensors
    v modulators
    vi electronic control unit.
b. Terms associated with ABS systems:
    i individual control
    ii modified individual control
    iii select low.
c. The construction and operation of heavy vehicle ASR systems.
d. The procedures used for inspecting the serviceability and condition of the ABS/ASR system.

Wheel and Tyres

a. The engineering principles for wheels and tyres
    i friction
    ii un-sprung weight
    iii dynamic and static balance
b. The construction of different types of tyre:
    i radial
    ii cross ply
    iii bias belted
    iv tread patterns
    v tyre mixing regulations
    vi tyre applications
    vii tyre markings
    viii wheel construction
c. Tyre markings:
    i tyre and wheel size markings
    ii speed rating
    iii direction of rotation
    iv profile
    v load rating
    vi ply rating
    vii tread-wear indicators.
d. Wheel construction:
    i light alloy
    ii pressed steel
    iii one-piece rims
    iv two-piece rims
    v three piece rims.
e. Wheel retention:
    i conical seating
    ii spherical seating
    iii spigot mounted.
f. Types of wheel bearing arrangements:
    i non-driving and driven wheels
    ii fully floating
    iii three quarter floating
g. Types of bearing used for wheel bearing arrangements and their adjustment:
    i taper roller
    ii angular contact ball
    iii integrated.
h. The procedures used for inspecting the serviceability and condition of:
    i tyres & wheels
    ii bearings.
i. The defects associated with tyres and wheels:
    i abnormal tyre wear
    ii cuts
    iii side wall damage
    iv wheel vibrations
    v loose wheel retainers
    vi tyre over heating
    vii tread separation.

j. Hazards when loading heavy vehicles
    i flammable liquids

ii Gases that are lighter than air and heavier than air
iii increased vehicle mass
iv raised tipper bodies
v raised centre of gravity
vi working at heights

General

The procedures for dismantling, removal and replacement of chassis system components

a. The preparation:
   i testing and use of tools and equipment
   ii electrical meters and equipment used for dismantling
   iii removing and replacing chassis systems and components.

b. Appropriate safety precautions:
   i PPE
   ii vehicle protection when dismantling
   iii removing and replacing chassis systems and components.

c. The importance of logical and systematic processes.

d. The inspection and testing of chassis systems and components.

e. The preparation of replacement units for re-fitting or replacement of chassis systems or components.

f. Identify the reasons why replacement components and units must meet the original specifications (OES):
   i warranty requirements
   ii to maintain performance
   iii safety requirements.

g. Refitting procedures.

h. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.

i. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
   i cleanliness of vehicle interior and exterior
   ii security of components and fittings
   iii re-instatement of components and fittings

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of removing and replacing **3 different units or components** in total which **must include items from** steering, suspension and braking systems. Their evidence must include demonstration of competence **in each** aspect of mechanical, electrical and hydraulic/fluid units or component removal and replacement
5. be observed in their normal workplace on at least **1 occasion** removing and replacing units and components from one of the following systems:
    - steering
    - suspension
    - braking.

Evidence from simulated activities is **not** acceptable for this unit

Unit 226 Inspect commercial vehicles

Level:	**6**
Credit value:	12
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about carrying out a range of inspections of commercial vehicles using a variety of testing methods and equipment.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-236 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.1** . 3.1 This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures
1.1 the health and safety legislation and workplace procedures relevant to conducting **vehicle inspections** and personal and vehicle protection 1.2 the legislation, including O-licensing, relevant to the types of **vehicle inspections** described in the Scoping Statement for this unit 1.3 their workplace procedures for: • recording vehicle inspections and any variations from acceptable tolerances • the referral of problems • reporting delays to the completion of work 1.4 the importance of making accurate records of the results of their tests and inspections and interpreting them correctly 1.5 the importance of working to agreed timescales and keeping others informed of progress 1.6 the relationship between time, costs and profitability 1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Sources of information
2.1 how to find, interpret and use technical information 2.2 the importance of using technical information to inform their inspection and testing of vehicles.

3. Testing methods and the conduct of inspections
3.1 how vehicle systems operate (including the engine area, transmission area, chassis or frame area and electrical area) and the operational tolerances for the vehicle(s) on which they are working 3.2 how to follow procedures for the systematic inspection of vehicles 3.3 how to test the operation of vehicle systems and vehicle condition, including workshop based and road tests 3.4 how to compare test and inspection results against vehicle specifications and legal requirements 3.5 how to record test and inspection results in the format required 3.6 how to make recommendations based upon the results of their inspections 3.7 the implications of failing to carry out an inspection correctly.

Performance objectives

To be competent the learner must:
1. use suitable personal protective equipment throughout all **vehicle inspection** activities
2. use suitable sources of technical and legal information to support their **vehicle inspection** activities
3. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate)
4. where necessary, confirm that **equipment** has been calibrated to meet manufacturers' and legal requirements
5. carry out systematic vehicle inspections following: • workplace procedures • health and safety requirements
6. conduct all vehicle testing following: • the manufacturer's instructions • the recognised **test methods** • workplace procedures • health and safety requirements
7. ensure their comparison of the vehicle against specification accurately identifies any: • differences from the vehicle specification • vehicle appearance and condition faults • non-compliance with statutory requirements
8. work in a way which minimises the risk of damage to the vehicle and its systems, other people and their property
9. make suitable recommendations for future action based upon the results of their tests and inspections
10. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
11. complete all inspection activities within the agreed timescale and to specification
12. report any anticipated delays in completion to the relevant person(s) promptly.

Unit 226 Inspect commercial vehicles

Supporting information

Key words and phrases

Agreed timescales

Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Commercial vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Sources of technical information:

Examples include: inspection schedules, mandatory annual test inspection manuals (VOSA) and guides, manufacturers' manuals and trade association check lists, workplace procedures.

Scope of this unit

1 **Vehicle inspections are:**

a. pre-delivery
b. pre-purchase
c. pre-VOSA and/or Preventative Maintenance Inspections (PMI)
d. safety e post-accident.

2 **Test methods are:**

a. visual
b. aural
c. functional
d. measurement.

3 **Equipment, e.g.:**

a. emissions testing
b. brake testing
c. headlamp alignment
d. wheel alignment
e. torque setting
f. specialist diagnostic equipment.

Unit range

Different types of heavy vehicle inspection

a. Types of inspection:
   i pre-purchase / pre-delivery
   ii pre-MOT inspection
   iii scheduled safety inspections
   iv daily vehicle checks v pre-rental / post rental inspections.

Vehicle inspections and maintenance records

a. The purpose and scope of the different types of vehicle inspection.
b. Vehicle inspection techniques for different types of inspection including:
   i systematic inspections
   ii aural
   iii visual and functional assessments on engine
   iv engine systems
   v chassis systems
   vi wheels and tyres
   vii transmission and driveline system
   viii electrical and electronic systems
   ix exterior vehicle body
   x vehicle interior.
c. The procedure for inspection of the vehicle for damage, corrosion, fluid leaks, wear, security, mounting security and condition to include:
   i engines and engine systems
   ii chassis systems
   iii brakes
   iv transmission and driveline
   v steering
   vi suspension
   vii wheels
   viii tyres
   ix body panels (stressed and non-stressed)
   x electrical and electronic systems and components
   xi vehicle seating and vehicle interior
   xii instruments.
d. Preparation and use of appropriate inspection equipment and tools including:
   i emission testing
   ii brake testing
   iii headlamp alignment
   iv wheel alignment
   v torque setting
   vi specialist diagnostic equipment
   vii tyre tread depth gauges.
e. Inspection procedures following inspection checklists.

f. Checking conformity to manufacturer's specifications and legal requirements:
   i workshop manuals
   ii heavy goods vehicle inspection manual.
g. Testing and operation of vehicle systems and vehicle condition including workshop based tests and road tests.
h. The completion and maintenance of:
   i documentation
   ii defect reports
   iii inspection records
   iv job cards
   v vehicle records.
i. Make recommendations based on results of vehicle inspections.
j. The implications of not carrying out vehicle inspections correctly including:
   i legal aspects (impact on Operator Licence)
   ii safety aspects
   iii financial aspects
   iv customer retention
   v customer relationships.

The need for vehicle protection prior to carrying out vehicle inspection

a. Protection relating to:
   i vehicle body panels
   ii paint surfaces
   iii seats
   iv carpets and floor mats.
b. Checks to be made following maintenance and repair:
   i vehicle body panels
   ii paint surfaces
   iii seats
   iv carpets and floor mats.

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   ii aural
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    iv transmission and driveline
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    vi suspension
    vii wheels
    viii tyres
    ix body panels (stressed and non-stressed
    x electrical and electronic systems and components
    xi vehicle seating and vehicle interior
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Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of carrying out **at least 2** different inspections on **2 occasions each** from the following**:**
    a. pre-MOT inspection
    b. scheduled safety inspections (PMI)
    c. post accident safety inspection
5. be observed by their assessor **in their normal workplace** carrying out an inspection on **at least 1 occasion.**

Evidence from simulated activities is **not** acceptable for this unit.

Unit 227 Diagnose and rectify commercial vehicle engine and component faults

Level:	**7**
Credit value:	17
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about diagnosing and rectifying faults occurring in commercial vehicle engine mechanical, electrical and hydraulic and fluid systems.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-237on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.2** **2.4** **4.4** **4.12** This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures
1.1 the health and safety legislation and workplace procedures relevant to workshop practices and personal and vehicle protection when diagnosing and rectifying engine faults
1.2 legal requirements relating to the vehicle (including road safety requirements)
1.3 their workplace procedures for: • recording diagnostic and rectification activities • the referral of problems • reporting delays to the completion of work
1.4 the importance of, documenting diagnostic and rectification information
1.5 the importance of working to agreed timescales and keeping others informed of progress
1.6 the relationship between time, costs and profitability
1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Electrical and electronic principles
2.1 electrical and electronic principles associated with engine systems, including types of sensors and actuators, their application and operation
2.2 how electrical and electronic engine systems operate, including electrical component function, electrical inputs, outputs, voltages and oscilloscope patterns, digital and fibre optics principles
2.3 the interaction between electrical, electronic and mechanical components with vehicle engine systems
2.4 electrical symbols, units and terms
2.5 electrical safety procedures.

3. Use of diagnostic and rectification equipment
3.1 how to prepare and test the accuracy of diagnostic testing equipment
3.2 how to use diagnostic and rectification equipment for engine mechanical, electrical, electronic, hydraulic and fluid systems; specialist engine repair tools and general workshop equipment.

4. Engine electrical faults, their diagnosis and correction	
4.1	how engine mechanical, electrical, electronic and hydraulic and fluid systems are constructed, operate, dismantled and reassembled
4.2	the types and causes of engine mechanical, electrical, electronic and hydraulic and fluid system, component and unit faults and failures
4.3	engine mechanical, electrical, electronic and hydraulic and fluid component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action
4.4	how to find, interpret and use sources of information on engine electrical and electronic operating specifications, diagnostic test procedures, repair procedures and legal requirements
4.5	vehicle operating specifications for limits, fits and tolerances relating to engine mechanical, electrical, electronic and hydraulic and fluid systems for the vehicle(s) on which they work
4.6	how to select the most appropriate diagnostic testing method for the symptoms presented
4.7	how to carry out systematic diagnostic testing of engine mechanical, electrical and electronic, hydraulic and fluid systems using a prescribed process or format and the diagnostic methods listed in the Scoping Statement for this unit
4.8	how to assess the condition evident within mechanical, electrical, electronic, hydraulic and fluid components and units
4.9	how to interpret test results and vehicle data in order to identify the location and cause of vehicle system faults
4.10	how to carry out the rectification activities listed in the Scoping Statement for this unit in order to correct faults in the engine mechanical, electrical, electronic and hydraulic and fluid systems
4.11	the relationship between test methodology and the faults repaired – the use of appropriate testing methods
4.12	how to make cost effective recommendations for rectification.

Performance objectives

To be competent the learner must:

1. wear suitable personal protective equipment and use vehicle coverings when using **diagnostic methods** and carrying out **rectification activities**
2. support the identification of **faults**, by reviewing vehicle:
    - technical data
    - diagnostic test procedures
3. prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate)
4. prepare, connect and test all the required **equipment** following manufacturers' instructions prior to use
5. use **diagnostic methods** which are relevant to the symptoms presented
6. collect sufficient diagnostic information in a systematic way to enable an accurate diagnosis of engine system faults
7. identify and record any system deviation from acceptable limits accurately
8. ensure their assessment of dismantled sub-assemblies, components and units identifies their condition and suitability for repair or replacement, accurately
9. inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform
10. use the **equipment required**, correctly and safely throughout all **rectification activities**
11. carry out all **rectification activities** following:
    - manufacturers' instructions
    - workplace procedures
    - health and safety requirements
12. work in a way which minimises the risk of:
    - damage to other vehicle systems
    - damage to other components and units
    - contact with leakages
    - contact with hazardous substances
13. ensure all repaired and replaced components and units conform to the vehicle operating specification and any legal requirements
14. when necessary, adjust components and units correctly to ensure that they operate to meet system requirements
15. record and report any additional faults they notice during the course of work promptly
16. use testing methods which are suitable for assessing the performance of the system rectified
17. ensure the engine system rectified performs to the vehicle operating specification and any legal requirements prior to return to the customer
18. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
19. complete all system diagnostic activities within the agreed timescale
20. report any anticipated delays in completion to the relevant person(s) promptly.

Unit 227 Diagnose and rectify commercial vehicle engine and component faults

Supporting information

Key words and phrases

Agreed timescales

Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Commercial Vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Diagnostic information

This relates to mechanical condition, including wear, run out, pressures and compressions, flow, leakage and electrical measurements such as voltage and pulse displays, electronic systems data, including fault codes, sensor measurements and control unit outputs and/or signals**.**

Engine Area

Engine mechanical, cooling systems, electronic ignition, petrol fuel injection, diesel fuel injection, lubrication, engine management systems, exhaust gas re-circulation and starting/charging.

Engine and component faults

These are faults that require a two or more step diagnostic activity using a prescribed process or format to identify the cause.

Functional testing

Examples include: performance testing and road testing where relevant.

Hydraulic and fluid systems

These are fuels, oil, lubrication, cooling etc.

Recommendations

Examples include: servicing, dismantling for further inspection and test, repair and replacement.

Scope of this unit

1. **Faults** occur within:

    a. the engine mechanical system
    b. the engine electrical and electronic systems
    c. the engine hydraulic and fluid systems.

2. **Diagnostic methods** are:

    a. measurement
    b. functional testing
    c. electrical and electronic systems testing.

3. **Equipment** is:

    a. diagnostic and rectification equipment for engine mechanical systems
    b. diagnostic and rectification equipment for engine electrical systems
    c. diagnostic and rectification equipment for engine hydraulic and fluid systems
    d. specialist repair tools
    e. general workshop equipment.

4. **Rectification activities** are:

    a. dismantling
    b. replacement of units and components
    c. adjustment of units and components
    d. repairs to wiring and connectors
    e. re-programming vehicle systems
    f. reassembly
    g. functional testing.

Unit range

a. The construction and operation of engine systems
   i electronic diesel control systems (EDC)
   ii common rail fuel systems
   iii unit injection fuel systems
   iv engine management
   v pressure charged induction systems
   vi exhaust emission reduction systems
   vii mechanical fuel injection systems
   viii valve mechanisms
   ix heating, ventilation and cooling

Common rail and unit injection systems

a. The operation and construction of common rail and unit injection systems including:
   i types of air flow sensor
   ii fuel supply system
   iii fuel pump
   iv filter
   v fuel regulator
   vi injectors
   vii main injection
   viii pre injection
   ix post injection
   x electronic control unit (ECU)
   xi injector pulse width
   xii sensors.

b. The operation of each system under various operating conditions including:
   i cold starting
   ii warm up
   iii hot starting
   iv acceleration
   v deceleration
   vi cruising
   vii full load.

Engine management

   a. The function and purpose of engine management systems.
   b. The difference between analogue, digital, programmable and nonprogrammable systems.
   c. Open loop and closed loop control, types of input and output devices.
   d. The function and operation of digital components and systems.
   e. The operation of engine management systems under various conditions.

Pressure charged induction systems

a. The meaning of volumetric efficiency; explain the effect of volumetric efficiency on engine performance, torque and power.

b. The methods used to improve volumetric efficiency:
   - i variable geometry turbo-charging
   - ii turbo-charging
   - iii supercharging
   - iv aftercoolers (intercooler).

c. The operation of turbo-chargers and the purpose of:
   - i turbo-charging
   - ii supercharging
   - iii aftercoolers (intercooler)
   - iv waste gates
   - v exhaust gas recirculation.

d. Advantages and disadvantages of pressure charging induction systems.

Terms associated with combustion

a. Phases of combustion, flame travel, pre-injection and diesel knock.

b. Fuel properties:
   - i cetane rating
   - ii flash point
   - iii fire point
   - iv volatility
   - v composition of compression ignition fuels
   - vi hydro-carbon content.

c. Composition of carbon fuels (petrol and diesel):
   - i % hydrogen and carbon
   - ii composition of air

d. The by-products of combustion for compression ignition engines:
   - i Carbon Monoxide
   - ii Carbon dioxide
   - iii Oxides of Nitrogen
   - iv Particulates.

Diesel exhaust emission control

a. Describe the legal requirements for exhaust emissions:
   - i MOT requirements
   - ii EU regulations.

b. The operation and construction of Selective Catalytic Reduction systems.

c. The operation and construction of Exhaust Gas Recirculation systems.

Assessment, repair and restoration of mechanical engine components

a. How engine mechanical components are assessed and measured for wear and serviceability:
   - i cylinder bores and liners
   - ii pistons
   - iii cylinder heads
   - iv crankshaft journals
   - v valve faces
   - vi valve guides
   - vii valve seats
   - viii camshafts.

b. The methods used for the repair and restoration of engine components.

Symptoms and faults in engine mechanical systems and components

a. Symptoms and faults related to:
   - i engine mechanical components
   - ii injection systems
   - iii fuel supply systems
   - iv engine management system
   - v pressure charged induction systems
   - vi exhaust emission reduction systems
   - vii valve mechanisms
   - viii heating and ventilation
   - ix cooling
   - x worn cylinders
   - xi cylinder liners
   - xii pistons
   - xiii piston rings
   - xiv crankshaft
   - xv camshaft
   - xvi bearings
   - xvii cylinder head and gasket
   - xviii valves
   - xix valve seats and valve guides
   - xx camshaft drives
   - xxi lubrication system and components
   - xxii oil pump
   - xxiii relief valve
   - xxiv filter
   - xxv turbo-charger
   - xxvi supercharger

Diagnosis of faults in engine mechanical systems and components

a. Interpret information for:
   i diagnostic tests
   ii manufacturer's vehicle and equipment specifications
   iii use of equipment
   iv testing procedures
   v test plans
   vi legal requirements.

b. The preparation of tools and equipment for use in diagnostic testing and assessment.
c. Systematic assessment, testing and inspection of engine components and systems including:
   i mechanical system & component condition
   ii engine balance
   iii power balance
   iv performance and operation
   v wear
   vi run out
   vii alignment.
d. Use of appropriate tools and equipment including:
   i compression gauges
   ii leakage testers
   iii cylinder balance tester
   iv pressure gauges
   v micrometers
   vi vernier gauges.
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. The procedures for dismantling, components and systems and the use of appropriate equipment and procedures.
h. Make suitable adjustments to components including
   i settings
   ii input and output values
   iii voltages
   iv current consumption
   v resistance
   vi output patterns with oscilloscope
   vii pressures
   viii condition
   ix wear and performance

i. Probable faults
   i malfunctions
   ii incorrect settings
   iii wear
j. Rectification or replacement procedures.
k. Evaluate operation of components and systems following diagnosis and repair to confirm system performance.

Faults and symptoms in electronic diesel injection systems

a. Diesel injection system failures or malfunctions including:
    i cold or hot starting problems
    ii poor performance
    iii exhaust emissions
    iv high fuel consumption
    v erratic running
    vi low power
    vii unstable idle speed.

Faults and symptoms in engine management systems

a. Engine management system failure or malfunctions including:
    i misfiring
    ii cold or hot starting problems
    iii poor performance
    iv diesel knock
    v exhaust emission levels
    vi fuel consumption
    vii low power
    viii unstable idle speed.

Diagnosis of faults in electronic diesel injection and engine management systems

a. Locate and interpret information for:
    i diagnostic tests
    ii manufacturer's vehicle and equipment specifications
    iii use of equipment
    iv testing procedures
    v test plans
    vi fault codes
    vii legal requirements.
b. The preparation of tools and equipment for use in diagnostic testing and assessment.
c. Conduct systematic assessment, testing of engine systems including:
    i component condition and performance
    ii component settings
    iii component values
    iv electrical and electronic values
    v system performance and operation
    vi use of appropriate tools and equipment including gauges
    vii multi-meter
    viii breakout box
    ix oscilloscope
    x diagnostic tester
    xi manufacturer's dedicated equipment
    xii exhaust gas analyser
    xiii pressure gauges.
d. Evaluate and interpret test results from diagnostic testing.
e. Compare test result, values and fault codes with vehicle manufacturer's specifications and settings.

f. The procedures for dismantling, components and systems using appropriate equipment.
g. Assess, examine and measure components including:
    i Settings
    ii input and output values
    iii voltages
    iv current consumption
    v resistance
    vi output patterns with oscilloscope
    vii condition
    viii wear and performance of components and systems.

h. Identify probable faults and indications of:
    i faults
    ii malfunctions
    iii incorrect settings
    iv wear
    v values
    vi inputs and outputs
    vii fault codes.
i. Rectification or replacement procedures.
j. Evaluation and the operation of components and systems following diagnosis and repair to confirm system performance.

Faults and symptoms in vehicle comfort systems

a. System failure, malfunction or ineffectiveness of internal heating system, air conditioning system or climatic control system including:
    i leaks
    ii abnormal noise
    iii ineffective operation
    iv failure to operate
    v control faults
    vi inadequate operation.

Diagnosis of faults in vehicle comfort systems

a. Locate and interpret information for:
    i diagnostic tests
    ii manufacturer's vehicle and equipment specifications
    iii use of equipment
    iv testing procedures
    v test plans
    vi fault codes
    vii legal requirements.
b. The preparation of tools and equipment for use in diagnostic testing and assessment.
c. Conduct systematic assessment and testing of comfort systems including:
    i component condition and performance
    ii component settings
    iii component values
    iv electrical and electronic values
    v system performance and operation

vi drive belts
vii controls
viii compressors
ix condensers
x receivers
xi dryers
xii connections
xiii valve
xiv hoses
xv thermostats and refrigerants
xvi sensors
xvii speed controls
xviii control systems
xix servomotors.

d. Use of appropriate tools and equipment including:
   i pressure gauges
   ii multi-meter
   iii breakout box
   iv oscilloscope
   v diagnostic tester
   vi manufacturer's dedicated equipment
   vii flow meter.
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result, values and fault codes with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. How to assess, examine and measure components including; settings, input and output values, voltages, current consumption, resistance, output patterns with oscilloscope, pressures, condition, wear and performance of components and systems.
i. Identification of probable faults and indications of faults, malfunctions, incorrect settings, wear, values, inputs and outputs, fault codes, pressures and leaks.
j. Rectification or replacement procedures.
k. Evaluation and operation of components and systems following diagnosis and repair to confirm system performance.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. use a **2 or more** step diagnostic activity
5. produce evidence of diagnosing and rectifying faults occurring in **4 out of the 7*** engine systems listed, **at least 3** of which must come from work carried out **in their normal workplace.**
    - engine mechanical components
    - cooling
    - fuel systems
    - engine management system
    - pressure charged induction systems
    - exhaust emission reduction systems
    - heating, and ventilation

6. be observed by their assessor on **at least 2 occasions**, **each** observation covering the diagnosis and rectification of a fault in **different** systems. **Both** of these observations must be carried out **in their normal workplace.**

* However, they must prove to their assessor that they have the necessary knowledge and understanding to be able to perform competently in respect of faults occurring in all the types of engine systems.

Simulated activity **will be** acceptable to assess candidates' competence in diagnosis and rectification on no more than **1** occasion.

Unit 228 Diagnose and rectify commercial vehicle chassis system faults

Level:	**7**
Credit value:	18
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about diagnosing and rectifying faults occurring within commercial vehicle steering and suspension systems, braking systems and other systems fitted to commercial vehicle chassis.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-238 online multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.1** 4.3 **2.3** 4.4 **2.4** 4.12 This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures	
1.1	the health and safety legislation and workplace procedures relevant to workshop practices and personal and vehicle protection when diagnosing and rectifying chassis faults
1.2	legal requirements relating to the vehicle (including road safety requirements)
1.3	their workplace procedures for: • recording diagnostic and rectification activities • the referral of problems • reporting delays to the completion of work
1.4	the importance of, documenting diagnostic and rectification information
1.5	the importance of working to agreed timescales and keeping others informed of progress
1.6	the relationship between time, costs and profitability
1.7	the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Electrical and electronic principles	
2.1	electrical and electronic principles associated with chassis systems, including types of sensors and actuators, their application and operation
2.2	how electrical and electronic chassis systems operate, including electrical component function, electrical inputs, outputs, voltages and oscilloscope patterns, digital and fibre optics principles
2.3	the interaction between electrical, electronic and mechanical components within vehicle chassis systems
2.4	electrical symbols, units and terms
2.5	electrical safety procedures.

3. Use of diagnostic and rectification equipment	
3.1	how to prepare and test the accuracy of diagnostic testing equipment
3.2	how to use diagnostic and rectification **equipment** for chassis mechanical, electrical, hydraulic and fluid systems, specialist repair tools and general workshop equipment.

4. Chassis faults, their diagnosis and correction	
4.1	how chassis mechanical, electrical, electronic, pneumatic and hydraulic and fluid systems are constructed, dismantled, reassembled and operate
4.2	the types and causes of chassis mechanical, electrical, electronic, pneumatic and hydraulic and fluid system component and unit faults and failures
4.3	chassis mechanical, electrical, electronic, pneumatic, hydraulic and fluid component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action.
4.4	how to find, interpret and use sources of information on chassis electrical and electronic operating specifications, diagnostic test procedures, repair procedures and legal requirements
4.5	vehicle operating specifications for limits, fits and tolerances relating to chassis mechanical, electrical, electronic, pneumatic and hydraulic and fluid systems for the vehicle(s) on which they work.
4.6	how to select the most appropriate diagnostic testing method for the symptoms presented
4.7	how to carry out systematic diagnostic testing of chassis mechanical, electrical and electronic, pneumatic, hydraulic and fluid systems using a prescribed process or format
4.8	how to assess the condition evident within chassis mechanical, electrical, electronic, pneumatic, hydraulic and fluid components and units
4.9	how to interpret test results and vehicle data in order to identify the location and cause of vehicle system faults
4.10	how to carry out the **rectification activities** listed in the Scoping Statement for this unit in order to correct faults in the chassis mechanical, electrical, electronic, pneumatic and hydraulic and fluid systems
4.11	the relationship between test methodology and the faults repaired – the use of appropriate testing methods
4.12	how to make cost effective recommendations for rectification.

Performance objectives

To be competent the learner must:	
1.	wear suitable personal protective equipment and use vehicle coverings when using **diagnostic methods** and carrying out **rectification activities**
2.	support the identification of **faults**, by reviewing vehicle: • technical data • diagnostic test procedures
3.	prepare the vehicle, vehicle systems and work area for safe working procedures (where appropriate)
4.	prepare, connect and test all the required **equipment** following manufacturers' instructions prior to use
5.	use **diagnostic methods** which are relevant to the symptoms presented
6.	collect diagnostic information in a systematic way relevant to the diagnostic methods used
7.	collect sufficient diagnostic information to enable an accurate diagnosis of chassis system faults
8.	identify and record any system deviation from acceptable limits accurately
9.	ensure their assessment of dismantled sub-assemblies, components and units identifies their condition and suitability for repair or replacement, accurately
10.	inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform
11.	use the **equipment** required, correctly and safely throughout all **rectification activities**
12.	carry out all rectification activities following: • manufacturers' instructions • workplace procedures • health and safety requirements
13.	work in a way which minimises the risk of : • damage to other vehicle systems • damage to other components and units • contact with leakages • contact with hazardous substances
14.	ensure all repaired and replaced components and units conform to the vehicle operating specification and any legal requirements
15.	when necessary, adjust components and units correctly to ensure that they operate to meet system requirements
16.	record and report any additional faults they notice during the course of work promptly
17.	use testing methods which are suitable for assessing the performance of the system rectified
18.	ensure the chassis system rectified performs to the vehicle operating specification and any legal requirements prior to return to the customer
19.	ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
20.	complete all system diagnostic activities within the agreed timescale
21.	report any anticipated delays in completion to the relevant person(s) promptly.

Unit 228 Diagnose and rectify commercial vehicle chassis system faults

Supporting information

Key words and phrases

Agreed timescales

Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Chassis or frame area

Suspension systems, assisted steering systems, non-assisted steering systems, braking systems, ABS/traction control, wheels and tyres.

Commercial vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Chassis system faults

These are faults that require a two or more step diagnostic activity using a prescribed process or format to identify the cause.

Diagnostic information

This relates to mechanical condition, including wear, run out, pressures, flow, leakage and electrical measurements such as voltage and pulse displays, electronic systems data, including fault codes, sensor measurements and control unit outputs and/or signals.

Functional testing

Examples include: brake roller testing, performance testing and road testing where relevant.

Hydraulic and fluid systems

Examples are: hydraulic braking systems, hydro-pneumatic suspension systems, power steering, hydraulic load handling and or moving systems.

Pneumatic systems

Examples are pneumatic braking systems, pneumatic suspension systems and pneumatic control systems.

Recommendations

Examples include: servicing, dismantling for further inspection and test, repair and replacement.

Scope of this unit

1. **Chassis systems** are**:**

   a. steering
   b. suspension
   c. braking.

2. **Diagnostic methods** are:
   a. measurement
   b. functional testing
   c. electrical and electronic systems testing.

3. **Equipment** is:
   a. diagnostic and rectification equipment for chassis mechanical systems
   b. diagnostic and rectification equipment for chassis electrical systems
   c. diagnostic and rectification equipment for chassis hydraulic and fluid systems
   d. diagnostic and rectification equipment for chassis pneumatic systems
   e. specialist repair tools
   f. general workshop equipment

4. **Faults** are:
   a. mechanical
   b. electrical and electronic
   c. hydraulic and fluid
   d. pneumatic.

5. **Rectification activities** are:
   a. dismantling
   b. replacement of units and components
   c. adjustment of units and components
   d. repairs to wiring and connectors
   e. re-programming vehicle systems
   f. reassembly
   g. functional testing
   h. repairs to air line and connectors.

Unit range

Chassis system operation:

a. Construction and operation of heavy vehicle chassis systems to include:
   i Anti-lock Braking Systems (ABS)
   ii Electronic Braking Systems (EBS)
   iii Electronic Brake-force Distribution (EBD)
   iv Anti-Slip Regulation / Traction Control (ASR)
   v Electronic Stability Programme (ESP)
   vi Rear wheel steer
   vii power assisted steering
   viii Electronically Controlled Air Suspension (ECAS)

b. The Engineering principle relating to heavy vehicle chassis systems:
   i inertia force, mass and acceleration
   ii laws of friction
   iii statics (springs and torsion bars)
   iv hydraulic and pneumatic principles

c. Make suitable adjustments to components including:
   i Settings
   ii input and output values
   iii voltages
   iv current consumption
   v resistance
   vi output patterns with oscilloscope
   vii pressures
   viii condition
   ix wear and performance

Electrical and electronic principles of heavy vehicle chassis systems

b. The operation of electrical and electronic systems and components related to heavy vehicle chassis systems including:
   i ECU
   ii sensors and actuators
   iii electrical inputs
   iv voltages
   v oscilloscope patterns
   vi digital and fibre optic principles

b. The interaction between the electrical/electronic system and mechanical components of chassis systems
c. Electronic and electrical safety procedures.

Operation of electronic ABS, EBS, ASR and EBD braking systems

a. Layout of:
   i ABS, EBS, ASR and EBD braking systems
   ii anti-lock braking
   iii anti-spin regulation systems
   iv warning systems.
b. Operation of:
   i pneumatic, hydraulic and electronic control units
   ii wheel speed sensors
   iii load sensors
   iv hoses
   v cables and connectors.
c. Advantage of ABS and EBS braking systems over conventional braking systems.
d. The relationship and interaction of electronic braking control with other vehicle systems.

Steering geometry for advanced heavy vehicle applications

a. Non-steered wheel geometry settings.
b. Front/rear wheel geometry:
   i castor
   ii camber
   iii kingpin or swivel pin inclination
   iv negative offset
   v wheel alignment (tracking)
   vi toe out on turns and steered wheel geometry
   vii Ackerman principle
   viii slip angles
   ix self-aligning torque
   x oversteer and understeer
   xi neutral steer.
c. The operation and layout of rear wheel steering and self-steered axles.
d. The construction and operation of power assisted steering systems:
   i hydraulic system
   ii power cylinders
   iii drive belts and pumps
   iv hydraulic valve (rotary, spool and flapper type).

Components and operation of electronically controlled air suspension

a. The components, construction and operation of an electronically controlled air suspension system.
b. The operation of electronically controlled air suspension systems under various conditions:
   i laden
   ii unladen
   iii cornering.
c. The relationship and interaction of electronically controlled air suspension with other vehicle systems.

Symptoms and faults in braking systems

a. Symptoms and faults associated with conventional braking systems, ABS, EBS and EBD systems:
   i mechanical
   ii hydraulic
   iii electrical and electronic systems
   iv fluid and air leaks
   v poor brake efficiency
   vi wheel locking under braking.

Diagnosis and faults in braking systems

a. Locate and interpret information for:
   i diagnostic tests
   ii vehicle and equipment specifications
   iii use of equipment
   iv testing procedures
   v test plans
   vi fault codes
   vii legal requirements.
b. Prepare equipment for use in diagnostic testing.
c. Conduct systematic testing and inspection of:
   i braking system
   ii ABS
   iii pneumatic
   iv mechanical
   v hydraulic
   vi electrical and electronic systems.
d. Using appropriate tools and equipment including:
   i multi-meters
   ii oscilloscope
   iii pressure gauges.
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle components and systems using appropriate Equipment and procedures
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions, incorrect settings.
j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance.

Symptoms and faults associated with steering systems

a. Symptoms and faults associated with steering systems:
   i mechanical
   ii hydraulic
   iii electrical and electronic
   iv steering boxes
   v steering arms and linkages
   vi steering joints and bushes
   vii idler gears
   viii bearings
   ix steering columns (collapsible and absorbing)
   x power assisted steering system.

Diagnosis and faults in steering systems

a. Locate and interpret information for:
   i diagnostic tests
   ii vehicle and equipment specifications
   iii use of equipment
   iv testing procedures
   v test plans
   vi fault codes
   vii legal requirements.
b. How to prepare equipment for use in diagnostic testing.
c. Conduct systematic testing and inspection of:
   i steering systems
   ii mechanical
   iii hydraulic
   iv electrical and electronic systems
   v power assisted steering system.
d. Using appropriate tools and equipment including:
   i multi-meters
   ii oscilloscope
   iii pressure gauges
   iv wheel alignment equipment
   v steering geometry equipment.
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the:
   i operation
   ii settings
   iii values
   iv condition and performance of components and systems
i. probable faults, malfunctions, and incorrect settings
j. rectification or replacement procedures
k. operation of systems following diagnosis and repair to confirm operation and performance.

Symptoms and faults associated with suspension systems

a. Symptoms and faults associated with suspension systems:
    i mechanical
    ii pneumatic
    iii electrical and electronic
    iv self-levelling and ride controlled suspension systems
    v ride height (unequal and low)
    vi wear
    vii noises under operation
    viii fluid or air leakage
    ix excessive travel
    x excessive tyre wear.

Diagnosis and faults in suspension systems

a. Locate and interpret information for:
    i diagnostic tests
    ii vehicle and equipment specifications
    iii use of equipment
    iv testing procedures
    v test plans
    vi fault codes
    vii legal requirements.
b. How to prepare equipment for use in diagnostic testing.
c. How to conduct systematic testing and inspection of:
    i suspension systems
    ii mechanical
    iii hydraulic
    iv electrical and electronic systems
    v self-levelling and ride controlled suspension systems.
d. Using appropriate tools and equipment including:
    i multi-meters
    ii oscilloscope
    iii pressure gauges
    iv alignment equipment
    v geometry equipment.
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions and incorrect settings.
j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance.

Symptoms and faults associated with suspension systems

a. Symptoms and faults associated with suspension systems:
   i mechanical
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   ix excessive travel
   x excessive tyre wear

Diagnosis and faults in suspension systems

a. Locate and interpret information for:
   i diagnostic tests
   ii vehicle and equipment specifications
   iii use of equipment
   iv testing procedures
   v test plans
   vi fault codes
   vii legal requirements
b. How to prepare equipment for use in diagnostic testing.
c. How to conduct systematic testing and inspection of:
   i suspension systems
   ii mechanical
   iii hydraulic
   iv electrical and electronic systems
   v self-levelling and ride controlled suspension systems
d. Using appropriate tools and equipment including:
   i multi-meters
   ii oscilloscope
   iii pressure gauges
   iv alignment equipment
   v geometry equipment
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions and incorrect settings.
j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. use a **2 or more** step diagnostic activity
4. produce evidence of diagnosing and rectifying **3 faults**. At least **1** fault must be from **each** system listed. The **range** of evidence must include demonstration of competence in diagnosis and rectification in at least **1** of **each**: mechanical, electrical/electronic and hydraulic/ pneumatic units or components. **At least 2** pieces of evidence must come from work carried out **in their normal workplace.**
    - Steering systems
    - Suspension systems
    - Braking systems
5. be observed by their assessor on at least 2 occasions, each observation covering the diagnosis and rectification of a fault in a different chassis system

Simulated activity **will be** acceptable to assess candidates' competence in diagnosis and rectification on no more than **1** occasion.

Unit 406 Diagnose and rectify motor vehicle electrical unit and component faults

Level:	**7**
Credit value:	16
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit is about identifying and rectifying faults occurring within electrical systems, units and components.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details. Candidates **must** take the City & Guilds 5310-456 on-line multiple choice test, which partly covers the **essential knowledge** within this unit. The essential knowledge statements, which are **not** covered by the test, are: **2.1** **2.2** **2.3** 4.9 This criteria **must** be assessed in one of the following ways: • oral or written questioning • professional discussion. Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.

Essential knowledge

The learner will need to understand:

1. Legislative and organisational requirements and procedures	
1.1	the health and safety legislation and workplace procedures relevant to workshop practices and personal and vehicle protection when diagnosing and rectifying complex electrical faults
1.2	legal requirements relating to the vehicle electrics (including road safety and refrigerant handling requirements)
1.3	their workplace procedures for: • recording fault location and **correction activities** • reporting the results of tests. • the referral of problems • reporting delays to the completion of work
1.4	the importance of working to recognised diagnostic procedures and processes and obtaining the correct information for diagnostic activities to proceed
1.5	the importance of, documenting diagnostic and rectification information
1.6	the importance of working to agreed timescales and keeping others informed of progress
1.7	the relationship between time, costs and profitability
1.8	the importance of reporting anticipated delays to the relevant person(s) promptly.

2. Electrical and electronic principles	
2.1	electrical and electronic principles, including Ohms Law, voltage, power, current (AC/DC) resistance, magnetism, electromagnetism and electromagnetic induction, digital and fibre optics principles
2.2	electrical symbols, units and terms
2.3	electrical safety procedures
2.4	how electrical and electronic units and components are constructed, dismantled and reassembled
2.5	how electrical and electronic units and components operate, including electrical component function, electrical inputs, outputs, voltages and patterns
2.6	the interaction between electrical, electronic and mechanical components within the systems defined
2.7	how electrical systems interlink and interact including multiplexing
2.8	the operation of the electrical and electronic systems for electric, hybrid and alternative fuel vehicles (including regenerative braking systems).

3. Use of electrical testing equipment	
3.1	how to prepare and test the accuracy of diagnostic testing equipment.
3.2	how to use **electrical and electronic testing equipment** to correctly and safely diagnose electrical faults.

4. Auxiliary equipment electrical faults, their diagnosis and correction	
4.1	the types and causes of electrical system, component and unit faults and failures
4.2	electrical component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action
4.3	how to find, interpret and use sources of information on electrical operating specifications, diagnostic test procedures, repair procedures and legal requirements
4.4	how to carry out systematic diagnostic testing of electrical and electronic systems using **electrical testing techniques**
4.5	how to select the most appropriate diagnostic testing method for the symptoms presented
4.6	how to interpret test results and vehicle data in order to identify the location and cause of vehicle system faults
4.7	how to rectify electrical and electronic faults
4.8	how to make suitable adjustments to components and units
4.9	how to make cost effective recommendations for rectification.

Performance objectives

To be competent the learner must:

1. wear suitable personal protective equipment and use vehicle coverings when using **electrical testing techniques** and carrying out **rectification activities**
2. support the identification of **electrical faults**, by reviewing vehicle:
    - technical data
    - diagnostic test procedures
3. prepare, connect and test all the required **electrical and electronic testing equipment** following manufacturers' instructions prior to use
4. use **electrical and electronic testing techniques** which are relevant to the symptoms presented
5. collect sufficient diagnostic information in a systematic way to enable an accurate diagnosis of electrical system faults
6. identify and record any system deviation from acceptable limits accurately
7. make cost effective recommendations for rectification based upon their analysis of the diagnostic information gained
8. use all **tools and equipment** required for their diagnostic and rectification activities, correctly and safely throughout
9. carry out all **diagnostic & rectification activities** following:
    - manufacturers' instructions
    - recognised repair methods
    - their workplace procedures
    - health and safety requirements
10. work in a way which minimises the risk of:
    - damage to other vehicle systems
    - damage to other components and units
    - contact with leakages
    - contact with hazardous substances
11. ensure all repaired and replaced electrical components and units conform to the vehicle operating specification and any legal requirements
12. when necessary, adjust components and units correctly to ensure that they operate to meet system requirements
13. ensure the electrical system rectified performs to the vehicle operating specification and any legal requirements prior to return to the customer
14. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
15. complete all diagnostic and rectification activities within the agreed timescale
16. report any anticipated delays in completion to the relevant person(s) promptly.

Unit 406 Diagnose and rectify motor vehicle electrical unit and component faults

Supporting information

Key words and phrases

Agreed timescales

Examples include: manufacturer's recommended work times, job times set by the company or a job time agreed with a specific customer.

Commercial vehicles

These are medium and large goods vehicles of 3500kgs gross vehicle mass (GVM) and above.

Comfort and convenience systems

Examples are heated seats, electrically adjusted seats, heated screens, electric mirrors, heating, climate control and air conditioning.

Auxiliary equipment electrical faults

These are faults that require a multi stage inspection and a series of test results to identify the cause.

Vehicles

These can be any of the following – light vehicles.

Additionally these vehicles may be Si, Ci, Hybrid, Electric or Alternative fuelled vehicles.

Alternative Fuel

This is defined as any type of fuel that may be used to power an internal combustion engine, examples would include LPG, bio ethanol etc.

Scope of this unit:

1. **Electrical faults** occurring within the following systems:
    a. infotainment
    b. comfort and convenience
    c. Supplementary Restraint Systems (SRS)
    d. networking systems
    e. body electric systems.

2. **Electrical and electronic testing equipment** covers:
    a. volt meters
    b. ammeters
    c. ohmeters
    d. multimeters
    e. battery testing equipment
    f. dedicated and computer based equipment
    g. oscilloscopes.

3. **Tools and equipment**:
    a. hand tools
    b. special purpose tools
    c. general workshop equipment.

4. **Diagnostic testing** is defined as:
    a. verify the fault
    b. collect further information
    c. evaluate the evidence
    d. carry out further tests in a logical sequence
    e. rectify the problem
    f. check all systems.

5. **Electrical and electronic testing techniques** are:
    a. voltage, resistance and current measuring
    b. frequency measuring
    c. visual
    d. dedicated and computer based testing.

6. **Rectification activities** are defined as:
    A suitable repair or replacement that rectifies the fault(s) identified from the diagnostic activities carried out.

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

The electrical principles that are related to light vehicle electrical circuits:

a. Ohms law.
b. Voltage.
c. Power.
d. Current (AC and DC).
e. Resistance.
f. Magnetism.
g. Electromagnetism and electromagnetic induction.
h. Digital and fibre optic principles.
i. Electrical units and symbols.
j. Electrical and electronic terminology.
k. Relevant electrical safety.

Battery and charging

a. The construction and operation of vehicle batteries including:
    i. low maintenance and maintenance free
    ii. lead acid and nickel cadmium types
    iii. cells
    iv. separators
    v. plates
    vi. electrolyte.
b. The operation of the vehicle charging system:
    i. alternator
    ii. rotor
    iii. stator
    iv. slip ring
    v. brush assembly
    vi. three phase output
    vii. diode rectification pack
    viii. voltage regulation
    ix. phased winding connections
    x. cooling fan
    xi. alternator drive system.

Starting

a. The layout, construction and operation of engine starting systems: inertia and pre-engaged principles.
b. The function and operation of the following components:
    i. inertia and pre-engaged starter motor
    ii. starter ring gear
    iii. pinion
    iv. starter solenoid
    v. ignition/starter switch
    vi. starter relay (if appropriate)
    vii. one-way clutch (pre-engaged starter motor).

Lighting systems and technology

a. Lighting systems should include:
    i. Xenon lighting
    ii. gas discharge lighting
    iii. ballast system
    iv. LED
    v. intelligent front lighting
    vi. blue lights
    vii. complex reflectors
    viii. fibre optic
    ix. optical patterning.

Lighting circuits and the relationship between each circuit

a. Circuits must include:
    i. sidelights including number plate lights and marker lights
    ii. dipped beam
    iii. main beam
    iv. dim/dip
    v. indicators and hazard lights
    vi. high intensity and fog light.

Common faults and testing methods associated with external lighting system

a. Fault diagnosis for:
    vii. lighting systems failing to operate correctly
    viii. switches
    ix. relays
    x. bulbs failing to operate.

The operating principles of external lighting systems and multiplexing systems

a. To include all external lighting systems and a good knowledge of multiplexing systems.

The different types of electric windows and mirror systems and components

a. Components should include:
    i. window
    ii. mirror motors
    iii. multi-functional switches
    iv. relays
    v. total closure modules.

The function of component parts in the electric window and mirror systems

a. Components must include:
    i. motors
    ii. relays
    iii. interfaces
    iv. modules
    v. switches.

The operating principles of electric windows and mirror systems

a. Operating principles of the following:
    i. motors
    ii. interfaces
    iii. switches
    iv. modules.

Common faults and testing methods associated with electric windows and mirror systems

a. Fault diagnosis for:
    i. electric windows failing to open or close
    ii. electric mirrors fail to adjust
    iii. slow operation on both systems.

The different types of screen heating systems and components

a. Systems must include:
    i. heated front screens
    ii. heated rear screens
    iii. heated mirrors.

The function and operating principles of components for heated screen and mirror systems

a. Components must include:
    i. front screen elements
    ii. mirror elements
    iii. time control relays
    iv. multifunction relays and switches.

Common faults and testing methods associated with heated screen and mirror systems

a. Faults must include:
    i. screen elements not operating
    ii. timer relays not operating and staying on permanently.

The different types of In Car Entertainment (I.C.E.) systems and components

a. Systems and components must include:
    i. radio CD and multi play units
    ii. DVD players
    iii. MP3 players
    iv. speakers
    v. aerial systems
    vi. amplifiers
    vii. V.D.U. screens
    viii. Satellite Navigation
    ix. communication units.

The function of components in I.C.E. systems

a. Systems include:
    i. radios
    ii. CD players
    iii. video players
    iv. DVD players
    v. aerial systems
    vi. speakers
    vii. amplifiers
    viii. VDU screens
    ix. mobile communication units.

The operating principles of I.C.E. systems

a. Operation of entertainment systems speaker and aerial systems.

Common faults and testing methods associated with I.C.E. systems

a. Faults to include:
    i. entertainment and navigation units not operating
    ii. speaker, aerial and amplifier systems not functioning correctly
    iii. excessive radio interference (suppression)
    iv. use of diagnostic computers and systems.

The different types of integrated security/warning systems and components

a. Components to include:
    i. control units
    ii. alarm modules
    iii. audible warning units
    iv. immobiliser units
    v. sensing units
    vi. horn
    vii. audible warning speakers.

The function of component parts in integrated security and warning systems

a. Components to include:
    i. control units
    ii. alarm modules
    iii. audible warning units
    iv. interior sensing systems
    v. immobiliser units
    vi. relays
    vii. LEDs
    viii. horns

The operating principles of integrated security and warning systems

a. Operation of alarm systems and audible warning units.

The relevant legislation relevant to security and warning systems

a. Find and apply all relevant legislation for the fitment and use of security and warning systems.

Common faults and testing methods associated with security and warning systems

a. Components to include:
    i. control units
    ii. audible warning units
    iii. immobiliser units
    iv. horns
    v. relays
    vi. LEDs
    vii. wiring
    viii. connections and protection devices
    ix. removal and refitting procedures
    x. using computer diagnostics to identify faults
    xi. use of manufacturer's diagnostic equipment.

The different wiper system components

a. Components must include:
    i. wiper motors
    ii. washer motors
    iii. wiper linkage
    iv. multifunction relays
    v. headlamp wash/wipe.

The function of component wiper and washer components

a. Components and systems must include:
    i. wiper motors
    ii. intermittent wash wipe relays
    iii. parking systems .

The operating principles, faults and testing methods of wiper and washer systems

a. Principles, fault diagnosis and testing for:
    i. wiper motors failing
    ii. damaged linkages
    iii. incorrect operation of intermittent and parking systems
    iv. earth faults
    v. control unit failure .

The different heater, cooling system components and air con.

a. Components include:
    i. heater motors
    ii. speed rheostats
    iii. switches
    iv. valves
    v. radiator cooling fan motors
    vi. relays
    vii. air conditioning units.

The function of component heater, cooling parts and air conditioning

a. Components include:
    i. heater motors
    ii. rheostats
    iii. valves
    iv. switches
    v. relays
    vi. cooling fan motors
    vii. air conditioning units
    viii. thermostatic switches.

The operating principles of heater, cooling systems and air conditioning

a. Principles to include:
    i. conduction
    ii. convection
    iii. radiation
    iv. circulation
    v. boiling points
    vi. states of matter (gas, liquid, solid)
    vii. temperature control
    viii. antifreeze mixtures
    ix. heat transfer.

Common faults and testing methods associated with heater, cooling systems and air conditioning

a. Fault diagnosis for:
    i. heater motor failing to operate on all/one speed
    ii. radiator cooling fan not operating
    iii. valves
    iv. relays
    v. switches not operating
    vi. electrical related faults on the air conditioning system.

The different types of locking system components

a. Door locking actuators, solenoids, deadlocking actuators and anti-theft modules.

The function of component parts in the locking system

a. Solenoids, actuators (electrical and pneumatic), multifunctional relays, anti-theft modules and release systems.

The operating principles of locking systems

a. Doors and cabs.

Common faults and testing methods associated with locking systems

a. Door locking actuators, solenoids, connections, wiring, relays, and protection devices/fuses.

The different types of Supplementary Restraint and Airbag systems

a. Components include:
    i. control units
    ii. sensors
    iii. seat belt pretensioners
    iv. airbag assemblies
    v. wiring systems
    vi. warning systems.

The function of component parts in the Supplementary Restraint and Airbag systems

a. Components include:
    i. control units
    ii. interfaces
    iii. sensors
    iv. airbag units
    v. pretensioners.

The operating principles of Supplementary Restraint and Airbag systems

a. Operation of the sensors.
b. Operation of the airbag unit.
c. Operation of the various types of pretension.
d. Safe handling procedures and regulations.

Common faults and testing methods associated Supplementary Restraint and Airbag systems

a. Fault diagnosis for Airbag and SRS faults:
    i. fault code identification
    ii. wiring faults
    iii. component failure
    iv. earth problems
    v. sensor faults.

How to examine, measure and make suitable adjustments to components:

a. Settings
b. Input and output values
c. Voltages
d. Current consumption
e. Resistance
f. Input and output patterns with oscilloscope (including frequency and duty cycle measurements)
g. Condition
h. Wear and performance

How to select, prepare and use diagnostic and rectification equipment for automotive auxiliary electrical systems:

a. Voltmeters
b. Ammeters
c. Ohmmeters
d. Multi-meters
e. Battery testing equipment
f. Dedicated and computer based diagnostic equipment
g. Oscilloscopes.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. produce evidence of carrying out diagnosis and rectification activities from **4 different systems out of the 16 listed below *.** The fault should involve a **2 or more** step diagnostic activity. **At least 3** pieces of evidence must come from work carried out **in their normal workplace.**
    - lighting systems
    - heated seats
    - electrically adjusted seats
    - heated screens
    - electric mirrors
    - electric sunroofs
    - electric windows
    - heating and ventilation systems
    - information and entertainment
    - communication systems
    - SRS
    - wash wipe
    - locking systems
    - security and warning systems
    - alternators
    - starter motors
5. be observed by their assessor on **at least 1 occasion**, covering the diagnosis and rectification of a fault.

*However, they must prove to their assessor that they have the necessary knowledge and understanding to be able to perform competently in respect of faults occurring in all the types of electrical systems.

Simulated activity **will be** acceptable to assess candidates' competence in diagnosis and rectification on no more than **1** occasion.

Unit 407 Carry out non high energy electrical system work on or near electric and hybrid vehicles

Level:	**4**
Credit value:	3
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This standard is for people who work on or near electric and hybrid vehicles **but do not work on the vehicle's high energy electrical system**. Examples of these job roles include: sales staff, cleaners/valeters or vehicle fitters. The standard includes essential knowledge of the hazards associated with electric and hybrid vehicles and the precautions to follow to avoid these. **Note:** This standard does not deem someone competent to maintain, service or repair high energy electrical systems.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details.

Essential knowledge

The learner will need to know and understand:
1. the hazards associated with high energy electrical vehicle components 2. the health and safety legislation and workplace procedures relevant to working on or near electric/hybrid vehicles, including the appropriate personal protective equipment and its use 3. their workplace procedures for: • checking that the vehicle has been made safe as appropriate to the work you are carrying out • referring/reporting problems when working with electric/hybrid vehicles • making others aware of the work carried out on **electric/hybrid vehicles** 4. the differences between an electric/hybrid and non-electric vehicle 5. how to operate an electric/hybrid vehicle safely 6. how to charge an electric//hybrid vehicle with plug-in capability 7. the precautions necessary when using plug-in charging equipment 8. how to make an electric/hybrid vehicle safe, including isolating high energy electrical systems where required within their level of training 9. the implications of electrical conductivity through the human body and other potential medical conditions that can occur regardless of current type present in the electric/hybrid vehicle 10. how to find, interpret and use sources of information applicable to electric/hybrid vehicles as appropriate to their job role.

11. the hazards associated with electric/hybrid vehicle batteries when exposed to extreme temperatures, impact and other adverse conditions

Performance objectives

To be competent the learner must:
1. collect relevant information about the electric/hybrid vehicle and any potential hazards 2. wear personal protective equipment appropriate to the work activities you are carrying out 3. follow the correct procedures to ensure the electric/hybrid vehicle has been made safe prior to starting any work 4. carry out work activities in a way that avoids contact with, or damage to, high energy electrical systems and their components 5. refer any problems with the **electric/hybrid** vehicle to a relevant person in their workplace 6. report the **work activities** you have carried out on or near the **electric/hybrid vehicle** to relevant colleagues

Unit 407 Carry out non high energy electrical system work on or near electric and hybrid vehicles

Supporting information

Scope of this unit

1. **Electric/hybrid vehicle** – any vehicle that is powered wholly or in part by an electrical drive train. This includes electric hybrid plug-in vehicles.
2. **High energy electrical/high voltage** – typical voltages used for a range of Electric and Hybrid Vehicles 100-650V **ECE R100** (relating to vehicle regulations) paragraph 2.14 clearly defines high voltage: “High Voltage" means the classification of an electric component or circuit, if its working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (rms).’
3. **Status of vehicle** – without any damage that might present a greater electrical hazard than an undamaged vehicle.
4. **Work activities** – not involving work on the high energy electrical system and its components.

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. Evidence must be provided to demonstrate competence in using relevant information to identify potential hazards relating to electric/hybrid vehicles.
5. Produce evidence of carrying out work activities on or around an electric or hybrid vehicle **on at least two of the below**:
    - Cordon off the vehicle
    - Removing the key from the vehicle
    - Charging the vehicle
    - Cleaning the vehicle
    - Demonstrating a vehicle to a customer
    - Preparing to service or repair the vehicle Steering systems
    - Suspension systems
    - Braking systems
6. Be observed by their assessor in their normal workplace **on at least one occasion** carrying out work on or near an electric and hybrid vehicle avoiding contact with high energy electrical systems.

Simulated activity for this unit will be acceptable to assess candidates' competence in non-high energy electrical system work on **no more than one occasion**.

Unit 408 Service and repair non-live electric and hybrid vehicle systems

Level:	**7**
Credit value:	3
Endorsement by a regulatory body:	This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.
Aim:	This unit covers the competence and knowledge technicians need to carry out servicing and general repairs on non-live high energy electrical systems and components on electric and hybrid vehicles safely. The unit also ensures that the technician is aware of the effect that high energy electrical component technology has on other vehicle systems. **Note:** This unit only covers the competence and knowledge required to work on **non-live** high energy electrical components and associated systems. It does not enable a candidate to dismantle 'live' components, for example battery packs.
Assessment requirements:	**Performance objectives must** be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the **Evidence Requirements** at the end of this unit for further details.

Essential knowledge

The learner will need to know and understand:

1. Safety precautions	
1.1	the health and safety legislation and workplace procedures relevant to working with electric/hybrid vehicles including appropriate personal protective equipment and its use
1.2	the legislation relevant to the activities described in the Scoping Statement for this NOS
1.3	their workplace procedures for the: • referral/reporting of problems when working with electric/hybrid vehicles • how to make others aware of the work carried out on electric/hybrid vehicles
1.4	the differences between an electric/hybrid vehicle and non-electric vehicles
1.5	the charging systems associated with electric/hybrid vehicles and how to charge electric/hybrid vehicles safely
1.6	the precautions necessary when using plug-in charging equipment.
1.7	how to carry out a risk assessment on damaged and broken down electric/hybrid vehicles
1.8	how to make electric/hybrid vehicles safe in order to carry out work activities, including isolating high energy electrical systems, where required, within their level of training
1.9	how to safely ensure that high energy electrical system is not live
1.10	how to reduce the risk of hazards when working on and around electric/hybrid vehicles
1.11	the hazards associated with electric/hybrid vehicle batteries when exposed to extreme temperatures, impact and other adverse conditions

1.12 the specific vehicle manufacturer restrictions regarding non-start and recovery, for example jump starting (hybrid only) and towing/lifting
1.13 the implications of electrical conductivity through the human body and the potential medical conditions that can occur regardless of voltage or current type present in an electric/hybrid vehicle
1.14 the disposal of waste materials including recycling obligations, as well as COSHH regulations with regards to hazardous battery chemicals and compounds
1.15 how to reduce the risk of hazards when working on and around electric/hybrid vehicles
1.16 how to work safely avoiding damage to other vehicle systems, components and units and contact with leakage and hazardous substances

2. Use of technical information
2.1 how to find, interpret and use sources of information applicable to component repair and replacement within high energy electrical systems
2.2 the importance of using the correct sources of technical information

3. Electrical/hybrid vehicle component construction
3.1 how **high energy electrical** components function and are constructed, including battery modules, electric motors and associated electrical components

4. Electrical/hybrid vehicle systems and component removal and replacement
4.1 how to identify the components that make up the high energy electrical system
4.2 how to identify the typical location of high energy electrical cabling and associated components including using wiring labelling and colour.
4.3 the different types of energy storage systems and voltages associated with electric/hybrid vehicles.
4.4 the manufacturer's specification for the type and quality of components to be used.
4.5 how to store, dispose of, recycle and return any removed **high energy electrical** components in line with legislation and organisational procedures.

5. Electrical and electronic principles
5.1 vehicle earthing principles and earthing methods as appropriate to electric/hybrid vehicles
5.2 basic electrical and electronic principles, including ohms law, voltage, power, current (ac/dc), resistance, magnetism, electromagnetism and electromagnetic induction
5.3 specific high energy circuit protection
5.4 electrical and electronic principles associated with ancillary systems, including types of sensors and actuators, their application and operation
5.5 the interaction between electrical, electronic and mechanical components within **electric/hybrid vehicle** systems
5.6 how electric vehicle systems interlink and interact, including multiplexing

6. Use of electrical testing equipment and electrical testing techniques
6.1 how to use the electrical testing equipment required
6.2 how to prepare, test and use all the repair and replacement equipment required
6.3 how to conduct tests on non-live high energy electrical systems following electrical safety and workplace procedures

6.4 how to determine the serviceability of a component in a high energy electrical system 6.5 how to interpret the results of their tests and make recommendations based on these results 6.6 the importance of basing their recommendations on test results 6.7 how to perform safety and operational checks on the tools and equipment required to remove and replace electrical components.

7. Vehicle electrical equipment faults and their correction
7.1 how to identify faults and damage in electric/hybrid vehicle high energy electrical systems 7.2 the common underlying causes of faults and damage in high energy electrical components 7.3 how to test and evaluate the performance of replacement components and the reassembled system against operating specifications and legal requirements 7.4 the importance of ensuring electrical components are functioning correctly before release to the customer

Performance objectives

To be competent the learner must:
1. wear suitable personal protective equipment and use appropriate vehicle coverings throughout all work activities 2. ensure the electric/hybrid vehicle is safe to work on 3. support their work activities by reviewing: • vehicle technical data • removal and replacement procedures • legal requirements 4. prepare, test and use all the test and diagnostic equipment required following manufacturers' instructions 5. carry out all removal and replacement activities following: • manufacturers' instructions • recognised researched repair methods • health and safety requirements 6. work in a way which minimises the risk of: • damage to other vehicle systems, components and units • damage to their working environment and injury to themselves and others 7. ensure replaced high energy electrical components meet the manufacturers' recommendations or conform to operating specification 8. record and report any additional faults you notice during the course of their work 9. use suitable testing methods to evaluate the performance of the reassembled high energy electrical system accurately 10. ensure the reassembled system performs to the vehicle operating specification and legal requirements before return to the customer 11. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required

Unit 408 Service and repair non-live electric and hybrid vehicle systems

Supporting information

Scope of this unit

1. **Electric/hybrid vehicle** – any vehicle that is powered wholly or in part by an electrical drive train. This includes electric hybrid plug-in vehicles.
2. **High energy electrical/high voltage** – typical voltages used for a range of Electric and Hybrid Vehicles 100-650V **ECE R100** (relating to vehicle regulations) paragraph 2.14 clearly defines high voltage: “High Voltage" means the classification of an electric component or circuit, if its working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (rms).’
3. Additional equipment includes:
   a. hand tools
   b. code readers
   c. specialist tools, for example manufacturer specific software
   d. safe and appropriate electrical testing equipment
   e. relevant safety equipment
4. Testing methods include:
   a. visual
   b. aural
   c. functional
   d. measurement
5. Components include:
   a. batteries/stack, pod, module
   b. motors
   c. cabling
   d. relays/control units
   e. charger and charging points
   f. isolators
   g. inverters
   h. battery management interface
   i. ignition/key-on control switch
   j. driver display panel
   k. multi-battery server unit
   l. drive trains
   m. power sources
   n. ancillary systems and components
6. Work activities
   a. servicing non-live high energy electrical systems and components
   b. general repair of non-live high energy electrical systems and components

7. Diagnostic testing as defined by:
   a. verifying the fault
   b. collecting further information
   c. evaluating the evidence
   d. carrying out further tests in a logical sequence
   e. rectifying the problem
   f. checking all systems

Evidence Requirements

The learner must:

1. produce evidence to show they meet **all** of the Essential Knowledge and Performance Objectives
2. produce performance evidence resulting from work they have carried out on real vehicles in their normal workplace or as defined within the IMI SVQ Assessment Strategy as managed and organised by an approved centre when naturally occurring performance evidence does not occur at frequent intervals in their normal workplace or when safety is at risk.
3. be observed by an assessor as defined in the IMI SVQ Assessment Strategy.
4. Produce evidence of ensuring that the vehicle has been made safe to work on.
5. the assessor must physically observe them in their normal workplace carrying out a range of servicing and repair activities **on at least 1 occasion**.
   - Cordon off the vehicle
   - Removing the key from the vehicle
   - Charging the vehicle
   - Cleaning the vehicle
   - Demonstrating a vehicle to a customer
   - Preparing to service or repair the vehicle Steering systems
   - Suspension systems
   - Braking systems
6. Provide evidence of removing and replacing high energy units or components including all of **the below:**
   - Batteries/stack, pod, module
   - Motors and/or inverters
7. Be observed by their assessor on a least one occasion removing and replacing components or units from one of the systems.

Evidence from simulated activities is **not** acceptable for this unit.

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:

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- 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.

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www.cityandguilds.com

Useful contacts

UK learners General qualification information	**E: learnersupport@cityandguilds.com**
International learners General qualification information	**E: intcg@cityandguilds.com**
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	**E: centresupport@cityandguilds.com**
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	**E: singlesubjects@cityandguilds.com**
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	**E: intops@cityandguilds.com**
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	**E: walledgarden@cityandguilds.com**
Employer Employer solutions including, Employer Recognition: Endorsement, Accreditation and Quality Mark, Consultancy, Mapping and Specialist Training Delivery	**E: business@cityandguilds.com**

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

Our vision is for a world in which everyone has the skills and opportunities to succeed. We support over 4 million people each year to develop skills that help them into a job, develop on that job and to prepare for their next job. As a charity, we're proud that everything we do is focused on achieving this purpose. Whether that's through delivering work-based learning programmes that build competency, providing flexible pathways that support lifelong employability or through the City & Guilds Foundation funding initiatives that help remove barriers to work and learning.

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