## Qualification at a glance

<table>
<thead>
<tr>
<th>Subject area</th>
<th>Heavy Vehicle Maintenance and Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>City &amp; Guilds number</td>
<td>4310</td>
</tr>
<tr>
<td>Age group approved</td>
<td>16-18, 19+</td>
</tr>
<tr>
<td>Assessment</td>
<td>Portfolio of Evidence and Online Multiple Choice Tests</td>
</tr>
<tr>
<td>Fast track</td>
<td>Not available. Automatic approval applies in some cases.</td>
</tr>
<tr>
<td>Support materials</td>
<td>Centre handbook Exam Success Book</td>
</tr>
<tr>
<td>Registration and Certification</td>
<td>See online catalogue/Walled Garden for last dates</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Title and level</th>
<th>City &amp; Guilds number</th>
<th>Accreditation number</th>
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<tbody>
<tr>
<td>SVQ 2 in Heavy Vehicle Maintenance and Repair at SCQF Level 5</td>
<td>4310-22</td>
<td>GD03 22</td>
</tr>
<tr>
<td>SVQ 3 in Heavy Vehicle Maintenance and Repair at SCQF Level 7</td>
<td>4310-23</td>
<td>GD02 23</td>
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</table>
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<td>Unit 213</td>
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<td>173</td>
</tr>
</tbody>
</table>
## 1 Introduction

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

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who are the qualifications for?</td>
<td>These qualifications in Heavy 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.</td>
</tr>
</tbody>
</table>
| 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? | After taking these qualifications candidates will have a qualification that show employers and customers they have the skills of a competent technician - for example to work on cars, motorcycles, light vans and commercial vehicles and will be able to progress into employment. |
**Structure**

To achieve the **SVQ 2 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. Details can be found in Section 4 of this Handbook and in the assessment requirements section of each individual unit.

<table>
<thead>
<tr>
<th>City &amp; Guilds unit</th>
<th>Unit title</th>
<th>Mandatory/optional for full qualification</th>
<th>SCQF level</th>
<th>SCQF credit value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4310-001</td>
<td>Contribute to housekeeping in motor vehicle environments</td>
<td>Mandatory</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4310-002</td>
<td>Reduce risks to health and safety in the motor vehicle environment</td>
<td>Mandatory</td>
<td>5</td>
<td>5</td>
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<tr>
<td>4310-003</td>
<td>Maintain working relationships in the motor vehicle environment</td>
<td>Mandatory</td>
<td>6</td>
<td>8</td>
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<tr>
<td>4310-004</td>
<td>Use of hand tools and equipment in motor vehicle engineering</td>
<td>Mandatory</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>4310-201</td>
<td>Carry out routine heavy vehicle maintenance</td>
<td>Mandatory</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>4310-202</td>
<td>Remove and replace heavy vehicle engine units and components</td>
<td>Mandatory</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>4310-203</td>
<td>Remove and replace commercial heavy vehicle electrical auxiliary units and components</td>
<td>Mandatory</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>4310-204</td>
<td>Remove and replace commercial heavy vehicle chassis units and components</td>
<td>Mandatory</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>4310-205</td>
<td>Conduct pre and post work heavy vehicle inspections</td>
<td>Optional</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>4310-212</td>
<td>Remove and replace commercial heavy vehicle transmission driveline units and components</td>
<td>Optional</td>
<td>5</td>
<td>16</td>
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</table>
To achieve the **SVQ 3 in Heavy Vehicle Maintenance and Repair at SCQF Level 7**, learners must achieve **7 mandatory units** and a minimum of **1 optional unit**. Some units require learners to successfully complete an online multiple choice test. Details can be found in Section 4 of this Handbook and in the assessment requirements section of each individual unit.

<table>
<thead>
<tr>
<th>City &amp; Guilds unit</th>
<th>Unit title</th>
<th>Mandatory/optional for full qualification</th>
<th>SCQF level</th>
<th>SCQF credit value</th>
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</thead>
<tbody>
<tr>
<td>4310-001</td>
<td>Contribute to housekeeping in motor vehicle environments</td>
<td>Mandatory</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4310-002</td>
<td>Reduce risks to health and safety in the motor vehicle environment</td>
<td>Mandatory</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4310-003</td>
<td>Maintain working relationships in the motor vehicle environment</td>
<td>Mandatory</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>4310-206</td>
<td>Inspect commercial heavy vehicles</td>
<td>Mandatory</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>4310-207</td>
<td>Diagnose and rectify commercial heavy vehicle engine and component faults</td>
<td>Mandatory</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>4310-406</td>
<td>Diagnose and rectify motor vehicle electrical unit and component faults</td>
<td>Mandatory</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>4310-208</td>
<td>Diagnose and rectify commercial heavy vehicle chassis system faults</td>
<td>Mandatory</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>4310-006</td>
<td>Facilitate individuals learning and development</td>
<td>Optional</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>4310-008</td>
<td>Identify and agree the motor vehicle customer needs</td>
<td>Optional</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>4310-011</td>
<td>Allocate and monitor the progress and quality of work in your area of responsibility</td>
<td>Optional</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>4310-211</td>
<td>Overhaul heavy vehicle mechanical units</td>
<td>Optional</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>4310-213</td>
<td>Diagnose and rectify commercial heavy vehicle transmission and driveline system faults</td>
<td>Optional</td>
<td>7</td>
<td>16</td>
</tr>
</tbody>
</table>
2 Centre requirements

Approval
If your Centre is approved to offer qualification Level 2 SVQ in Automotive Maintenance and Repair - Heavy Vehicle (4101-24) you will be granted automatic approval for SVQ 2 in Heavy Vehicle Maintenance and Repair at SCQF Level 5 (4310-22) and will be able to make registrations straight away.

In regards to the level 3, the Level 3 SVQ in Automotive Maintenance and Repair - Heavy Vehicle (4101-29) will provide you with automatic approval for SVQ 3 in Heavy Vehicle Maintenance and Repair at SCQF Level 7 (4310-23).

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 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, e.g. 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 candidate should be made before the start of their programme to identify:
- if the candidate has any specific training needs,
- support and guidance they may need when working towards their qualifications.
- any units they have already completed, or credit they have accumulated which is relevant to the qualifications.
- the appropriate type and level of qualification.

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

Support materials
City & Guilds will provide the following learning and support resources which will be posted on our website.
www.cityandguilds.com/automotive
- Useful material is available on SmartScreen www.smartscreen.co.uk.
- Exam Success book TL024290

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

To support the delivery of vocational qualifications we offer our own ePortfolio, Learning Assistant, an easy to use and secure online tool to support and evidence candidates’ progress towards achieving qualifications. Further details are available at: www.cityandguilds.com/eportfolios.

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. They 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 verifier
• the assessor can assure that the simulation will provide evidence that is valid, reliable and authentic.

Any simulation must be carried out using actual vehicle; 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 verifier 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 verifier.

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 Centre Manual - Supporting Customer Excellence.

Equal opportunities

It is a requirement of centre approval that centres have an equal opportunities policy (see Centre Manual - Supporting Customer Excellence). The regulatory authorities require City & Guilds to monitor centres to ensure that equal opportunity policies are being followed.
The City & Guilds equal opportunities policy is set out on the City & Guilds website, in *Centre Manual - Supporting Customer Excellence*, and is also available from the City & Guilds Customer Relations department.

Access to qualifications is open to all, irrespective of gender, race, creed, age or special needs. The centre co-ordinator should ensure that no candidate is subject to unfair discrimination on any ground in relation to access to assessment and the fairness of the assessment.

**Access to assessment**

City & Guilds’ guidance and regulations on access to assessment are designed to facilitate access to assessments and qualifications for candidates who are eligible for adjustments to assessment arrangements. Access arrangements are designed to allow attainment to be demonstrated. For further information, please see *Access to assessment and qualifications*, available on the City & Guilds website.

**Appeals**

Centres must have their own, auditable, appeals procedure that must be explained to candidates during their induction. Appeals must be fully documented by the quality assurance co-ordinator and made available to the external verifier or City & Guilds.

Further information on appeals is given in *Centre Manual - Supporting Customer Excellence*. There is also information on appeals for centres and learners on the City & Guilds website or available from the Customer Relations department.
4 Assessment

Candidates must complete a portfolio of evidence for each unit (for all competence aspects of the unit).
Where stipulated, particular units require candidates to achieve an online multiple choice test, graded as Pass, Merit, Distinction. 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 verifier 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.

SVQ 2 in Heavy Vehicle Maintenance and Repair at SCQF Level 5

<table>
<thead>
<tr>
<th>Unit title</th>
<th>Assessment method</th>
<th>Unit number</th>
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</thead>
<tbody>
<tr>
<td>Contribute to housekeeping in motor vehicle environments</td>
<td>Portfolio</td>
<td>4310-001</td>
</tr>
<tr>
<td>Reduce risks to health and safety in the motor vehicle environment</td>
<td>Portfolio</td>
<td>4310-002</td>
</tr>
<tr>
<td>Maintain working relationships in the motor vehicle environment</td>
<td>Portfolio</td>
<td>4310-003</td>
</tr>
<tr>
<td>Use of hand tools and equipment in motor vehicle engineering</td>
<td>Portfolio</td>
<td>4310-004</td>
</tr>
<tr>
<td>Carry out routine heavy vehicle maintenance</td>
<td>Portfolio</td>
<td>4310-201</td>
</tr>
<tr>
<td>Multipurpose online test</td>
<td></td>
<td>4310-251</td>
</tr>
<tr>
<td>Remove and replace heavy vehicle engine units and components</td>
<td>Portfolio</td>
<td>4310-202</td>
</tr>
<tr>
<td>Multipurpose online test</td>
<td></td>
<td>4310-252</td>
</tr>
<tr>
<td>Remove and replace commercial heavy vehicle electrical auxiliary units and components</td>
<td>Portfolio</td>
<td>4310-203</td>
</tr>
<tr>
<td>Multipurpose online test</td>
<td></td>
<td>4310-253</td>
</tr>
<tr>
<td>Remove and replace commercial heavy</td>
<td>Portfolio</td>
<td>4310-204</td>
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</table>
### City & Guilds SVQ 2/3 in Heavy Vehicle Maintenance and Repair at SCQF Level 5/7

<table>
<thead>
<tr>
<th>Unit title</th>
<th>Assessment method</th>
<th>Unit number</th>
</tr>
</thead>
<tbody>
<tr>
<td>vehicle chassis units and components</td>
<td>Multiple choice online test</td>
<td>4310-254</td>
</tr>
<tr>
<td>Conduct pre and post work heavy vehicle inspections</td>
<td>Portfolio</td>
<td>4310-205</td>
</tr>
<tr>
<td></td>
<td>Multiple choice online test</td>
<td>4310-255</td>
</tr>
<tr>
<td>Remove and replace commercial heavy vehicle transmission driveline units</td>
<td>Portfolio</td>
<td>4310-212</td>
</tr>
<tr>
<td>and components</td>
<td>Multiple choice online test</td>
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</table>

### SVQ 3 in Heavy Vehicle Maintenance and Repair at SCQF Level 7

<table>
<thead>
<tr>
<th>Unit title</th>
<th>Assessment method</th>
<th>Unit number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribute to housekeeping in motor vehicle environments</td>
<td>Portfolio</td>
<td>4310-001</td>
</tr>
<tr>
<td>Reduce risks to health and safety in the motor vehicle environment</td>
<td>Portfolio</td>
<td>4310-002</td>
</tr>
<tr>
<td>Maintain working relationships in the motor vehicle environment</td>
<td>Portfolio</td>
<td>4310-003</td>
</tr>
<tr>
<td>Facilitate individuals learning and development</td>
<td>Portfolio</td>
<td>4310-006</td>
</tr>
<tr>
<td>Identify and agree the motor vehicle customer needs</td>
<td>Portfolio</td>
<td>4310-008</td>
</tr>
<tr>
<td>Allocate and monitor the progress and quality of work in your area of responsibility</td>
<td>Portfolio</td>
<td>4310-011</td>
</tr>
<tr>
<td>Inspect commercial heavy vehicles</td>
<td>Portfolio</td>
<td>4310-206</td>
</tr>
<tr>
<td></td>
<td>Multiple choice online test</td>
<td>4310-255</td>
</tr>
<tr>
<td>Diagnose and rectify commercial heavy vehicle engine and component faults</td>
<td>Portfolio</td>
<td>4310-207</td>
</tr>
<tr>
<td></td>
<td>Multiple choice online test</td>
<td>4310-257</td>
</tr>
<tr>
<td>Diagnose and rectify commercial heavy vehicle chassis system faults</td>
<td>Portfolio</td>
<td>4310-208</td>
</tr>
<tr>
<td></td>
<td>Multiple choice online test</td>
<td>4310-258</td>
</tr>
<tr>
<td>Overhaul heavy vehicle mechanical units</td>
<td>Portfolio</td>
<td>4310-211</td>
</tr>
<tr>
<td></td>
<td>Multiple choice online test</td>
<td>4310-261</td>
</tr>
<tr>
<td>Diagnose and rectify commercial heavy vehicle transmission and driveline system faults</td>
<td>Portfolio</td>
<td>4310-213</td>
</tr>
<tr>
<td></td>
<td>Multiple choice online test</td>
<td>4310-263</td>
</tr>
<tr>
<td>Diagnose and rectify motor vehicle electrical unit and component faults</td>
<td>Portfolio</td>
<td>4310-406</td>
</tr>
<tr>
<td></td>
<td>Multiple choice online test</td>
<td>4310-456</td>
</tr>
</tbody>
</table>
5 Units

Structure 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

<table>
<thead>
<tr>
<th>Level:</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit value:</td>
<td>5</td>
</tr>
<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>This unit is about the routine maintenance of the workplace, carrying out basic, non-specialist checks of work tools and equipment, cleaning the work area and using resources economically.</td>
</tr>
</tbody>
</table>

**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 hand tools, equipment and their work area
   1.2 workplace policies and schedules for **housekeeping activities** and **equipment maintenance**
   1.3 the manufacturer’s requirements for the cleaning and general, non-specialist maintenance of the tools and 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 used for basic hand tool maintenance activities
   2.2 how to store hand tools safely and accessibly
   2.3 how to report faulty or damaged **work tools and equipment**
   2.4 how to work safely when cleaning and maintaining **work tools and equipment**.
3. General work area housekeeping

3.1 how to select and use cleaning equipment
3.2 how to use resources economically
3.3 how to use work area cleaning materials and agents
3.4 how to clean and maintain the work tools and equipment and work areas for which they are responsible
3.5 how to dispose of unused cleaning agents, materials and debris
3.6 the properties and hazards associated with the use of cleaning agents and materials
3.7 the importance of wearing personal protective equipment
3.8 the importance of using resources economically and for their intended purpose only.

Performance objectives

To be competent the learner must:

1. wear 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 economically and for their intended purpose only, following manufacturers' instructions and workplace procedures
4. follow workplace policies, schedules and manufacturers’ instructions when cleaning and maintaining hand tools and equipment
5. clean the work area(s), for which they are responsible, at the specified time and frequency
6. carry out housekeeping activities safely and in a way which minimises inconvenience to customers and staff
7. follow the manufacturer’s instructions when using cleaning and sanitising agents
8. ensure their housekeeping activities keep their work area clean and free from debris and waste materials
9. ensure their equipment maintenance activities keep their work tools and equipment fit for purpose
10. dispose of used cleaning agents, materials and debris to comply with legal and workplace requirements
11. store their work tools and equipment in a safe manner which permits ease of access and identification for use
12. report any faulty or damaged tools and equipment to the relevant person(s) clearly and promptly
13. 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:
1  Equipment maintenance covers:
   a  routine checks on work tools and equipment
   b  cleaning work tools and equipment
   c  replacing minor parts
   d  visual inspection of electrical equipment.

2  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.

3  Work tools and equipment are:
   a  hand
   b  electrical
   c  mechanical
   d  pneumatic
   e  hydraulic.

Unit range

Economic use of Resources
a.  Consumable materials eg 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. Power Presses Regulations 1992
c. Pressure Systems and Transportable Gas Containers Regulations 1989
d. Electricity at Work Regulations 1989
e. Noise at Work Regulations 1989
g. Health and Safety (Display Screen Equipment) Regulations 1992
h. Abrasive Wheel Regulations
i. Safe Working Loads
j. Working at Height Regulations.

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 eg electrical safety check log.

Legislation relevant to Health and Safety
a. HASAWA
b. COSHH
c. EPA
e. PPE 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
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 eg 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 of 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:
   vi. foam
   vii. dry powder
   viii. CO2
   ix. water
   x. fire blanket.

Action to be taken in the event of a fire to include:
a. 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 personal, customers, contractors etc entering your 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 your 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 polices 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 002  Reduce risks 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 do not create any health and safety risks
- the learner does not ignore significant risks in your workplace, and
- the learner takes sensible action to put things right, including reporting situations which pose a danger to people in the workplace, and seeking advice from others.

This unit does not require the learner to undertake a full risk assessment. It is about having an appreciation of significant risks in the workplace and knowing how to identify them and deal with them. When the learner has completed this unit, they will have proved they can:
- identify hazards and evaluate risks in their workplace
- reduce the risks to health and safety in their workplace.

Essential knowledge
The learner will need to understand:

<table>
<thead>
<tr>
<th>1.</th>
<th>Health and safety legislation and workplace policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>their legal duties for health and safety in the workplace as required by the Health and Safety at Work Act 1974, and any other policies or procedures that govern their working practices</td>
</tr>
<tr>
<td>1.2</td>
<td>their duties for health and safety as defined by any specific legislation covering their job role</td>
</tr>
<tr>
<td>1.3</td>
<td>agreed workplace policies relating to controlling risks to health and safety</td>
</tr>
<tr>
<td>1.4</td>
<td>responsibilities for health and safety in their job description</td>
</tr>
<tr>
<td>1.5</td>
<td>the responsible persons to whom they report health and safety matters.</td>
</tr>
</tbody>
</table>
2. Risks to health and safety

2.1 what hazards may exist in their workplace (e.g., slips, trips, and falls)
2.2 health and safety risks 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 risks
2.5 the importance of dealing with or promptly reporting risks
2.6 the requirements and guidance on the precautions
2.7 the specific workplace policies covering their job role
2.8 suppliers’ and manufacturers’ instructions for the safe use of equipment, materials, and products
2.9 safe working practices for their own job role
2.10 the importance of personal presentation in maintaining health and safety in the workplace
2.11 the importance of personal conduct in maintaining the health and safety of themselves and others
2.12 the importance of personal protective equipment, when and where it should be used and the importance of maintaining it correctly
2.13 their scope and responsibility for rectifying risks
2.14 workplace procedures for handling risks which they are unable to deal with.

Performance objectives

To be competent, the learner must:

1. carry out their working practices in accordance with legal requirements
2. identify the correct personal and vehicle protective equipment required to correctly carry out their workplace practices
3. carry out their workplace practices using the correct personal protective equipment
4. follow the most recent workplace policies for their job role
5. rectify health and safety risks that are within their capability and scope of their job responsibilities
6. pass on any suggestions for reducing risks to health and safety within their job role to the responsible persons
7. ensure their personal conduct in the workplace does not endanger the health and safety of themselves or other persons
8. follow the workplace policies and suppliers’ or manufacturers’ instructions for the safe use of equipment, materials, and products
9. report any differences between workplace policies and suppliers’ or manufacturers’ instructions as appropriate
10. ensure their personal presentation at work:
    - ensures the health and safety of themselves and others
    - meets any legal duties
    - is in accordance with workplace policies.
Unit 002  Reduce risks to health and safety in the motor vehicle environment

Supporting information

Scope of this unit:
1  Risks resulting from:
   a  the use and maintenance of machinery and equipment
   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.

2  Workplace policies cover:
   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.

Unit range
Economic use of Resources
a.  Consumable materials eg 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. Power Presses Regulations 1992
c. Pressure Systems and Transportable Gas Containers Regulations 1989
d. Electricity at Work Regulations 1989
e. Noise at Work Regulations 1989
g. Health and Safety (Display Screen Equipment) Regulations 1992
h. Abrasive Wheel Regulations
i. Safe Working Loads
j. Working at Height Regulations.

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 eg electrical safety check log.

Legislation relevant to Health and Safety
a. HASAWA
b. COSHH
c. EPA
e. PPE Regulations 1992

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c. Health and Safety (Safety Signs and Signals) Regulations 1996
d. Health and Safety (Consultation with Employees) Regulations 1996
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 eg 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 of 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:
   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 personal, customers, contractors etc entering
           your 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 your 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 003  Maintain working relationships in the motor vehicle environment

Level: 6
Credit value: 8
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 spoken communication skills when responding to and interacting with others
   2.2 how to adapt written and spoken communication methods to satisfy the needs of colleagues
   2.3 how to report problems using written and spoken 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 accepting other peoples’ views and opinions
   2.6 the importance of making and honouring realistic commitments to colleagues.

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 003  Maintain working relationships in the motor vehicle environment

Supporting information

Scope of this unit:
1. Colleagues are:
   a. immediate work colleagues
   b. supervisors and managers.

2. Requests for assistance covering:
   a. technical assistance
   b. personal assistance.

Unit range
Sections within a typical vehicle repair business
a. Reception.
b. Body shop.
c. Service repair workshop.
d. Valeting.
e. Parts.
f. Sales.
g. Administration.

Different sources of information in an automotive work environment
a. Other staff.
b. Manuals.
c. Parts lists.
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.
b. Customer expectation.

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 004  Use of hand 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:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>the organisational procedures developed to report and rectify inappropriate information and unsuitable resources, and how they are implemented</td>
</tr>
<tr>
<td>2.</td>
<td>the types of information, their source and how they are interpreted</td>
</tr>
<tr>
<td>3.</td>
<td>the organisational procedures to solve problems with the information and why it is important they are followed</td>
</tr>
<tr>
<td>4.</td>
<td>the level of understanding operatives must have of information for relevant, current legislation and official guidance and how it is applied</td>
</tr>
<tr>
<td>5.</td>
<td>what the accident reporting procedures are and who is responsible for making the reports</td>
</tr>
<tr>
<td>6.</td>
<td>why and when personal protective equipment (PPE) should be used</td>
</tr>
<tr>
<td>7.</td>
<td>why disposal of waste should be carried out safely and how it is achieved</td>
</tr>
<tr>
<td>8.</td>
<td>demonstrate an understanding of material properties</td>
</tr>
<tr>
<td>9.</td>
<td>investigate the use of materials and fabrication</td>
</tr>
<tr>
<td>10.</td>
<td>how to file, fit, tap, thread, cut and drill plastics and metals</td>
</tr>
<tr>
<td>11.</td>
<td>how to select and use gaskets, sealants, seals, fittings and fasteners.</td>
</tr>
</tbody>
</table>
### Performance objectives

The learner must be able to:

1. interpret the given information relating to the work and resources to confirm its relevance
2. carry out pre-start preparation inspections on power tools and equipment in accordance with approved procedures
3. carry out operations using power tools and equipment in accordance with safe working practices to achieve the work outcome
4. identify problems associated with power tools and equipment which need to be referred to authorised personnel
5. demonstrate work skills to:
   - measure, mark out, file, fit, tap, thread, cut, drill, finish, position and secure
6. use and maintain:
   - hand tools
   - ancillary equipment
   - safety aids
7. dispose of waste in accordance with legislation to maintain a clean work space
8. checks carried out in accordance with manufacturer's/operator's guidance, legislation and official guidance and organisational requirements
9. demonstrate work skills to select correct materials and fabrication for project.
Unit 004  Use of hand tools and equipment in motor vehicle engineering

Supporting information

Unit range

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 environment. 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.

**The properties, application and limitations to include safe use of ferrous and non-ferrous metals**

Materials to include:  
 a. carbon steels  
 b. alloy steels  
 c. cast iron  
 d. aluminium alloys  
 e. brass  
 f. copper  
 g. lead.

**The properties, application and limitations to include safe use of non-metallic materials**

Materials to include:  
 a. glass  
 b. plastics  
 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: 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:

<table>
<thead>
<tr>
<th>4. Demonstrate skills and methods to learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 base the demonstration on an analysis of the skills needed and the order they must be learned in</td>
</tr>
<tr>
<td>4.2 ensure that the demonstration is accurate and realistic</td>
</tr>
<tr>
<td>4.3 structure the demonstration so the learner can get the most out of it</td>
</tr>
<tr>
<td>4.4 encourage learners to ask questions and get explanation at appropriate stages in the demonstration</td>
</tr>
<tr>
<td>4.5 give learners the opportunities to practise the skill being demonstrated and give them positive feedback</td>
</tr>
<tr>
<td>4.6 give extra demonstrations of the skills being taught to reinforce learning</td>
</tr>
<tr>
<td>4.7 ensure that demonstrations take place in a safe environment and allow learners to see the demonstration clearly</td>
</tr>
<tr>
<td>4.8 respond to the needs of learners during the demonstration</td>
</tr>
<tr>
<td>4.9 reduce distractions and disruptions as much as possible.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Instruct learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 match instruction to the needs of the learners</td>
</tr>
<tr>
<td>5.2 identify which learning outcomes will be achieved through instruction</td>
</tr>
<tr>
<td>5.3 ensure that the manner, level and speed of the instruction encourages learners to take part</td>
</tr>
<tr>
<td>5.4 regularly check that learners understand and adapt instruction as appropriate</td>
</tr>
<tr>
<td>5.5 give learners positive feedback on the learning experience and the outcomes achieved</td>
</tr>
<tr>
<td>5.6 identify anything that prevents learning and review this with the learners.</td>
</tr>
</tbody>
</table>
Unit 006 Facilitate individuals learning and development

Supporting information

Unit Range

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 is required to body movements 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.** Diagnose the learning needs of their audience to include:

a. what competencies they already have
b. what experience they have of the subject area
c. what competencies they need to achieve
d. what demonstration techniques are best suited to their needs
e. how they will 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 to include:

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 effect learning. Environmental factors that should be considered before demonstration/instruction to include:

a. loud noises
b. bright colours
c. bright lights
d. strong smells
e. atmosphere
f. temperature
g. classroom seating
h. classroom layout
i. bright lights.

Health and safety factors that affect learning. Health and safety factors that should be considered before demonstration/instruction to include:

a. assessment of risk and hazards
b. condition of electrical/electronic equipment
c. position of cables and wires
d. safety of equipment used in demonstration/instruction
e. condition of classroom equipment/furniture/structure
f. 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

a. Putting information in order.
b. Deciding whether the language used is appropriate.
c. Type of material, ie 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

<table>
<thead>
<tr>
<th>Level:</th>
<th>6</th>
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</thead>
<tbody>
<tr>
<td>Credit value:</td>
<td>10</td>
</tr>
<tr>
<td><strong>Endorsement by a regulatory body:</strong></td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td><strong>Aim:</strong></td>
<td>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.</td>
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</tbody>
</table>

## Essential knowledge

The learner will need to understand:

1. **Legislative and organisational requirements and procedures**
   - **1.1** the fundamental legal requirements of current consumer legislation and the consequences of their own actions in respect of this legislation
   - **1.2** the content and limitations of company and product warranties for the vehicles dealt with by their company
   - **1.3** the limits of their own authority for accepting vehicles
   - **1.4** the importance of keeping customers informed of progress
   - **1.5** their workplace requirements for the completion of records
   - **1.6** how to complete and process all the necessary 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 use effective questioning techniques
   - **2.4** how to care for customers and achieve customer satisfaction.

3. **Company products and services**
   - **3.1** the range of options available to resolve vehicle problems
   - **3.2** the range and type of services offered by their company
   - **3.3** the effect of resource availability upon the receipt of customer vehicles and the completion work
   - **3.4** 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

Unit range
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 their 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.

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.

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 training workshop as managed and organised by an approved centre.
3. be observed by an assessor as defined by the IMI Assessment Strategy.
4. produce evidence, including records, to show that they have dealt with 3 different customers.
5. be observed by their assessor on at least 1 occasion

Evidence from real activity or role-play is acceptable for this unit.
Unit 011  Allocate and monitor the progress and quality of work in your area of responsibility

Level: 8  
Credit value: 14  
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 ensuring that the work required in your area of responsibility is effectively planned and fairly allocated to individuals and/or teams. It also involves monitoring the progress and quality of the work of individuals and/or teams to ensure that the required level or standard of performance is being met and reviewing and updating plans of work in the light of developments. The ‘area of responsibility’ may be, for example, a branch or department or functional area or an operating site within an organisation. The unit is recommended for first line managers and middle managers.

Essential knowledge
The learner will need to know and understand:

1. how to select and successfully apply different methods for communicating with people across an area of responsibility
2. the importance of confirming/clarifying the work required in their area of responsibility with their manager and how to do this effectively
3. how to identify and take due account of health and safety issues in the planning, allocation and monitoring of work
4. how to produce a plan of work for their area of responsibility, including how to identify any priorities or critical activities and the available resources
5. how to identify sustainable resources and ensure their effective use when planning the work for their area of responsibility
6. the importance of seeking views from people working in their area and how to take account of their views in producing the plan of work
7. the values, ethics, beliefs, faith, cultural conventions, perceptions and expectations of any team members from a different country or culture and how their own values, ethics, beliefs, faith, cultural conventions, perceptions, expectations, use of language, tone of voice and body language may appear to them
8. why it is important to allocate work to individuals and/or teams on a fair basis and how to do so effectively
9. why it is important that individuals and/or teams are briefed on allocated work and the standard or level of expected performance and how to do so effectively
10. the importance of showing individuals and/or teams how their work fits with the vision and objectives of the area and those of the organisation
11. ways of encouraging individuals and/or teams to ask questions and/or seek clarification in relation to the work which they have been allocated
12. effective ways of regularly and fairly monitoring the progress and quality of work of individuals and/or teams against the standards or level of expected performance
13. how to provide prompt and constructive feedback to individuals and/or teams
14. why it is important to monitor their area for conflict and how to identify the cause(s) of conflict when it occurs and deal with it promptly and effectively
15. how to take account of diversity and inclusion issues when supporting and encouraging individuals and/or teams to complete the work they have been allocated
16. why it is important to identify unacceptable or poor performance by individuals and/or teams and how to discuss the cause(s) and agree ways of improving performance with them
17. the type of problems and unforeseen events that may occur and how to support individuals and/or teams in dealing with them
18. the additional support and/or resources which individuals and/or teams might require to help them complete their work and how to assist in providing this
19. how to select and successfully apply different methods for encouraging, motivating and supporting individuals and/or teams to complete the work they have been allocated, improve their performance and for recognising their achievements
20. how to log information on the ongoing performance of individuals and/or teams and use this information for formal performance appraisal purposes.

1. Industry/sector specific knowledge and understanding

1.1 industry/sector requirements for the development or maintenance of knowledge, understanding and skills
1.2 industry/sector specific legislation, regulations, guidelines, codes of practice relating to carrying out work.
Performance objectives

To be competent the learner must be able to:

1. confirm the work required in their area of responsibility with their manager and seek clarification, where necessary, on any outstanding points and issues
2. plan how the work will be undertaken, seeking views from people in their area of responsibility, identifying any priorities or critical activities and making best use of the available resources
3. ensure that work is allocated to individuals and/or teams on a fair basis taking account of skills, knowledge and understanding, experience and workloads and the opportunities for development
4. ensure that individuals and/or teams are briefed on allocated work, showing how it fits with the vision and objectives for the area and the overall organisation, and the standard or level of expected performance
5. recognise and seek to find out about differences in expectations and working methods of any team members from a different country or culture and promote ways of working that take account of their expectations and maximise productivity
6. encourage individuals and/or team members to ask questions, make suggestions and seek clarification in relation to allocated work
7. monitor the progress and quality of the work of individuals and/or teams on a regular and fair basis against the standard or level of expected performance and provide prompt and constructive feedback
8. support individuals and/or teams in identifying and dealing with problems and unforeseen events
9. motivate individual and/or teams to complete the work they have been allocated and provide, where requested and where possible, any additional support and/or resources to help completion
10. monitor their area for conflict, identifying the cause(s) when it occurs and dealing with it promptly and effectively
11. identify unacceptable or poor performance, discuss the cause(s) and agree ways of improving performance with individuals and/or teams
12. recognise successful completion of significant pieces of work or work activities by individuals and/or teams
13. use information collected on the performance of individuals and/or teams in any formal appraisals of performance
14. review and update plans of work for their area, clearly communicating any changes to those affected.
Unit 011  Allocate and monitor the progress and quality of work in your area of responsibility

Supporting information

Skills
Listed below are the main generic ‘skills’ which need to be applied in allocating and monitoring the progress and quality of work in the learner's area of responsibility. These skills are explicit/implicit in the detailed content of the unit and are listed here as additional information:

- communicating
- consulting
- decision making
- delegating
- information management
- leadership
- managing conflict
- monitoring
- motivating
- planning
- problem solving
- providing feedback
- prioritising
- reviewing
- setting objectives
- stress management
- valuing and supporting others.

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 assessed by an assessor as defined by the IMI Assessment Strategy on communication techniques to include body language, tone of voice and words used in the following situations:
   i. the extent and nature of the work to be undertaken
   ii. the terms and conditions of acceptance
   iii. the cost
   iv. the timescale.

4. produce evidence on at least 2 occasions where prompt and accurate feedback has been given to a team or individual.

5. produce evidence of planning work on at least 3 occasions to be undertaken to include:
   i. fair allocation of work to complement an individual's skill set
   ii. allocation of work to provide an individual with experience
   iii. allowing for health and safety issues

6. produce evidence of regularly monitoring progress and quality of work. Evidence may be obtained from:
   i. customer feedback
   ii. time taken to complete the work
   iii. quality inspection on completion of work

7. be assessed an assessor as defined by the IMI Assessment Strategy dealing with at least 2 of the following situations:
   i. customer complaint
   ii. unacceptable or poor performance of a team or individual
   iii. conflict.
### Unit 201  Carry out routine heavy vehicle maintenance

<table>
<thead>
<tr>
<th>Level:</th>
<th>5</th>
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<tbody>
<tr>
<td>Credit value:</td>
<td>10</td>
</tr>
<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>This unit is about conducting routine examination, adjustment and replacement activities as part of the periodic servicing of vehicles.</td>
</tr>
<tr>
<td>Assessment requirements:</td>
<td><strong>Performance objectives must</strong> be assessed via a portfolio of evidence, gathered through observing the candidate at work. See the <strong>Evidence Requirements</strong> at the end of this unit for further details. Candidates <strong>must</strong> take the City &amp; Guilds 4310-251 online multiple choice test, which partly covers the <strong>essential knowledge</strong> within this unit. The essential knowledge statements, which are <strong>not</strong> covered by the test, are:</td>
</tr>
<tr>
<td></td>
<td>3.1</td>
</tr>
<tr>
<td>This criteria <strong>must</strong> be assessed in one of the following ways:</td>
<td></td>
</tr>
<tr>
<td>• oral or written questioning</td>
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</tr>
<tr>
<td>• professional discussion.</td>
<td></td>
</tr>
<tr>
<td>Centres must keep an audit trail to show that candidates have covered all of the essential knowledge.</td>
<td></td>
</tr>
</tbody>
</table>
## Essential knowledge

The learner will need to understand:

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

<table>
<thead>
<tr>
<th>2. Use of technical information</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 how to find, interpret and use sources of technical information for scheduled maintenance activities, including on-board diagnostic displays</td>
</tr>
<tr>
<td>2.2 the importance of using the correct sources of technical information</td>
</tr>
<tr>
<td>2.3 the purpose of and how to use identification codes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Vehicle system operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
</tr>
<tr>
<td>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</td>
</tr>
<tr>
<td>3.3 how suspension systems, steering systems, braking systems, non-electrical body systems, wheels and tyres operate for the type of vehicle on which they are working</td>
</tr>
<tr>
<td>3.4 how batteries, starting systems, charging systems, lighting systems and ancillary equipment operate for the type of vehicle on which they are working</td>
</tr>
<tr>
<td>3.5 the operating specifications and tolerances for the type(s) of vehicles on which they are working.</td>
</tr>
</tbody>
</table>
4. Routine maintenance requirements

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 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 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. use the correct specifications and tolerances for the vehicle when making **assessments** of system and component performance

4. 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

5. examine the vehicle’s systems and components following:
   - the manufacturer’s approved **examination methods**
   - their workplace procedures
   - health and safety requirements

6. ensure their **examination methods** identify accurately any vehicle system and component problems falling outside the servicing schedule specified

7. 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

8. 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

9. work in a way which minimises the risk of damage to the vehicle and its systems

10. use suitable testing methods to evaluate the performance of all replaced and adjusted components and systems accurately, prior to
11. report any problems or issues relating to the vehicle's condition or conformity to the relevant person(s) promptly
12. ensure their maintenance records are accurate, complete and passed to the relevant person(s) promptly in the format required
13. complete all vehicle maintenance activities within the agreed timescale
14. report any anticipated delays in completion to the relevant persons(s) promptly.
Unit 201 Carry out routine heavy 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 worked 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).

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
   v. interior floor protection
   vi. 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 based on routine checks and inspections **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**.
Unit 202
Remove and replace heavy vehicle engine units and components

<table>
<thead>
<tr>
<th>Level:</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit value:</td>
<td>16</td>
</tr>
<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>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.</td>
</tr>
</tbody>
</table>
| 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 4310-252 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 | 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:

<table>
<thead>
<tr>
<th></th>
<th>Legislative and organisational requirements and procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>the legal requirements (eg European Emission Standards) relating to the vehicle (including road safety requirements)</td>
</tr>
<tr>
<td>1.2</td>
<td>the health and safety legislation and workplace procedures relevant to vehicle maintenance activities and personal and vehicle protection</td>
</tr>
<tr>
<td>1.3</td>
<td>their workplace procedures for:</td>
</tr>
<tr>
<td></td>
<td>• recording removal and replacement information</td>
</tr>
<tr>
<td></td>
<td>• the referral of problems</td>
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<tr>
<td></td>
<td>• reporting delays to the completion of work</td>
</tr>
<tr>
<td>1.4</td>
<td>the importance of documenting removal and replacement information</td>
</tr>
<tr>
<td>1.5</td>
<td>the importance of working to agreed timescales and keeping others informed of progress</td>
</tr>
<tr>
<td>1.6</td>
<td>the relationship between time and costs</td>
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<tr>
<td>1.7</td>
<td>the importance of reporting anticipated delays to the relevant person(s) promptly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Use of technical information</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>how to find, interpret and use sources of information applicable to unit and component removal and replacement within engine systems</td>
</tr>
<tr>
<td>2.2</td>
<td>the importance of using the correct sources of technical information</td>
</tr>
<tr>
<td>2.3</td>
<td>the purpose of and how to use identification codes.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Engine system operation and construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>how engine systems and their related units and components are constructed, dismantled and reassembled for the classification of vehicle worked upon</td>
</tr>
<tr>
<td>4.2</td>
<td>how engine systems and their related units and components operate for the classification of vehicle worked upon.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>how to prepare, test and use all the removal and replacement equipment required.</td>
</tr>
</tbody>
</table>
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 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. carry out all removal and replacement activities following:
   • manufacturers’ instructions
   • their workplace procedures
   • health and safety requirements
5. 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.
6. ensure replaced engine units and components conform to the vehicle operating specification and any legal requirements
7. record and report any additional faults they notice during the course of their work promptly
8. use suitable testing methods to evaluate the performance of the reassembled system accurately
9. ensure the reassembled engine system performs to the vehicle operating specification and meets any legal requirements prior to return to the customer
10. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
11. complete all removal and replacement activities within the agreed timescale
12. report any expected delays in completion to the relevant person(s) promptly.
Unit 202  Remove and replace heavy 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  Equipment 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
   iii. erratic running
   iv. low power
   v. exhaust emissions
   vi. abnormal exhaust smoke
   vii. unable to start
   viii. exhaust gas leaks to cooling system
   ix. 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 important 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 at least 1 unit or component from at least 4 of the 5* systems listed below. The evidence must come from work in their normal workplace, not including standard external filters
   • 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.
Unit 203

Remove and replace commercial heavy vehicle electrical auxiliary units and components

Level: 5
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 removing and replacing commercial vehicle units and components previously identified as faulty, damaged, deteriorated or, where the customer has requested, replacements.
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 4310-253 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:

- 2.2
- 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:

<table>
<thead>
<tr>
<th>1. Legislative and organisational requirements and procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 the legal requirements relating to the vehicle (including road safety and refrigerant handling requirements)</td>
</tr>
<tr>
<td>1.2 the health and safety legislation and workplace procedures relevant to vehicle maintenance activities and personal and vehicle protection</td>
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<tr>
<td>1.3 their workplace procedures for:</td>
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<td>• recording removal and replacement information</td>
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<th>2. Use of technical information</th>
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<tbody>
<tr>
<td>2.1 how to find, interpret and use sources of information applicable to <strong>electrical unit and component</strong> removal and replacement</td>
</tr>
<tr>
<td>2.2 the importance of using the correct sources of technical information</td>
</tr>
<tr>
<td>2.3 the purpose of and how to use identification codes.</td>
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</table>

<table>
<thead>
<tr>
<th>3. Electrical auxiliary system operation and construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 how <strong>electrical auxiliary units and components</strong> are constructed, removed and replaced for the classification of vehicle worked upon</td>
</tr>
<tr>
<td>3.2 how electrical <strong>auxiliary units and components</strong> operate for the classification of vehicle worked upon.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>4. Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 how to prepare, test and use all the removal and replacement <strong>equipment</strong> required.</td>
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<table>
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<tr>
<th>5. Electrical and electronic principles</th>
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<tbody>
<tr>
<td>5.1 vehicle earthing principles and earthing methods</td>
</tr>
<tr>
<td>5.2 electrical and electronic principles associated with electrical auxiliary systems, including types of sensors and actuators, their application and operation</td>
</tr>
<tr>
<td>5.3 types of circuit protection and why these are necessary</td>
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<td>5.4 electrical safety procedures</td>
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<tr>
<td>5.5 how lighting, warning, charging and starter circuits work</td>
</tr>
<tr>
<td>5.6 electric symbols, units and terms</td>
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<tr>
<td>5.7 electrical/electronic control system principles.</td>
</tr>
</tbody>
</table>
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 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. carry out all removal and replacement activities following;
   - manufacturers’ instructions
   - workplace procedures
   - health and safety requirements
5. 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
6. ensure replaced **electrical auxiliary units and components** conform to the vehicle operating specification and any legal requirements
7. record and report any additional faults they notice during the course of their work promptly
8. use suitable **testing methods** to evaluate the performance of the reassembled system accurately
9. ensure the reassembled system performs to the vehicle operating specification and meets any legal requirements prior to return to the customer
10. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
11. complete all removal and replacement activities within the agreed timescale
12. report any expected delays in completion to the relevant person(s) promptly.
Unit 203 Remove and replace commercial heavy 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 Equipment 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

Electrical and electronic principles

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.

c. The direction of current flow and electron flow.

d. 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).

e. Earth and insulated return systems.

f. Cable sizes and colour codes.

g. Different types of connectors, terminals and circuit protection devices.

h. Common electrical and electronic symbols.

i. The meaning of:
   i. short circuit
   ii. open circuit
   iii. bad earth
   iv. high resistance
   v. electrical capacity.

j. The principles of vehicle electronic systems and component.

k. Interpret vehicle wiring diagrams to include:
   i. vehicle lighting
   ii. auxiliary circuits
   iii. indicators
   iv. starting and charging systems.

l. 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.
**m.** 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.

**n.** 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.

**o.** 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
   vii. high resistance
   viii. volt drop
   ix. current consumption
   x. output patterns (oscilloscope).

**p.** 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:

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 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.
5. 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
6. 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 204  Remove and replace commercial heavy vehicle chassis units and components

<table>
<thead>
<tr>
<th>Level:</th>
<th>5</th>
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<tbody>
<tr>
<td>Credit value:</td>
<td>16</td>
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<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>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.</td>
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</table>

**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 4310-254 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:

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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:

<table>
<thead>
<tr>
<th>1. Legislative and organisational requirements and procedures</th>
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<tbody>
<tr>
<td>1.1 the legal requirements relating to the vehicle (including road safety requirements)</td>
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<tr>
<td>1.2 the health and safety legislation and workplace procedures relevant to vehicle maintenance activities and personal and vehicle protection</td>
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<tr>
<td>1.3 their workplace procedures for:</td>
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<tr>
<td>- recording removal and replacement information</td>
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<td>- the referral of problems</td>
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<td>- reporting delays to the completion of work</td>
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<tr>
<td>1.4 the importance of documenting removal and replacement information</td>
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<td>1.5 the importance of working to agreed timescales and keeping others informed of progress</td>
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<tr>
<td>1.6 the relationship between time and costs</td>
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<td>1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.</td>
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<tr>
<th>2. Use of technical information</th>
</tr>
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<tbody>
<tr>
<td>2.1 how to find, interpret and use sources of information applicable to <strong>unit and component</strong> removal and replacement within <strong>chassis systems</strong></td>
</tr>
<tr>
<td>2.2 the importance of using the correct sources of technical information</td>
</tr>
<tr>
<td>2.3 the purpose of and how to use identification codes.</td>
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<tr>
<th>3. Electrical and electronic principles</th>
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<tr>
<th>4. Chassis system operation and construction</th>
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<tbody>
<tr>
<td>4.1 how commercial vehicle <strong>chassis systems</strong> and their related <strong>units and components</strong> are constructed, removed and replaced</td>
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<tr>
<td>4.2 how commercial vehicle <strong>chassis systems</strong> and their related <strong>units and components</strong> operate.</td>
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<tr>
<th>5. Equipment</th>
</tr>
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<tbody>
<tr>
<td>5.1 how to prepare, test and use all the removal and replacement <strong>equipment</strong> required.</td>
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</tbody>
</table>
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 (eg HAZCHEM, load type and capacity).

Performance objectives

To be competent the learner must:

1. wear suitable personal protective equipment and use vehicle coverings 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. carry out all removal and replacement activities following:
   - manufacturers’ instructions
   - their workplace procedures
   - health and safety requirements

5. work in a way which minimises the risk of:
   - damage to other vehicle systems
   - contact with leakage
   - contact with hazardous substances

6. ensure replaced chassis units and components conform to the vehicle operating specification and any legal requirements

7. record and report any additional faults they notice during the course of their work promptly

8. use suitable testing methods to evaluate the performance of the reassembled system accurately

9. ensure the reassembled chassis system performs to the vehicle operating specification and meets any legal requirements prior to return to the customer
10. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
11. complete all removal and replacement activities within the agreed timescale
12. report any expected delays in completion to the relevant person(s) promptly.
Unit 204  Remove and replace commercial heavy 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
   a 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.
   b 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.
   c 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.
   d The advantages of power assisted steering.
   e The operation of hydraulic power assisted steering.
   f The principles of electronic power steering systems.
   g The procedures used for inspecting the serviceability and condition of:
      i manual steering
      ii power assisted steering.
h  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.  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.

b.  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 wish bones
   ix ball joints
   x  track control arms
   xi bump stops
   xii anti-roll bars
   xiii stabiliser bars
   xiv swinging arms
   xv parallel link
   xvi transverse link
   xvii ‘A’ frame axle location.

c.  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.

d.  The principles of electronically controlled air suspensions systems.

e.  The forces acting on suspension systems during braking, driving and cornering.

f.  The methods of locating the road wheels against braking, driving and cornering forces.
g. The methods of controlling cornering forces by fitting anti-roll torsion members.

h. Suspension terms:
   i. rebound
   ii. bump
   iii. yaw
   iv. dive
   v. pitch
   vi. roll
   vii. compliance.

i. The procedures used for inspecting the serviceability and condition of the suspension system.

j. 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. 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
   vi. automatic adjusters
   vii. backing plates
   viii. parking brake system
   ix. wear indicators and warning lamps.

b. 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.
c. The construction and operation of the hydraulic braking system:
   i  single and dual line layout
   ii master cylinders
   iii wheel cylinders
   iv disc brake caliper & pistons
   v brake pipe
   vi brake servo
   vii warning lights
   viii parking brakes
   ix equalising valves.

d. 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.

e. 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.

f. 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.

g. Terms associated with air and hydraulic braking systems:
   i  braking efficiency
   ii brake fade
   iii brake balance.

h. 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 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 three (1S/1M)
     ii. category two (2S/1M)
     iii. category one (2S/2M)
     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 construction of different types of tyre:
     i. radial
     ii. cross ply
     iii. bias belted
     iv. tread patterns
     v. tyre mixing regulations
     vi. tyre applications.
b. 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.
c. Wheel construction:
i. light alloy
ii. pressed steel
iii. one-piece rims
iv. two-piece rims
v. three piece rims.
d. Wheel retention:
i. conical seating
ii. spherical seating
iii. spigot mounted.
e. Types of wheel bearing arrangements:
i. non-driving and driven wheels
ii. fully floating
iii. three quarter floating
iv. semi floating axles.
f. Types of bearing used for wheel bearing arrangements and their adjustment:
i. taper roller
ii. angular contact ball
iii. integrated.
g. The procedures used for inspecting the serviceability and condition of:
i. tyres & wheels
ii. bearings.
h. 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.

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:
      • non independent suspension
      • independent suspension
      • air suspension
      • electronically controlled air suspension (ECAS)
      • steel suspension
      • rubber suspension
      • lifting axles.

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 or pneumatic units.

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.
Unit 205  Conduct pre and post work heavy vehicle inspections

<table>
<thead>
<tr>
<th>Level:</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit value:</td>
<td>7</td>
</tr>
<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>This unit is about carrying out pre and post work inspections of commercial vehicles using a variety of basic inspection methods and defect recording.</td>
</tr>
</tbody>
</table>
| 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 4310-255 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 2.2  
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 pre and post work vehicle inspections and personal and vehicle protection
   1.2 their workplace procedures for:
      • recording pre and post work inspections and any variations from specifications
      • the referral of problems
      • reporting delays to the completion of work
   1.3 the importance of making accurate records of the results of their inspections and interpreting them correctly
   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. Sources of information
   2.1 how to find, interpret and use recommended sources of information, for example tester’s manual, driver’s handbook
   2.2 the importance of using recommended sources of information to assist their inspection of vehicles.

3. Inspection and fault recording methods and the conduct of inspections
   3.1 how to follow workplace procedures for the systematic pre and post work inspection of vehicles
   3.2 how to check the basic operation of vehicle systems and vehicle condition
   3.3 how to compare inspection results against vehicle specifications and legal requirements
   3.4 how to record faults and inspection results in the format required
   3.5 the importance of discussing findings based upon the results of their inspections to the relevant person(s).

Performance objectives
To be competent the learner must:

1. use suitable personal protective equipment throughout all inspection activities
2. use suitable sources of technical information to support their inspection activities
3. carry out systematic vehicle inspections following:
   • workplace procedures
   • health and safety requirements
   • the manufacturer’s instructions (if appropriate)
4. ensure their comparison of the vehicle against specification accurately identifies any:
- differences from the vehicle specification
- vehicle appearance and condition faults

5. work in a way which minimises the risk of damage to the vehicle and its systems, other people and their property
6. make suitable recommendations for future action based upon the results of their inspections
7. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
8. complete all inspection activities within the agreed timescale and to specification
9. report any anticipated delays in completion to the relevant person(s) promptly.
Unit 205  Conduct pre and post work heavy vehicle inspections

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, manufacturers’ manuals and Trade Association check lists, workplace procedures.

Scope of this unit:
1  Inspections are:
   a  pre-work
   b  post work.

2  Test methods are:
   a  visual
   b  aural
   c  functional.

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.
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 (structural and non-structural)
   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.

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 from the following:
   - pre-delivery and pre-purchase
   - daily vehicle checks
   - pre and post rental inspections

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 206

**Inspect commercial heavy vehicles**

<table>
<thead>
<tr>
<th>Level:</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>Credit value:</td>
<td>7</td>
</tr>
<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>This unit is about carrying out a range of inspections of commercial vehicles using a variety of testing methods and equipment.</td>
</tr>
</tbody>
</table>

**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 4310-255 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
- 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:

<table>
<thead>
<tr>
<th>1.</th>
<th>Legislative and organisational requirements and procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>the health and safety legislation and workplace procedures relevant to conducting <strong>vehicle inspections</strong> and personal and vehicle protection</td>
</tr>
<tr>
<td>1.2</td>
<td>the legislation, including O-licensing, relevant to the types of <strong>vehicle inspections</strong> described in the Scoping Statement for this unit</td>
</tr>
</tbody>
</table>
| 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. |

<table>
<thead>
<tr>
<th>2.</th>
<th>Sources of information</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>how to find, interpret and use technical information</td>
</tr>
<tr>
<td>2.2</td>
<td>the importance of using technical information to inform their inspection and testing of vehicles.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.</th>
<th>Testing methods and the conduct of inspections</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>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</td>
</tr>
<tr>
<td>3.2</td>
<td>how to follow procedures for the systematic inspection of vehicles</td>
</tr>
<tr>
<td>3.3</td>
<td>how to test the operation of vehicle systems and vehicle condition, including workshop based and road tests</td>
</tr>
<tr>
<td>3.4</td>
<td>how to compare test and inspection results against vehicle specifications and legal requirements</td>
</tr>
<tr>
<td>3.5</td>
<td>how to record test and inspection results in the format required</td>
</tr>
<tr>
<td>3.6</td>
<td>how to make recommendations based upon the results of their inspections</td>
</tr>
<tr>
<td>3.7</td>
<td>the implications of failing to carry out an inspection correctly.</td>
</tr>
</tbody>
</table>
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. where necessary, confirm that equipment has been calibrated to meet manufacturers’ and legal requirements
4. carry out systematic vehicle inspections following:
   - workplace procedures
   - health and safety requirements
5. conduct all vehicle testing following:
   - the manufacturer’s instructions
   - the recognised test methods
   - workplace procedures
   - health and safety requirements
6. 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
7. work in a way which minimises the risk of damage to the vehicle and its systems, other people and their property
8. make suitable recommendations for future action based upon the results of their tests and inspections
9. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
10. complete all inspection activities within the agreed timescale and to specification
11. report any anticipated delays in completion to the relevant person(s) promptly.
Unit 206  Inspect commercial heavy 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, eg:
   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.

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:
   - pre-MOT inspection
   - scheduled safety inspections (PMI)
   - 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 207 Diagnose and rectify commercial heavy vehicle engine and component faults

<table>
<thead>
<tr>
<th>Level:</th>
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<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>This unit is about diagnosing and rectifying faults occurring in commercial vehicle engine mechanical, electrical and hydraulic and fluid systems.</td>
</tr>
<tr>
<td>Assessment requirements:</td>
<td>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 &amp; Guilds 4310-257 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: 2.2 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.</td>
</tr>
</tbody>
</table>
### Essential knowledge

The learner will need to understand:

<table>
<thead>
<tr>
<th>1. Legislative and organisational requirements and procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
</tr>
<tr>
<td>1.2 legal requirements relating to the vehicle (including road safety requirements)</td>
</tr>
<tr>
<td>1.3 their workplace procedures for:</td>
</tr>
<tr>
<td>• recording diagnostic and rectification activities</td>
</tr>
<tr>
<td>• the referral of problems</td>
</tr>
<tr>
<td>• reporting delays to the completion of work</td>
</tr>
<tr>
<td>1.4 the importance of, documenting diagnostic and rectification information</td>
</tr>
<tr>
<td>1.5 the importance of working to agreed timescales and keeping others informed of progress</td>
</tr>
<tr>
<td>1.6 the relationship between time, costs and profitability</td>
</tr>
<tr>
<td>1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Electrical and electronic principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 electrical and electronic principles associated with engine systems, including types of sensors and actuators, their application and operation</td>
</tr>
<tr>
<td>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</td>
</tr>
<tr>
<td>2.3 the interaction between electrical, electronic and mechanical components with vehicle engine systems</td>
</tr>
<tr>
<td>2.4 electrical symbols, units and terms</td>
</tr>
<tr>
<td>2.5 electrical safety procedures.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Use of diagnostic and rectification equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 how to prepare and test the accuracy of diagnostic testing equipment</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Engine electrical faults, their diagnosis and correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 how engine mechanical, electrical, electronic and hydraulic and fluid systems are constructed, operate, dismantled and reassembled</td>
</tr>
<tr>
<td>4.2 the types and causes of engine mechanical, electrical, electronic and hydraulic and fluid system, component and unit faults and failures</td>
</tr>
<tr>
<td>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</td>
</tr>
<tr>
<td>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</td>
</tr>
</tbody>
</table>
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, connect and test all the required equipment following manufacturers’ instructions prior to use
4. use diagnostic methods which are relevant to the symptoms presented
5. collect sufficient diagnostic information in a systematic way to enable an accurate diagnosis of engine system faults
6. identify and record any system deviation from acceptable limits accurately
7. ensure their assessment of dismantled sub-assemblies, components and units identifies their condition and suitability for repair or replacement, accurately
8. inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform
9. use the equipment required, correctly and safely throughout all rectification activities
10. carry out all rectification activities following:
    • manufacturers’ instructions
    • workplace procedures
    • health and safety requirements
11. 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
12. ensure all repaired and replaced components and units conform to the vehicle operating specification and any legal requirements
13. when necessary, adjust components and units correctly to ensure that they operate to meet system requirements
14. record and report any additional faults they notice during the course of work promptly
15. use testing methods which are suitable for assessing the performance of the system rectified
16. ensure the engine system rectified performs to the vehicle operating specification and any legal requirements prior to return to the customer
17. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
18. complete all system diagnostic activities within the agreed timescale
19. report any anticipated delays in completion to the relevant person(s) promptly.
Unit 207  
**Diagnose and rectify commercial heavy vehicle engine and component faults**

Supporting information

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

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.

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
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 non-programmable 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 petrol and diesel fuels
   vi. hydro-carbon content.
c. Composition of carbon fuels (petrol and diesel):
   i. % hydrogen and carbon
   ii. composition of air
   iii. % oxygen
   iv. % nitrogen.
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. EURO 3, 4 and 5 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  worn cylinders
   ii  cylinder liners
   iii  pistons
   iv  piston rings
   v  crankshaft
   vi  camshaft
   vii  bearings
   viii cylinder head and gasket
   ix  valves
   x  valve seats and valve guides
   xi  camshaft drives
   xii lubrication system and components
   xiii  oil pump
   xiv  relief valve
   xv  filter
   xvi  turbo-charger
   xvii supercharger.

b. The preparation of tools and equipment for use in diagnostic testing and assessment.

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. Assess, examine and measure components including:
   i. settings
   ii. values
   iii. condition
   iv. wear and performance of components and systems.

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. fuel flow meter
   xiv. 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 208  Diagnose and rectify commercial heavy vehicle chassis system faults

<table>
<thead>
<tr>
<th>Level:</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit value:</td>
<td>16</td>
</tr>
<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td>Aim:</td>
<td>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.</td>
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</tbody>
</table>

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 4310-258 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
- 2.3
- 2.4
- 4.3
- 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:

<table>
<thead>
<tr>
<th>1. Legislative and organisational requirements and procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
</tr>
<tr>
<td>1.2 legal requirements relating to the vehicle (including road safety requirements)</td>
</tr>
<tr>
<td>1.3 their workplace procedures for:</td>
</tr>
<tr>
<td>• recording diagnostic and rectification activities</td>
</tr>
<tr>
<td>• the referral of problems</td>
</tr>
<tr>
<td>• reporting delays to the completion of work</td>
</tr>
<tr>
<td>1.4 the importance of, documenting diagnostic and rectification information</td>
</tr>
<tr>
<td>1.5 the importance of working to agreed timescales and keeping others informed of progress</td>
</tr>
<tr>
<td>1.6 the relationship between time, costs and profitability</td>
</tr>
<tr>
<td>1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Electrical and electronic principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 electrical and electronic principles associated with chassis systems, including types of sensors and actuators, their application and operation</td>
</tr>
<tr>
<td>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</td>
</tr>
<tr>
<td>2.3 the interaction between electrical, electronic and mechanical components within vehicle chassis systems</td>
</tr>
<tr>
<td>2.4 electrical symbols, units and terms</td>
</tr>
<tr>
<td>2.5 electrical safety procedures.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Use of diagnostic and rectification equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 how to prepare and test the accuracy of diagnostic testing equipment</td>
</tr>
<tr>
<td>3.2 how to use diagnostic and rectification equipment for chassis mechanical, electrical, hydraulic and fluid systems, specialist repair tools and general workshop equipment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Chassis faults, their diagnosis and correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 how chassis mechanical, electrical, electronic, pneumatic and hydraulic and fluid systems are constructed, dismantled, reassembled and operate</td>
</tr>
<tr>
<td>4.2 the types and causes of chassis mechanical, electrical, electronic, pneumatic and hydraulic and fluid system component and unit faults and failures</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>4.4 how to find, interpret and use sources of information on chassis</td>
</tr>
</tbody>
</table>
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 and 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.

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**Performance objectives**

To be competent the learner must:

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>wear suitable personal protective equipment and use vehicle coverings when using <strong>diagnostic methods</strong> and carrying out <strong>rectification activities</strong></td>
</tr>
<tr>
<td>2.</td>
<td>support the identification of <strong>faults</strong>, by reviewing vehicle:</td>
</tr>
<tr>
<td></td>
<td>• technical data</td>
</tr>
<tr>
<td></td>
<td>• diagnostic test procedures</td>
</tr>
<tr>
<td>3.</td>
<td>prepare, connect and test all the required <strong>equipment</strong> following manufacturers’ instructions prior to use</td>
</tr>
<tr>
<td>4.</td>
<td>use <strong>diagnostic methods</strong> which are relevant to the symptoms presented</td>
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<tr>
<td>5.</td>
<td>collect diagnostic information in a systematic way relevant to the diagnostic methods used</td>
</tr>
<tr>
<td>6.</td>
<td>collect sufficient diagnostic information to enable an accurate diagnosis of chassis system faults</td>
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<tr>
<td>7.</td>
<td>identify and record any system deviation from acceptable limits accurately</td>
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<tr>
<td>8.</td>
<td>ensure their assessment of dismantled sub-assemblies, components and units identifies their condition and suitability for repair or replacement, accurately</td>
</tr>
<tr>
<td>9.</td>
<td>inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform</td>
</tr>
<tr>
<td>10.</td>
<td>use the <strong>equipment</strong> required, correctly and safely throughout all <strong>rectification activities</strong></td>
</tr>
<tr>
<td>11.</td>
<td>carry out all rectification activities following:</td>
</tr>
<tr>
<td></td>
<td>• manufacturers’ instructions</td>
</tr>
<tr>
<td></td>
<td>• workplace procedures</td>
</tr>
</tbody>
</table>
• 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 chassis 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 208

Diagnose and rectify commercial heavy 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

**Electrical and electronic principles of heavy vehicle chassis systems**

a. 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 (rack and pinion, worm and re-circulating ball)
   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
   v. probable faults, malfunctions, and incorrect settings
   vi. rectification or replacement procedures
   vii. 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.
**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.

4. use a 2 or more step diagnostic activity

5. 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 1 occasion in their normal workplace, covering the diagnosis and rectification of a fault.

Simulated activity will be acceptable to assess candidates' competence in diagnosis and rectification on no more than 1 occasion.
Unit 211 Overhaul heavy 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 4310-261 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 health and safety legislation and workplace procedures relevant to workshop practices and personal and vehicle protection

   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 units

   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
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 heavy 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:  

1 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.

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
  vii. high resistance
  viii. volt drop
  ix. current consumption
  x. output patterns (oscilloscope).
Faults associated with electrical and electronic components and systems

a. 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.

The procedures for dismantling, removal and replacement of electrical and electronic units and components

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 and fittings
   v. cancelling of any fault codes and warning lights.
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.
Unit 212

Remove and replace commercial heavy vehicle transmission driveline units and components

Level: 5
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 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 4310-262 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:

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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:

<table>
<thead>
<tr>
<th>1. Legislative and organisational requirements and procedures</th>
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</thead>
<tbody>
<tr>
<td>1.1 the legal requirements relating to the vehicle (including road safety requirements)</td>
</tr>
<tr>
<td>1.2 the health and safety legislation and workplace procedures relevant to vehicle maintenance activities and personal and vehicle protection</td>
</tr>
<tr>
<td>1.3 their workplace procedures for:</td>
</tr>
<tr>
<td>• recording removal and replacement information</td>
</tr>
<tr>
<td>• the referral of problems</td>
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<tr>
<td>• reporting delays to the completion of work</td>
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<tr>
<td>1.4 the importance of documenting removal and replacement information</td>
</tr>
<tr>
<td>1.5 the importance of working to agreed timescales and keeping others informed of progress</td>
</tr>
<tr>
<td>1.6 the relationship between time and costs</td>
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<td>1.7 the importance of reporting anticipated delays to the relevant person(s) promptly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Use of technical information</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 how to find, interpret and use sources of information applicable to unit and component removal and replacement within transmission and driveline systems</td>
</tr>
<tr>
<td>2.2 the importance of using the correct sources of technical information</td>
</tr>
<tr>
<td>2.3 the purpose of and how to use identification codes.</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>4. Transmission and driveline system operation and construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 how commercial vehicle transmission and driveline systems and their related units and components are constructed, removed and replaced</td>
</tr>
<tr>
<td>4.2 how commercial vehicle transmission and driveline systems and their related units and components operate.</td>
</tr>
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<tr>
<th>5. Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 how to prepare, test and use all the removal and replacement equipment required.</td>
</tr>
</tbody>
</table>
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 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. carry out all removal and replacement activities following:
   - manufacturers’ instructions
   - their workplace procedures
   - health and safety requirements
5. 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
6. ensure replaced transmission and driveline **units and components** conform to the vehicle operating specification and any legal requirements
7. record and report any additional faults they notice during the course of their work promptly
8. use suitable **testing methods** to evaluate the performance of the reassembled system accurately
9. ensure the reassembled **transmission and driveline system** performs to the vehicle operating specification and meets any legal requirements prior to return to the customer
10. ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required
11. complete all removal and replacement activities within the agreed timescale
12. report any expected delays in completion to the relevant person(s) promptly.
Unit 212  
Remove and replace commercial heavy vehicle transmission 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:

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 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

The operation of clutch operating systems
a. Clutch operating mechanisms:
   i. pedal and lever
   ii. hydraulic operated
   iii. air assisted
   iv. cable operated
   v. hydraulic components
   vi. master cylinder
   vii. slave cylinder
   viii. hydraulic pipes
   ix. 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.
c. Types of friction materials used in clutch construction:
   i. organic
   ii. ceramic.

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, sliding mesh, constant mesh and synchromesh gearboxes, reverse gear.
d. The construction and operation of:
   i. gear selection linkages
   ii. selector 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.

The operation of automatic gearboxes

a. The reasons for using automatic gearboxes over manual (urban use, stop/start applications).

b. The construction and operation of:
   i. epicyclic geartrain
   ii. brake bands
   iii. fluid couplings and torque converters.

c. Properties of automatic transmission fluid.

The operation of driveline components

a. The layout and construction of propshafts and drive shafts used in 4x2, 6x4 and 4x4 drive systems.

b. The reasons for using flexible couplings and sliding joints in transmissions systems.

c. The reason for using constant velocity joints in drive shafts incorporating steering mechanisms.

d. The construction and operation of:
   i. universal joints
   ii. sliding couplings
   iii. constant velocity joints
   iv. centre bearings.

e. The simple stresses applied to shafts; torsional, bending and shear.

f. The construction and operation of:
   i. final drive units
   ii. through-drive axles
   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.

g. The reasons for fitting a differential.

h. Calculate final drive gear ratios.

i. Calculate the overall gear ratio from given data (gearbox ratio x final drive ratio).
The operation of gear selector systems
a. 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.
b. 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 transmission 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):
   i. warranty requirements
   ii. to maintain performance
   iii. 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:
      - coil spring clutches
      - diaphragm spring clutches
      - single plate clutches
      - multi plate clutches
      - air assistance
      - hydraulic operation
      - cable operation.
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 the list 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

Simulated activity will be acceptable to assess candidates’ competence in removal and replacement on no more than 1 occasion
Unit 213  Diagnose and rectify commercial heavy vehicle transmission and driveline system 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 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 4310-263 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 2.2 2.4 2.5 4.1 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:

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

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<thead>
<tr>
<th>2. Electrical and electronic principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 electrical and electronic principles associated with commercial vehicle transmission and driveline systems, including types of sensors and actuators, their application and operation</td>
</tr>
<tr>
<td>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 fibre optics principles</td>
</tr>
<tr>
<td>2.3 the interaction between electrical, electronic and mechanical components within commercial vehicle transmission and driveline systems</td>
</tr>
<tr>
<td>2.4 electrical symbols, units and terms</td>
</tr>
<tr>
<td>2.5 electrical safety procedures.</td>
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<thead>
<tr>
<th>3. Use of diagnostic and rectification equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 how to prepare diagnostic testing equipment</td>
</tr>
<tr>
<td>3.2 how to use diagnostic and rectification <strong>equipment</strong> for commercial vehicle transmission and driveline mechanical, electrical, hydraulic and fluid systems, specialist repair tools and general workshop equipment.</td>
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</tbody>
</table>
4. Transmission and driveline faults, their diagnosis and correction

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<tbody>
<tr>
<td>4.1</td>
<td>how commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic and hydraulic and fluid systems are constructed, dismantled, reassembled and operate</td>
</tr>
<tr>
<td>4.2</td>
<td>the types and causes of commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic and hydraulic and fluid system component and unit faults and failures</td>
</tr>
<tr>
<td>4.3</td>
<td>commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic and hydraulic and fluid component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action</td>
</tr>
<tr>
<td>4.4</td>
<td>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</td>
</tr>
<tr>
<td>4.5</td>
<td>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</td>
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<tr>
<td>4.6</td>
<td>how to select the most appropriate diagnostic testing method for the symptoms presented</td>
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<tr>
<td>4.7</td>
<td>how to carry out systematic diagnostic testing of commercial vehicle transmission and driveline mechanical, electrical and electronic, pneumatic, hydraulic and fluid systems using a prescribed process or format</td>
</tr>
<tr>
<td>4.8</td>
<td>how to assess the condition evident within commercial vehicle transmission and driveline mechanical, electrical, electronic, pneumatic, hydraulic and fluid components and units</td>
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<tr>
<td>4.9</td>
<td>how to interpret test results and vehicle data in order to identify the location and cause of vehicle system faults</td>
</tr>
<tr>
<td>4.10</td>
<td>how to carry out the <strong>rectification activities</strong> 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</td>
</tr>
<tr>
<td>4.11</td>
<td>the relationship between test methodology and the faults repaired – the use of appropriate testing methods</td>
</tr>
<tr>
<td>4.12</td>
<td>how to make cost effective recommendations for rectification.</td>
</tr>
</tbody>
</table>
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, connect and test all the required **equipment** following manufacturers’ instructions prior to use
4. use **diagnostic methods** which are relevant to the symptoms presented
5. collect diagnostic information in a systematic way relevant to the diagnostic methods used
6. collect sufficient diagnostic information to enable an accurate diagnosis of transmission and driveline 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 transmission and driveline 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 213 Diagnose and rectify commercial heavy 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:

1. **Transmission and driveline systems** are:
   a. gearbox and power take off
   b. hubs and bearings
   c. driveline shafts
   d. clutch
   e. final drive.

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

3. **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
   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

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. 5, 6, 8, 12 and 16 speed gearboxes
   ii. gear arrangements
   iii. shaft 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. conventional 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. difficulty engaging or disengaging gears
   v. automatic gear box types
   vi. abnormal noises
   vii. vibrations
   viii. loss of drive
   ix. failure to engage gear
   x. failure to disengage gear
   xi. leaks
   xii. failure to operate
   xiii. incorrect shift patterns
   xiv. 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, multimeter, 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:
   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
      • settings
      • input and output values
      • voltages
      • current consumption
      • resistance
      • output patterns with oscilloscope
      • pressures
      • condition
      • 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 406
**Diagnose and rectify motor vehicle electrical unit and component faults**

<table>
<thead>
<tr>
<th>Level:</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit value:</td>
<td>16</td>
</tr>
<tr>
<td>Endorsement by a regulatory body:</td>
<td>This unit is endorsed by IMI, the Sector Skills Council for the automotive retail industry.</td>
</tr>
<tr>
<td><strong>Aim:</strong></td>
<td>This unit is about identifying and rectifying faults occurring within electrical systems, units and components.</td>
</tr>
</tbody>
</table>

**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 4310-456 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:

<table>
<thead>
<tr>
<th>1. Legislative and organisational requirements and procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
</tr>
<tr>
<td>1.2 legal requirements relating to the vehicle electrics (including road safety and refrigerant handling requirements)</td>
</tr>
<tr>
<td>1.3 their workplace procedures for:</td>
</tr>
<tr>
<td>- recording fault location and <strong>correction activities</strong></td>
</tr>
<tr>
<td>- reporting the results of tests.</td>
</tr>
<tr>
<td>- the referral of problems</td>
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<tr>
<td>- reporting delays to the completion of work</td>
</tr>
<tr>
<td>1.4 the importance of working to recognised diagnostic procedures and processes and obtaining the correct information for diagnostic activities to proceed</td>
</tr>
<tr>
<td>1.5 the importance of, documenting diagnostic and rectification information</td>
</tr>
<tr>
<td>1.6 the importance of working to agreed timescales and keeping others informed of progress</td>
</tr>
<tr>
<td>1.7 the relationship between time, costs and profitability</td>
</tr>
<tr>
<td>1.8 the importance of reporting anticipated delays to the relevant person(s) promptly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Electrical and electronic principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
</tr>
<tr>
<td>2.2 electrical symbols, units and terms</td>
</tr>
<tr>
<td>2.3 electrical safety procedures</td>
</tr>
<tr>
<td>2.4 how electrical and electronic units and components are constructed, dismantled and reassembled</td>
</tr>
<tr>
<td>2.5 how electrical and electronic units and components operate, including electrical component function, electrical inputs, outputs, voltages and patterns</td>
</tr>
<tr>
<td>2.6 the interaction between electrical, electronic and mechanical components within the systems defined</td>
</tr>
<tr>
<td>2.7 how electrical systems interlink and interact including multiplexing</td>
</tr>
<tr>
<td>2.8 the operation of the electrical and electronic systems for electric, hybrid and alternative re-fuel vehicles (including regenerative braking systems).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Use of electrical testing equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 how to prepare and test the accuracy of diagnostic testing equipment.</td>
</tr>
<tr>
<td>3.2 how to use <strong>electrical and electronic testing equipment</strong> to correctly and safely diagnose electrical faults.</td>
</tr>
</tbody>
</table>
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 researched repair methods
   - 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
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>11.</td>
<td>ensure all repaired and replaced electrical components and units conform to the vehicle operating specification and any legal requirements</td>
</tr>
<tr>
<td>12.</td>
<td>when necessary, adjust components and units correctly to ensure that they operate to meet system requirements</td>
</tr>
<tr>
<td>13.</td>
<td>ensure the electrical system rectified performs to the vehicle operating specification and any legal requirements prior to return to the customer</td>
</tr>
<tr>
<td>14.</td>
<td>ensure their records are accurate, complete and passed to the relevant person(s) promptly in the format required</td>
</tr>
<tr>
<td>15.</td>
<td>complete all diagnostic and rectification activities within the agreed timescale</td>
</tr>
<tr>
<td>16.</td>
<td>report any anticipated delays in completion to the relevant person(s) promptly.</td>
</tr>
</tbody>
</table>
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  ohmmeters
   d  multimeters
   e  battery testing equipment
   f  dedicated and computer based diagnostic 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 of a component(s) that rectifies the fault(s) identified form the diagnostic activities carried out.

**Unit range**

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:
   i. lighting systems failing to operate correctly
   ii. switches
   iii. relays
   iv. bulbs failing to operate.

The operating principles of external lighting systems and multiplexing systems
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 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 (ICE) 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. VDU screens
   viii. satellite navigation
   ix. communication units.

The function of components in ICE 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 ICE systems
Operation of entertainment systems speaker and aerial systems.

Common faults and testing methods associated with ICE 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
Operation of alarm systems and audible warning units.

The relevant legislation relevant to security and warning systems
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 manufacturers 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 conditioning
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. vi. electrical related faults on the air conditioning system.

The different types of locking system components
Door locking actuators, solenoids, deadlocking actuators, anti-theft modules.

The function of component parts in the locking system
Solenoids, actuators (electrical and pneumatic), multifunctional relays, anti-theft modules and release systems.

The operating principles of locking systems
Doors and cabs.

Common faults and testing methods associated with locking systems
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 are:
 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
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 14 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.
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.

Centre Manual - Supporting Customer Excellence 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 such on such things as:

- **Walled Garden**: how to register and certificate candidates on line
- **Qualifications and Credit Framework (QCF)**: general guidance about the QCF and how qualifications will change, as well as information on the IT systems needed and FAQs
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.
## Useful contacts

<table>
<thead>
<tr>
<th>Category</th>
<th>Services Provided</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UK learners</strong></td>
<td>General qualification information</td>
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<td><strong>Single subject qualifications</strong></td>
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