

# City & Guilds Level 1 Certificate and Diploma in Vehicle Maintenance (7290-10/11)

(610/0062/X and 610/0063/0)

March 2024 Version 1.3

**Qualification Handbook**

## Qualification at a glance

<b>Subject area</b>	Vehicle Maintenance and Repair
<b>City &amp; Guilds number</b>	7290 -10/11
<b>Age group approved</b>	14+
<b>Entry requirements</b>	There are no entry requirements
<b>Assessment</b>	Online multiple-choice tests and assignments
<b>Approvals</b>	Fast track or Full approval applies
<b>Support materials</b>	Centre handbook, Qualification handbook, Assessment packs, Sample test materials, SmartScreen
<b>Registration and certification</b>	Consult the Walled Garden/online catalogue for registration and certification end dates

Title and level	City & Guilds number	Qualification number	Total GLH	TQT
City & Guilds Level 1 Certificate in Vehicle Maintenance	7290-10	610/0062/X	173	250
City & Guilds Level 1 Diploma in Vehicle Maintenance	7290-11	610/0063/0	323	410

Version and date	Change detail	Section
V1.0	n/a	n/a
V1.1 May 2022	Added details re RA/SC and grading to include fail details	Appendix 1 and Grading section
V1.2 August 2023	Revised unit 594 description from evolve to assignment	Page 19
V1.3 March 2024	Update of assessment type for 081 Update of assessment type for 552	Page 35 Page 104

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# 1 Introduction

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

Area	Description
Who are the qualifications for?	<p>The qualifications are aimed at learners aged 14+ who would like to develop basic knowledge and skills in motor vehicle systems.</p> <p>Successful learners will have acquired the basic skills and understanding needed to apply for an automotive apprenticeship.</p> <p>These qualifications could also be used as an 'interest' course for a wide range of learners.</p>
What do the qualifications cover?	<p>These qualifications allow learners to learn, develop and practise the skills required for employment and/or career progression in the automotive industry.</p>
What opportunities for progression are there?	<p>Upon successful completion of these qualifications, learners will be equipped with the knowledge and skills required for progression in the automotive industry, either by applying for an automotive apprenticeship or progression on the following City &amp; Guilds qualifications:</p> <ul style="list-style-type: none"><li>• 7290-12 City &amp; Guilds Level 2 Diploma in Light Vehicle Maintenance &amp; Repair Principles</li><li>• 7270-12 City &amp; Guilds Level 2 Diploma in Light Vehicle Maintenance &amp; Repair Competence</li><li>• 4290-22 City &amp; Guilds Level 2 Diploma in Heavy Vehicle Maintenance &amp; Repair Principles</li><li>• 4270-22 City &amp; Guilds Level 2 Diploma in Heavy Vehicle Maintenance &amp; Repair Competence</li><li>• 4290-32 City &amp; Guilds Level 2 Diploma in Motorcycle Maintenance &amp; Repair Principles</li><li>• 4270-32 City &amp; Guilds Level 2 Diploma in Motorcycle Maintenance &amp; Repair Competence</li><li>• 7290-01 City &amp; Guilds Level 1 Award in Introduction to Electric and Hybrid Vehicle High Energy Systems</li><li>• 7290-02 City &amp; Guilds Level 2 Award in Safe Maintenance of Electric and Hybrid Vehicles</li><li>• 7290-72 City &amp; Guilds Level 2 Award in Hazard Management of Electric and Hybrid Vehicles</li><li>• 7290-03 City &amp; Guilds Level 3 Award in Component Removal and Replacement in Electric and Hybrid Vehicles</li><li>• 7290-04 City &amp; Guilds Level 4 Award in Diagnosis and Rectification of Faults in Electric and Hybrid Vehicles</li></ul>

	<ul style="list-style-type: none"> <li>• 7290-63 City &amp; Guilds Level 3 Award in Component Removal and Replacement in Hydrogen Fuel Cell Electric Vehicles</li> <li>• 7290-64 City &amp; Guilds Level 4 Award in Diagnosis and Rectification of Faults in Hydrogen Fuel Cell Electric Vehicles</li> <li>• 7290-83 City &amp; Guilds Level 3 Award in Diagnosis, Repair and Recalibration of Advanced Driver Assist Systems</li> </ul>
<p>Who did we develop the qualification with?</p>	<p>This qualification has been developed using the National Occupational Standards as set by automotive industry experts.</p>

## Structure

Full qualification certificates will be awarded to successful candidates on completion of the required rules of combination, as indicated below.

To achieve the **City & Guilds Level 1 Certificate in Vehicle Maintenance (7290-10)** candidates must achieve the following rules of combination:

All **four** mandatory units: 001, 031, 051, 081.

In addition, **one** optional unit group (comprising of two units) from the following:

(726 and 776) or

(727 and 777) or

(302 and 352) or

(305 and 355) or

(501 and 551) or

(503 and 553) or

(544 and 594)

### Or

All **four** mandatory units: 001, 031, 051, 081.

In addition to **one** optional unit from any of the following optional units:

701, 702, 703, 704, 705, 706, 707, 708, 709, 712

In addition, candidates can also choose the following Electric Vehicle elective unit: 601.

This unit does not form part of the rules of combination to achieve the full Certificate but can be taken as supplementary unit. On successful completion of the unit a CUC will be awarded.

City & Guilds unit number	Unit title	GLH
<b>Mandatory</b>		
001	Skills in Health, Safety and Good Housekeeping in the Automotive Environment	60
031	Skills to Support Working Relationships in the Automotive Work Environment	27
051	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	30
081	Knowledge to Support Working Relationships in the Automotive Work Environment	28
<b>Optional groups (Combinations)</b>		
726/776	Introduction to Automotive Technology and Workshop Skills	60
727/777	Carry out Basic Routine Vehicle Maintenance	90

City & Guilds unit number	Unit title	GLH
302	Skills in Motorcycle Internal Engine Systems	45
352	Knowledge of Motorcycle Internal Engine Systems	20
305	Skills in Motorcycle Preparation and Inspection	20
355	Knowledge of Motorcycle Preparation and Inspection	20
501	Skills in Inspection, Repair and Replacement of Standard Light Vehicle Tyres	46
551	Knowledge in Inspection, Repair and Replacement of Standard Light Vehicle Tyres	24
503	Skills in Inspection, Repair and Replacement of Commercial Vehicle Tyres	44
553	Knowledge of Inspection, Repair and Replacement of Commercial Vehicle Tyres	26
544	Skills in Receiving and Storing Stock	34
594	Knowledge of Receiving and Storing Stock	28
701	Skills in Vehicle Engine Lubrication Systems	38
702	Skills in Vehicle Engine Cooling Systems	32
703	Skills in Vehicle Fuel and Exhaust Systems	39
704	Skills in Vehicle Spark Ignition Systems	43
705	Skills in Vehicle Electrical Systems	38
706	Skills in Vehicle Braking Systems	35
707	Skills in Vehicle Transmission Systems	38



City & Guilds unit number	Unit title	GLH
708	Skills in Vehicle Steering and Suspension Systems	36
709	Skills in Vehicle Wheels and Tyre Systems	32
712	Skills in Vehicle Hand Skills and Manufacturing Techniques	28
<b>Elective</b>	<b>(Electrical Vehicle)</b>	
601	Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle	8

To achieve the **City & Guilds Level 1 Diploma in Vehicle Maintenance (7290-11)** candidates must achieve the following rules of combination:

All **eight** mandatory units: 001, 031, 051, 081, 726, 776, 727 and 777

In addition, **one** optional unit group (comprising of two or three units) from the following:

(102, 152 and 172) or  
 (103 and 153) or  
 (104 and 154) or  
 (112 and 162) or  
 (218 and 268) or  
 (302 and 352) or  
 (305 and 355) or  
 (501 and 551) or  
 (503 and 553) or  
 (544 and 594)

**Or**

All **eight** mandatory units: 001, 031, 051, 081, 726, 776, 727 and 777

In addition to **one** optional unit from any of the following optional units:  
 701, 702, 703, 704, 705, 706, 707, 708, 709, 712

In addition, candidates can also choose the following Electric Vehicle elective unit: 601.

This unit does not form part of the rules of combination to achieve the full Diploma but can be taken as supplementary unit. On successful completion of the unit a CUC will be awarded.

City & Guilds unit number	Unit title	GLH
<b>Mandatory</b>		
001	Skills in Health, Safety and Good Housekeeping in the Automotive Environment	60
031	Skills to Support Working Relationships in the Automotive Work Environment	27
051	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	30
081	Knowledge to Support Working Relationships in the Automotive Work Environment	28
726/776	Introduction to Automotive Technology and Workshop Skills	60
727/777	Carry out Basic Routine Vehicle Maintenance	90
<b>Optional Groups (Combinations)</b>		
102	Skills in Removing and Replacing Light Vehicle Combustion Engine Units and Components	45
152	Knowledge of Light Vehicle Combustion Engine Mechanical, Lubrication and Cooling System Units and Components	20
172	Knowledge of Light Vehicle Fuel Ignition, Air and Exhaust System Units and Components	20
103	Skills in Removing and Replacing Light Vehicle Electrical Units and Components	54
153	Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components	45
104	Skills in Removing and Replacing Light Vehicle Chassis Units and Components	45
154	Knowledge of Removing and Replacing Light Vehicle Chassis Units and Components	45
112	Skills in Removing and Replacing Light Vehicle Driveline Units and Components	45
162	Knowledge of Light Vehicle Transmission and Driveline Units and Components	45

City & Guilds unit number	Unit title	GLH
218	Skills in Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	20
268	Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	20
302	Skills in Motorcycle Internal Engine Systems	45
352	Knowledge of Motorcycle Internal Engine Systems	20
305	Skills in Motorcycle Preparation and Inspection	20
355	Knowledge of Motorcycle Preparation and Inspection	20
501	Skills in Inspection, Repair and Replacement of Standard Light Vehicle Tyres	46
551	Knowledge in Inspection, Repair and Replacement of Standard Light Vehicle Tyres	24
503	Skills in Inspection, Repair and Replacement of Commercial Vehicle Tyres	44
553	Knowledge of Inspection, Repair and Replacement of Commercial Vehicle Tyres	26
544	Skills in Receiving and Storing Stock	34
594	Knowledge of Receiving and Storing Stock	28
701	Skills in Vehicle Engine Lubrication Systems	38
702	Skills in Vehicle Engine Cooling Systems	32
703	Skills in Vehicle Fuel and Exhaust Systems	39
704	Skills in Vehicle Spark Ignition Systems	43

City & Guilds unit number	Unit title	GLH
705	Skills in Vehicle Electrical Systems	38
706	Skills in Vehicle Braking Systems	35
707	Skills in Vehicle Transmission Systems	38
708	Skills in Vehicle Steering and Suspension Systems	36
709	Skills in Vehicle Wheels and Tyre Systems	32
712	Skills in Vehicle Hand Skills and Manufacturing Techniques	28
<b>Elective</b>	<b>(Electrical Vehicle)</b>	
601	Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle	8

Full qualification certificates will be awarded to successful candidates on completion of the required combinations of units. Candidates completing one or more units, rather than the full qualification(s), will receive a Certificate of Unit Credit (CUC).

## Total Qualification Time

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a qualification.

TQT is comprised of the following two elements:

1. The number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and
2. An estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by - but, unlike Guided Learning, not under the Immediate Guidance or Supervision of - a lecturer, supervisor, tutor or other, appropriate provider of education or training

Title and level	GLH	TQT
City & Guilds Level 1 Certificate in Vehicle Maintenance (7290-10)	173	250
City & Guilds Level 1 Diploma in Vehicle Maintenance (7290-11)	323	410

## 2 Centre requirements

### Approval

If your Centre is approved to offer the qualification 4290-11 you can apply for the new approval using the **fast-track approval form**, available from the City & Guilds website.

Centres should use the fast-track form if:

- there have been no changes to the way the qualifications are delivered, and
- they meet all the approval criteria in the fast-track form guidance notes.

Fast track approval is available for 12 months from the launch of the qualification. After 12 months, the Centre will have to go through the standard Qualification Approval Process. The centre is responsible for checking that fast-track approval is still current at the time of application.

To offer these qualifications, new centres will need to gain both centre and qualification approval. Please refer to the City & Guilds website for further information on the approval process: **[www.cityandguilds.com](http://www.cityandguilds.com)**

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

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

### Internal quality assurance

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

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

Standards and rigorous quality assurance are maintained using:

- internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers must have appropriate teaching and vocational knowledge and expertise. Assessor/Verifier (A/V) units are valued as qualifications for the centre, but they are not currently a requirement for this qualification.

Staff must:

- be familiar with the occupation and technical content covered within the qualification.

## **Learner 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.

## **Recognition of Prior Learning (RPL)**

Recognition learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification. RPL is not allowed for any previous units contained in the 4290 suite or equivalent units taken with other awarding organisations for the new 7290 suite of qualifications.

However, RPL is available for any elective units taken and will be recognised for Electric Vehicle/ADAS qualification(s), full registration to the EV/ADAS qualification must take place to claim RPL for elective units achieved in Light Vehicle qualifications.

## **Age restrictions**

City & Guilds cannot accept any registrations for candidates under 14 as these qualifications are not approved for under 14s.

### 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

The following resources are available for these qualifications:

Description	How to access
Fast track approval form	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Assessment pack	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Sample test materials	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
SmartScreen	<a href="http://www.smartscreen.co.uk">www.smartscreen.co.uk</a>
Learning Assistant	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>

#### Recording documents

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

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

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

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



## 4 Assessment

### Summary of assessment methods

City & Guilds has written the following assessments to use with these Qualification(s):

- Online multiple-choice tests.
- Practical Assignments to assess essential skills: comprising of practical tasks, observation, verbal questioning and short answer questions to cover all learning outcomes.  
These are carried out in the classroom and must be completed to current industry standards and practice.

Practical Assignment requirements and relevant documentation are available in the corresponding qualification(s) Assessment Packs, which can be downloaded from the 7290 qualification web page.

Materials for units 701-712 can be downloaded from the 3902 qualification page.

Assignments are carried out in centres and must be completed to current industry standards and practice. It is important to note that although the units within these qualifications bear a close relationship to the VCQ units, they do not imply occupational competence.

### Time constraints

Candidates must complete their assessments within their registration period.

### Test specifications

Summary test specifications for all 7290 evolve online knowledge tests can be found in the *7290/7270 Evolve Test Specification* Document downloadable from [www.cityandguilds.com](http://www.cityandguilds.com).

## Unit Assessment Type

Unit	Level	Unit title	Assessment method	Where to obtain assessment materials
7290-001	Level 2	Skills in Health, Safety and Good Housekeeping in the Automotive Environment	Assignment	www.cityandguilds.com.
7290-031	Level 1	Skills to Support Working Relationships in the Automotive Work Environment	Assignment	www.cityandguilds.com.
7290-051	Level 2	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	Assignment	www.cityandguilds.com
7290-081	Level 1	Knowledge to Support Working Relationships in the Automotive Work Environment	Assignment	www.cityandguilds.com
7290-102	Level 2	Skills in Removing and Replacing Light Vehicle Combustion Engine Units and Components	Assignment	www.cityandguilds.com.
7290-103	Level 2	Skills in Removing and Replacing Light Vehicle Electrical Units and Components	Assignment	www.cityandguilds.com.
7290-104	Level 2	Skills in Removing and Replacing Light Vehicle Chassis Units and Components	Assignment	www.cityandguilds.com.
7290-112	Level 2	Skills in Removing and Replacing Light Vehicle Driveline Units and Components	Assignment	www.cityandguilds.com.
7290-152	Level 2	Knowledge of Light Vehicle Combustion Engine Mechanical, Lubrication and Cooling System Units and Components	Multiple choice test	Evolve
7290-153	Level 2	Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components	Multiple choice test	Evolve
7290-154	Level 2	Knowledge of Removing and Replacing Light Vehicle Chassis Units and Components	Multiple choice test	Evolve
7290-162	Level 2	Knowledge of Light Vehicle Transmission and Driveline Units and Components	Multiple choice test	Evolve

Unit	Level	Unit title	Assessment method	Where to obtain assessment materials
7290-172	Level 2	Knowledge of Light Vehicle Fuel, Ignition, Air and Exhaust System Units and Components	Multiple choice test	Evolve
7290-218	Level 2	Skills in Removing and Fitting of Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	Assignment	www.cityandguilds.com.
7290-268	Level 2	Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	Multiple choice test	Evolve
7290-302	Level 2	Skills in Motorcycle Internal Engine Systems	Assignment	www.cityandguilds.com.
7290-305	Level 2	Skills in Motorcycle Preparation and Inspection	Assignment	www.cityandguilds.com.
7290-352	Level 2	Knowledge of Motorcycle Internal Engine Systems	Multiple choice test	Evolve
7290-355	Level 2	Knowledge of Motorcycle Preparation and Inspection	Multiple choice test	Evolve
7290-501	Level 1	Skills in Inspection, Repair and Replacement of Standard Light Vehicle Tyres	Assignment	www.cityandguilds.com.
7290-503	Level 1	Skills in Inspection Repair and Replacement of Commercial Vehicle Tyres	Assignment	www.cityandguilds.com.
7290-544	Level 1	Skills in Receiving and Storing Stock	Assignment	www.cityandguilds.com.
7290-551	Level 1	Knowledge in Inspection, Repair and Replacement of Standard Light Vehicle Tyres	Multiple choice test	Evolve
7290-553	Level 1	Knowledge of Inspection, Repair and Replacement of Commercial Vehicle Tyres	Multiple choice test	Evolve
7290-594	Level 1	Knowledge of Receiving and Storing Stock	Assignment	www.cityandguilds.com.
7290-601	Level 1	Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle	Multiple choice test	Evolve
7290-701	Level 1	Skills in Vehicle Engine Lubrication Systems	Assignment	www.cityandguilds.com.
7290-702	Level 1	Skills in Vehicle Engine Cooling Systems	Assignment	www.cityandguilds.com.

Unit	Level	Unit title	Assessment method	Where to obtain assessment materials
7290-703	Level 1	Skills in Vehicle Fuel and Exhaust Systems	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-704	Level 1	Skills in Vehicle Spark Ignition Systems	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-705	Level 1	Skills in Vehicle Electrical Systems	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-706	Level 1	Skills in Vehicle Braking Systems	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-707	Level 1	Skills in Vehicle Transmission Systems	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-708	Level 1	Skills in Vehicle Steering and Suspension Systems	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-709	Level 1	Skills in Vehicle Wheels and Tyre Systems	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-712	Level 1	Skills in Vehicle Hand Skills and Manufacturing Techniques	Assignment	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> .
7290-726/776	Level 1	Introduction to Automotive Technology and Workshop Skills	Assignment /Multiple choice test	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> . Evolve
7290-727/777	Level 1	Carry out Basic Routine Vehicle Maintenance	Assignment /Multiple choice test	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> . Evolve

## 5 Grading

### Grading of individual assessments

Assignments will be graded as Pass only as detailed in the Assessment Pack.

Multiple choice tests will be graded as Pass/Merit/Distinction apart from the elective unit 7290-601 which is graded Pass only.

### Grading of qualifications

The overall grading of both qualifications is Pass/Fail only.

All assessments, within the designated rules of combination must be achieved at a minimum of **Pass** for the qualification(s) to be awarded.

## 6 Units

### Structure of the units

Each unit will follow the following format:

- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Relationship to NOS
- Assessment type
- Aim
- Learning outcomes, which are comprised of a number of assessment criteria
- Supporting information (unit range) where applicable

A unit describes what is expected of a competent person in particular aspects of his/her job.

Each **unit** is divided into **learning outcomes** which describe in further detail the skills and knowledge that a candidate should possess.

Each **learning outcome** has a set of **assessment criteria** which specify the desired criteria that have to be satisfied before an individual can be said to have performed to the agreed standard.

**Supporting information** define the breadth or scope of a learning outcome and its assessment criteria by setting out the various circumstances in which they are to be applied.

## Unit 001

# Skills in Health, Safety and Good Housekeeping in the Automotive Environment

<b>Level:</b>	Level 2
<b>GLH:</b>	60
<b>Relationship to NOS:</b>	This unit is linked to G1 Contribute to Housekeeping in Motor Vehicle Environment and G2 Reduce Risks to Health and Safety in the Motor Vehicle Environment.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop skills to carry out day to day work area cleaning, clearing away, dealing with spillages and disposal of waste, used materials and debris, and to identify hazards and risks in the automotive workplace to comply with relevant legislation and good practice.

<b>Learning outcome</b>	<b>The learner will:</b>
1.	be able to use correct personal and vehicle protection within the automotive environment
<b>Assessment criteria</b>	
The learner can:	
1.1	select and use personal protective equipment throughout activities, to include appropriate protection of: a. eyes b. ears c. head d. skin e. feet f. hands g. lungs
1.2	select and use vehicle protective equipment throughout all activities

<b>Learning outcome</b>	<b>The learner will:</b>
2.	be able to carry out effective housekeeping practices in the automotive environment
<b>Assessment criteria</b>	
The learner can:	
2.1	select and use cleaning equipment which is of the right type and suitable for the task
2.2	use utilities and appropriate consumables, avoiding waste
2.3	use materials and equipment to carry out cleaning and maintenance duties in allocated work areas, following automotive work environment policies, schedules and manufacturers' instructions
2.4	perform housekeeping activities safely and in a way which minimizes inconvenience to customers and staff
2.5	keep the work area clean and free from debris and waste materials
2.6	keep tools and equipment fit for purpose by regular cleaning and keeping tidy
2.7	dispose of used cleaning agents, waste materials and debris to comply with legal and workplace requirements.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	be able to recognise and deal with dangers to work safely within the automotive workplace
<b>Assessment criteria</b>	
The learner can:	
3.1	name and locate the responsible persons for health and safety in their relevant workplace
3.2	identify and report working practices and hazards which could be harmful to themselves or others
3.3	carry out safe working practices whilst working with equipment, materials and products in the automotive environment
3.4	rectify health and safety risks encountered at work, within the scope and capability of their job role.

<b>Learning outcome</b>	<b>The learner will:</b>
4.	be able to conduct themselves responsibly
<b>Assessment criteria</b>	
The learner can:	
4.1	show personal conduct in the workplace which does not endanger the health and safety of themselves or others
4.2	display suitable personal presentation at work which ensures the health and safety of themselves and others at work.



## Unit 031

## Skills to Support Working Relationships in the Automotive Work Environment

<b>Level:</b>	Level 1
<b>GLH:</b>	27
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop skills in keeping good working relationships with all colleagues in the workplace by using effective communication and support skills.

<b>Learning outcome</b>	<b>The learner will:</b>
1. be able to work effectively within the organisational structure of the automotive work environment	
<b>Assessment criteria</b>	
The learner can:	
1.1	show a prompt and willing response to requests from customers and colleagues in the work environment
1.2	refer customers and colleagues to the correct person should requests fall outside their responsibility and capability.

<b>Learning outcome</b>	<b>The learner will:</b>
2. be able to obtain and use information to support their job role within the automotive work environment	
<b>Assessment criteria</b>	
The learner can:	
2.1	identify, locate and use relevant information, in an automotive work environment.

<b>Learning outcome</b>	<b>The learner will:</b>
3. be able to communicate with and support colleagues and customers within the automotive work environment	
<b>Assessment criteria</b>	
The learner can:	
3.1	use methods of communication with customers and colleagues which meet their needs
3.2	give customers and colleagues accurate information
3.3	communicate with customers and colleagues clearly and courteously.

<b>Learning outcome</b>	<b>The learner will:</b>
4. be able to demonstrate good working relationships in the automotive work environment	

**Assessment criteria**

The learner can:

- 4.1 demonstrate positive teamwork within an automotive environment
- 4.2 treat customers and colleagues in a way which shows respect for their views and opinions
- 4.3 make and keep achievable commitments to customers and colleagues
- 4.4 identify and inform colleagues promptly of anything likely to affect their own work.

## Unit 051

# Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment

<b>Level:</b>	Level 2
<b>GLH:</b>	30
<b>Relationship to NOS:</b>	This unit is linked to G1 Contribute to Housekeeping in Motor Vehicle Environment and G2 Reduce Risks to Health and Safety in the Motor Vehicle Environment.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop skills in routine maintenance and cleaning of the automotive environment and using resources economically. It will also provide skills in Health and Safety legislation and an appreciation of significant risks in the automotive environment and how to identify and deal with them. Once completed the learner will be able to identify hazards and evaluate and reduce risk.

Learning outcome	The learner will:
1.	understand the correct personal and vehicle protective equipment to be used within the automotive environment
<b>Assessment criteria</b>	
The learner can:	
1.1	explain the importance of wearing the types of PPE required for a range automotive repair activities
1.2	identify vehicle protective equipment for a range of repair activities
1.3	describe vehicle and personal safety considerations when working at the roadside.

Learning outcome	The learner will:
2.	understand effective housekeeping practices in the automotive environment
<b>Assessment criteria</b>	
The learner can:	
2.1	describe why the automotive environment should be properly cleaned and maintained.
2.2	describe requirements and systems which may be put in place to ensure a clean automotive environment.
2.3	describe how to minimise waste when using utilities and consumables
2.4	state the procedures and precautions necessary when cleaning and maintaining an automotive environment.
2.5	describe the selection and use of cleaning equipment when dealing with general cleaning, spillages and leaks in the automotive environment.
2.6	describe procedures for correct disposal of waste materials from an automotive environment

2.7 describe procedures for starting and ending the working day which ensure effective housekeeping practices are followed.

<b>Learning outcome</b>	<b>The learner will:</b>
3. understand key health and safety requirements relevant to the automotive environment	
<b>Assessment criteria</b>	
The learner can:	
3.1 list the main legislation relating to automotive environment health and safety.	
3.2 describe the general legal duties of employers and employees required by current health and safety legislation	
3.3 describe key, current health and safety requirements relating to the automotive environment.	
3.4 describe why workplace policies and procedures relating to health and safety are important.	

<b>Learning outcome</b>	<b>The learner will:</b>
4. understand about hazards and potential risks relevant to the automotive environment	
<b>Assessment criteria</b>	
The learner can:	
4.1 identify key hazards and risks in an automotive environment	
4.2 describe policies and procedures for reporting hazards, risks, health and safety matters in the automotive environment.	
4.3 state precautions and procedures which need to be taken when working with vehicles, associated materials, tools and equipment.	
4.4 identify fire extinguishers in common use and which types of fire they should be used on	
4.5 identify key warning signs and their characteristics that are found in the vehicle repair environment.	
4.6 state the meaning of common product warning labels used in an automotive environment.	

<b>Learning outcome</b>	<b>The learner will:</b>
5. understand personal responsibilities	
<b>Assessment criteria</b>	
The learner can:	
5.1 explain the importance of personal conduct in maintaining the health and safety of the individual and others	
5.2 explain the importance of personal presentation in maintaining health safety and welfare.	

## Unit 601

# Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.**

### **Economic use of Resources**

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

### **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
- f. Manual Handling Operations Regulations 1992
- 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 e.g., electrical safety check log.

### **Legislation relevant to Health and Safety**

- a. HASAWA
- b. COSHH
- c. EPA
- d. Manual Handling Operations Regulations 1992
- 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
- e. Employers Liability (Compulsory Insurance) Act 1969 and Regulations 1998
- f. Confined Spaces Regulations 1997
- g. Noise at Work Regulations 1989
- h. Electricity at Work Regulations 1989
- i. Electricity (Safety) Regulations 1994
- j. Fire Precautions Act 1971
- k. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985
- l. Pressure Systems Safety Regulations 2000
- m. Waste Management 1991
- n. Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002
- o. Control of Asbestos at Work Regulations 2002.

### **Legislative duties**

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

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

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

### **PPE to include:**

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

- ii. ears
- iii. head
- iv. skin
- v. feet
- vi. hands
- vii. lungs.

### **Fire and extinguishers**

- a. Classification of fire types.
- b. Using a fire extinguisher effectively.
- c. Types of extinguishers:
  - i. foam
  - ii. dry powder
  - iii. CO<sub>2</sub>
  - 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 is 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.

## Unit 081

# Knowledge to Support Working Relationships in the Automotive Work Environment

<b>Level:</b>	Level 1
<b>GLH:</b>	28
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assessment
<b>Aim:</b>	This unit enables the learner to develop an understanding of how to keep good working relationships with all colleagues in the automotive work environment by using effective communication and support skills.

Learning outcome	The learner will:
1.	know key organisational structures, functions and roles within the automotive work environment
<b>Assessment criteria</b>	
The learner can:	
1.1 list the main sections which may be found within a typical automotive work environment.	
1.2 outline typical organisational structures and lines of communication within an automotive work environment. to include:	
a. non franchised dealer	
b. franchised dealer	
1.3 state typical levels of responsibility within specific job roles in an automotive work environment. to include a:	
a. trainee	
b. skilled technician	
c. supervisor.	

Learning outcome	The learner will:
2.	know the importance of obtaining, interpreting and using information to support their job role within the automotive work environment
<b>Assessment criteria</b>	
The learner can:	
2.1 give examples of different sources of information and when they would be used within the automotive environment	
2.2 give examples of the legal requirements relating to the use of a vehicle on the road, including safety requirements.	
2.3 state the importance of obtaining correct information and working to recognised procedures and processes	

- 2.4 give examples of when replacement units and components must meet the original equipment specification
- 2.5 give examples of identification codes and how they are used.

<b>Learning outcome</b>	<b>The learner will:</b>
	3. know where different types of communication within the automotive work environment can be used.
<b>Assessment criteria</b>	
The learner can:	
3.1 give examples of alternative methods of communication and where they could be used within the automotive environment.	

<b>Learning outcome</b>	<b>The learner will:</b>
	4. know communication requirements when carrying out vehicle repairs in the automotive work environment
<b>Assessment criteria</b>	
The learner can:	
4.1 give examples of when it is important to communicate with a supervisor whilst carrying out repairs in the automotive environment	
4.2 state the importance of keeping records of vehicle repair information	
4.3 state why it is important to work to agreed timescales.	

<b>Learning outcome</b>	<b>The learner will:</b>
	5. know how to develop good working relationships with colleagues and customers in the automotive workplace
<b>Assessment criteria</b>	
The learner can:	
5.1 outline how to develop positive working relationships with colleagues and customers	
5.2 give examples of why it is important to accept other peoples' views and opinions within the workplace	
5.3 state why it is important to make and honour realistic commitments to colleagues and customers.	

## Unit 081

# Knowledge to Support Working Relationships in the Automotive Work Environment

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.**

### **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.
- d. Computer software / internet.
- e. Manufacturer.
- f. Diagnostic equipment.

### **Locating and using correct documentation and information for:**

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

### **Alternative methods of communication**

- a. Verbal.
- b. Signs and notices.
- c. Memos.
- d. Telephone.
- e. Electronic mail.
- f. Vehicle job card.
- g. Notice boards.
- h. SMS text messaging.

**Communication with a supervisor**

- a. Referral of problems.
- b. Reporting delays.
- c. Additional work identified during repair or maintenance.
- d. Keep others informed of progress.

**Agreed timescales**

- a. Relationship between time and cost.
- b. Customer expectation.

**Typical levels of responsibility within specific job roles in an automotive work environment**

- a. to include a:
  - i. trainee
  - ii. skilled technician
  - iii. supervisor.

## Unit 102

# Skills in Removing and Replacing Light Vehicle Engine Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	45
<b>Relationship to NOS:</b>	This unit is linked to LV02 Remove and Replace Motor Engine Units and Components.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop skills to remove and replace light vehicle combustion engine system components. It also covers the evaluation of performance of the replaced units and systems.

Learning outcome	The learner will:
1.	be able to work safely when carrying out removal and replacement activities
<b>Assessment criteria</b>	
The learner can:	
1.1	use suitable personal and vehicle protective equipment when working on light vehicle engine systems and components
1.2	work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: <ol style="list-style-type: none"> <li>a. damage to other vehicle systems</li> <li>b. damage to other vehicle components and units</li> <li>c. contact with leakage</li> <li>d. contact with hazardous substances</li> </ol>
1.3	prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.

Learning outcome	The learner will:
2.	be able to use relevant information to carry out the task
<b>Assessment criteria</b>	
The learner can:	
2.1	select suitable sources of technical information to support light vehicle engine unit and component removal and replacement activities including: <ol style="list-style-type: none"> <li>a. vehicle technical data</li> <li>b. removal and replacement procedures</li> <li>c. legal requirements</li> </ol>
2.2	use technical information to support light vehicle engine unit and component removal and replacement activities.

Learning outcome	The learner will:
3.	be able to use appropriate tools and equipment

**Assessment criteria**

The learner can:

- 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of motor vehicle engine system components
- 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements
- 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace motor vehicle engine systems.

**Learning outcome****The learner will:**

4. be able to carry out removal and replacement of light vehicle engine mechanical, lubrication and cooling units and components.

**Assessment criteria**

The learner can:

- 4.1 remove and replace the light vehicle's engine systems and components, adhering to the correct specifications and tolerances for the vehicle and following:
  - a. the manufacturer's approved removal and replacement methods
  - b. recognised workplace procedures
  - c. health and safety and environmental requirements
- 4.2 ensure that reassembled/replaced light vehicle engine units and components conform to the vehicle operating specification and any legal requirements
- 4.3 use suitable testing methods to evaluate the performance of the reassembled system
- 4.4 complete all system remove and refit activities within the agreed timescale.

**Learning outcome****The learner will:**

5. be able to record information and make suitable recommendations

**Assessment criteria**

The learner can:

- 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required
- 5.2 make suitable and justifiable recommendations for cost effective repairs
- 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly
- 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.



## Unit 103

# Skills in Removing and Replacing Light Vehicle Electrical Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	54
<b>Relationship to NOS:</b>	This unit is linked to LV03 Remove and Replace Motor Electrical Units and Components.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop skills to remove and replace light vehicle engine system components. It also covers the evaluation of performance of the replaced units and systems.

<b>Learning outcome</b>	<b>The learner will:</b>
	1. be able to work safely when carrying out removal and replacement activities
<b>Assessment criteria</b>	
The learner can:	
1.1 use suitable personal and vehicle protective equipment when working on light vehicle electrical systems and components	
1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area	
1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

<b>Learning outcome</b>	<b>The learner will:</b>
	2. be able to use relevant information to carry out the task
<b>Assessment criteria</b>	
The learner can:	
2.1 select suitable sources of technical information to support light vehicle electrical unit and component removal and replacement activities including:	
a. vehicle technical data	
b. removal and replacement procedures	
c. legal requirements	
2.2 use technical information to support light vehicle electrical unit and component removal and replacement activities.	

<b>Learning outcome</b>	<b>The learner will:</b>
	3. be able to use appropriate tools and equipment
<b>Assessment criteria</b>	
The learner can:	

- 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of motor vehicle electrical system components
- 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements
- 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace motor vehicle electrical auxiliary systems.

<b>Learning outcome</b>	<b>The learner will:</b>
	4. be able to carry out removal and replacement of light vehicle electrical units and components.
<b>Assessment criteria</b>	
The learner can:	
4.1 remove and replace the motor vehicle's electrical systems and components, adhering to the specifications and tolerances for the vehicle and following: <ul style="list-style-type: none"> <li>a. the manufacturer's approved removal and replacement methods</li> <li>b. recognised researched repair methods</li> <li>c. health and safety and environmental requirements.</li> </ul>	
4.2 ensure that replacement electrical auxiliary units and components conform to the vehicle operating specification and any legal requirements	
4.3 use suitable testing methods to evaluate the performance of the reassembled system	
4.4 complete all the system remove and refit activities within the agreed timescale.	

<b>Learning outcome</b>	<b>The learner will:</b>
	5. be able to record information and make suitable recommendations
<b>Assessment criteria</b>	
The learner can:	
5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required	
5.2 make suitable and justifiable recommendations for cost effective repairs	
5.3 identify and report any expected delays in completion to the relevant person(s) promptly	
5.4 record and report any additional faults noticed during the course of their work promptly in the format required.	

## Unit 104

# Skills in Removing and Replacing Light Vehicle Chassis Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	45
<b>Relationship to NOS:</b>	This unit is linked to LV04 Remove and Replace Motor Vehicle Chassis Units and Components.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit allows the learner to develop skills to remove and replace light vehicle steering, suspension and braking units (including wheels and tyres). It also covers the evaluation of performance of the replaced units and systems.

<b>Learning outcome</b>	<b>The learner will:</b>
	1. be able to work safely when carrying out removal and replacement activities
<b>Assessment criteria</b>	
The learner can:	
1.1 use suitable personal and vehicle protective equipment throughout all light vehicle chassis unit and component removal and replacement activities	
1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area	
1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

<b>Learning outcome</b>	<b>The learner will:</b>
	2. be able to use relevant information to carry out the task
<b>Assessment criteria</b>	
The learner can:	
2.1 select suitable sources of technical information to support light vehicle chassis unit and component removal and replacement activities including:	
a. vehicle technical data	
b. removal and replacement procedures	
c. legal requirements	
2.2 use technical information to support light vehicle chassis unit and component removal and replacement activities.	

<b>Learning outcome</b>	<b>The learner will:</b>
	3. be able to use appropriate tools and equipment
<b>Assessment criteria</b>	
The learner can:	

- 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of light vehicle chassis systems including:
  - a. steering
  - b. suspension
  - c. braking
  - d. wheels and tyres
- 3.2 ensure that equipment has been calibrated to meet manufacturers and legal requirements
- 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace light vehicle chassis systems.

<b>Learning outcome</b>	<b>The learner will:</b>
4.	be able to carry out removal and replacement of light vehicle chassis units and components
<b>Assessment criteria</b>	
The learner can:	
4.1	remove and replace the light vehicle's chassis systems and components, adhering to the correct specifications and tolerances for the vehicle and following: <ul style="list-style-type: none"> <li>a. the manufacturer's approved removal and replacement methods</li> <li>b. recognised researched repair methods</li> <li>c. health and safety and environmental requirements</li> </ul>
4.2	ensure that replacement light vehicle chassis units and components conform to the vehicle operating specification and any legal requirements
4.3	use suitable testing methods to evaluate the performance of the reassembled system
4.4	ensure that the reassembled light vehicle chassis system performs to the vehicle operating specification and meets any legal requirements
4.5	complete all system diagnostic activities within the agreed timescale.

<b>Learning outcome</b>	<b>The learner will:</b>
5.	be able to record information and make suitable recommendations
<b>Assessment criteria</b>	
The learner can:	
5.1	ensure your records are accurate, complete and passed to the relevant person(s) in the agreed timescale and in the format required
5.2	make suitable and justifiable recommendations for cost effective repairs
5.3	identify and report any expected delays in completion to the relevant person(s) promptly in the format required
5.4	record and report any additional faults noticed during the course of their work promptly in the format required.

## Unit 112

## Skills in Removing and Replacing Light Vehicle Driveline Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	45
<b>Relationship to NOS:</b>	This unit is linked to LV12 Remove and Replace Light Vehicle Driveline Units and Components.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit allows the learner to develop skills in removing and replacing light vehicle transmission and driveline units. It also covers the evaluation of performance of the replaced units and systems.

Learning outcome	The learner will:
1	be able to work safely when carrying out removal and replacement activities
<b>Assessment criteria</b>	
The learner can	
1.1	use suitable personal and vehicle protective equipment when working on light vehicle transmission and driveline unit and component removal and replacement activities
1.2	work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: <ol style="list-style-type: none"> <li>damage to other vehicle systems</li> <li>damage to other vehicle components and units</li> <li>contact with leakage</li> <li>contact with hazardous substances</li> </ol>
1.3	prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.

Learning outcome	The learner will:
2	be able to use relevant information to carry out the task
<b>Assessment criteria</b>	
The learner can	
2.1	select suitable sources of technical information to support light vehicle transmission and driveline unit and component removal and replacement activities including: <ol style="list-style-type: none"> <li>vehicle technical data</li> <li>removal and replacement procedures</li> <li>legal requirements</li> </ol>
2.2	use technical information to support light vehicle transmission and driveline unit and component removal and replacement activities.

Learning outcome	The learner will:
3	be able to use appropriate tools and equipment

**Assessment criteria**

The learner can

- 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of light vehicle transmission and driveline systems
- 3.2 ensure that equipment has been calibrated to meet manufacturers and legal requirements
- 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace light vehicle transmission and driveline systems.

**Learning outcome****The learner will:**

- 4 be able to carry out removal and replacement of light vehicle transmission and driveline units and components

**Assessment criteria**

The learner can

- 4.1 remove and replace the light vehicle's transmission and driveline systems and components, adhering to the correct specifications and tolerances for the vehicle and following:
  - a. the manufacturer's approved removal and replacement methods
  - b. recognised workplace procedures
  - c. health and safety and environmental requirements
- 4.2 ensure that replacement/reassembled light vehicle transmission and driveline units and components conform to the vehicle operating specification and any legal requirements
- 4.3 use suitable testing methods to evaluate the performance of the reassembled system
- 4.4 complete all the system remove and refit activities within the agreed timescale.

**Learning outcome****The learner will:**

- 5 be able to record information and make suitable recommendations

**Assessment criteria**

The learner can

- 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required
- 5.2 make suitable and justifiable recommendations for cost effective repairs
- 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly
- 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.

## Unit 152

# Knowledge of Light Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	20
<b>Relationship to NOS:</b>	This unit is linked to LV02 Remove and Replace Light Vehicle Engine Units and Components.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop an understanding of light vehicle combustion engine, mechanical, lubrication and cooling system units and components when conducting routine maintenance, adjustment and replacement activities.

<b>Learning outcome</b>	<b>The learner will:</b>
1	understand how the main light vehicle engine mechanical systems operate
<b>Assessment criteria</b>	
The learner can	
1.1 describe how to work safely when carrying out removal and replacement activities, including:	
a. avoiding injury to self/others	
b. damage to vehicle systems, components and units	
c. contact with leakage and hazardous substances	
d. waste disposal (including environmental impact)	
e. when working on hybrid/electric and alternative fuel vehicles	
1.2 describe how combustion engine systems and their related units and components operate	
1.3 identify light vehicle engine mechanical system components	
1.4 describe the construction and operation of light vehicle engine mechanical systems	
a. four stroke	
b. spark ignition	
c. compression ignition	
d. rotary	
1.5 identify the key engineering principles that are related to light vehicle engine mechanical systems	
a. compression ratios	
b. cylinder capacity	
c. power	
d. torque	
1.6 state common terms used in light vehicle engine mechanical system design	
a. tdc	
b. bdc	
c. stroke	

d. bore.

<b>Learning outcome</b>	<b>The learner will:</b>
2	understand how light vehicle engine lubrication systems operate
<b>Assessment criteria</b>	
The learner can	
2.1 identify light vehicle engine lubrication system components	
2.2 describe the construction and operation of light vehicle engine lubrication components and systems, including:	
a. full flow	
b. bypass	
c. wet sump	
d. dry sump	
2.3 compare key light vehicle engine lubrication system components and assemblies to identify differences in construction and operation	
2.4 identify the key engineering principles that are related to light vehicle engine lubrication systems	
a. classification of lubricants	
b. properties of lubricants	
c. methods of reducing friction	
2.5 state common terms used in light vehicle engine lubrication system design.	

<b>Learning outcome</b>	<b>The learner will:</b>
3	understand how light vehicle engine cooling, heating and ventilation systems operate
<b>Assessment criteria</b>	
The learner can	
3.1 identify light vehicle engine cooling, heating and ventilation system components	
3.2 describe the construction and operation of light vehicle engine cooling, heating and ventilation systems	
3.3 compare key light vehicle engine cooling, heating and ventilation system components and assemblies against alternatives to identify differences in construction and operation	
3.4 identify the key engineering principles that are related to light vehicle engine cooling, heating and ventilation systems	
a. heat transfer	
b. linear and cubical expansion	
c. specific heat capacity	
d. boiling point of liquids	
3.5 state common terms used in key light vehicle engine cooling, heating and ventilation system design.	

<b>Learning outcome</b>	<b>The learner will:</b>
4	understand how to check, replace and test light vehicle engine mechanical, lubrication and cooling systems system units and components
<b>Assessment criteria</b>	
The learner can	
4.1 describe how to prepare, check and use all the removal and replacement equipment required	



- 4.2 describe how to remove and replace engine system mechanical and electrical unit and components
- 4.3 describe how combustion engine systems and their related units and components are constructed, dismantled and reassembled
- 4.4 identify the properties of jointing materials and when and where they should be used including gaskets, sealants, fittings and fasteners
- 4.5 explain the relationship between testing methods and the engine units and components being replaced
- 4.6 describe common types of testing methods used to check the operation of engine mechanical, lubrication and cooling systems and their purpose
- 4.7 describe how to test and evaluate the performance of replacement engine units and components and the reassembled system against vehicle operating specifications and any legal requirements
- 4.8 identify common faults found in light vehicle engine mechanical, lubrication and cooling systems and their causes.
- 4.9 identify manufacturers' specifications for the type and quality of engine units and components to be used.

## Unit 152

# Knowledge of Light Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.**

### Engines

Knowledge to include, inspection, adjustment and recording findings, including for Hybrid and alternative fuel vehicles and components.

- a. Engine types and configurations:
  - i. inline
  - ii. flat
  - iii. vee
  - iv. rotary
  - v. four-stroke cycle and two-stroke cycle for spark ignition and compression ignition engines
  - vi. naturally aspirated and forced induction engines
  - vii. hybrid/alternative fuel engines.
- b. Relative advantages and disadvantages of different engine types and configurations.
- c. Engine components and layouts:
  - i. single (OHC) and multi camshaft (DOHC)
  - ii. single and multi-cylinder (2, 4, 6, 8-cylinder types).
- d. Cylinder head layout and design, combustion chamber and piston design including:
  - i. tdc
  - ii. bdc
  - iii. bore
  - iv. stroke.
- e. Calculate compression ratios and cylinder volume for given data.
- f. The procedures used when inspecting engines.
- g. 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.
- h. 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. The advantages and disadvantages of wet and dry systems.
- b. Engine lubrication system:
  - i. splash and pressurised systems
  - ii. full flow systems
  - iii. pumps
  - iv. pressure relief valve
  - v. bypass valve
  - vi. filters
  - vii. oil galleries
  - viii. oil coolers.
- c. Terms associated with lubrication and engine oil:
  - i. full flow
  - ii. hydrodynamic
  - iii. boundary
  - iv. viscosity
  - v. natural and synthetic oil
  - vi. viscosity index
  - vii. multi-grade.
- d. The requirements and features of engine oil:
  - i. operating temperatures
  - ii. pressures
  - iii. lubricant grades
  - iv. viscosity
  - v. multi-grade oil
  - vi. additives
  - vii. detergents
  - viii. dispersants
  - ix. antioxidants inhibitors
  - x. anti-foaming agents
  - xi. anti-wear
  - xii. synthetic oils
  - xiii. organic oils
  - xiv. mineral oils.
- e. Symptoms and faults associated with lubrication systems:
  - i. excessive oil consumption

- ii. oil leaks
  - iii. oil in water
  - iv. low or excessive pressure
  - v. oil contamination.
- f. The procedures used when inspecting lubrication system operation.

### **Cooling, Heating and Ventilation**

- a. The components, operating principles, and functions of engine cooling systems.
- 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. heater matrix and temperature control systems
  - iv. expansion tanks hoses, clips and pipes
  - v. thermostats water pumps and coolant
  - vi. 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. hydrometer, or anti-freeze testing equipment
  - iv. chemical tests for the detection of combustion gas.
- d. The layout and construction of internal heater systems.
- e. The controls and connections within internal heater system.
- f. Symptoms and faults associated with cooling systems:
  - i. coolant leaks
  - ii. coolant 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**

- h. The preparation, testing and use of tools and equipment used for:
  - i. dismantling and refitting
  - ii. removal and replacement of engine units and components including electrical equipment.
- i. Appropriate safety precautions:
  - i. personal protective equipment (PPE)
  - ii. vehicle protective equipment (VPE)
  - iii. removal and replacing engine units and components.
- j. The importance of logical and systematic processes.
- k. The inspection and testing of engine units and components.
- l. The preparation of replacement units for re-fitting or replacement.
- m. The reasons why replacement components and units must meet the original specifications - Original Equipment manufacturer (OEM) – warranty requirements, to maintain performance and safety requirements.
- n. Refitting procedures.

- o. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
- p. Manufacturer's recommended work times, job times set by your company, or a job time agreed with a specific customer.
- q. 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
  - iv. testing and programming components for correct operation (as necessary)
  - v. cancelling of any fault codes and warning lights
  - vi. documentation completed prior to handover to customer (electronic/written)
  - vii. explanation to customer of work completed (if applicable).

## Unit 153

# Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	45
<b>Relationship to NOS:</b>	This unit is linked to LV03 Remove and Replace Light Vehicle Electrical Units and Components.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop an understanding of the principles, construction and operation and testing methods of common electrical and electronic systems and components. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	The learner will:
1	understand light vehicle electrical and electronic principles
<b>Assessment criteria</b>	
1.1	describe how to work safely when working on light vehicle electrical units and components, including: <ol style="list-style-type: none"> <li>avoiding injury to self/others</li> <li>damage to vehicle systems, components and units</li> <li>contact with leakage and hazardous substances</li> <li>waste disposal (including environmental impact)</li> </ol>
1.2	identify electrical symbols and units found in light vehicle circuits
1.3	interpret simple light vehicle wiring diagrams
1.4	describe the types and operation of light vehicle circuit protection devices and why these are necessary
1.5	describe earthing principles and earthing methods
1.6	identify the use of different cables and connectors used in light vehicle circuits
1.7	describe the operation and application of electrical and electronic sensors and actuators
1.8	identify the key electrical and electronic control principles that are related to light vehicle electrical circuits
1.9	state common terms used in light vehicle electrical circuits
1.10	identify the hazards associated with working on or near Hybrid/electric and alternative fuel vehicles and components.

Learning outcome	The learner will:
2	understand how light vehicle batteries, starting, charging, warning systems and components operate

<b>Assessment criteria</b>	
The learner can	
2.1	identify light vehicle batteries, starting, charging, warning systems and components
2.2	describe the construction and operation of light vehicle batteries, starting, charging, warning systems and components
2.3	describe how to remove and replace batteries, starting, charging, warning systems and components
2.4	compare light vehicle batteries, starting, charging, warning systems and components and assemblies against alternatives to identify differences in construction and operation
2.5	state common terms used in conjunction with light vehicle batteries, starting, charging, warning systems and components.

<b>Learning outcome</b>	<b>The learner will:</b>
3	understand how light vehicle auxiliary electrical systems operate
<b>Assessment criteria</b>	
The learner can	
3.1	identify light vehicle auxiliary system components
3.2	describe the construction and operation of light vehicle auxiliary systems, including: <ul style="list-style-type: none"> <li>a. lighting</li> <li>b. wiper</li> <li>c. security and alarm</li> <li>d. comfort and convenience (including refrigerant legal requirements)</li> <li>e. information and entertainment</li> <li>f. telephone and communication</li> <li>g. electric window</li> <li>h. monitoring and instrumentation</li> </ul>
3.3	compare key light vehicle auxiliary system components and assemblies against alternatives to identify differences in construction and operation
3.4	state common terms used in light vehicle auxiliary system design.

<b>Learning outcome</b>	<b>The learner will:</b>
4	understand how to check, replace and test light vehicle electrical systems and components
<b>Assessment criteria</b>	
The learner can	
4.1	describe how to remove and replace light vehicle electrical system units and components
4.2	describe the hazards associated with working on or near Hybrid/electric and alternative fuel vehicles and components
4.3	describe common and appropriate types of testing methods used to check the operation of light vehicle electrical systems and components and their purpose
4.4	explain how to test evaluate the performance of replacement electrical units and components and the reassembled system against vehicle operating specifications and legal requirements
4.5	identify common faults found in light vehicle electrical systems and components.

## Unit 153

# Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.**

Knowledge to include Hybrid/electrical and alternative fuel vehicles.

### Electrical/electronic principles

- a. The requirements for an electrical circuit:
  - i. battery
  - ii. cables
  - iii. switch
  - iv. current consuming device
  - v. continuity.
- b. Electrical units:
  - i. volt (electrical pressure)
  - ii. ampere (electrical current)
  - iii. ohm (electrical resistance)
  - iv. watt (power).
- c. The direction of current flow and electron flow.
- d. Series and parallel circuits to include:
  - i. current flow
  - ii. voltage of components
  - 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. Methods of electronic communication systems (including multiplexing)
- j. The meaning of:
  - i. short circuit
  - ii. open/complete circuit
  - iii. bad earth
  - iv. high resistance
  - v. earth return circuits.
- k. The principles of vehicle electronic systems and components.
- l. Interpret vehicle wiring diagrams to include:



- i. vehicle lighting
  - ii. auxiliary circuits
  - iii. warning circuits
  - iv. comfort and convenience systems
  - v. starting and charging systems.
- m. Function and construction of electrical components including:
- i. circuit relays
  - ii. bulb types
  - iii. fan and heater
  - iv. circuit protection.
- n. 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 (high voltage systems)
  - v. protection of electrical and electronic components
  - vi. protection of circuits from overload or damage.
- o. The set-up and use of:
- i. digital multi-meters
  - ii. voltmeter
  - iii. ammeter/amp clamp
  - iv. ohmmeter
  - v. oscilloscope
  - vi. manufacturer's dedicated test equipment.
- p. 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).
- q. 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. different types of automotive batteries
  - ii. cells
  - iii. separators
  - iv. plates
  - v. 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, gear reduction.: and pre-engaged principles.
- b. The function and operation of the following components:
  - i. gear reduction 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**

- a. Function and construction of electrical components including:
  - i. front and tail lamps
  - ii. main and dip beam headlamps
  - iii. fog and spot lamps
  - iv. lighting and dip switch
  - v. directional indicators.
  - vi. daytime running lights
- b. The circuit diagram and operation of components for:
  - i. side and tail lamps
  - ii. headlamps
  - iii. interior lamps
  - iv. fog and spot lamps
  - v. direction indicators.
  - vi. daytime running lights.
- c. The statutory requirements for vehicle lighting when using a vehicle on the road.
- d. Headlamp adjustment and beam setting.

## Auxiliary systems

- e. Auxiliary
  - i. function and operation of electrical components including:
  - ii. satellite navigation
  - iii. blue tooth systems
  - iv. cruise control including adaptive
  - v. speed limiter
  - vi. electric folding roof
  - vii. immobiliser
  - viii. keyless entry
  - ix. self-parking
  - x. parking sensors
  - xi. reverse camera
  - xii. steering wheel controls
  - xiii. airbags
  - xiv. supplementary restraint systems
  - xv. Tyre Pressure Monitoring Systems (TPMS)
  - xvi. digital dashboard
  - xvii. smart phone integration
  - xviii. tracking and vehicle shut down devices
  - xix. active window displays
  - xx. automatic high beam control
  - xxi. vehicle to vehicle communication
  - xxii. automatic tailgate/boot opening
  - xxiii. lane departure warning
  - xxiv. lane assist
  - xxv. blind spot alert
  - xxvi. collision warning
  - xxvii. wi-fi connectivity
  - xxviii. voice recognition
  - xxix. Hybrid and electric charging systems
  - xxx. heated seats
  - xxxi. electrically adjusted seats
  - xxxii. heated screens
  - xxxiii. electric mirrors
  - xxxiv. climate control
  - xxxv. air conditioning
  - xxxvi. any other current/state of art safety/comfort/convenience features.

## General

- a. How to prepare, check and use removal and replacement:
  - i. tools and equipment
  - ii. electrical testing equipment and equipment used for dismantling
  - iii. removal and replacement of electrical and electronic systems and components.
- b. Appropriate safety precautions:
  - i. Protective Protection Equipment (PPE)
  - ii. vehicle protection (VPE) when dismantling
  - iii. removal of and replacing electrical and electronic components and systems

- iv. the hazards associated with working on or near hybrid/electric and alternative fuel vehicles and components.
- 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. 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
  - iv. testing and programming components for correct operation (as necessary)
  - v. cancelling of any fault codes and warning lights.
  - vi. documentation completed prior to handover to customer (electronic/written)
  - vii. explanation to customer of work completed (if applicable).

## Unit 154

# Knowledge in Removing and Replacing Light Vehicle Chassis Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	45
<b>Relationship to NOS:</b>	This unit is linked to LV04 Remove and Replace Light Vehicle Chassis Units and Components.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop an understanding of the construction and operation of common steering, suspension and braking systems (including wheels and tyres). It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	The learner will:
1	understand how light vehicle steering and suspension systems operate
<b>Assessment criteria</b>	
The learner can	
1.1 describe how to work safely when working on chassis units and components, including: <ol style="list-style-type: none"> <li>a. avoiding injury to self/others</li> <li>b. damage to vehicle systems, components and units</li> <li>c. contact with leakage and hazardous substances</li> <li>d. waste disposal (including environmental impact)</li> <li>e. when working on hybrid/electric and alternative fuel vehicles.</li> </ol>	
1.2 identify light vehicle steering and suspension system components	
1.3 describe the construction and operation of light vehicle steering and suspension systems	
1.4 compare key light vehicle steering and suspension system components and assemblies against alternatives to identify differences in construction and operation	
1.5 identify the key engineering principles that are related to light vehicle steering and suspension systems, including: <ol style="list-style-type: none"> <li>a. steering angles</li> <li>b. hydraulic forces</li> <li>c. stress and strain</li> </ol>	
1.6 state common terms used in light vehicle steering and suspension system design.	

Learning outcome	The learner will:
2	understand how light vehicle braking systems operate
<b>Assessment criteria</b>	

- The learner can
- 2.1 identify light vehicle braking system components
  - 2.2 describe the construction and operation of light vehicle braking systems
  - 2.3 compare key light vehicle braking system components and assemblies against alternatives to identify differences in construction and operation
  - 2.4 identify the key engineering principles that are related to light vehicle braking systems, including:
    - a. laws of friction
    - b. hydraulics
    - c. pneumatics
    - d. properties of fluids
    - e. properties of air
    - f. braking efficiency
  - 2.5 state common terms used in light vehicle braking system design.

<b>Learning outcome</b>	<b>The learner will:</b>
3	understand how light vehicle wheel and tyre systems operate
<b>Assessment criteria</b>	
<p>The learner can</p> <ol style="list-style-type: none"> <li>3.1 identify light vehicle wheel and tyre components</li> <li>3.2 describe the construction and operation of light vehicle wheels and tyres</li> <li>3.3 compare key light vehicle wheel and tyre components and assemblies against alternatives to identify differences in construction and operation</li> <li>3.4 identify the key engineering principles that are related to light vehicle wheel and tyre systems, including:           <ol style="list-style-type: none"> <li>a. friction</li> <li>b. un-sprung weight</li> <li>c. dynamic and static balance</li> </ol> </li> <li>3.5 state common terms used in light vehicle wheel and tyre design.</li> </ol>	

<b>Learning outcome</b>	<b>The learner will:</b>
4	understand how to check, replace and test light vehicle chassis units and components
<b>Assessment criteria</b>	
<p>The learner can</p> <ol style="list-style-type: none"> <li>4.1 describe how to remove and replace chassis units and components</li> <li>4.2 describe the hazards associated with working on or near Hybrid/electric and alternative fuel vehicles and components</li> <li>4.3 describe the common and appropriate types of testing methods used to check the operation of chassis units and components and their purpose</li> <li>4.4 explain how to test and evaluate the performance of replacement chassis system units and components and the reassembled system against vehicle operating specifications and legal requirements</li> <li>4.5 identify common faults found in light vehicle chassis units and components.</li> </ol>	

## Unit 154

# Knowledge in Removing and Replacing Light Vehicle Chassis Units and Components

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.**

Knowledge to include Hybrid/electrical and alternative fuel vehicles.

### Steering

- a. The action and purpose of steering geometry:
  - i. castor angle
  - ii. camber angle
  - iii. kingpin or swivel pin inclination
  - iv. wheel/rim offset
  - v. wheel alignment (tracking) (toe in and toe out)
  - vi. toe out on turns
  - vii. four-wheel alignment.
- b. The following terms associated with steering:
  - i. Ackerman principle
  - ii. slip angles
  - iii. self-aligning torque oversteer and understeer
  - iv. neutral steer.
- c. The components and layout of hydraulic power steering systems:
  - i. piston and power cylinders
  - ii. drive belts and pumps
  - iii. hydraulic valve (rotary, spool and flapper type)
  - iv. hydraulic fluid.
- d. The advantages of power assisted steering.
- e. The operation of hydraulic power steering.
- f. The principles of electric 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. flats on tread
  - v. steering vibrations

- vi. wear in linkage
- vii. damage linkage
- viii. incorrect wheel alignment
- ix. incorrect steering geometry.

## **Suspension**

- a. The layout and components of suspension systems:
  - i. non-independent suspensions
  - ii. independent front suspension (IFS)
  - iii. independent rear suspension (IRS)
  - iv. hydraulic
  - v. pneumatic
  - vi. rigid axle types.
- b. The operation of suspension systems and components:
  - i. leaf and coil springs
  - ii. torsion bar
  - iii. rubber springs
  - iv. Macpherson strut system
  - v. hydraulic
  - vi. pneumatic
  - vii. hydraulic dampers
  - viii. trailing arms
  - ix. wish bones
  - x. ball joints
  - xi. track control arms
  - xii. bump stops
  - xiii. anti-roll bars
  - xiv. stabiliser bars
  - xv. swinging arms
  - xvi. parallel link
  - xvii. swinging half-axles
  - xviii. transverse link
  - xix. semi-swinging arms.
- c. The advantages of different systems including:
  - i. non-independent
  - ii. independent suspension (IFS)
  - iii. independent suspension (IRS)
  - iv. hydraulic
  - v. hydro-pneumatic
  - vi. rigid axle.
- d. The principles of electronic 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. float
  - 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. ride height (unequal and low)
  - ii. wear
  - iii. noises under operation
  - iv. fluid leakage
  - v. excessive travel
  - vi. excessive tyre wear
  - vii. bounce
  - viii. poor vehicle handling
  - ix. worn dampers
  - x. worn joints
  - xi. damaged linkages.

### **Brakes**

- a. The construction and operation of drum brakes:
  - i. leading and trailing shoe construction
  - ii. self-servo action
  - iii. automatic adjusters
  - iv. backing plates
  - v. parking brake system.
- b. The construction and operation of disc brakes:
  - i. disc pads
  - ii. caliper
  - iii. brake disc
  - iv. ventilated disc
  - v. disc pad retraction
  - vi. parking brake system
  - vii. electrical and electronic components
  - viii. wear indicators and warning lamps.
- c. The construction and operation of the hydraulic braking system:
  - i. dual line layout
  - ii. master cylinders
  - iii. wheel cylinders
  - iv. disc brake caliper and pistons
  - v. brake pipe
  - vi. brake servo
  - vii. warning lights
  - viii. parking brakes
  - ix. load sensing valve/brake proportioning valve.
- d. The principles and components of electronic ABS systems, electrical and electronic components.
- e. 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.
- f. Terms associated with mechanical and hydraulic braking systems:
  - i. braking efficiency
  - ii. brake fade
  - iii. brake imbalance
  - iv. ABS.
- g. The procedures used for inspecting the serviceability and condition of the braking system.
- h. Braking system defects:
  - i. worn shoes or pads
  - ii. worn or scored brake surfaces
  - iii. abnormal brake noises
  - iv. brake judder
  - v. fluid contamination of brake surfaces
  - vi. fluid leaks
  - vii. pulling to one side
  - viii. poor braking efficiency
  - ix. lack of servo assistance
  - x. brake drag
  - xi. brake grab
  - xii. brake fade.

### **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 and wire wheels
  - iii. well based wheel rims.
- d. Types of bearing used for wheel bearing arrangements:
  - i. roller
  - ii. taper roller
  - iii. needle
  - iv. ball and plain.
- e. The procedures used for inspecting the serviceability and condition of:

- i. tyres & wheels
- ii. bearings.
- f. The defects associated with tyres and wheels:
  - i. abnormal tyre wear
  - ii. cuts
  - iii. puncture and puncture repair
  - iv. side wall damage
  - v. wheel vibrations
  - vi. tyre noise (squeal during cornering)
  - vii. tyre over heating (low pressure)
  - viii. tread separation
  - ix. tyre pressure monitoring systems (TPMS) including valves.

### **General**

- a. The procedures for dismantling, removal and replacement of chassis system components including the preparation of:
  - i. testing and use of tools and equipment
  - ii. electrical meters
  - iii. removing and replacing chassis systems and components.
- b. Appropriate safety precautions:
  - i. personal protective equipment (PPE)
  - ii. vehicle protective equipment (VPE)
  - 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, including original equipment manufacturer (OEM):
  - 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
  - iv. testing and programming components for correct operation (as necessary)
  - v. cancelling of any fault codes and warning lights.
  - vi. documentation completed prior to handover to customer (electronic/written)
  - vii. explanation to customer of work completed (if applicable).

## Unit 162

# Knowledge of Light Vehicle Transmission and Driveline Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	45
<b>Relationship to NOS:</b>	This unit is linked to LV12 Remove and Replace Light Vehicle Driveline Units and Components.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop an understanding of the construction and operation of common transmission and driveline systems. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	The learner will:
1	understand how light vehicle clutch systems operate
<b>Assessment criteria</b>	
The learner can	
1.1 describe how to work safely when working on light vehicle transmission and driveline units and components, including: <ol style="list-style-type: none"> <li>a. avoiding injury to self/others</li> <li>b. damage to vehicle systems, components and units</li> <li>c. contact with leakage and hazardous substances</li> <li>d. waste disposal (including environmental impact)</li> <li>e. when working on hybrid/electric and alternative fuel vehicles.</li> </ol>	
1.2 identify light vehicle clutch system components	
1.3 describe the construction and operation of light vehicle clutch systems	
1.4 compare key light vehicle clutch system components and assemblies against alternatives to identify differences in construction and operation	
1.5 identify the key engineering principles that are related to light vehicle clutch systems to include: <ol style="list-style-type: none"> <li>a. principles of friction</li> <li>b. principle of levers</li> <li>c. torque transmission</li> </ol>	
1.6 state common terms used in light vehicle clutch system design.	

<b>Learning outcome</b>	<b>The learner will:</b>
2	understand how light vehicle manual gearbox systems operate
<b>Assessment criteria</b>	
The learner can	
2.1 identify light vehicle manual gearbox system components	
2.2 describe the construction and operation of light vehicle manual gearbox systems.	
2.3 compare key light vehicle manual gearbox system components and assemblies against alternatives to identify differences in construction and operation	
2.4 identify the key engineering principles that are related to light vehicle manual gearbox systems	
a. gear ratios	
b. torque multiplication	
2.5 state common terms used in light vehicle manual gearbox system design.	

<b>Learning outcome</b>	<b>The learner will:</b>
3	understand how light vehicle driveline systems operate
<b>Assessment criteria</b>	
The learner can	
3.1 explain how to find, interpret and use sources of information applicable to units and component removal and replacement within transmission and driveline systems	
3.2 describe the importance of using the correct sources of technical information, including identification codes	
3.3 identify light vehicle driveline components	
3.4 describe the construction and operation of light vehicle driveline systems	
3.5 compare key light vehicle driveline components and assemblies against alternatives to identify differences in construction and operation	
3.6 identify the key engineering principles that are related to light vehicle driveline systems	
a. final drive and overall gear ratios	
b. simple stresses	
3.7 state common terms used in light vehicle driveline design.	
3.8 explain the electrical and electronic principles associated with transmission and driveline systems including:	
a. vehicle earthing principles and earthing methods	
b. types of circuit protection	
c. electrical safety procedures	
d. electric symbols	
e. units and terms	
f. electronic control system principles	
3.9 describe the importance of work-based policies for the following:	
a. removal and refitting activities	
b. working to agreed timescales and keeping others informed of progress	
c. the relationship between time, costs and productivity.	

<b>Learning outcome</b>	<b>The learner will:</b>
4	understand how to check, replace and test transmission and driveline units and components
<b>Assessment criteria</b>	
The learner can	

- 4.1 describe how transmission and driveline systems operate and how their related units and components are constructed, removed and replaced
- 4.2 describe how to remove and replace transmission and driveline system mechanical, electrical and hydraulic/pneumatic units and components
- 4.3 identify the properties of jointing materials and when and where they should be used including gaskets, sealants, fittings and fasteners
- 4.4 describe common types of testing methods used to check the operation of transmission and driveline systems and their purpose
- 4.5 explain how to evaluate the performance of replacement units against vehicle specification
- 4.6 identify common faults found in light vehicle transmission and driveline systems and their causes.
- 4.7 explain 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
- 4.8 explain how to select the appropriate testing method for transmission and driveline systems following replacement of components
- 4.9 explain why replacement units and components must meet the original equipment manufacturer (OEM) for warranty or other requirements.

## Unit 162

# Knowledge of Light Vehicle Transmission and Driveline Units and Components

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.**

Knowledge to include Hybrid/electric and alternative fuel vehicles and components.

### **The operation of clutch operating systems**

- a. Clutch operating mechanisms
  - i. clutch fork and pedal assembly
  - ii. hydraulic operated
  - iii. mechanical
  - iv. cable operated
  - v. hydraulic components
  - vi. pneumatic
  - vii. master cylinder
  - viii. slave cylinder
  - ix. hydraulic pipes
  - x. 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. hydraulically and cable operated clutches
  - ii. coil spring clutches
  - iii. diaphragm spring clutches
  - iv. single plate clutches
  - v. multi plate clutches.

### **The operation of gearboxes**

- a. The reasons for fitting gearboxes, to provide neutral, reverse, torque multiplication.
- b. An awareness of different gearbox types:
  - i. transverse
  - ii. inline
  - iii. manual and semi-automated
  - iv. automatic
  - v. constantly variable transmission (CVT)
  - vi. direct shift gearbox (DSG)
  - vii. new technologies for transmission systems.
- c. The layout and construction of gears and shafts for different gear box 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 and gearbox lubrication
  - iv. speedometer drive.
- g. The electrical and electronic components including reverse lamp switch
- h. Calculate gear ratios and driving torque for typical gearbox specifications.

### **The operation of driveline components**

- a. The layout and construction of prop shafts and drive shafts used in front wheel, rear wheel and four-wheel 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.
- e. The simple stresses applied to shafts: torsional, axial, bending and shear.
- f. The construction and operation of:
  - i. final drive units
  - ii. crown wheel & pinion
  - iii. bevel
  - iv. hypoid and helical gears
  - v. differential gears
  - vi. sun & planet gears
  - vii. epicyclic gears
  - viii. lubricants
  - ix. lubrication bearings and seals
  - x. limited slip differential.
- 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 testing and inspection techniques used for light 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
  - 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) including:
  - i. security



- ii. serviceability of rubber boots
  - iii. leaks
  - iv. alignment
  - v. balance weights (where applicable).
- d. The techniques used when inspecting and testing final drive systems including:
- i. fluid levels
  - ii. leaks
  - iii. noise.

### **The faults and symptoms associated with vehicle transmissions systems**

- a. The faults and symptoms associated with transmission systems:
- i. clutch faults
  - ii. gearbox faults
  - iii. drive line faults (prop-shaft, drive shaft, universal and constant velocity joints)
  - iv. universal joint alignment
  - v. final drive 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. Personal protective equipment (PPE)
  - ii. vehicle protective equipment (VPE)
  - 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 (Original Equipment Manufacturer (OEM):
- i. warranty requirements
  - ii. to maintain performance
  - iii. safety requirements.
- g. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
- h. 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
  - iv. testing and programming components for correct operation (as necessary)
  - v. documentation completed prior to handover to customer (electronic/written)
  - vi. explanation to customer of work completed (if applicable).

### **Types of wheel bearing arrangements:**

- i. fully floating
- ii. three quarter floating
- iii. semi floating axles.

## Unit 172

# Knowledge of Light Vehicle Fuel, ignition, Air and Exhaust System Units and Components

<b>Level:</b>	Level 2
<b>GLH:</b>	20
<b>Relationship to NOS:</b>	This unit is linked to LV02 Remove and Replace Light Vehicle Engine Units and Components.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop an understanding of the construction, removal, replacement and operation of common fuel, ignition, air and exhaust systems. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	The learner will:
1	understand how light vehicle engine fuel systems operate
<b>Assessment criteria</b>	
The learner can	
1.1 describe how to work safely when carrying out removal and replacement activities, including: <ul style="list-style-type: none"> <li>a. avoiding injury to self/others</li> <li>b. damage to vehicle systems, components and units</li> <li>c. contact with leakage and hazardous substances</li> <li>d. waste disposal (including environmental impact)</li> <li>e. when working on hybrid/electric and alternative fuel vehicles.</li> </ul>	
1.2 describe how combustion engine systems and their related units and components operate	
1.3 identify light vehicle engine fuel system components	
1.4 describe the construction and operation of light vehicle engine fuel systems <ul style="list-style-type: none"> <li>a. multi point injection</li> <li>b. single point injection</li> <li>c. gasoline direct injection (GDI)</li> </ul>	
1.5 compare key light vehicle engine fuel system components and assemblies against alternatives to identify differences in construction and operation	
1.6 identify the key principles that are related to light vehicle engine fuel systems <ul style="list-style-type: none"> <li>a. properties of fuels</li> <li>b. combustion processes</li> <li>c. exhaust gas constituents</li> </ul>	
1.7 state common terms used in light vehicle engine fuel system design.	

Learning outcome	The learner will:
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2 understand how light vehicle engine ignition systems operate
<b>Assessment criteria</b>
<p>The learner can</p> <p>2.1 identify light vehicle engine ignition system components</p> <p>2.2 describe the construction and operation of light vehicle engine ignition systems</p> <p>2.3 compare key light vehicle engine ignition system components and assemblies against alternatives to identify differences in construction and operation</p> <p>2.4 identify the key principles that are related to light vehicle engine ignition systems</p> <p style="padding-left: 20px;">a. flame travel</p> <p style="padding-left: 20px;">b. ignition timing</p> <p>2.5 state common terms used in key light vehicle engine ignition system design.</p>

<b>Learning outcome</b>	<b>The learner will:</b>
3 understand how light vehicle engine air supply and exhaust systems operate	
<b>Assessment criteria</b>	
<p>The learner can</p> <p>3.1 identify light vehicle engine air supply and exhaust system components</p> <p>3.2 describe the construction and operation of light vehicle engine air supply and exhaust systems</p> <p style="padding-left: 20px;">a. supercharging</p> <p style="padding-left: 20px;">b. turbocharging</p> <p style="padding-left: 20px;">c. exhaust gas recirculation (egr)</p> <p style="padding-left: 20px;">d. diesel particulate filters (dpf)</p> <p style="padding-left: 20px;">e. catalytic converters</p> <p style="padding-left: 20px;">f. exhaust emission additive systems</p> <p>3.3 compare key light vehicle engine air supply and exhaust system components and assemblies against alternatives to identify differences in construction and operation</p> <p>3.4 identify the key principles that are related to light vehicle engine air supply and exhaust systems</p> <p style="padding-left: 20px;">a. sound absorption</p> <p style="padding-left: 20px;">b. reduction of harmful emissions</p> <p>3.5 state common terms used in key light vehicle engine air supply and exhaust system design.</p>	

<b>Learning outcome</b>	<b>The learner will:</b>
4 understand how to check, replace and test light vehicle engine fuel system units and components	
<b>Assessment criteria</b>	
<p>The learner can</p> <p>4.1 describe how to remove and replace fuel, ignition, air and exhaust systems units and components</p> <p>4.2 explain how combustion engine systems and their related units and components are constructed, dismantled and reassembled</p> <p>4.3 identify the properties of jointing materials and when and where they should be used including gaskets, sealants, fittings and fasteners</p> <p>4.4 describe common types of testing methods used to check the operation of engine fuel, air supply and exhaust systems and their purpose</p>	

- 4.5 describe how to evaluate the performance of replacement units against vehicle specification
- 4.6 explain common faults found in light vehicle fuel, air supply and exhaust systems and their causes
- 4.7 identify the manufacturer's specification for the type and quality of engine units and components to be used.

## Unit 172

# Knowledge of Light Vehicle Fuel, ignition, Air and Exhaust System Units and Components

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.**

Knowledge to include Hybrid and alternative fuel vehicles and components.

### Fuel - Petrol

- a. The function and layout of petrol injection systems:
  - i. single and multi-point systems
  - ii. injection components
  - iii. fuel pump
  - iv. injector(s)
  - v. air flow sensor
  - vi. throttle potentiometer
  - vii. idle speed control valve
  - viii. coolant sensor
  - ix. MAP and air temperature sensors
  - x. mechanical control devices
  - xi. electronic control units
  - xii. fuel pressure regulators
  - xiii. fuel pump relays
  - xiv. lambda exhaust sensors
  - xv. flywheel and camshaft sensors
  - xvi. air flow sensors (air flow meter and air mass meter)
  - xvii. EGR valve.
  - xviii. additional manufacturers specific sensors/actuators
- b. The operation of single, multi-point and Gasoline Direct Injection (GDI) petrol injection systems and components:
  - i. fuel pump
  - ii. single and multi-point systems
  - iii. injection components
  - iv. injector(s)
  - v. air flow sensor
  - vi. throttle potentiometer
  - vii. mechanical control devices
  - viii. idle speed control valve
  - ix. coolant sensor
  - x. MAP and air temperature sensors
  - xi. electronic control units

- xii. fuel pressure regulators
  - xiii. fuel pump relays
  - xiv. lambda exhaust sensors
  - xv. flywheel and camshaft sensors
  - xvi. air flow sensors (air flow meter and air mass meter)
  - xvii. EGR valve
  - xviii. additional manufacturers specific sensors/actuators.
- c. The procedures used when inspecting petrol system.

### **Fuel – Diesel**

- a. The layout and construction of inline, rotary, common rail and unit injection type diesel systems.
- b. The principles and requirements of compression ignition engines:
  - i. combustion chambers (direct and indirect injection).
- c. The function and operation of diesel fuel injection components:
  - ii. fuel filters
  - iii. sedimenters
  - iv. injectors
  - v. injector types (direct and indirect injection)
  - vi. multi-hole and pintle nozzle designs
  - vii. governors
  - viii. fuel pipes
  - ix. glow plugs (heater plugs)
  - x. fuel cut-off devices
  - xi. electronic control systems and components.
- d. The construction, purpose and operation of:
  - i. turbochargers
  - ii. use of inter-coolers.
- e. Explain the procedures for injection pump timing
- f. The safety procedures used when inspecting and bleeding diesel system.

### **Fuel**

- a. The meaning of terms related to:
  - i. hydro-carbon fuels
  - ii. volatility
  - iii. calorific value
  - iv. flash point
  - v. octane value
  - vi. cetane value.
- b. The composition of hydro-carbon fuels:
  - i. % Hydrogen and carbon in petrol and diesel fuels.
- c. The composition of air (% nitrogen, oxygen), % of oxygen.
- d. The chemically correct air/fuel ratio for petrol engines as 14.7:1 (lambda 1, stoichiometric ratio).
- e. Weak and rich air/fuel ratios for petrol engines.
- f. Exhaust composition and by-products for chemically correct, rich and weak air/fuel ratios of petrol engines:
  - i. water vapour (H<sub>2</sub>O)
  - ii. nitrogen (N)
  - iii. carbon monoxide (CO)

- iv. carbon dioxide (CO<sub>2</sub>)
- v. carbon (C)
- vi. hydrocarbon (HC)
- vii. oxides of nitrogen (NO<sub>x</sub>, NO<sub>2</sub>, NO) and particulates, particulate matter (PM).
- g. The relative advantages and disadvantages of diesel and petrol engines.
- h. Symptoms and faults associated with fuel systems
  - i. diesel fuel system: air in fuel system, water in fuel, filter blockage, leaks, difficult starting, erratic running, excessive smoke (black, blue, white), engine knock, turbocharger faults
  - ii. petrol injection system: leaks, erratic running, excessive smoke, poor starting, poor performance, poor fuel economy, failure to start, exhaust emissions, running-on, excessive fuel consumption and surging.

## Ignition

- a. The layout of electronic ignition systems.
- b. Electronic ignition circuits and components:
  - i. LT Circuit
  - ii. battery
  - iii. ignition switch
  - iv. electronic trigger sensors
  - v. HT Circuit
  - vi. spark plugs (reach, heat range, electrode features and electrode polarity)
  - vii. ignition coil
  - viii. electronic ignition timing system
- c. The operation electronic system components:
  - i. amplifiers
  - ii. triggering systems
  - iii. inductive pick-ups
  - iv. hall generators
  - v. optical pulse generators
  - vi. control units.
- d. The operation of amplifier units.
- e. Ignition terminology:
  - i. electronic ignition control systems
  - ii. advance and retard of ignition timing
- f. The operation of electronic ignition systems under various conditions and loads to include:
  - i. engine idling
  - ii. during acceleration
  - iii. under full load
  - iv. cruising
  - v. overrun
  - vi. cold starting.
- g. The principles of engine management systems:
  - i. closed loop system
  - ii. integrated ignition
  - iii. injection systems
  - iv. sensors.
- h. The procedures used when inspecting:
  - i. ignition system

- ii. engine management
- iii. sensors.
- i. Symptoms and faults associated with ignition system operation:
  - i. Failure to start hot or cold,
  - ii. erratic running
  - iii. poor performance
  - iv. misfire
  - v. exhaust emissions irregularities
  - vi. ignition noise (pinking).

### **Air supply and exhaust systems**

- a. The construction, operation and purpose of air filtration systems.
- b. The construction, operation and purpose of the exhaust systems.
- c. Exhaust system design to include silencers, Diesel Particulate Filters (DPF) and catalytic converters.
- d. The procedures used when inspecting induction, air filtration and exhaust systems.
- e. Exhaust emission additive systems
- f. Positive Crankcase Ventilation (PCV) valve
- g. EVAP systems
- h. Symptoms and faults associated with air and exhaust systems:
  - i. exhaust gas leaks
  - ii. air leaks.

### **General**

- a. The preparation, testing and use of tools and equipment used for:
  - i. dismantling and reassembling
  - ii. removal and replacement of engine units and components.
- b. Appropriate safety precautions:
  - i. Personal Protective Equipment (PPE)
  - ii. Vehicle Protective Equipment (VPE)
  - iii. removal and replacing engine units and components.
- c. The importance of logical and systematic processes.
- d. The inspection and testing of engine units and components.
- e. The preparation of replacement units for re-fitting or replacement.
- f. The reasons why replacement components and units must meet the original specifications Original Equipment Manufacturers (OEM) – warranty requirements, to maintain performance and safety requirements.
- g. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
- h. 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
  - iv. testing and programming components for correct operation (as necessary)
  - v. cancelling of any fault codes and warning lights
  - vi. documentation completed prior to handover to customer (electronic/written)
  - vii. explanation to customer of work completed (if applicable).



## Unit 218

# Skills in Removing and Fitting of Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Vehicle Body Panels

<b>Level:</b>	Level 2
<b>GLH:</b>	20
<b>Relationship to NOS:</b>	This unit is linked to BP18 Remove and Fit Basic Motor Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Motor Vehicle Body Panels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to demonstrate they can carry out a range of removal and fitting of basic mechanical, electrical and trim (MET) components and non-permanently fixed light vehicle body panels. It also covers the evaluation of the operation of the components when fitted.

<b>Learning outcome</b>	<b>The learner will:</b>
1.	be able to work safely when carrying out removal and fitting of basic met components and non-permanently fixed light vehicle body panels
<b>Assessment criteria</b>	
The learner can:	
1.1	use suitable personal protective equipment and vehicle coverings throughout all light vehicle removal and fitting of basic met components and non-permanently fixed light vehicle body panels
1.2	work in a way which minimises the risk of damage or injury to the vehicle, people and the environment.

<b>Learning outcome</b>	<b>The learner will:</b>
2.	be able to use relevant information to carry out the task
<b>Assessment criteria</b>	
The learner can:	
2.1	select suitable sources of technical information to support light vehicle removal and fitting activities including: <ol style="list-style-type: none"> <li>a. vehicle technical data</li> <li>b. removal and fitting procedures</li> <li>c. legal requirements</li> </ol>
2.2	use technical information to support light vehicle removal and fitting activities.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	be able to use appropriate tools and equipment

**Assessment criteria**

The learner can:

- 3.1 select the appropriate tools and equipment necessary for carrying out removal and fitting of basic met components and non-permanently fixed light vehicle body panels
- 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements
- 3.3 use the correct tools and equipment in the way specified by manufacturers when carrying removal and fitting of basic met components and non-permanently fixed light vehicle body panels.

**Learning outcome****The learner will:**

- 4. be able to carry out removal and fitting of basic met components and non-permanently fixed light vehicle body panels

**Assessment criteria**

The learner can:

- 4.1 remove and fit basic met components and non-permanently fixed light vehicle body panels
- 4.2 ensure that the removal and fitting of basic met components and non-permanently fixed light vehicle body panels conforms to the vehicle operating specification and any legal requirements
- 4.3 ensure no damage occurs to other components when removal and fitting of basic met components and non-permanently fixed light vehicle body panels
- 4.4 ensure all components and panels are stored safely and in the correct location.

**Learning outcome****The learner will:**

- 5. be able to record information and make suitable recommendations

**Assessment criteria**

The learner can:

- 5.1 produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required
- 5.2 make suitable and justifiable recommendations for cost effective repairs
- 5.3 record and report any additional faults noticed during the course of their work promptly in the format required.

## Unit 268

# Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Vehicle Body Panels

<b>Level:</b>	Level 2
<b>GLH:</b>	20
<b>Relationship to NOS:</b>	This unit is linked to BP18 Remove and Fit Basic Motor Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Motor Vehicle Body Panels.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop an understanding of carrying out a range of removal and fitting of basic mechanical, electrical and trim (MET) components and non-permanently fixed light vehicle body panels. It also covers the evaluation of the operation of the components when fitted.

Learning outcome	The learner will:
1.	understand how to carry out removal and fitting of basic light vehicle mechanical electrical and trim (met) components
<b>Assessment criteria</b>	
The learner can:	
1.1	identify the procedures involved in carry out the systematic removal and fitting of basic light vehicle met components to the standard required including: <ol style="list-style-type: none"> <li>a. bumpers</li> <li>b. headlamp units</li> <li>c. road wheels</li> <li>d. batteries</li> <li>e. bonnet and boot trim</li> <li>f. interior trim components</li> <li>g. exterior trim components</li> </ol>
1.2	identify the procedures involved in working with supplementary safety systems when fitting basic light vehicle met components
1.3	identify the procedures involved in working with gas discharge headlamp systems when fitting basic light vehicle met components
1.4	explain the methods and procedures for storing removed light vehicle met components
1.5	identify the different types of fastenings and fixings used when removing and fitting light vehicle met components
1.6	explain the reasons for the use of different types of fastenings and fixings used in light vehicle met components
1.7	explain the procedures, methods and reasons for ensuring correct alignment of light vehicle met components

- 1.8 identify the quality checks that can be used to ensure correct alignment and operation of light vehicle met components
- 1.9 identify correct conformity of vehicle systems against light vehicle specification and legal requirements on completion
- 1.10 explain the procedure for reporting cosmetic damage to light vehicle met components and units.

<b>Learning outcome</b>	<b>The learner will:</b>
2.	understand how to carry out removal and fitting of basic light vehicle non permanently fixed vehicle body panels
<b>Assessment criteria</b>	
The learner can:	
2.1	identify the procedures involved in carry out the systematic removal and fitting of basic light vehicle non-welded, non-structural body panels to the standard required including: <ul style="list-style-type: none"> <li>a. wings</li> <li>b. doors</li> <li>c. bonnets</li> <li>d. boot lids and tailgates</li> <li>e. bumper bars, covers and components</li> </ul>
2.2	identify the procedures involved in working with supplementary safety systems when fitting basic light vehicle non-welded, non-structural body panels
2.3	explain the methods and procedures for storing removed light vehicle non-welded, non-structural body panels
2.4	identify the different types of fastenings and fixings used when removing and fitting light vehicle non-welded, non-structural body panels
2.5	explain the reasons for the use of different types of fastenings and fixings used in light vehicle non-welded, non-structural body panels
2.6	explain the procedures, methods and reasons for ensuring correct alignment of light vehicle non-welded, non-structural body panels
2.7	identify the quality checks that can be used to ensure correct alignment and operation of light vehicle non-welded, non-structural body panels
2.8	identify correct conformity of vehicle systems against light vehicle specification and legal requirements on completion
2.9	explain the procedure for reporting cosmetic damage to light vehicle non-welded, non-structural body panels.

## Unit 302

## Skills in Motorcycle Internal Engine Systems

<b>Level:</b>	Level 2
<b>GLH:</b>	45
<b>Relationship to NOS:</b>	This unit is linked to MC02 Remove and Replace Motorcycle Engine Units and Components.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop an understanding of the construction and operation of common motorcycle engine systems: mechanical, lubrication and cooling systems. It also covers the clutch and transmission systems. It covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

<b>Learning outcome</b>	<b>The learner will:</b>
1.	be able to work safely when carrying out removal and replacement activities
<b>Assessment criteria</b>	
The learner can:	
1.1	use suitable personal protective equipment and motorcycle coverings throughout all light motorcycle routine maintenance activities
1.2	work in a way which minimises the risk of damage or injury to the motorcycle, people and the environment.

<b>Learning outcome</b>	<b>The learner will:</b>
2.	be able to use relevant information to carry out the task
<b>Assessment criteria</b>	
The learner can:	
2.1	select suitable sources of technical information to support motorcycle engine power train unit and component removal and replacement activities including: <ul style="list-style-type: none"> <li>a. motorcycle technical data</li> <li>b. removal and replacement procedures</li> <li>c. legal requirements</li> </ul>
2.2	use technical information to support motorcycle engine power train unit and component removal and replacement activities.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	be able to use appropriate tools and equipment
<b>Assessment criteria</b>	
The learner can:	

- 3.1 select the appropriate tools and equipment necessary for removal and replacement of motorcycle engine power train systems
- 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements
- 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace light motorcycle engine systems.

<b>Learning outcome</b>	<b>The learner will:</b>
4.	be able to carry out removal and replacement of motorcycle electrical units and components
<b>Assessment criteria</b>	
<p>The learner can:</p> <ul style="list-style-type: none"> <li>4.1 remove and replace the motorcycle electrical systems and components, adhering to the correct specifications and tolerances for the motorcycle and following: <ul style="list-style-type: none"> <li>a. the manufacturer's approved and workplace removal and replacement methods</li> <li>b. recognised researched repair methods</li> <li>c. health and safety requirements</li> </ul> </li> <li>4.2 check that replaced motorcycle electrical units and components conform to the motorcycle operating specification and any legal requirements</li> <li>4.3 use suitable testing methods to evaluate the performance of the reassembled system</li> <li>4.4 ensure that the reassembled motorcycle electrical system performs to the motorcycle operating specification and meets any legal requirements.</li> </ul>	

## Unit 305

## Skills in Motorcycle Preparation and Inspection

<b>Level:</b>	Level 2
<b>GLH:</b>	20
<b>Relationship to NOS:</b>	This unit is linked to MC05 Carry Out Motorcycle Preparation and Inspections.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop skills in the assembly and pre delivery inspection preparation of motorcycles. In accordance with manufacturers' and legal requirements.

<b>Learning outcome</b>	<b>The learner will:</b>
1.	be able to work safely when carrying out motorcycle preparation activities and inspections
<b>Assessment criteria</b>	
The learner can:	
1.1	use suitable personal protective equipment and use suitable motorcycle coverings throughout all light motorcycle inspection activities
1.2	work in a way which minimises the risk of damage or injury to the motorcycle, people and the environment.

<b>Learning outcome</b>	<b>The learner will:</b>
2.	be able to use relevant information to carry out preparation activities and inspections of motorcycles
<b>Assessment criteria</b>	
The learner can:	
2.1	select suitable sources of technical information to support motorcycle inspection activities including: <ul style="list-style-type: none"> <li>a. motorcycle technical data</li> <li>b. inspection procedures</li> <li>c. legal requirements</li> </ul>
2.2	use technical information to support motorcycle inspection activities.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	be able to use appropriate tools and equipment to carry out preparation activities and inspections of motorcycles
<b>Assessment criteria</b>	
The learner can:	
3.1	select the appropriate tools and equipment necessary for carrying out preparation and inspections
3.2	ensure that equipment has been calibrated to meet manufacturers' and legal requirements
3.3	use the correct tools and equipment in the way specified by manufacturers when carrying out a range of inspections on motorcycle systems.

<b>Learning outcome</b>	<b>The learner will:</b>
4.	be able to carry out the preparation activities and inspections of motorcycles
<b>Assessment criteria</b>	
The learner can:	
4.1	carry out motorcycle preparation and inspections using prescribed methods, adhering to the correct specifications and tolerances for the motorcycle
4.2	ensure that inspected motorcycle conforms to the motorcycle operating specification and any legal requirements
4.3	ensure any comparison of the motorcycle against specification accurately identifies any differences from the motorcycle specification
4.4	use suitable testing methods to evaluate the performance of the inspected systems.

<b>Learning outcome</b>	<b>The learner will:</b>
5.	be able to record information and make suitable recommendations
<b>Assessment criteria</b>	
The learner can:	
5.1	produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required
5.2	make suitable and justifiable recommendations for cost effective repairs
5.3	record and report any additional faults noticed during the course of their work promptly in the format required.



## Unit 352

# Knowledge of Motorcycle Internal Engine Systems

<b>Level:</b>	Level 2
<b>GLH:</b>	20
<b>Relationship to NOS:</b>	This unit is linked to MC02 Remove and Replace Motorcycle Engine Units and Components.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	<p>This unit enables the learner to develop an understanding of the construction and operation of common engine power train systems: mechanical, lubrication and cooling systems. It also covers the clutch and transmission systems.</p> <p>It covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.</p>

Learning outcome	The learner will:
1.	understand how the main motorcycle engine mechanical systems operate
<b>Assessment criteria</b>	
The learner can:	
1.1 identify motorcycle engine mechanical system components	
1.2 describe the construction and operation of motorcycle engine mechanical systems.	
1.3 compare key engine mechanical system components and assemblies against alternatives to identify differences in construction and operation	
1.4 identify the key engineering principles that are related to engine mechanical systems:	
a. compression ratios	
b. cylinder capacity	
c. power	
d. torque	
1.5 state common terms used in motorcycle engine mechanical system design:	
a. tdc	
b. bdc	
c. stroke	
d. bore.	

Learning outcome	The learner will:
2.	understand how motorcycle engine lubrication systems operate
<b>Assessment criteria</b>	
The learner can:	
2.1 identify motorcycle engine lubrication system components	
2.2 describe the construction and operation of motorcycle engine lubrication components and systems	

- 2.3 compare key motorcycle engine lubrication system components and assemblies to identify differences in construction and operation
- 2.4 identify the key engineering principles that are related to motorcycle engine lubrication systems:
  - a. classification of lubricants
  - b. properties of lubricants
  - c. methods of reducing friction
- 2.5 state common terms used in motorcycle engine lubrication system design.

<b>Learning outcome</b>	<b>The learner will:</b>
	3. understand how motorcycle engine cooling systems operate
<b>Assessment criteria</b>	
The learner can:	
3.1 identify motorcycle engine cooling system components	
3.2 describe the construction and operation of motorcycle engine cooling systems	
3.3 compare key motorcycle engine cooling system components and assemblies against alternatives to identify differences in construction and operation	
3.4 identify the key engineering principles that are related to motorcycle engine cooling systems <ul style="list-style-type: none"> <li>a. heat transfer</li> <li>b. linear and cubical expansion</li> <li>c. specific heat capacity</li> <li>d. boiling point of liquids</li> </ul>	
3.5 state common terms used in key motorcycle engine cooling system design.	

<b>Learning outcome</b>	<b>The learner will:</b>
	4. understand how motorcycle clutch and transmission systems operate
<b>Assessment criteria</b>	
The learner can:	
4.1 identify motorcycle clutch and transmission system components	
4.2 describe the construction and operation of motorcycle clutch and transmission system components	
4.3 compare key motorcycle clutch and transmission system components and assemblies against alternatives to identify differences in construction and operation.	

<b>Learning outcome</b>	<b>The learner will:</b>
	5. understand how to check, replace and test power train systems, units and components
<b>Assessment criteria</b>	
The learner can:	
5.1 describe how to remove and replace power train systems, units and components	
5.2 describe common types of testing methods used to check the operation of engine power train systems and their purpose	
5.3 explain how to test and evaluate the performance of replacement units against motorcycle specification	
5.4 explain common faults found in motorcycle power train systems and their causes.	

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.**

### Engines

- a. Engine types and configurations:
  - i. inline
  - ii. flat
  - iii. vee
  - iv. four-stroke and two-stroke cycle for spark ignition engines
  - v. naturally aspirated and turbo-charged engines.
- b. Relative advantages and disadvantages of different engine types and configurations.
- c. Engine components and layouts:
  - i. single (OHC) and multi camshaft (DOHC)
  - ii. single and multi-cylinder (2, 3, 4, 6 - cylinder types)
  - iii. port design: inlet, transfer and exhaust.
- d. Cylinder head layout and design, combustion chamber and piston design.
- e. The procedures used when inspecting engines.
- f. 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.
- g. 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. The advantages and disadvantages of wet and dry systems.
- b. Engine lubrication system:
  - i. splash and pressurised systems
  - ii. pumps
  - iii. pressure relief valve
  - iv. filters
  - v. oil ways
  - vi. oil coolers.
- c. 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.
- d. The requirements and features of engine oil:
  - i. operating temperatures
  - ii. pressures
  - iii. lubricant grades
  - iv. viscosity
  - v. multi-grade oil
  - vi. additives
  - vii. detergents
  - viii. dispersants
  - ix. antioxidants inhibitors
  - x. anti-foaming agents
  - xi. anti-wear
  - xii. synthetic oils
  - xiii. organic oils
  - xiv. mineral oils.
- e. Symptoms and faults associated with lubrication systems:
  - i. excessive oil consumption
  - ii. oil leaks
  - iii. oil in water
  - iv. low or excessive pressure
  - v. oil contamination.
- f. The procedures used when inspecting lubrication system

## **Cooling**

- a. The components, operating principles, and functions of engine cooling systems.
- b. Procedures used to remove, replace and adjust cooling system components:
  - i. cooling fans and control devices
  - ii. fins and cowlings
  - iii. header tanks, radiators and pressure caps
  - iv. expansion tanks hoses, clips and pipes

- v. thermostats impellers and coolant.
- 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.
- d. Symptoms and faults associated with cooling systems:
  - i. water leaks
  - ii. water in oil
  - iii. blocked fins
  - iv. excessively low or high coolant temperature.
- e. The procedures used when inspecting cooling systems.

### **Clutch**

- a. The components, operating principles, and functions of clutches:
  - i. wet clutch
  - ii. dry clutch
  - iii. centrifugal
  - iv. cable control
  - v. hydraulic control.
- b. Procedures used to remove, replace and adjust clutch systems and components.
- c. The preparation and method of use of appropriate specialist equipment used to evaluate system performance following component replacement.
- d. Symptoms and faults associated with clutch systems:
  - i. slip
  - ii. drag.

### **Transmission**

- a. The components, operating principles, and function of transmission systems:
  - i. conventional gear
  - ii. CVT
  - iii. automatic.
- b. The operating components within transmission systems:
  - i. gears
  - ii. shafts
  - iii. selectors
  - iv. shift lever and drum mechanisms
  - v. bearings
  - vi. pulleys.
- c. The preparation and method of use of appropriate specialist equipment used to evaluate transmission system performance following component replacement.
- d. Procedures used to remove, replace and adjust transmission systems and components.
- e. Symptoms and faults associated with transmission systems:
  - i. abnormal noises
  - ii. vibration
  - iii. fluid leaks
  - iv. wear
  - v. gear selection.

## General

- a. The preparation, testing and use of tools and equipment used for:
  - i. dismantling
  - ii. removal and replacement of engine mechanical and power train system components.
- b. Appropriate safety precautions:
  - i. PPE
  - ii. motorcycle protection when dismantling
  - iii. removal of and replacing engine mechanical and power train units and components.
- c. The importance of logical and systematic processes.
- d. The inspection and testing of engine mechanical and power train 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. Re-fitting 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 motorcycle following repair to ensure customer satisfaction:
  - i. cleanliness of motorcycle
  - ii. security of components and fittings
  - iii. re-instatement of components and fittings.
- j. Construction and operation of motorcycle engine mechanical systems
  - i. four stroke
  - ii. two stroke.
- k. Key engineering principles that are related to engine mechanical systems
  - i. compression ratios
  - ii. volumetric efficiency
  - iii. cylinder capacity.
- l. Common terms used in motorcycle engine mechanical system design
  - i. tdc
  - ii. bdc
  - iii. stroke
  - iv. bore
  - v. ports.
- m. Construction and operation of motorcycle engine lubrication components and systems
  - i. full flow
  - ii. bypass
  - iii. wet sump
  - iv. dry sump
  - v. total loss.
- n. Key engineering principles that are related to motorcycle engine lubrication systems
  - i. classification of lubricants
  - ii. properties of lubricants
  - iii. methods of reducing friction.
- o. Common terms used in motorcycle engine lubrication system design

- p. Identify motorcycle engine cooling system components
  - i. air cooling
  - ii. liquid cooling
- q. Key engineering principles that are related to motorcycle engine cooling systems
  - i. heat transfer
  - ii. linear and cubical expansion
  - iii. specific heat capacity
  - iv. boiling point of liquids.
- r. Construction and operation of motorcycle clutch and transmission system components
  - i. dry clutch
  - ii. wet clutch
  - iii. constant mesh
  - iv. CVT
  - v. Automatic
  - vi. chain and sprocket
  - vii. shaft and gear
  - viii. belt and pulley.

## Unit 355

# Knowledge of Motorcycle Preparation and Inspection

<b>Level:</b>	Level 2
<b>GLH:</b>	20
<b>Relationship to NOS:</b>	This unit is linked to MC05 Carry Out Motorcycle Preparation and Inspections.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop an understanding of the assembly and pre delivery inspection preparation of both new and used motorcycles.

Learning outcome	The learner will:
1.	understand how to carry out preparation activities and inspections of motorcycles
<b>Assessment criteria</b>	
The learner can:	
1.1	explain the difference between the various motorcycle preparation activities and inspections
1.2	identify the different systems to be inspected when using inspection methods
1.3	identify the procedures involved in carrying out the preparation and inspection of motorcycles
1.4	identify correct conformity of motorcycle systems and condition on motorcycle inspections
1.5	compare test and inspection results against motorcycle specifications and legal requirements
1.6	explain how to record and complete the preparation and inspection results in the format required
1.7	identify the recommendations that can be made based on results of the motorcycle inspections
1.8	explain the implications of failing to carry out motorcycle preparation and inspection activities correctly
1.9	explain the implications of signing workplace documentation and motorcycle records
1.10	explain the procedure for reporting cosmetic damage to motorcycle components and units outside normal inspection items.



## Unit 355

## Knowledge of Motorcycle Preparation and Inspection

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.**

### **Assembly, pre and post work motorcycle inspections**

- a. PPE and motorcycle protection relating to:
  - i. motorcycle body panels and frame
  - ii. paint surfaces
  - iii. polished surfaces
  - iv. seats.
- b. Assembly, pre and post work motorcycle inspection procedures:
  - i. aural
  - ii. visual and functional assessments on engine
  - iii. engine systems
  - iv. chassis systems
  - v. wheels and tyres
  - vi. transmission system
  - vii. electrical and electronic systems
  - viii. exterior motorcycle body panels and frame.
- c. The methods for carrying out inspections for: damage, corrosion, fluid leaks, wear, security, mounting security and condition to include:
  - i. engines and engine systems
  - ii. chassis systems
  - iii. transmission systems
  - iv. brakes
  - v. steering
  - vi. suspension
  - vii. wheels
  - viii. tyres
  - ix. body panels and frame
  - x. electrical and electronic systems and components
  - xi. motorcycle seating and mirrors
  - xii. motorcycle instrumentation
  - xiii. driver controls.
- d. Check conformity to manufacturer's specifications and legal requirements.
- e. Completion of documentation to include:
  - i. inspection records
  - ii. job cards

- iii. motorcycle records.
- f. Make recommendations based on results of motorcycle inspections.
- g. The checks necessary to ensure customer satisfaction for:
  - i. motorcycle body panels
  - ii. paint surfaces
  - iii. polished surfaces
  - iv. chromed surfaces
  - v. seats and mirrors.
- h. Prepare and use appropriate inspection equipment and tools.
- i. Inspection procedures following inspection checklists.
- j. Various motorcycle preparation activities and inspections to include:
  - i. new motorcycle assembly
  - ii. pre and post work
  - iii. pre-delivery on new and used motorcycles
  - iv. MOT test
  - v. safety
  - vi. post repair.

## Unit 501

# Skills in Inspection, Repair and Replacement of Standard Light Vehicle Tyres

<b>Level:</b>	Level 1
<b>GLH:</b>	46
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will help the learner to develop the skills required to inspect, fit, repair and maintain standard light vehicle tyres.

Learning outcome	The learner will:
1.	be able to work safely when carrying out removal and replacement activities
<b>Assessment criteria</b>	
The learner can:	
1.1	use suitable personal protective equipment and vehicle coverings when working on vehicles
1.2	work in a way which minimises the risk of damage or injury to the vehicle, people and the environment.

Learning outcome	The learner will:
2.	be able to use light vehicle tyre inspection techniques
<b>Assessment criteria</b>	
The learner can:	
2.1	carry out inspection of wheels and tyres using appropriate techniques, suitable tools, equipment and manufacturers' instructions where relevant. to include:
a.	visual inspection
b.	measurement of tread depth
c.	tyre pressures
d.	balance.

Learning outcome	The learner will:
3.	be able to carry out the repair and replacement of standard light vehicle tyres
<b>Assessment criteria</b>	
The learner can:	
3.1	carry out tyre repair activities within appropriate timescales, using:
a.	suitable tools and equipment
b.	correct repair and replacement techniques
c.	correct type and size of replacement components
d.	correct materials

3.2 carry out tyre replacement activities within appropriate timescales.

<b>Learning outcome</b>	<b>The learner will:</b>
4. be able to balance wheels and carry out final checks on the vehicle	
<b>Assessment criteria</b>	
The learner can:	
4.1 carry out wheel balancing to within acceptable limits	
4.2 carry out final vehicle safety checks in the workshop, prior to releasing the vehicle to the customer.	

<b>Learning outcome</b>	<b>The learner will:</b>
5. be able to record information and make suitable recommendations	
<b>Assessment criteria</b>	
The learner can:	
5.1 produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required	
5.2 make suitable and justifiable recommendations for cost effective repairs	
5.3 record and report any additional faults noticed during the course of their work promptly in the format required.	

## Unit 503

# Skills in Inspection Repair and Replacement of Commercial Vehicle Tyres

<b>Level:</b>	Level 1
<b>GLH:</b>	44
<b>Relationship to NOS:</b>	This unit is linked to VF03.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will help the learner to develop the skills required to inspect, fit, repair and maintain high performance light vehicle tyres.

Learning outcome	The learner will:
1.	be able to work safely when carrying out removal and replacement activities
<b>Assessment criteria</b>	
The learner can:	
1.1	use suitable personal protective equipment and vehicle coverings when working on vehicles
1.2	work in a way which minimises the risk of damage or injury to the vehicle, people and the environment.

Learning outcome	The learner will:
2.	be able to inspect commercial vehicle wheels and tyres
<b>Assessment criteria</b>	
The learner can:	
2.1	inspect commercial vehicle wheels and tyres using appropriate techniques, suitable tools, equipment, technical information and manufacturers' instructions where relevant. to include:
a.	visual inspection
b.	measurement of tread depth
c.	tyre pressures.

Learning outcome	The learner will:
3.	be able to carry out the repair and replacement of commercial vehicle tyres, wheels and tubes
<b>Assessment criteria</b>	
The learner can:	
3.1	carry out tyre repair activities within appropriate timescales using:
a.	suitable tools and equipment
b.	correct repair techniques
c.	correct type and size of replacement components

- d. correct materials
- 3.2 carry out tyre replacement activities within appropriate timescales
- 3.3 carry out final checks to ensure that replaced and refitted tyres and valves are correctly fitted and conform to legal requirements prior to releasing the vehicle to the customer.

Learning outcome	The learner will:
4. be able to carry out tread regrooving on commercial vehicle tyres	
<b>Assessment criteria</b>	
The learner can:	
4.1 carry out tread re-grooving on suitable tyres, complying with legal requirements using: <ul style="list-style-type: none"> <li>a. suitable tools and equipment</li> <li>b. correct re-grooving techniques</li> <li>c. suitable personal protection</li> </ul>	
4.2 carry out final checks to ensure that re-grooved tyres meet manufacturers' and legal requirements prior to release to the customer.	

Learning outcome	The learner will:
5. be able to record information and make suitable recommendations	
<b>Assessment criteria</b>	
The learner can:	
5.1 produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required	
5.2 make suitable and justifiable recommendations for cost effective repairs	
5.3 record and report any additional faults noticed during the course of their work promptly in the format required.	

## Unit 544

## Skills in Receiving and Storing Stock

<b>Level:</b>	Level 1
<b>GLH:</b>	34
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will help the learner to develop the skills required to receive parts into storage, placing them correctly in location, updating stock control systems and completing documentation in a dealership, fast fit centre, parts distribution centre or similar situation.

<b>Learning outcome</b>	<b>The learner will:</b>
1. be able to accept parts deliveries	
<b>Assessment criteria</b>	
The learner can:	
1.1 check that parts delivered conform to the type, quality and quantity expected	
1.2 report any discrepancies in deliveries and storage to the relevant person promptly	
1.3 identify and use location systems and place parts in the correct location for storage	
1.4 store parts in a way that makes the best use of the space available and conforms to relevant regulations and practice and conforms with stock rotation requirements.	

<b>Learning outcome</b>	<b>The learner will:</b>
2. be able to deal with stock control systems and documentation	
<b>Assessment criteria</b>	
The learner can:	
2.1 enter details of stock received into the stock control system accurately	
2.2 complete receipt and storage documentation accurately, following company procedures.	

## Unit 551

# Knowledge in Inspection, Repair and Replacement of Standard Light Vehicle Tyres

<b>Level:</b>	Level 2
<b>GLH:</b>	24
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit will help the learner to develop an understanding of inspecting, fitting, repairing and maintaining standard light vehicle tyres and wheels.

<b>Learning outcome</b>	<b>The learner will:</b>
	1. know about light vehicle standard tyre's, legislation and special workplace procedures
<b>Assessment criteria</b>	
The learner can:	
1.1 state the main purpose of tyres	
1.2 identify the different types of standard light vehicle wheel and rim construction	
1.3 identify the types and application of light vehicle tyre construction.	
1.4 state the legal requirements for light vehicle tyres.	
1.5 state the relevant parts of the British and European standard for the repair of light vehicle tyres	
1.6 give examples of how to deal with specialist waste materials in their workplace.	

<b>Learning outcome</b>	<b>The learner will:</b>
	2. know about the tools and equipment used when working with light vehicle tyres
<b>Assessment criteria</b>	
The learner can:	
2.1 list the tools and equipment used when working with standard light vehicle tyres.	
2.2 state specialist maintenance requirements of wheel balancing and tyre removal and refitting machinery	

<b>Learning outcome</b>	<b>The learner will:</b>
	3. know about materials used in the repair of light vehicle tyres
<b>Assessment criteria</b>	
The learner can:	
3.1 state the types of repair materials available and when they would be used	

<b>Learning outcome</b>	<b>The learner will:</b>
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4. know about the inspection, removal and replacement of light vehicle tyres

**Assessment criteria**

The learner can:

- 4.1 state the meaning of markings on standard light vehicle tyres.
- 4.2 state the inspection and fault identification methods and procedures associated with light vehicle tyres.
- 4.3 give examples of the common faults associated with standard light vehicle tyres and wheels.
- 4.4 describe standard light vehicle tyre, wheel and valve removal and refitting methods and procedures.
- 4.5 outline the principles of interchanging tyres or wheels
- 4.6 outline the principles of wheel balancing, including:
  - a. static balancing
  - b. dynamic balancing.

## Unit 553

# Knowledge in Inspection, Repair and Replacement of Standard Light Vehicle Tyres

<b>Level:</b>	Level 2
<b>GLH:</b>	26
<b>Relationship to NOS:</b>	This unit is linked to VF03.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	This unit enables the learner to develop and understanding of inspection, fitting, repairing and maintaining high performance light vehicle tyres.

Learning outcome	The learner will:
1.	understand commercial vehicle wheel and tyre construction, legislation and special workplace procedures
<b>Assessment criteria</b>	
The learner can:	
1.1	state the purpose, function and construction of commercial vehicle wheels and tyres.
1.2	state the current legal requirements for commercial vehicle tyres.
1.3	state the relevant parts of the prevailing British and European standard for the repair of commercial vehicle tyres
1.4	give examples of how to deal with specialist waste materials in their workplace.
1.5	outline manufacturers' recommendations on the 'repairability' of their tyres.

Learning outcome	The learner will:
2.	understand the tools and equipment used when working with commercial vehicle tyres
<b>Assessment criteria</b>	
The learner can:	
2.1	give examples of how to select, prepare and use tools and equipment appropriate to working with commercial vehicle tyres.
2.2	state specialist maintenance requirements of commercial vehicle wheel and tyre removal and refitting machinery.

<b>Learning outcome</b>	<b>The learner will:</b>
3. understand the construction of, and the materials used in the manufacture and repair of commercial vehicle tyres	
<b>Assessment criteria</b>	
The learner can:	
3.1 state the types of repair materials available and when they should be used.	
3.2 state the difference between a 'remould' and a 'recut' when applied to commercial vehicle tyre.	

<b>Learning outcome</b>	<b>The learner will:</b>
4. understand how to inspect, remove, repair and replace of commercial vehicle tyres	
<b>Assessment criteria</b>	
The learner can:	
4.1 state the different types of commercial vehicle tyre valve and their installation techniques	
4.2 state the meaning of markings on commercial vehicle tyres and where these can be found	
4.3 state the inspection and fault identification methods and procedures associated with commercial vehicle tyres	
4.4 give examples of the common faults associated with commercial vehicle tyres and wheels	
4.5 describe commercial vehicle tyre, tube and wheel and rim removal and refitting methods and procedures	
4.6 outline the principles of wheel balancing. to include: a static balancing b dynamic balancing	
4.7 state the process to re-groove a commercial vehicle tyre.	

## Unit 594

# Knowledge of Receiving and Storing Stock

<b>Level:</b>	Level 1
<b>GLH:</b>	28
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit enables the learner to develop an understanding in order to receive parts into storage, place them correctly in location, update stock control systems and complete documentation in a dealership, fast fit centre, parts distribution centre or similar situation.

Learning outcome	The learner will:
1. know their organisation's systems and procedures	
<b>Assessment criteria</b>	
The learner can:	
1.1 state their organisation's systems and procedures for: a. the receipt and storage of goods, including 'special order' parts. b. parts storage, rotation and management c. update of stock records d. completion of parts receipt and storage documentation. e. reporting damage or incomplete deliveries	
1.2 identify the person to whom discrepancies and storage problems should be reported	
1.3 give examples of the differing security, safety (COSHH) and environmental conditions required for parts storage, including the storage and handling of replacement air bags, and the reasons for these.	
1.4 state the requirements for and the importance of, wearing personal protective equipment when handling and moving parts.	
1.5 state the costs associated with damaged parts and why it is important that damaged parts are reported promptly.	

Learning outcome	The learner will:
2. know about parts handling and storage	
<b>Assessment criteria</b>	
<p>The learner can:</p> <ul style="list-style-type: none"> <li>2.1 give examples of how to perform visual and physical quality checks at the time of receipt of parts.</li> <li>2.2 give examples of how to locate where parts are stored using the parts information system in operation in your organisation.</li> <li>2.3 give examples of how to handle and move parts safely</li> <li>2.4 give examples of how to use the mechanical handling equipment available in their parts operation.</li> <li>2.5 state how to store parts to make best use of available space and to adhere to regulations. to include: <ul style="list-style-type: none"> <li>a. adjustable storage racking</li> <li>b. tyre racking</li> <li>c. exhaust racking</li> <li>d. drawers</li> <li>e. wall bins</li> <li>f. battery storage</li> <li>g. lockable cabinets</li> </ul> </li> <li>2.6 state how to store parts to conform with any stock rotation requirements.</li> <li>2.7 identify when and where handling equipment should be used</li> <li>2.8 state the storage requirements for special and or easily damaged parts and consumables. to include: <ul style="list-style-type: none"> <li>a. body panels</li> <li>b. air bags</li> <li>c. tyres</li> <li>d. exhaust components</li> <li>e. batteries</li> <li>f. brake parts</li> <li>g. oil.</li> <li>h. paint and thinners</li> <li>i. gases.</li> </ul> </li> </ul>	

Learning outcome	The learner will:
3. know about stock records and stock control	
<b>Assessment criteria</b>	
<p>The learner can:</p> <ul style="list-style-type: none"> <li>3.1 give examples of how to access and interpret information to determine what parts deliveries are expected.</li> <li>3.2 give examples of how to update stock records on the receipt of goods.</li> <li>3.3 give examples of how to complete relevant parts receipt and storage documentation.</li> <li>3.4 state the parts numbering system for the makes and types of parts they deal with</li> <li>3.5 state how their parts stock control system works.</li> </ul>	

## Unit 601

# Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle

<b>Level:</b>	Level 1
<b>GLH:</b>	8
<b>Relationship to NOS:</b>	EV01: carry out non high voltage operations on, near or with an electric vehicle.
<b>Assessment type:</b>	Multiple choice test
<b>Aim:</b>	<p>To be able to identify and name the types of electric vehicles and the high voltage components fitted, and to be able to state the legislation and understand the hazards associated with working around high voltage vehicles. Know how to identify the different types of charging systems, and how to safely charge on electric vehicles.</p> <p>This unit is for people who work on, near or with electric vehicles but do not work on the vehicle's high voltage system.</p>

Learning outcome	The learner will:
1.	understand the operational differences between electric and non-electric vehicles, and know how to identify the different types of electric vehicles
<b>Assessment criteria</b>	
The learner must know:	
1.1	the differences between an electric vehicle and a non-electric vehicle
1.2	how to identify electric vehicles and their type
1.3	how to identify and locate high voltage electrical components in an electric vehicle
1.4	the function of high voltage components
1.5	how to identify the types of charging systems associated with electric vehicles
1.6	the methods of sourcing information related to electric vehicles
1.7	how to use and interpret technical information on electric vehicles.

Learning outcome	The learner will:
2.	understand the importance of adhering to health and safety legislation, regulations, guidelines and workplace procedures and know how to work safely around electric vehicles
<b>Assessment criteria</b>	
The learner must know:	
2.1	current health and safety legislation, industry codes of practice or guidelines relevant to working on, near or with electric vehicles
2.2	the personal protective equipment required when working on or around electric vehicles
2.3	the importance of ensuring a safe working environment
2.4	the workplace procedures for working safely around electric vehicles

- 2.5 how to safely operate an electric vehicle
- 2.6 how to safely work around high voltage components
- 2.7 the precautionary measures necessary when using plug-in charging equipment and how to use charging systems safely
- 2.8 workplace procedures that must be followed in the event of emergencies.

Learning outcome	The learner will:
3.	understand the hazards associated with working on or around electric vehicles
<b>Assessment criteria</b>	
The learner must know:	
3.1	the hazards associated with high voltage components
3.2	the hazards associated with electric vehicles when exposed to extreme temperatures, vehicle impact and other adverse conditions
3.3	the health implications of strong magnetic fields and electrical conductivity through the human body .

## Unit 601

# Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

### Learning outcome 1 Range

- 1.1 **Differences between**
  - a. Internal combustion engines
  - b. Starting systems
  - c. Charging systems
  - d. Regenerative braking
  - e. Layouts
  - f. Badging / logos
  - g. Components
  
- 1.1-1.5 **Electric vehicle(s)**
  - a. Pure (PEV) / battery electric vehicle (BEV)
  - b. Extended range (ER-EV)
  - c. Range extended (RE-EV)
  - d. Fuel cell (FCEV)
  - e. Hybrid (HEV)
  - f. Plug-in hybrid (PHEV)
  - g. Mild hybrid
  
- 1.3-1.4 **Components**
  - a. High voltage batteries
  - b. Low voltage batteries
  - c. Invertor
  - d. High voltage cables
  - e. DC to DC convertor
  - f. Fuel cell
  - k. Charging equipment and cables
  - l. Motor/generators
  
- 1.4 **Types of charging systems**
  - a. Plugs / sockets (AC to DC)
  - b. Trickle charging (3 pin socket)
  - c. AC charging
  - d. DC charging (charging station)
  - e. Combined charging systems
  - f. Hybrid self-charging systems



- 1.6 **Sources of information**
- a. Manufacturer or vehicle technical information
  - b. Job cards
  - c. Equipment manufacturer's websites

- 1.7 **Technical information on**
- a. Charging socket type and location
  - b. Location of high voltage components
  - c. Location of low voltage batteries
  - d. Connecting an auxiliary power source
  - e. Battery range/capacity
  - f. Dashboard symbols

## Learning outcome 2

### Range

- 2.1 **Health and safety legislation, industry codes of practice, guidelines**
- a. Health and safety at work act (HASWA)
  - b. Electrical equipment regulations
  - c. Electricity at work regulations
  - d. Regulation No 100 of the Economic Commission for Europe of the United Nations (UNECE) – 'High Voltage means the classification of an electric component or circuit, if it's working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC
  - e. HSE guidelines
- The latest relevant legislation should be referred to.
- 2.1-2.2  
2.4-2.5 **Electric vehicle(s)**
- a. Pure (PEV) / battery electric vehicle (BEV)
  - b. Extended range (ER-EV)
  - c. Range extended (RE-EV)
  - d. Fuel cell (FCEV)
  - e. Hybrid (HEV)
  - f. Plug-in hybrid (PHEV)
  - g. Mild hybrid
- 2.2 **Personal protective equipment**
- a. Overalls
  - b. Foot protection
  - c. Gloves (correctly rated)
  - d. Eye protection
- 2.3 **Safe working environment**
- a. Signage
  - b. Barriers
  - c. Cordoning
  - d. Secure key box
  - e. Spill kit
  - f. Warning labels
- 2.4 **Workplace procedures for**
- a. Ensuring that the vehicle has been made safe as appropriate to the work you are carrying out
  - b. Referring/reporting problems when working with electric vehicles

- c. Recording and reporting work carried out on electric vehicles

- 2.5 **Safely operate** procedures include
- a. Ensure vehicle is in ready mode
  - b. Check for warning symbols on dashboard
  - c. Check for system displays and messages
  - d. Check surroundings before moving off
  - e. Awareness that an engine may start at any time on a hybrid vehicle

- 2.6 **High voltage components**
- a. Batteries
  - b. Capacitors
  - c. Invertor
  - d. DC to DC convertor
  - e. Motors(AC/traction)
  - f. Cabling
  - g. Air conditioning compressor

- 2.8 **Emergencies**
- a. Electric shock
  - b. Fire
  - c. Flood
  - d. Chemical leakage

### **Learning outcome 3 Range**

- 3.1, 3.2 **Hazards**
- a. Fire / thermal runaway
  - b. Explosion
  - c. Arc flash
  - d. Gases/fumes
  - e. Chemicals
  - f. Electric shock
  - h. Dangerous voltage retention in components even when vehicle is switched off

- 3.1 **High voltage components**
- a. Batteries
  - b. Capacitors
  - c. Invertor
  - d. DC to DC convertor
  - e. Motors (AC/traction)
  - f. Cabling
  - g. Air conditioning compressor

- 3.2 **Electric vehicle(s)**
- a. Pure (PEV) / battery electric vehicle (BEV)
  - b. Extended range (ER-EV)
  - c. Range extended (RE-EV)
  - d. Fuel cell (FCEV)
  - e. Hybrid (HEV)
  - f. Plug-in hybrid (PHEV)
  - g. Mild hybrid

### 3.3

#### **Implications**

- a. Cardiac arrest
- b. Muscle, nerve and tissue damage
- c. Thermal burns
- d. Medical equipment damage including pacemakers

## Unit 701

# Skills in Vehicle Engine Lubrication Systems

<b>Level:</b>	Level 1
<b>GLH:</b>	38
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities on engine lubrication systems for a number of vehicle types, including how to source appropriate information, recognise and different types of engines and components and their purpose, select appropriate tools and equipment and identify basic faults.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment
1.4	demonstrate and describe workplace procedures for <ol style="list-style-type: none"> <li>handling and disposal of used and waste oils</li> <li>handling and disposal of used and waste oil filters</li> <li>Starting and safe running of engines in a confined space</li> </ol>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ol style="list-style-type: none"> <li>documenting vehicle type</li> <li>specification</li> <li>maintenance information</li> <li>tightening torque figures</li> <li>types of oils used</li> </ol>

- 2.2 demonstrate the importance of following correct technical data for removal and replacement activities of
  - a. oil
  - b. filter
  - c. valve cover
  - d. engine cover/casing gasket
- 2.3 demonstrate the importance of working to agreed timescales and keeping others informed of progress.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	understand how the vehicle engine lubrication system operates
<b>Assessment criteria</b>	
The learner can:	
3.1	describe the concept of the engine and major components which are relevant to the engines cylinder head and its systems they are working on <ul style="list-style-type: none"> <li>a. petrol four stroke</li> <li>b. diesel four stroke</li> <li>c. two stroke</li> </ul>
3.2	describe the operation and purpose of the main engine components which include: <ul style="list-style-type: none"> <li>a. crankshaft and bearings</li> <li>b. cylinder head gasket</li> <li>c. lubricating oils</li> <li>d. cylinder head</li> <li>e. valves or ports</li> <li>f. piston and rings.</li> </ul>

<b>Learning outcome</b>	<b>The learner will:</b>
4.	know how to select and use the appropriate tools and equipment to carry out the removal and replacement activities to the engine lubrication system
<b>Assessment criteria</b>	
The learner can:	
4.1	demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the engine cylinder head and its systems. <ul style="list-style-type: none"> <li>a. Tightening angle gauge</li> <li>b. General hand tools</li> <li>c. Specialist tools</li> <li>d. Torque wrench</li> <li>e. Straight edge</li> <li>f. Feeler blades.</li> </ul>

<b>Learning outcome</b>	<b>The learner will:</b>
5. know how to carry out the removal and replacement activities on engine lubrication systems	
<b>Assessment criteria</b>	
<p>The learner can:</p> <p>5.1 demonstrate the correct procedure for carrying out cylinder head removal and replacement activities:</p> <ol style="list-style-type: none"> <li>a. checking cylinder head flatness</li> <li>b. tightening bolt torque procedure</li> <li>c. filling of liquids and lubricants</li> <li>d. tightening using angle gauge</li> <li>e. removing cylinder head</li> <li>f. selecting hand tools</li> <li>g. disposal of waste</li> <li>h. draining fluids</li> </ol> <p>5.2 demonstrate the correct procedure for carrying out cylinder head inspection for flatness</p> <ol style="list-style-type: none"> <li>a. clean off old gasket</li> <li>b. straight edge and feeler blades</li> </ol> <p>5.3 demonstrate basic examination methods which include</p> <ol style="list-style-type: none"> <li>a. aural</li> <li>b. visual</li> <li>c. functional</li> <li>d. measurements</li> </ol> <p>5.4 describe how to recognise and report cosmetic damage to vehicle components and units outside normal engine mechanical systems activities</p> <p>5.5 describe how to identify codes and grades of lubricants and coolants.</p>	

<b>Level:</b>	Level 1
<b>GLH:</b>	32
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle engine cooling systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant to cooling systems and their operation, select appropriate tools and equipment and identify basic faults.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment
1.4	demonstrate and describe workplace procedures for <ul style="list-style-type: none"> <li>a. handling and disposal of used and waste coolant</li> <li>b. handling and disposal of waste cooling system components</li> <li>c. starting and safe running of engines in a confined space</li> </ul>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ul style="list-style-type: none"> <li>a. vehicle types</li> <li>b. specification</li> <li>c. replacement information</li> <li>d. tightening torque figures</li> <li>e. electrical and electronic readings</li> </ul>

- f. types of coolant and percentages of antifreeze used
- 2.2 demonstrate the importance of following correct technical data for removal and replacement activities for
  - a. thermostat
  - b. thermistor
  - c. fan control thermal switch
- 2.3 demonstrate the importance of following correct cooling system test technical data for:
  - a. fan control thermal switch
  - b. thermostat opening time
  - c. thermistor
- 2.4 demonstrate the importance of working to agreed timescales and keeping others informed of progress.

Learning outcome	The learner will:
3.	understand how the vehicle engine cooling system operates
<b>Assessment criteria</b>	
The learner can:	
3.1	describe the concept of the engine and components which are relevant to the cooling system they are working on <ul style="list-style-type: none"> <li>a. petrol four stroke</li> <li>b. diesel four stroke</li> <li>c. two stroke</li> </ul>
3.2	describe the basic operation and purpose of the <ul style="list-style-type: none"> <li>a. fan control thermal switch</li> <li>b. thermostat</li> <li>c. thermistor.</li> </ul>

Learning outcome	The learner will:
4.	know how to select and use the appropriate tools and equipment to carry out the removal and replacement activities to the engine cooling system
<b>Assessment criteria</b>	
The learner can:	
4.1	demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the engine cooling system <ul style="list-style-type: none"> <li>a. electrical test equipment</li> <li>b. pressure test equipment</li> <li>c. antifreeze equipment</li> <li>d. general hand tools</li> <li>e. torque wrench.</li> </ul>



<b>Learning outcome</b>	<b>The learner will:</b>
5. know how to carry out the relevant removal and replacement activities on engine cooling systems	
<b>Assessment criteria</b>	
<p>The learner can:</p> <ul style="list-style-type: none"> <li>5.1 demonstrate the correct procedure for carrying out cooling system removal and replacement activities: <ul style="list-style-type: none"> <li>a. fan control thermal switch</li> <li>b. coolant thermistor</li> <li>c. thermostat</li> </ul> </li> <li>5.2 carry out basic electrical functional tests on the <ul style="list-style-type: none"> <li>a. fan control thermal switch</li> <li>b. coolant thermistor</li> </ul> </li> <li>5.3 carry out functional tests to the thermostat</li> <li>5.4 demonstrate they can manufacture a gasket to fit the thermostat casing gasket</li> <li>5.5 demonstrate basic examination methods which include <ul style="list-style-type: none"> <li>a. aural</li> <li>b. visual</li> <li>c. functional</li> <li>d. measurements</li> </ul> </li> <li>5.6 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items</li> <li>5.7 describe how to identify codes and grades of coolant additives.</li> </ul>	

## Unit 703

## Skills in Vehicle Fuel and Exhaust Systems

<b>Level:</b>	Level 1
<b>GLH:</b>	39
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle fuel and exhaust systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant to fuel and exhaust systems and their operation, select appropriate tools and equipment and identify basic faults.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon.
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment
1.4	demonstrate and describe workplace procedures for handling and disposal of: <ol style="list-style-type: none"> <li>fuel and exhaust components</li> <li>engine lambda sensor</li> <li>starting and safe running of engines in a confined space.</li> </ol>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for: <ol style="list-style-type: none"> <li>vehicle type and specification</li> <li>types of fuel and lambda sensor</li> <li>maintenance information</li> <li>tightening torque figures</li> </ol>

- e. exhaust catalyst
- 2.2 demonstrate the importance of following correct technical data for removal and replacement activities for all the following components:
  - a. a fuel injector
  - b. exhaust catalyst
  - c. lambda sensor
- 2.3 demonstrate the importance of working to agreed timescales and keeping others informed of progress.

<b>Learning outcome</b>	<b>The learner will:</b>
3. understand how the vehicle fuel and exhaust systems operate	
<b>Assessment criteria</b>	
The learner can:	
3.1 describe and demonstrate the concept of the engine and major components which are relevant to the fuel injector, lambda sensor and exhaust system	
3.2 describe the operation and purpose of the <ul style="list-style-type: none"> <li>a. exhaust catalyst</li> <li>b. lambda sensor</li> <li>c. fuel injector.</li> </ul>	

<b>Learning outcome</b>	<b>The learner will:</b>
4. know how to select and use the appropriate tools and equipment to remove and replace fuel and exhaust systems	
<b>Assessment criteria</b>	
The learner can:	
4.1 demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the engine fuel injector, lambda sensor and exhaust catalyst. <ul style="list-style-type: none"> <li>a. general hand tools</li> <li>b. torque wrench</li> <li>c. electrical test equipment</li> <li>d. exhaust emissions tester.</li> </ul>	

<b>Learning outcome</b>	<b>The learner will:</b>
5. know how to carry removal and replacement activities for fuel and exhaust systems	
<b>Assessment criteria</b>	
The learner can:	
5.1 demonstrate the correct procedure for carrying out removal and replacement activities to <ul style="list-style-type: none"> <li>a. engine fuel injectors</li> <li>b. lambda sensors</li> <li>c. exhaust catalysts</li> <li>d. check for fuel leaks</li> <li>e. check for exhaust leaks</li> <li>f. disposal of waste components</li> </ul>	
5.2 demonstrate examination methods which include <ul style="list-style-type: none"> <li>a. aural</li> </ul>	

- b. visual
  - c. functional
  - d. measurements
- 5.3 demonstrate and describe operational test procedures for:
- a. lambda sensor
  - b. exhaust catalyst
- 5.4 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items
- 5.5 describe how to identify for correct replacement component codes.

<b>Level:</b>	Level 1
<b>GLH:</b>	43
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle ignition systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant ignition systems and their operation, select appropriate tools and equipment and identify basic faults.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon.
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment
1.4	demonstrate and describe workplace procedures for: <ul style="list-style-type: none"> <li>a. handling and disposal of spark ignition components</li> <li>b. starting and safe running of engines in a confined space.</li> </ul>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ul style="list-style-type: none"> <li>a. vehicle types</li> <li>b. specification</li> <li>c. maintenance information</li> <li>d. tightening torque figures</li> <li>e. types of ignition components used</li> </ul>

2.2	demonstrate the importance of following correct technical data for removal and replacement activities for all the following components <ul style="list-style-type: none"> <li>a. electronic engine sensor</li> <li>b. engine electronic control unit</li> <li>c. ignition coil</li> </ul>
2.3	demonstrate the importance of working to agreed timescales and keeping others informed of progress.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	understand how the vehicle ignition system operates
<b>Assessment criteria</b>	
The learner can:	
3.1	describe the concept of the engine and major components which are relevant to the ignition system they are working on.
3.2	describe the basic operation and purpose of the <ul style="list-style-type: none"> <li>a. engine position sensor</li> <li>b. engine electronic control unit</li> <li>c. ignition coil/s.</li> </ul>

<b>Learning outcome</b>	<b>The learner will:</b>
4.	know how to select and use the appropriate tools and equipment to carry out removal and replacement activities to the engine ignition system
<b>Assessment criteria</b>	
The learner can:	
4.1	demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the engine ignition system. <ul style="list-style-type: none"> <li>a. general hand tools</li> <li>b. torque wrench</li> <li>c. electrical test equipment.</li> </ul>

<b>Learning outcome</b>	<b>The learner will:</b>
5.	know how to carry out the relevant removal and replacement activities
<b>Assessment criteria</b>	
The learner can:	
5.1	demonstrate the correct procedure for carrying out engine ignition system removal and replacement activities: <ul style="list-style-type: none"> <li>a. engine position sensor</li> <li>b. engine electronic control unit</li> <li>c. ignition coil/s</li> </ul>
5.2	demonstrate a diagnostic fault code reader activity and search system for stored fault codes/data
5.3	measure the internal resistance of <ul style="list-style-type: none"> <li>a. engine position sensor</li> <li>b. ignition coil/s</li> </ul>
5.4	demonstrate basic examination methods which include <ul style="list-style-type: none"> <li>a. aural</li> <li>b. visual</li> </ul>

- c. functional
- d. measurements
- e. comparisons

5.5 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items.

## Unit 705

## Skills in Vehicle Electrical Systems

<b>Level:</b>	Level 1
<b>GLH:</b>	38
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle electrical systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant electrical systems and their operation, select appropriate tools and equipment and identify basic faults.

<b>Learning outcome</b>	<b>The learner will:</b>
1. know legislative and organisational requirements	
<b>Assessment criteria</b>	
The learner can:	
1.1 describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon.	
1.2 ensure the legal requirements relating to the activity are maintained	
1.3 demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment	
1.4 demonstrate and describe workplace procedures for:	
a. handling and disposal of electrical system components	
b. starting and safe running of engines in a confined space.	
1.5 work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.	
1.6 demonstrate that they have shown an awareness of education for sustainable development and global citizenship.	



<b>Learning outcome</b>	<b>The learner will:</b>
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ul style="list-style-type: none"> <li>a. vehicle type</li> <li>b. specification</li> <li>c. maintenance information</li> <li>d. tightening torque figures</li> <li>e. types of electrical components used</li> </ul>
2.2	demonstrate the importance of following correct technical data for removal and replacement activities for all the following components <ul style="list-style-type: none"> <li>a. battery</li> <li>b. starter motor</li> <li>c. alternator</li> </ul>
2.3	demonstrate the importance of working to agreed timescales and keeping others informed of progress.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	understand how the vehicle system operates
<b>Assessment criteria</b>	
The learner can:	
3.1	describe the concept of the engines components which are relevant to the electrical system they are working on.
3.2	describe the basic operation and purpose of the <ul style="list-style-type: none"> <li>a. battery</li> <li>b. starter motor</li> <li>c. alternator.</li> </ul>

<b>Learning outcome</b>	<b>The learner will:</b>
4.	know how to select and use the appropriate tools and equipment to carry out removal and replacement activities to the vehicle electrical system
<b>Assessment criteria</b>	
The learner can:	
4.1	demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the vehicle electrical system. <ul style="list-style-type: none"> <li>a. general hand tools</li> <li>b. general multi-meter</li> <li>c. torque wrench</li> <li>d. jump leads.</li> </ul>

Learning outcome	The learner will:
5. know how to carry out basic system checks and relevant removal, repair and replacement activities	
<b>Assessment criteria</b>	
<p>The learner can:</p> <ul style="list-style-type: none"> <li>5.1 describe the correct procedure for carrying out system checks to the vehicle electrical systems <ul style="list-style-type: none"> <li>a. battery</li> <li>b. alternator</li> <li>c. starter motor</li> </ul> </li> <li>5.2 carry out removal and replacement activities to: <ul style="list-style-type: none"> <li>a. battery</li> <li>b. alternator</li> <li>c. starter motor</li> </ul> </li> <li>5.3 carry out a simple starter motor test with: <ul style="list-style-type: none"> <li>a. battery</li> <li>b. jump leads</li> </ul> </li> <li>5.4 carry out a simple alternator charge test with: <ul style="list-style-type: none"> <li>a. voltmeter</li> </ul> </li> <li>5.5 carry out a simple battery test with: <ul style="list-style-type: none"> <li>a. voltmeter</li> </ul> </li> <li>5.6 demonstrate basic examination methods which include <ul style="list-style-type: none"> <li>a. aural</li> <li>b. visual</li> <li>c. functional</li> <li>d. measurements</li> <li>e. comparisons</li> </ul> </li> <li>5.7 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items.</li> </ul>	

## Unit 706

## Skills in Vehicle Braking Systems

<b>Level:</b>	Level 1
<b>GLH:</b>	35
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle braking systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant braking systems and their operation, select appropriate tools and equipment and identify basic faults.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon.
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment
1.4	demonstrate and describe workplace procedures for <ol style="list-style-type: none"> <li>handling and disposal of used and waste brake fluid</li> <li>handling and disposal of waste braking system components</li> <li>starting and safe running of engines in a confined space.</li> </ol>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ol style="list-style-type: none"> <li>vehicle types</li> <li>specification</li> <li>maintenance information</li> <li>brake disc run out</li> <li>tightening torque figures</li> </ol>

<ul style="list-style-type: none"> <li>f. types of brake fluid used</li> <li>g. brake pipe materials</li> </ul> <p>2.2 demonstrate the importance of following correct technical data for removal and replacement activities for the following</p> <ul style="list-style-type: none"> <li>a. brake calliper</li> <li>b. brake pads</li> <li>c. brake fluid</li> </ul> <p>2.3 demonstrate the importance of working to agreed timescales and keeping others informed of progress.</p>
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<b>Learning outcome</b>	<b>The learner will:</b>
3. understand how the vehicle system operates	
<b>Assessment criteria</b>	
The learner can:	
3.1 describe the concept of the vehicles major components which are relevant to the braking system they are working on.	
3.2 describe the basic operation and purpose of the following	
<ul style="list-style-type: none"> <li>a. master cylinder</li> <li>b. brake calliper</li> <li>c. brake pipes</li> <li>d. brake pads</li> <li>e. brake disc</li> <li>f. brake fluid.</li> </ul>	

<b>Learning outcome</b>	<b>The learner will:</b>
4. know how to select and use the appropriate tools and equipment to carry out removal and replacement activities to the vehicles braking system	
<b>Assessment criteria</b>	
The learner can:	
4.1 demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the vehicles braking system.	
<ul style="list-style-type: none"> <li>a. general hand tools</li> <li>b. brake bleed tools</li> <li>c. torque wrench</li> </ul>	
4.2 demonstrate and describe how to prepare, test and use all the equipment required to carry out brake disc run out inspection	
<ul style="list-style-type: none"> <li>a. dial test equipment</li> </ul>	
4.3 demonstrate and describe how to prepare, test and use all the equipment required to carry out brake pipe manufacture	
<ul style="list-style-type: none"> <li>a. brake flaring tool</li> <li>b. brake pipe bend equipment.</li> </ul>	

Learning outcome	The learner will:
5.	know how to carry out the relevant removal and replacement activities and level checks, including basic manufacturing techniques and system checks
<b>Assessment criteria</b>	
<p>The learner can:</p> <ul style="list-style-type: none"> <li>5.1 describe and demonstrate the correct procedure for carrying out braking system removal and replacement activities: to <ul style="list-style-type: none"> <li>a. brake calliper</li> <li>b. brake pads</li> <li>c. Brake disc</li> </ul> </li> <li>5.2 carry out a brake disc run-out inspection and use <ul style="list-style-type: none"> <li>a. dial test equipment</li> </ul> </li> <li>5.3 manufacture a brake pipe and use <ul style="list-style-type: none"> <li>a. brake flaring tools</li> <li>b. pipe bending equipment</li> </ul> </li> <li>5.4 check and top up brake fluid <ul style="list-style-type: none"> <li>a. Hygrometer (boil test)</li> </ul> </li> <li>5.5 demonstrate examination methods which include <ul style="list-style-type: none"> <li>a. aural</li> <li>b. visual</li> <li>c. functional</li> <li>d. measurements</li> </ul> </li> <li>5.6 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items</li> <li>5.7 describe how to identify codes and grades of brake fluid.</li> </ul>	

<b>Level:</b>	Level 1
<b>GLH:</b>	38
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle transmission systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant transmission systems and their operation, select appropriate tools and equipment and identify basic faults.

<b>Learning outcome</b>	<b>The learner will:</b>
	1. know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1 describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon.	
1.2 ensure the legal requirements relating to the activity are maintained	
1.3 demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment	
1.4 demonstrate and describe workplace procedures for	
a. handling and disposal of used transmission lubricants	
b. handling and disposal of waste transmission system components	
c. starting and safe running of engines in a confined space.	
1.5 work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.	
1.6 demonstrate that they have shown an awareness of education for sustainable development and global citizenship.	

<b>Learning outcome</b>	<b>The learner will:</b>
	2. know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1 ensure their records are accurate for	
a. vehicle types	
b. specification	
c. maintenance information	
d. tightening torque figures	
e. types of transmission fluid used	

- 2.2 demonstrate the importance of following correct technical data for removal and replacement activities for any **one** of the following
  - a. manual gearbox
  - b. automatic gearbox
  - c. range change device
  - d. P.T.O. Device
- 2.3 demonstrate the importance of working to agreed timescales and keeping others informed of progress.

<b>Learning outcome</b>	<b>The learner will:</b>
3. understand how the vehicle system operates	
<b>Assessment criteria</b>	
The learner can:	
3.1 describe the concept of the vehicles major components which are relevant to the transmission system they are working upon, from <ul style="list-style-type: none"> <li>a. manual gearbox</li> <li>b. automatic gearbox</li> <li>c. range change device</li> <li>d. P.T.O. Device</li> </ul>	
3.2 describe the basic purpose of the following <ul style="list-style-type: none"> <li>a. clutch</li> <li>b. torque converter</li> <li>c. manual gearbox</li> <li>d. automatic gearbox</li> <li>e. range change device.</li> </ul>	

<b>Learning outcome</b>	<b>The learner will:</b>
4. know how to select and use the appropriate tools and equipment to carry out removal and replacement activities to the vehicles transmission system	
<b>Assessment criteria</b>	
The learner can:	
4.1 demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the vehicles transmission system. <ul style="list-style-type: none"> <li>a. general hand tools</li> <li>b. lifting equipment</li> <li>c. torque wrench.</li> </ul>	

Learning outcome	The learner will:
5.	know how to carry out the relevant removal and replacement activities and level checks
<b>Assessment criteria</b>	
<p>The learner can:</p> <p>5.1 describe and demonstrate the correct procedure for carrying out transmission system removal and replacement activities: to one of the following</p> <ul style="list-style-type: none"> <li>a. manual gearbox</li> <li>b. automatic gearbox</li> <li>c. range change device</li> <li>d. P.T.O. device</li> </ul> <p>5.2 check and top up transmission lubricants</p> <p>5.3 demonstrate basic examination methods which include</p> <ul style="list-style-type: none"> <li>a. aural</li> <li>b. visual</li> <li>c. functional</li> <li>d. measurements</li> </ul> <p>5.4 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items</p> <p>5.5 describe how to identify codes and grades of transmission lubricants.</p>	



## Unit 708

## Skills in Vehicle Steering and Suspension Systems

<b>Level:</b>	Level 1
<b>GLH:</b>	36
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle steering and suspension systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant steering and suspension systems and their operation, select appropriate tools and equipment and identify basic faults.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon.
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment
1.4	demonstrate and describe workplace procedures for <ol style="list-style-type: none"> <li>a. handling and disposal of used steering and suspension lubricants</li> <li>b. handling and disposal of waste steering and suspension system components</li> <li>c. starting and safe running of engines in a confined space.</li> </ol>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ol style="list-style-type: none"> <li>a. vehicle types</li> <li>b. specification</li> <li>c. maintenance information</li> <li>d. tightening torque figures</li> </ol>

- e. types of steering and suspension fluids used
- 2.2 demonstrate the importance of following correct technical data for removal and replacement activities for steering and suspension components
- 2.3 demonstrate the importance of working to agreed timescales and keeping others informed of progress.

Learning outcome	The learner will:
3.	understand how the vehicle suspension and steering systems operate
<b>Assessment criteria</b>	
The learner can:	
3.1	describe the basic concept of the vehicles major components which are relevant to the steering and suspension system they are working upon.
3.2	describe the operation and purpose of the following <ul style="list-style-type: none"> <li>a. suspension</li> <li>b. steering system</li> <li>c. steering components</li> <li>d. suspension components.</li> </ul>

Learning outcome	The learner will:
4.	know how to select and use the appropriate tools and equipment to carry out removal and replacement activities to the vehicles steering and suspension system
<b>Assessment criteria</b>	
The learner can:	
4.1	demonstrate and describe how to prepare, test and use all the equipment required to carry out removal and replacement activities to the vehicles steering and suspension system. <ul style="list-style-type: none"> <li>a. general hand tools</li> <li>b. spring compressor</li> <li>c. alignment equipment</li> <li>d. torque wrench.</li> </ul>

Learning outcome	The learner will:
5.	know how to carry out the relevant removal and replacement activities and alignment checks
<b>Assessment criteria</b>	
The learner can:	
5.1	demonstrate the correct procedure for carrying out steering and suspension system removal and replacement activities: to the following <ul style="list-style-type: none"> <li>a. suspension strut unit</li> <li>b. steering joint or bearing</li> </ul>
5.2	carry out strip down procedure <ul style="list-style-type: none"> <li>a. suspension strut unit</li> <li>b. steering joint or bearing</li> </ul>
5.3	evaluate and report on unit components <ul style="list-style-type: none"> <li>a. suspension strut unit</li> <li>b. steering joint or bearing</li> </ul>
5.4	reassemble unit components

- a. suspension strut unit
- b. steering joint or bearing
- 5.5 adjust and align unit components
  - a. suspension strut unit
  - b. steering joint or bearing
- 5.6 demonstrate examination methods which include
  - a. aural
  - b. visual
  - c. functional
  - d. measurements
- 5.7 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items
- 5.8 describe how to identify codes and grades of steering and suspension lubricants.

## Unit 709

## Skills in Vehicle Wheel and Tyre Systems

<b>Level:</b>	Level 1
<b>GLH:</b>	32
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out removal and replacement activities to vehicle wheel and tyre systems for a number of vehicle types, including how to source appropriate information, recognise different types of engines and components which are relevant wheel and tyre systems and their operation, select appropriate tools and equipment and identify basic faults.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to removal and replacement activities for the types of vehicles worked upon.
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle maintenance activities including personal protective equipment
1.4	demonstrate and describe workplace procedures for <ol style="list-style-type: none"> <li>handling and disposal of used wheels and tyres</li> <li>correct use of air supply systems</li> <li>starting and safe running of engines in a confined space.</li> </ol>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ol style="list-style-type: none"> <li>vehicle types</li> <li>specification</li> <li>maintenance information</li> <li>tightening torque figures</li> </ol>

- 2.2 demonstrate the importance of following correct technical data for removal and replacement activities for:
  - a. wheels
  - b. tyres
- 2.3 demonstrate the importance of following correct technical data for tyre repair activities on
  - a. puncture
  - b. balance
  - c. air valve (schrader)
- 2.4 demonstrate the importance of working to agreed timescales and keeping others informed of progress.

<b>Learning outcome</b>	<b>The learner will:</b>
3.	understand how the vehicle system operates
<b>Assessment criteria</b>	
The learner can:	
3.1	describe the basic concept of the vehicles major components which are relevant to the wheels and tyres system they are working upon
3.2	describe the construction, operation and purpose of the following <ul style="list-style-type: none"> <li>a. tyres</li> <li>b. valves</li> <li>c. wheels</li> <li>d. balance weights</li> </ul>
3.3	describe legal impacts relating to repair activities to the tyre and further use.

<b>Learning outcome</b>	<b>The learner will:</b>
4.	know how to select and use the appropriate tools and equipment to carry out the activity
<b>Assessment criteria</b>	
The learner can:	
4.1	demonstrate and describe how to prepare, test and use all the equipment required carrying out removal and replacement activities to the vehicles wheels and tyres system. <ul style="list-style-type: none"> <li>a. wheel balance equipment</li> <li>b. puncture repair equipment</li> <li>c. pressure test equipment</li> <li>d. general hand tools</li> <li>e. tyre depth gauge</li> <li>f. torque wrench</li> <li>g. water bath</li> <li>h. air line.</li> </ul>

Learning outcome	The learner will:
5.	know how to carry out the relevant removal and replacement activities and checks
<b>Assessment criteria</b>	
<p>The learner can:</p> <p>5.1 demonstrate the correct procedure for carrying out wheels and tyres system removal and replacement activities to the types of vehicles worked upon</p> <p>5.2 demonstrate wheel and tyre checks including examination procedures for</p> <ol style="list-style-type: none"> <li>a. wear limits and characteristics</li> <li>b. tyre types and side wall marking</li> <li>c. damage</li> <li>d. balance</li> <li>e. leaks</li> </ol> <p>5.3 carry out a puncture repair to a tyre and making good for use, using</p> <ol style="list-style-type: none"> <li>a. wheel balance equipment</li> <li>b. puncture repair equipment</li> <li>c. pressure test equipment</li> <li>d. general hand tools</li> <li>e. tyre depth gauge</li> <li>f. torque wrench</li> <li>g. water bath</li> <li>h. air line</li> </ol> <p>5.4 demonstrate basic examination methods which include</p> <ol style="list-style-type: none"> <li>a. visual</li> <li>b. functional</li> <li>c. measurements</li> </ol> <p>5.5 describe how to recognise and report cosmetic damage to vehicle components and units outside normal service items</p> <p>5.6 describe how to identify wheel and tyre types and markings.</p>	

## Unit 712

## Skills in Vehicle Hand Skills and Manufacturing Techniques

<b>Level:</b>	Level 1
<b>GLH:</b>	28
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Assignment
<b>Aim:</b>	This unit will enable the learner to develop skills to carry out hand skills and manufacturing activities for a number of vehicle types, including how to source appropriate information, select appropriate tools and equipment and use basic engineering drawings.

Learning outcome	The learner will:
1.	know legislative and organisational requirements
<b>Assessment criteria</b>	
The learner can:	
1.1	describe and demonstrate the manufacturers and legal requirements relating to vehicle hand skills and manufacturing techniques.
1.2	ensure the legal requirements relating to the activity are maintained
1.3	demonstrate the health and safety legislation and workplace procedures relevant to vehicle hand skills and manufacturing techniques including personal protective equipment
1.4	demonstrate and describe workplace procedures for <ol style="list-style-type: none"> <li>a. handling and disposal of used lubricants</li> <li>b. handling and disposal of waste metals</li> </ol>
1.5	work in a way which minimises the risk of damage to the vehicle, its systems, other people and their property.
1.6	demonstrate that they have shown an awareness of education for sustainable development and global citizenship.

Learning outcome	The learner will:
2.	know how to locate and use relevant sources of information
<b>Assessment criteria</b>	
The learner can:	
2.1	ensure their records are accurate for <ol style="list-style-type: none"> <li>a. specification</li> <li>b. maintenance information</li> <li>c. dimensions</li> <li>d. materials</li> <li>e. equipment</li> </ol>

- 2.2 demonstrate the importance of following correct technical data for vehicle hand skills and manufacturing techniques
- 2.3 demonstrate the importance of working to agreed timescales and keeping others informed of progress.

<b>Learning outcome</b>	<b>The learner will:</b>
	3. understand how to carry out vehicle hand skills and manufacturing techniques
<b>Assessment criteria</b>	
The learner can:	
3.1 describe and illustrate vehicle hand skills and manufacturing techniques for <ul style="list-style-type: none"> <li>a. joining techniques</li> <li>b. making threads</li> <li>c. cutting metals</li> <li>d. measuring</li> <li>e. filing</li> </ul>	
3.2 describe the importance of using correct materials for carrying out vehicle hand skills and manufacturing techniques	
3.3 illustrate examples of understanding simple engineering drawings for <ul style="list-style-type: none"> <li>a. dimensions</li> <li>b. materials</li> <li>c. joining</li> <li>d. threads.</li> </ul>	

<b>Learning outcome</b>	<b>The learner will:</b>
	4. know how to select and use the appropriate tools and equipment to carry out the activity
<b>Assessment criteria</b>	
The learner can:	
4.1 describe and demonstrate how to prepare, test and use all the equipment required for carrying out vehicle hand skills and manufacturing techniques <ul style="list-style-type: none"> <li>a. general hand tools</li> <li>b. files</li> <li>c. taps</li> <li>d. dies</li> <li>e. hammer</li> <li>f. drills</li> <li>g. vice</li> <li>h. centre punch</li> <li>i. micrometer</li> <li>j. rule.</li> </ul>	



Learning outcome	The learner will:
5. know how to carry out vehicle hand skills and manufacturing techniques	
<b>Assessment criteria</b>	
<p>The learner can:</p> <p>5.1 illustrate they are able to understand basic engineering drawings for</p> <ol style="list-style-type: none"> <li>a. dimensions</li> <li>b. materials</li> <li>c. joining</li> <li>d. threads</li> </ol> <p>5.2 demonstrate the correct procedure for manufacturing a simple vehicle service tool using techniques of</p> <ol style="list-style-type: none"> <li>a. making threads</li> <li>b. cutting metals</li> <li>c. measuring</li> <li>d. joining</li> <li>e. filing</li> </ol> <p>5.3 demonstrate and use all the equipment required to carrying out vehicle hand skills and manufacturing techniques</p> <ol style="list-style-type: none"> <li>a. general hand tools</li> <li>b. files</li> <li>c. taps</li> <li>d. dies</li> <li>e. hammer</li> <li>f. drill</li> <li>g. vice</li> <li>h. centre punch</li> <li>i. micrometer</li> <li>j. rule.</li> </ol>	

## Unit 726/776

# Introduction to Vehicle Technology and Workshop Methods and Processes

<b>Level:</b>	Level 1
<b>GLH:</b>	60
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Multiple choice test and Assignment
<b>Aim:</b>	This unit allows the learner to develop the knowledge and skills to carry out basic vehicle routine maintenance and carrying out adjustment or replacement activities of components during the maintenance activity.

<b>Learning outcome</b>	<b>The learner will:</b>
1. understand the operation and use of workshop equipment	
<b>Assessment criteria</b>	
The learner can:	
1.1 identify and use common workshop equipment	
1.2 state safety precautions and regular checks of common workshop equipment and identify the correct methods, tools and equipment are used as specified by manufacturers.	

<b>Learning outcome</b>	<b>The learner will:</b>
2. understand the use of tools and measuring equipment; identify joining methods and materials	
<b>Assessment criteria</b>	
The learner can:	
2.1 identify and use common hand tools	
2.2 identify locking and securing devices	
2.3 describe the principles of measurement	
2.4 identify and use measuring equipment	
2.5 identify materials and their properties	
2.6 restore threads and remove broken studs	
2.7 describe the correct methods tools and equipment that are used as specified by manufacturers.	

<b>Learning outcome</b>	<b>The learner will:</b>
3. understand basic electrical principles and basic use of test equipment	
<b>Assessment criteria</b>	
The learner can:	
3.1 describe the principles of electricity and electrical circuits	

3.2 identify and use electrical measuring equipment.

<b>Learning outcome</b>	<b>The learner will:</b>
4. understand vehicle construction materials, components, methods and safety features	
<b>Assessment criteria</b>	
The learner can:	
4.1 identify materials used in vehicle construction	
4.2 identify the components used in vehicle construction	
4.3 describe the types of vehicle chassis and different construction methods	
4.4 describe the safety features used in vehicle construction	
4.5 state current regulations controlling design, construction and use of vehicles.	

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit. The following is included to support centres in terms of teaching and delivery.**

Knowledge to include an awareness of Hybrid/electric and alternative fuel vehicles and components

### **Workshop equipment**

- i. inspection lights
- ii. trolley jacks
- iii. axle stands
- iv. ramps and wheel chocks
- v. single post lifts
- vi. two post lifts
- vii. four post lifts
- viii. compressors and air lines
- ix. oil drainage equipment
- x. tyre changing machines
- xi. wheel balancing equipment
- xii. de-greasing and cleaning equipment
- xiii. cranes, slings and chains
- xiv. pillar and handheld drills
- xv. bench grinders
- xvi. battery chargers
- xvii. welding equipment (basics only)
- xviii. headlamp alignment

### **Safety precautions**

#### **Safety regulations:**

- i. Health and Safety at Work Act (HASWA)
- ii. Control of Substances Hazardous to Health (COSHH)
- iii. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)
- iv. Environmental Protection Act (EPA)

### **Hand tools**

- i. files
- ii. saws
- iii. hammers
- iv. pliers and grips
- v. screwdrivers
- vi. drills and drill bits

- vii. spanners
- viii. punches and chisels
- ix. air tools
- x. taps and dies
- xi. holding equipment (vices etc.)
- xii. sockets.

### **Locking and securing devices**

- a.
  - i. fixing devices
  - ii. nuts
  - iii. bolts
  - iv. screws
  - v. cable ties
  - vi. rivets
  - vii. locking and securing devices
- b.
  - i. locking nuts
  - ii. split pins
  - iii. locking washers

### **Materials**

- i. ferrous metals
- ii. non-ferrous metals
- iii. steel
- iv. aluminium
- v. brass
- vi. copper
- vii. lead
- viii. cast iron
- ix. plastic
- x. kevlar
- xi. rubber
- xii. carbon fibre
- xiii. laminated and tempered glass

### **Properties**

- i. ductility
- ii. malleability
- iii. hardness
- iv. toughness
- v. strength
- vi. elasticity
- vii. conductivity

### **Principles**

- a. symbols, switches, conductors, insulators and system protection devices
- b. Ohm's Law and the power equation
  - i. amps

- ii. watts
- iii. ohms
- iv. volts
- c. series and parallel circuits
- d. production of electricity
  - i. alternating current
  - ii. direct current
- e. wiring diagrams
  - i. flow
  - ii. layout
  - iii. destination

### **Measuring equipment**

- i. test light
- ii. ammeter/amp clamp
- iii. voltmeter
- iv. ohmmeter

### **Components**

- a) sills, wings and inner wings
- b) scuttle and valances
- c) doors, roof
- d) sub frames and assemblies
- e) spoilers and air dams
- f) wheel arches
- g) bonnet and boot panels
- h) door, bonnet and boot fixings

### **Vehicle chassis types and construction methods**

- i. monocoque
- ii. composite
- iii. integral types
- iv. commercial vehicle ladder

### **Safety features**

- i. crumple zones
- ii. side impact protection
- iii. bumpers
- iv. safety glass
- v. seat belts and pre-tensioners
- vi. air bags
- vii. active and passive safety systems

### **Regulations**

- i. MOT testing frequency of new unused vehicles
- ii. minimum requirement for exterior vehicle lighting
- iii. statutory standard setting bodies for the motor industry.
- iv. construction and use regulations

## Unit 727/777

## Carry Out Basic Routine Vehicle Maintenance

<b>Level:</b>	Level 1
<b>GLH:</b>	90
<b>Relationship to NOS:</b>	Developed by City & Guilds to support NOS requirements at higher levels.
<b>Assessment type:</b>	Multiple choice test and Assignment
<b>Aim:</b>	This unit allows the learner to develop the knowledge and skills to carry out basic vehicle routine maintenance, adjustments and replacement activities which are part of the periodic servicing of vehicles.

Learning outcome	The learner will:
1.	understand the purpose of routine maintenance; identify sources of information and regulations; describe the purpose of inspections
<b>Assessment criteria</b>	
The learner can:	
1.1	state the purpose of routine maintenance
1.2	state the reasons for observing time scales
1.3	state the types of documentations used
1.4	identify sources of information and regulations
1.5	describe the purpose and methods of inspections
1.6	explain the need for vehicle protection prior to maintenance activities
1.7	identify the current regulations relating to the repair and use of light vehicles
1.8	identify safe working practices and environmental impact including waste disposal.

Learning outcome	The learner will:
2.	understand the basic operating principles, components and features of petrol and diesel engines
<b>Assessment criteria</b>	
The learner can:	
2.1	describe the basic operating principles of petrol engines
2.2	describe the basic operating principles of four stroke diesel engines
2.3	identify and state the functions of petrol and diesel engine components
2.4	describe engine configurations
2.5	describe engine layouts using single and twin camshafts
2.6	describe the operation of and service requirements of the exhaust/air supply system.

Learning outcome	The learner will:
3.	understand the basic operating principles, components, features and maintenance requirements of lubrication and cooling systems.

**Assessment criteria**

The learner can:

- 3.1 describe the principles of engine lubrication systems
- 3.2 explain the routine maintenance requirements for engine lubrication systems
- 3.3 describe the basic operating principles of cooling systems
- 3.4 identify and state the functions of the components used in liquid cooled systems
- 3.5 state the routine maintenance requirements for cooling systems.

**Learning outcome****The learner will:**

- 4. be able to understand the basic operating principles, components, features and maintenance requirements of ignition and petrol fuel systems

**Assessment criteria**

The learner can:

- 4.1 identify ignition systems
- 4.2 identify components
- 4.3 identify ignition system controls during changes in engine load and speed
- 4.4 explain the reasons for ignition timing
- 4.5 state the safety implications when handling petrol
- 4.6 state the regulations regarding petrol storage and handling
- 4.7 state the basic principles of fuel atomisation
- 4.8 identify the layout and basic operation of fuel injection systems.

**Learning outcome****The learner will:**

- 5. be able to understand the basic operating principles, components and features of diesel fuel systems

**Assessment criteria**

The learner can:

- 5.1 state the safety implications when handling diesel
- 5.2 state the regulations regarding diesel storage and handling
- 5.3 describe the basic operating principles of diesel fuel systems
- 5.4 identify fuel tanks, pipes, water traps and filters, tank venting and emission systems, injection pumps and governors, injectors, cold starting aids, fuel cut-off devices, sensors, ecu control of fueling
- 5.5 state the basic principles for fuel atomisation
- 5.6 explain the reasons for injection timing.

**Learning outcome****The learner will:**

- 6. understand the basic operating principles, components and features of clutches and gearboxes

**Assessment criteria**

The learner can:

- 6.1 identify and state the functions of clutches
- 6.2 identify pressure plates and driven/centre plates, flywheels including dual mass
- 6.3 identify release and spigot bearings
- 6.4 identify cables
- 6.5 identify master and slave cylinders



- 6.6 identify the reasons for fitting a clutch
- 6.7 identify and state the functions of manual gearboxes
- 6.8 identify and state the functions of gear selector mechanisms, gears, bearings and shafts, constant mesh gears, oil seals and gaskets
- 6.9 identify and state the functions of gearbox lubrication and venting
- 6.10 identify and state the functions of automatic gearboxes
- 6.11 identify and state the functions of torque converters, gear selector mechanisms, gears, bearings and shafts, clutches and control mechanisms, oil seals and gaskets, sensors and actuators and ecu.

<b>Learning outcome</b>	<b>The learner will:</b>
7.	understand the basic operating principles, components and features of driveline and final drive systems
<b>Assessment criteria</b>	
The learner can:	
7.1	identify and state the functions of drive shafts
7.2	identify and state the functions of universal joints, sliding couplings and constant velocity joints
7.3	identify final drive systems
7.4	identify components and basic operation of final drive gears (helical and hypoid)
7.5	identify components and basic operation of differentials
7.6	identify components and basic operation of hubs, bearings and half shafts.

<b>Learning outcome</b>	<b>The learner will:</b>
8.	understand the basic operating principles, components and features of steering.
<b>Assessment criteria</b>	
The learner can:	
8.1	identify and state the basic functions of steering systems
8.2	identify and state the basic functions of steering boxes, steering arms and linkages, steering joints and bushes, bearings, steering columns (collapsible and absorbing), wheels and hydraulic pump and control valves
8.3	describe steering geometry measurement and adjustments.

<b>Learning outcome</b>	<b>The learner will:</b>
9.	understand the basic operating principles, components and features of suspension, wheels and tyres
<b>Assessment criteria</b>	
The learner can:	
9.1	identify and state the functions of suspension systems (non-independent and independent)
9.2	identify and state the functions of springs, dampers, struts, arms and swivels
9.3	describe the current legal requirements governing the use of tyres
9.4	identify the markings on tyres (speed rating, direction of rotation profile, load handling and ply rating, pressure, tread wear indicators)
9.5	identify the different types of wheels and rim construction (steel wheels, alloy wheels, wire wheels, space saver wheels)
9.6	identify methods of tyre construction (tubed and tubeless, radial, bias belted tyres, braced tyres, valves).

<b>Learning outcome</b>	<b>The learner will:</b>
10	understand the basic operating principles, components, service requirements and features of brakes
<b>Assessment criteria</b>	
The learner can:	
10.1	identify and state the basic functions of disc and drum brake systems (divided (split systems, dual systems), antilock brake systems
10.2	identify and state the basic functions of hydraulic cylinders and calipers, discs and drums, brake pads and shoes, pipes and cables, vacuum servos and warning lights and sensors, brake fluid and its specifications, pressure controlling valves, parking brakes, wheel speed sensors
10.3	explain the routine maintenance requirements for braking systems (acceptable levels of component wear)
10.4	explain the checks required for braking systems; components for wear, security and serviceability, fluid levels and contamination, efficiency.

<b>Learning outcome</b>	<b>The learner will:</b>
11	understand the basic operating principles, components, service requirements and features of electrical and electronic systems
<b>Assessment criteria</b>	
The learner can:	
11.1	identify and state the functions of battery and charging systems
11.2	identify and state the function and basic operation of lead acid battery, alternator, alternator drive systems
11.3	identify and state the functions of engine starting systems
11.4	identify and state the function and basic operation of starter motor, starter ring gear, ignition switch.
11.5	explain the purpose and use of electrical wiring diagrams
11.6	identify and state the functions of auxiliary and lighting systems
11.7	identify and state the functions and basic operation of exterior and interior lights and bulbs (filament and arc) indicators, fan, heater and de-misting systems
11.8	describe the routine maintenance requirements for electrical and electronic systems.

## Unit 727/777

# Carry Out Basic Routine Vehicle Maintenance

Supporting information

**Candidates will be assessed on the assessment criteria as specified within the unit. The following is included to support centres in terms of teaching and delivery.**

Knowledge to include an awareness of Hybrid/electric and alternative fuel vehicles and components

### Reasons for observing time scales

- i. to adhere to completion times
- ii. to keep customers and management informed of progress

### Types of documentation used

- i. job cards
- ii. stores and material records

### Sources of information and regulations

- a. information
  - i. online resources
  - ii. technical manuals
  - iii. technical bulletins
  - iv. servicing schedules
  - v. job card instructions
  - vi. inspection records
  - vii. check lists
- b. regulations
  - i. Road Traffic Act
  - ii. MOT regulations
  - iii. Highway Code

### Purpose of inspections

- i. malfunction of systems and components
- ii. damage and corrosion to structural and support regions
- iii. leaks
- iv. water ingress
- v. component and system wear and security

### Vehicle inspection techniques

- i. aural
- ii. visual
- iii. functional assessments

### **Fault finding techniques**

- i. road tests
- ii. questioning
- iii. review of symptom
- iv. ECU/fault code interrogation

### **Importance of recording details**

- i. audit trail of data
- ii. warranty protection
- iii. insurance requirements
- iv. legal requirements
- v. costing
- vi. customer support
- vii. sales and marketing

### **Personal protective equipment (PPE) and Vehicle protective equipment (VPE)\_**

- i. appropriate PPE
- ii. appropriate VPE including
- iii. vehicle body panels
- iv. seats covers
- v. floor mats

### **Petrol engines**

- i. four stroke
- ii. two stroke
- iii. cycles of operation
- iv. valve control systems
- v. compression ratios

### **Four stroke diesel engine**

- i. cycles of operation
- ii. fuel injection and ignition principles
- iii. injection timing
- iv. compression ratios

### **Petrol and diesel engine components**

- i. engine block and cylinder liners
- ii. cylinder head and valves
- iii. crankshafts, camshafts and drives
- iv. pistons, piston rings and connecting rods
- v. bearings/shells bushes and thrust bearings
- vi. flywheel and flywheel ring gear
- vii. gaskets and oil seals
- viii. crankcases and sumps
- ix. vehicle inspection techniques
- x. engine components (main castings, reciprocating/rotating components, valve/timing gear, gaskets and fasteners)

## **Engine configurations**

- i. inline
- ii. flat
- iii. vee

## **Engine lubrication systems**

- i. overview and layout of engine lubrication systems
- ii. oil pan /sum/dry sump
- iii. oil pumps (gear, vane, eccentric rotor)
- iv. oil pump drives and relief valves
- v. filters (full flow and by-pass) and strainers
- vi. sensors, pressure gauges and warning lights
- vii. coolers
- viii. crankcase ventilation

## **Routine maintenance requirements**

- i. checking levels
- ii. lubricant selection
- iii. filter removal and replacement
- iv. lubricant refilling
- v. waste disposal

## **Principles of cooling systems**

- i. layout of liquid cooled systems
- ii. basic air cooling

## **Components used in liquid cooled systems**

- i. radiator, hoses, pressure caps and expansion tanks
- ii. coolant pumps (mechanical and electrical)
- iii. thermostats and fans
- iv. temperature sensors, warning systems and control valves
- v. antifreeze and corrosion inhibitors

## **Components**

- i. battery, wiring and ignition switch
- ii. coils (separate, distributor less, direct)
- iii. spark plugs and HT leads
- iv. timing control devices
- v. ECUs
- vi. engine sensors

## **Fuel delivery systems**

- i. throttle components
- ii. stoichiometric ratio
- iii. atomisation/vaporisation
- iv. manifold depression

### **Fuel injection systems**

- i. fuel tanks, pipelines and filters
- ii. emission control systems
- iii. fuel gauges and warning systems
- iv. fuel pumps
- v. injectors
- vi. throttle potentiometer
- vii. idle speed control valve / auxiliary air device
- viii. engine management sensors
- ix. electronic control units
- x. fuel pressure regulators
- xi. relays
- xii. EGR systems

### **Diesel fuel systems**

- i. inline pump systems
- ii. rotary pump systems
- iii. common rail system

### **Checks required for braking systems**

- i. hygrometer

### **Markings on tyres**

- i. width
- ii. rim size
- iii. aspect ratio
- iv. speed rating
- v. load index

### **Tyre construction**

- i. radial

### **Auxiliary drive belts**

- i. vee
- ii. multi-rib
- iii. serpentine

### **Starter motors**

- i. pre-engaged
- ii. gear reduction

### **Bulb types**

- i. tungsten filament
- ii. halogen
- iii. high Intensity Discharge (HID)
- iv. light Emitting Diode (LED)

## 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](http://www.cityandguilds.com).

### City & Guilds / ILM Quality Assurance Standards: Centre Handbook

This document 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
- Reasonable adjustments and special considerations
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

### City & Guilds / ILM Quality Assurance Standards: Centre Approval Process

This document explains the requirements for the delivery, assessment and awarding of our qualifications. All centres working with City & Guilds must adopt and implement these requirements across all of their qualification provision. Specifically, this document:

- specifies the quality assurance and control requirements that apply to all centres
- sets out the basis for securing high standards, for all our qualifications and/or assessments
- details the impact on centres of non-compliance

Our Quality Assurance Requirements document encompasses the relevant regulatory requirements of the following documents, which apply to centres working with City & Guilds:

- Ofqual's General Conditions of Recognition

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

- **Walled Garden:** how to register and certificate candidates online
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for e-assessments.

## Useful contacts

### UK learners

General qualification information

**E:**  
**[learnersupport@cityandguilds.com](mailto:learnersupport@cityandguilds.com)**

### International learners

General qualification information

**E:** **[intcg@cityandguilds.com](mailto:intcg@cityandguilds.com)**

### Centres

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

**E:**  
**[centresupport@cityandguilds.com](mailto:centresupport@cityandguilds.com)**

### Single subject qualifications

Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

**E:**  
**[singlesubjects@cityandguilds.com](mailto:singlesubjects@cityandguilds.com)**

### International awards

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

**E:** **[intops@cityandguilds.com](mailto:intops@cityandguilds.com)**

### Walled Garden

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

**E:** **[walledgarden@cityandguilds.com](mailto:walledgarden@cityandguilds.com)**

### Employer

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

**E:** **[business@cityandguilds.com](mailto:business@cityandguilds.com)**

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



## About City & Guilds

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

## City & Guilds Group

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

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