Diploma in Heavy Vehicle Maintenance and Repair Principles at SCQF Level 5 and Level 7 (5380-25/27)

October 2022 Version 1.1

Qualification Handbook

Qualification at a glance

Subject area	**Heavy Vehicle Maintenance and Repair**
City & Guilds number	5380
Age group approved	16-18, 19+
Entry requirements	None
Assessment	Online multiple choice tests (graded Pass, Merit, Distinction) and assignments (graded Pass)
Approvals	Automatic approval available
Support materials	Centre handbook SmartScreen
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds number	Accreditation number
Diploma in Heavy Vehicle Maintenance and Repair Principles at SCQF Level 5	5380-25	R494 04
Diploma in Heavy Vehicle Maintenance and Repair Principles at SCQF Level 7	5380-27	R495 04

Version and date	Change detail	Section
1.0 December 2019	Initial version	All
1.1 October 2022	Sources of general information updated	Appendix 2

Contents

1 Introduction

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

Area	Description
Who are the qualifications for?	For Level 5 - Candidates wanting to develop some of the key skills and understanding in motor vehicle systems. Successful candidates will have the basic skills needed to apply for an automotive apprenticeship or similar engineering pathway. This qualification could also be used as an 'interest' course for a wide range of learners. For Level 7 - Candidates wanting to develop practical skills in, and broaden their understanding of motor vehicle systems. It also gives them the opportunity to learn how to develop others.
What do the qualifications cover?	These qualifications allow candidates to learn, develop and practise the skills required for employment and/or career progression in the automotive industry.
Are the qualifications part of a framework or initiative?	These qualifications are part of the Scottish Automotive Maintenance and Repair Modern Apprenticeship Framework.
What opportunities for progression are there?	They allow candidates to progress into employment or to the following City & Guilds qualifications: SCQF Level 5: 5380-27 Diploma in Heavy Vehicle Maintenance and Repair Principles at SCQF Level 7 5310-25/27 SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 5/7 SCQF Level 7: 5310-27 SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 7 ILM Management and Leadership qualifications.
Who did we develop the qualification with?	These qualifications were developed in collaboration with the Institute of the Motor Industry (IMI), the sector skills council for the automotive retail industry and other awarding organisations.

Structure

To achieve the **Diploma in Heavy Vehicle Maintenance and Repair Principles at SCQF Level 5** learners must achieve all mandatory units and a minimum of 1 optional group from the optional units. Some units require learners to successfully complete an online multiple choice test or assignment. Details can be found in later sections of this Handbook and in the assessment requirements section of each individual unit.

City & Guilds unit number	Unit title	SCQF level	SCQF credit value
Mandatory			
5380-001	Skills in Health, Safety and Good Housekeeping in the Automotive Environment	5	7
5380-003	Skills in Supporting Job Roles in the Automotive Work Environment	6	5
5380-004	Skills in Materials, Fabrication, Tools and Measuring Devices used in the Automotive Environment	5	7
5380-051	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	5	3
5380-053	Knowledge of Support for Job Roles in the Automotive Work Environment	6	3
5380-054	Knowledge of Materials, Fabrication, Tools and Measuring Devices used in the Automotive Environment	5	4
5380-201	Skills in Conducting Routine Heavy Vehicle Maintenance	5	3
5380-202	Skills in Removing and Replacing Heavy Vehicle Engine Units and Components	5	5
5380-203	Skills in Removing and Replacing Heavy Vehicle Electrical Units and Components	5	5
5380-204	Skills in Removing and Replacing Heavy Vehicle Chassis Units and Components	5	5
5380-252	Knowledge of Heavy Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components	5	3
5380-253	Knowledge of Heavy Vehicle Electrical Units and Components	5	6
5380-254	Knowledge of Heavy Vehicle Chassis Units and Components	5	6
5380-262	Knowledge of Heavy Vehicle Transmission and Driveline Units and Components	5	6
5380-272	Knowledge of Heavy Vehicle Fuel, Air Supply and Exhaust System Units and Components	5	3
5380-291	Knowledge of Conducting Routine Heavy Vehicle Maintenance	5	3

Optional Groups			
Optional Group 1			
5830-209	Skills in Inspecting Heavy Vehicles to Comply With Legal Requirements	6	2
5380-259	Knowledge of Inspecting Heavy Vehicles to Comply with Legal Requirements	5	4
Optional Group 2			
5380-214	Skills in Overhauling Heavy Vehicle Engine Mechanical Units	7	4
5380-264	Knowledge of Overhauling Heavy Vehicle Engine Units	7	4
Optional Group 3			
5380-223	Skills in Overhauling Heavy Vehicle Transmission Units	7	4
5380-273	Knowledge of Overhauling Heavy Vehicle Transmission Units	7	4
Optional Group 4			
5380-232	Skills in Overhauling Heavy Vehicle Steering and Suspension Units	7	4
5380-282	Knowledge of Overhauling Heavy Vehicle Steering and Suspension Units	7	4
Optional Group 5			
5380-212	Skills in Removing and Replacing Heavy Vehicle Transmission and Driveline Units and Components	5	5

To achieve the **Diploma in Heavy Vehicle Maintenance and Repair Principles at SCQF Level 7** learners must achieve all mandatory units and a minimum of 1 optional group from the optional units below. Some units require learners to successfully complete an online multiple choice test or assignment. Details can be found in later sections of this Handbook and in the assessment requirements section of each individual unit.

City & Guilds unit number	Unit title	SCQF level	SCQF credit value
Mandatory			
5380-001	Skills in Health, Safety and Good Housekeeping in the Automotive Environment	5	7
5380-003	Skills in Supporting Job Roles in the Automotive Work Environment	6	5
5380-004	Skills in Materials, Fabrication, Tools and Measuring Devices used in the Automotive Environment	5	7
5380-051	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	5	3
5380-053	Knowledge of Support for Job Roles in the Automotive Work Environment	6	3
5380-054	Knowledge of Materials, Fabrication, Tools and Measuring Devices used in the Automotive Environment	5	4
5380-207	Skills in Diagnosing and Rectifying Heavy Vehicle Engine Faults	7	5
5380-208	Skills in Diagnosing and Rectifying Heavy Vehicle Chassis System Faults	7	5
5380-209	Skills in Inspecting Heavy Vehicles to Comply With Legal Requirements	6	2
5380-257	Knowledge of Diagnosis and Rectification of Heavy Vehicle Engine Faults	7	6
5380-258	Knowledge of Diagnosis and Rectification of Heavy Vehicle Chassis Faults	7	6
5380-259	Knowledge of Inspecting Heavy Vehicles to Comply with Legal Requirements	5	4
5380-263	Knowledge of Diagnosis and Rectification of Heavy Vehicle Transmission and Driveline Faults	7	6
5380-406	Skills in Diagnosing and Rectifying Vehicle Auxiliary Electrical Faults	7	5
5380-456	Knowledge of Diagnosis and Rectification of Vehicle Auxiliary Electrical Faults	7	6
5380-291	Knowledge of Conducting Routine Heavy Vehicle Maintenance	5	3

Optional Groups			
Optional Group 1			
5380-006	Skills in how to Make Learning Possible through Demonstrations and Instruction	7	5
5380-056	Knowledge of How to Make Learning Possible through Demonstrations and Instruction	7	5
Optional Group 2			
5380-008	Skills to Identify and Agree Motor Vehicle Customer Service Needs	6	5
5380-058	Knowledge of how to Identify and Agree Motor Vehicle Customer Service Needs	6	5
Optional Group 3			
5380-214	Skills in Overhauling Heavy Vehicle Engine Mechanical Units	7	4
5380-264	Knowledge of Overhauling Heavy Vehicle Engine Units	7	4
Optional Group 4			
5380-223	Skills in Overhauling Heavy Vehicle Transmission Units	7	4
5380-273	Knowledge of Overhauling Heavy Vehicle Transmission Units	7	4
Optional Group 5			
5380-232	Skills in Overhauling Heavy Vehicle Steering and Suspension Units	7	4
5380-282	Knowledge of Overhauling Heavy Vehicle Steering and Suspension Units	7	4
Optional Group 6			
5380-213	Skills in Diagnosing and Rectifying Heavy Vehicle Transmission and Driveline Faults	7	5

2 Centre requirements

Approval

Centres already approved to offer the Diploma in Heavy Vehicle Maintenance & Repair Principles at SCQF Level 5 (4390-52) will be automatically approved to register and certificate candidates on the 5380-25 (unless the centre is already subject to sanctions).

Centres already approved to offer the Diploma in Heavy Vehicle Maintenance & Repair Principles at SCQF Level 7 (4390-53) will be automatically approved to register and certificate candidates on the 5380-27 (unless the centre is already subject to sanctions).

To offer these qualifications, new centres will need to gain both centre and qualification approval. Please refer to the *City & Guilds Centre Manual* for further information.

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

Resource requirements

Physical resources and site agreements

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

Centre staffing

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

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

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

Assessor and verifiers

While the Assessor/Verifier (A/V) units are valued as qualifications for centre staff, they are not currently a requirement for this qualification.

Continuing professional development (CPD)

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

Learner entry requirements

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

Please note that for funding purposes, candidates should not be entered for a qualification of the same type, content and level as that of a qualification they already hold.

Age restrictions

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

3 Delivering the qualification

Initial assessment and induction

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

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

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification[s], 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
Centre handbook	www.cityandguilds.com/automotive
Practical assessment workbook	www.cityandguilds.com/automotive

Recording documents

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

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

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

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external 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 this qualification:

- Assignments (practical assessment workbooks) comprising of practical tasks and knowledge based questions to cover all learning outcomes graded Pass only.
- Online multiple choice tests graded Pass, Merit, Distinction.

Assignments can be downloaded from **www.cityandguilds.com/automotive**. These assessments are carried out in the centres and must be completed to current industry standards and practice.

Assessment Types			
City & Guilds unit	**SCQF Level**	**Unit title**	**Assessment method**
001	Level 5	Skills in health, safety and good housekeeping in the automotive environment	Assignment
003	Level 6	Skills in supporting job roles in the automotive work environment	Assignment
004	Level 5	Skills in materials, fabrication, tools and measuring devices used in the automotive environment	Assignment
006	Level 7	Skills in how to make learning possible through demonstrations and instruction	Assignment
008	Level 6	Skills to identify and agree motor vehicle customer service needs	Assignment
051	Level 5	Knowledge of health, safety and good housekeeping in the automotive environment	Assignment
053	Level 6	Knowledge of support for job roles in the automotive work environment	Assignment
054	Level 5	Knowledge of materials, fabrication, tools and measuring devices used in the automotive environment	Assignment
056	Level 7	Knowledge of how to make learning possible through demonstrations and instruction	Assignment
058	Level 6	Knowledge of how to Identify and agree motor vehicle customer service needs	Assignment
201	Level 5	Skills in Conducting Routine Heavy Vehicle Maintenance	Assignment
202	Level 5	Skills in Removing and Replacing Heavy Vehicle Engine Units and Components	Assignment
203	Level 5	Skills in Removing and Replacing Heavy Vehicle Electrical Units and Components	Assignment
204	Level 5	Skills in Removing and Replacing Heavy Vehicle Chassis Units and Components	Assignment
207	Level 7	Skills in Diagnosing and Rectifying Heavy Vehicle Engine Faults	Assignment
208	Level 7	Skills in Diagnosing and Rectifying Heavy Vehicle Chassis System Faults	Assignment
209	Level 6	Skills in Inspecting Heavy Vehicles To Comply With Legal Requirements	Assignment
212	Level 5	Skills in Removing and Replacing Heavy Vehicle Transmission and Driveline Units and Components	Assignment
213	Level 7	Skills in Diagnosing and Rectifying Heavy Vehicle Transmission and Driveline Faults	Assignment
214	Level 7	Skills in Overhauling Heavy Vehicle Engine Mechanical Units	Assignment
223	Level 7	Skills in Overhauling Heavy Vehicle Transmission Units	Assignment

232	Level 7	Skills in Overhauling Heavy Vehicle Steering and Suspension Units	Assignment
252	Level 5	Knowledge of Heavy Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components	Multiple choice test
253	Level 5	Knowledge of Heavy Vehicle Electrical Units and Components	Multiple choice test
254	Level 5	Knowledge of Heavy Vehicle Chassis Units and Components	Multiple choice test
257	Level 7	Knowledge of Diagnosis and Rectification of Heavy Vehicle Engine Faults	Multiple choice test
258	Level 7	Knowledge of Diagnosis and Rectification of Heavy Vehicle Chassis Faults	Multiple choice test
259	Level 5	Knowledge of Inspecting Heavy Vehicles to Comply with Legal Requirements	Multiple choice test
262	Level 5	Knowledge of Heavy Vehicle Transmission and Driveline Units and Components	Multiple choice test
263	Level 7	Knowledge of Diagnosis and Rectification of Heavy Vehicle Transmission and Driveline Faults	Multiple choice test
264	Level 7	Knowledge of Overhauling Heavy Vehicle Engine Units	Multiple choice test
272	Level 5	Knowledge of Heavy Vehicle Fuel, Air Supply and Exhaust System Units and Components	Multiple choice test
273	Level 7	Knowledge of Overhauling Heavy Vehicle Transmission Units	Multiple choice test
282	Level 7	Knowledge of Overhauling Heavy Vehicle Steering and Suspension Units	Multiple choice test
291	Level 5	Knowledge of Conducting Routine Heavy Vehicle Maintenance	Multiple choice test
406	Level 7	Skills in diagnosing and rectifying vehicle auxiliary electrical faults	Assignment
456	Level 7	Knowledge of diagnosis and rectification of vehicle auxiliary electrical faults	Multiple choice test

Time constraints

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

- Candidates must complete their assessments within their registration period.

5 Units

Structure of units

These units each have the following:

- City & Guilds reference number
- title
- level
- credit value
- unit aim
- relationship to NOS, other qualifications and frameworks
- information on assessment
- learning outcomes which are comprised of a number of assessment criteria
- notes for guidance.

The units were developed by the IMI, the sector skills council for the automotive retail industry. All assessments have been developed in accordance with the IMI Assessment Requirements.

Unit 001 Skills in health, safety and good housekeeping in the automotive environment

Level:	**5**
Credit value:	7
Relationship to NOS:	This unit is linked to G3 Maintain Working Relationships in the Motor Vehicle Environment.
Aim:	This unit will help the learner develop the skills required to keep good working relationships with all colleagues and customers in the automotive work environment by using effective communication and support.

Learning outcome	**The learner will:**
1. be able to work effectively within the organisational structure of the automotive work environment	
Assessment criteria	
The learner can 1.1 respond promptly and willingly to requests for assistance from customers and colleagues 1.2 refer customers and colleagues to the correct person should requests fall outside their responsibility and capability.	

Learning outcome	**The learner will:**
2. be able to obtain and use information in order to support their job role within the automotive work environment	
Assessment criteria	
The learner can 2.1 select and use legal and technical information, in an automotive work environment.	

Learning outcome	The learner will:
3. be able to communicate with and support colleagues and customers effectively within the automotive work environment	
Assessment criteria	
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 make requests for assistance from or to customers and colleagues clearly and courteously.	

Learning outcome	The learner will:
4. be able to develop and keep good working relationships in the automotive work environment	
Assessment criteria	
The learner can 4.1 contribute to team work by initiating ideas and co-operating with customers and colleagues 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 inform colleagues promptly of anything likely to affect their own work.	

Unit 003 Skills in supporting job roles in the automotive work environment

Level:	**6**
Credit value:	5
Relationship to NOS:	This unit is linked to G3 Maintain Working Relationships in the Motor Vehicle Environment.
Aim:	This unit will help the learner develop the skills required to keep good working relationships with all colleagues and customers in the automotive work environment by using effective communication and support.

Learning outcome	**The learner will:**
1. be able to work effectively within the organisational structure of the automotive work environment	
Assessment criteria	
The learner can: 1.1 respond promptly and willingly to requests for assistance from customers and colleagues 1.2 refer customers and colleagues to the correct person should requests fall outside their responsibility and capability.	

Learning outcome	**The learner will:**
2. be able to obtain and use information in order to support their job role within the automotive work environment	
Assessment criteria	
The learner can: 2.1 select and use legal and technical information in an automotive work environment.	

Learning outcome	**The learner will:**
3. be able to communicate with and support colleagues and customers effectively within the automotive work environment	
Assessment criteria	
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 make requests for assistance from or to customers and colleagues clearly and courteously.	

Learning outcome	The learner will:
4. be able to develop and keep good working relationships in the automotive work environment	
Assessment criteria	
The learner can: 4.1 contribute to team work by initiating ideas and co-operating with customers and colleagues 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 inform colleagues promptly of anything likely to affect their own work.	

Unit 004 Skills in materials, fabrication, tools and measuring devices used in the automotive environment

Level:	**5**
Credit value:	7
Relationship to NOS:	This unit is linked to G4 Use of hand tools and equipment in motor vehicle engineering.
Aim:	This unit helps the learner to develop the skills required for: • the correct selection, care and use of key hand tools and measuring devices for modification, fabrication and repair in the automotive environment • the correct preparation and use of common work environment equipment • the correct selection and fabrication of materials used when modifying and repairing • the correct application of automotive engineering fabrication and fitting principles.

Learning outcome	**The learner will:**
1. be able to select, maintain and use hand tools and measuring devices in the automotive environment	
Assessment criteria	
The learner can: 1.1 select, maintain and use suitable hand tools safely when fabricating and fitting in the automotive workplace 1.2 select, maintain and use suitable measuring devices safely when fabricating and fitting in the automotive environment 1.3 select, maintain and use suitable PPE for fabrication, repair and fitting in the automotive environment 1.4 select, maintain and use suitable electrical measuring tools safely when repairing vehicles and components.	

Learning outcome	The learner will:
2. be able to prepare and use common workshop equipment	
Assessment criteria	
The learner can: 2.1 use suitably maintained workshop equipment safely 2.2 use correct interpretation of 'safe working load' on lifting and supporting equipment 2.3 report any faulty or damaged tools and equipment to the relevant persons clearly and promptly 2.4 store work tools and equipment in a safe manner which permits ease of access and identification for use.	

Learning outcome	The learner will:
3. be able to select materials when fabricating, modifying and repairing vehicles and fitting components	
Assessment criteria	
The learner can: 3.1 select and use appropriate materials whilst constructing, fitting, modifying or repairing vehicles and components.	

Learning outcome	The learner will:
4. be able to apply automotive engineering, fabrication and fitting principles when modifying and repairing vehicles and components	
Assessment criteria	
The learner can: 4.1 use correct procedures when: a. filing b. tapping threads c. cutting plastics and metals d. drilling plastics and metals e. fitting 4.2 use appropriate techniques when fabricating, repairing and modifying vehicles and components 4.3 select and use: a. gaskets b. seals c. sealants d. fittings and fasteners 4.4 apply modification and repair techniques to automotive electrical circuits 4.5 select and use locking, fixing and fastening devices.	

Unit 006 Skills in how to make learning possible through demonstrations and instruction

Level:	**7**
Credit value:	5
Relationship to NOS:	This unit is linked to G6 Enable Learning through Demonstration and Instruction.
Aim:	This unit covers the skills needed in order to carry out demonstrations and instruction which will help the learner to learn. It includes demonstrating equipment, showing skills, giving instruction, deciding when to use demonstration or instruction, potential of technology based learning, checking on learners' progress and giving feedback.

Learning outcome	**The learner will:**
1. be able to demonstrate skills and methods to learners	
Assessment criteria	
The learner can: 1.1 perform demonstrations based on an analysis of the skills needed and the order in which they must be learned 1.2 perform demonstrations that are accurate and realistic 1.3 perform structured demonstrations so that the learner can get the most out of it 1.4 perform demonstrations whilst encouraging learners to ask questions and get explanation at appropriate stages in the demonstration 1.5 provide positive feedback to learners whilst they are being given the opportunity to practice the skills that have been demonstrated 1.6 perform additional demonstrations of skills being taught to reinforce learning 1.7 perform demonstrations in a safe environment which also allows learners to see clearly 1.8 respond to the needs of the learners during demonstrations 1.9 reduce distractions and disruptions as much as possible.	

Learning outcome	The learner will:
2. be able to instruct learners	
Assessment criteria	
The learner can: 2.1 implement instruction which is matched to the needs of learners 2.2 use identified learning outcomes which can be achieved through instruction 2.3 perform instruction, ensuring that the manner, level and speed of the instruction encourages learners to take part 2.4 perform instruction whilst regularly checking that the learners understand and adapt instruction as appropriate 2.5 give learners positive feedback on the learning experience and the outcomes achieved 2.6 carry out a review with the learners to identify anything that prevented learning and adapt instruction as appropriate.	

Unit 008 Skills to identify and agree motor vehicle customer service needs

Level:	**6**
Credit value:	5
Relationship to NOS:	This unit is linked to G8 Identify and agree the motor vehicle customer needs.
Aim:	This unit is about the skills required to: gain information from customers on their perceived needs; give advice and information and agree a course of action; contract for the agreed work and complete all necessary records and instructions.

Learning outcome	**The learner will:**
1. be able to obtain relevant information from the customer	
Assessment criteria	
The learner can: 1.1 obtain and interpret sufficient, relevant information, from the customer to make an assessment of their needs 1.2 clarify customer and vehicle needs by referring to vehicle data and operating procedures.	

Learning outcome	**The learner will:**
2. be able to provide relevant information to the customer	
Assessment criteria	
The learner can: 2.1 provide customers with accurate, current and relevant advice and information, in a form that the customer will understand 2.2 demonstrate techniques which encourage customers to ask questions and seek clarification during conversation.	

Learning outcome	**The learner will:**
3. be able to agree work undertaken with the customer	
Assessment criteria	
The learner can: 3.1 summarise and record work agreed with the customer, before accepting the vehicle 3.2 implement confirmation of the agreement by ensuring customer understanding.	

Learning outcome	The learner will:
4. be able to ensure recording systems are implemented correctly	
Assessment criteria	
The learner can: 4.1 use recording systems which are accurate and complete, in the required format and signed by the customer where necessary 4.2 perform the next stage in the process by passing on completed records to the correct person promptly 4.3 demonstrate correct procedures for customer approval where the contracted agreement is likely to be exceeded.	

Unit 051 Knowledge of health, safety and good housekeeping in the automotive environment

Level:	**5**
Credit value:	3
Relationship to NOS:	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.
Aim:	This unit enables the learner to develop an understanding of: • routine maintenance and cleaning of the automotive environment and using resources economically • health and safety legislation and duties of everyone in the motor vehicle environment. It will provide 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	
Assessment criteria	
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	
Assessment criteria	
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.	

Learning outcome	The learner will:
3. understand key health and safety requirements relevant to the automotive environment	
Assessment criteria	
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.	

Learning outcome	The learner will:
4. understand about hazards and potential risks relevant to the automotive environment	
Assessment criteria	
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.	

Learning outcome	The learner will:
5. understand personal responsibilities	
Assessment criteria	
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 051 Knowledge of health, safety and good housekeeping in the automotive environment

Supporting information

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

Economic use of resources

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

Requirement to maintain work area effectively

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

Spillages, leaks and waste materials

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

Basic legislative requirements

a. Provision And Use of Work Equipment Regulations 1992
b. 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. Trainee's 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 heath 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. CO2
    iv. water
    v. fire blanket.

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

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

Product warning labels to include:

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

Warning signs and notices

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

Hazards and risks to include:

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

Personal responsibilities

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

Action to be taken in the event of colleagues suffering accidents

a. The typical sequence of events following the discovery of an accident such as:
    i. make the area safe
    ii. remove hazards if appropriate i.e. switch off power
    iii. administer minor first aid
    iv. take appropriate action to re-assure the injured party
    v. raise the alarm
    vi. get help
    vii. report on the accident.

b. Typical examples of first aid which can be administered by persons at the scene of an accident:
    i. check for consciousness
    ii. stem bleeding
    iii. keep the injured person's airways free
    iv. place in the recovery position if injured person is unconscious
    v. issue plasters for minor cuts
    vi. action to prevent shock i.e. keep the injured party warm
    vii. administer water for minor burns or chemical injuries
    viii. wash eyes with water to remove dust or ingress of chemicals (battery acid)
    ix. need to seek professional help for serious injuries.

c. Examples of bad practice which may result in further injury such as:
    i. moving the injured party
    ii. removing foreign objects from wounds or eyes
    iii. inducing vomiting
    iv. straightening deformed limbs.

Unit 053 Knowledge of support for job roles in the automotive work environment

Level:	**6**
Credit value:	3
Relationship to NOS:	This unit is linked to G3 Maintain Working Relationships in the Motor Vehicle Environment.
Aim:	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. understand key organisational structures, functions and roles within the automotive work environment	
Assessment criteria	
The learner can: 1.1 identify the purpose of the different sections of a typical automotive work environment 1.2 explain organisational structures and lines of communication within the automotive work environment 1.3 explain levels of responsibility within specific job roles in an automotive workplace. To include: a. trainee b. skilled technician c. supervisor d. manager.	

Learning outcome	**The learner will:**
2. understand the importance of obtaining, interpreting and using information in order to support their job role within the automotive work environment	
Assessment criteria	
The learner can: 2.1 explain the importance of different sources of information in an automotive work environment 2.2 explain how to find, interpret and use relevant sources of information 2.3 describe the main legal requirements relating to the vehicle, including road safety requirements 2.4 explain the importance of working to recognised procedures and processes 2.5 explain when replacement units and components must meet the manufacturers' original equipment specification 2.6 explain the purpose of how to use identification codes.	

Learning outcome	The learner will:
3. understand the importance of different types of communication within the automotive work environment	
Assessment criteria	
The learner can: 3.1 explain where different methods of communication would be used within the automotive environment 3.2 explain the factors which can determine their choice of communication 3.3 explain how the communication of information can change with the target audience to include informed and uninformed people.	

Learning outcome	The learner will:
4. understand communication requirements when carrying out vehicle repairs in the automotive work environment	
Assessment criteria	
The learner can: 4.1 explain how to report using written and verbal communication 4.2 explain the importance of documenting information relating to work carried out in the automotive environment 4.3 explain the importance of working to agreed timescales.	

Learning outcome	The learner will:
5. understand how to develop good working relationships with colleagues and customers in the automotive workplace	
Assessment criteria	
The learner can: 5.1 describe how to develop positive working relationships with colleagues and customers 5.2 explain the importance of developing positive working relationships 5.3 explain the importance of accepting other peoples' views and opinions 5.4 explain the importance of making and honouring realistic commitments to colleagues and customers.	

Unit 053 Knowledge of support for job roles in the automotive work environment

Supporting information

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

The structure of a typical vehicle repair business

a. How these areas relate to each other within the business:
    i. body shop
    ii. vehicle repair workshop
    iii. paint shop
    iv. valeting
    v. vehicle parts store
    vi. main office
    vii. vehicle sales
    viii. reception.

Sources of information

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

Communication requirements when carrying out vehicle repairs

a. Locating and using correct documentation and information for:
    i. recording vehicle maintenance and repairs
    ii. vehicle specifications
    iii. component specifications
    iv. oil and fluid specifications
    v. equipment and tools
    vi. identification codes.
b. Procedures for:
    i. referral of problems
    ii. reporting delays
    iii. additional work identified during repair or maintenance
    iv. keeping others informed of progress.

c. Methods of communication:
    i. verbal
    ii. signs and notices
    iii. memos
    iv. telephone
    v. electronic mail
    vi. vehicle job card
    vii. notice boards
    viii. SMS text messaging
    ix. letters.
d. Organisational and customer requirements:
    i. importance of time scales to customer and organization
    ii. relationship between time and costs
    iii. meaning of profit.
e. Choice of communication
    i. distance
    ii. location
    iii. job responsibility.
f. Importance of maintaining positive working relationships:
    i. morale
    ii. productivity
    iii. company image
    iv. customer relationships
    v. colleagues.

Unit 054 Knowledge of materials, fabrication, tools and measuring devices in the automotive environment

Level:	**5**
Credit value:	4
Relationship to NOS:	This unit is linked to G4 Use of hand tools and equipment in Motor Vehicle Engineering.
Aim:	This unit enables the learner to develop an understanding of: • the correct selection, care and use of key hand tools and measuring devices for modification, fabrication and repair in the automotive environment • the correct preparation and use of common work environment equipment • the correct selection and fabrication of materials used when modifying and repairing • the correct application of automotive engineering fabrication and fitting principles.

Learning outcome	**The learner will:**
1. understand how to select, use and care for hand tools and measuring devices in the automotive environment	
Assessment criteria	
The learner can: 1.1 identify and explain the use of common types of hand tools used for fabricating and fitting in the automotive environment 1.2 identify and explain the use of common measuring devices used for fabrication and fitting in the automotive environment 1.3 describe, within the scope of their responsibilities, how to select, prepare and maintain hand tools, measuring devices and PPE used for fabrication, repair and fitting in the automotive environment 1.4 state the limitations of common hand tools and measuring devices used for fabricating, repair and fitting in the automotive workplace 1.5 explain how common hand tools and measuring devices used for fabricating, repair and fitting in the automotive environment should be stored and maintained 1.6 identify common electrical measuring tools used in the repair of vehicles and components 1.7 explain the preparation and safe and correct use of common electrical tools when measuring voltage, current and resistance.	

Learning outcome	The learner will:
2. understand how to prepare and use common workshop equipment	
Assessment criteria	
The learner can: 2.1 describe the preparation and safe use of workshop equipment 2.2 explain the term: safe working load.	

Learning outcome	The learner will:
3. understand how to select materials when fabricating, modifying and repairing vehicles and fitting components	
Assessment criteria	
The learner can: 3.1 describe the properties, application and limitations of ferrous and non-ferrous metals, including their safe use 3.2 describe the properties, application and limitations of common non-metallic materials, including their safe use 3.3 define common terms relating to the properties of materials.	

Learning outcome	The learner will:
4. understand how to apply automotive engineering, fabrication and fitting principles when modifying and repairing vehicles and components	
Assessment criteria	
The learner can: 4.1 describe how to tap threads, file, cut and drill plastics and metals when modifying or repairing vehicles 4.2 describe how to measure, mark out, shape and join materials when fabricating 4.3 describe the selection and fitting procedures of the following: a. gaskets and seals b. sealants and adhesives c. fittings and fasteners d. electrical circuit components 4.4 identify locking, fastening and fixing devices 4.5 state the importance of current operating specifications for limits, fits and tolerances in the automotive environment.	

Unit 054 Knowledge of materials, fabrication, tools and measuring devices in the automotive environment

Supporting information

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

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

a. files
b. hacksaws and snips
c. hammers
d. screwdrivers
e. pliers
f. spanners
g. sockets
h. punches
i. types of drill and drill bits
j. taps and dies
k. stud removers
l. marking out tools.

Common measuring devices used for fabrication and fitting in the automotive environment. To include:

a. rule or tape
b. callipers
c. feeler gauge
d. volume measures
e. micrometre
f. dial gauges
g. torque wrenches
h. depth gauges.

Common electrical measuring tools used in the repair of vehicles and components. To include:

a. ammeter
b. voltmeter
c. ohmmeter
d. multi-meter.

Common electrical terms when measuring:

a. voltage
b. current
c. resistance.

Workshop equipment (including appropriate PPE) to include:

a. hydraulic jacks
b. axle stands
c. pillar drills
d. air tools
e. vehicle lifts
f. cranes
g. hoists
h. electrical power tools.

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

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

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

a. glass
b. plastics
c. Kevlar
d. rubber.

Terms relating to the properties of materials to include:

a. hardness
b. toughness
c. ductility
d. elasticity
e. tenacity
f. malleability
g. plasticity.

Unit 056 Knowledge of how to make learning possible through demonstrations and instruction

Level:	**7**
Credit value:	5
Relationship to NOS:	This unit is linked to G6 Enable Learning through Demonstration and Instruction.
Aim:	This unit enables the learner to develop an understanding of how to carry out demonstrations and instruction which will help the learner to learn. It includes demonstrating equipment, showing skills, giving instruction, deciding when to use demonstration or instruction, potential of technology based learning, checking on learners' progress and giving feedback.

Learning outcome	**The learner will:**
1. understand the nature and role of demonstrations and instruction	
Assessment criteria	
The learner can: 1.1 classify the separate areas of demonstrations which encourage learning 1.2 identify which types of learning are best achieved and supported through demonstrations 1.3 explain how to identify and use different learning opportunities 1.4 explain how to structure demonstrations and instruction sessions 1.5 explain how to choose from a range of demonstration techniques.	

Learning outcome	**The learner will:**
2. understand the principles and concepts of demonstration and instruction	
Assessment criteria	
The learner can: 2.1 describe how to put learners at ease and encourage them to take part 2.2 justify the choice between demonstration and instruction as a learning method 2.3 explain how to identify individual learning needs 2.4 clarify which factors are likely to prevent learning and how to overcome them 2.5 explain how to check learners' understanding and progress 2.6 explain how to choose and prepare appropriate materials 2.7 explain the separate areas of instructional techniques which encourage learning 2.8 describe which types of learning are best achieved and supported through instruction.	

Learning outcome	The learner will:
3. understand the external factors influencing human resource development	
Assessment criteria	
The learner can: 3.1 explain how to make sure everybody acts in line with health, safety and environmental protection, legislation and best practice 3.2 analyse developments in technology based learning and new ways of delivery.	

Unit 056 Knowledge of how to make learning possible through demonstrations and instruction

Supporting information

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

Separate areas of demonstration which encourage learning to include:

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

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

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

How to structure demonstration and instruction sessions to include:

a. Before the demonstration and/or instruction ensure that the following good practice is recognised:
    i. identify key points
    ii. relate theoretical underpinning knowledge to key points
    iii. rehearse to ensure that all equipment is working
    iv. ensure all students can see even small equipment and processes
    v. time the demonstration
    vi. consider how to make students participate
    vii. consider how to emphasise safe working practices.
b. During the demonstration and/or instruction good practice is to:
    i. give a clear introduction
    ii. identify any tools/equipment
    iii. determine the current audience level of knowledge

iv. complete the demonstration correctly (do not show how not to do it)
v. stress key points and show links between them
vi. monitor safety aspects
vii. check learner understanding.

c. After the demonstration (if possible)
   i. enable the audience to practise the techniques
   ii. provide feedback on their performance.

How to identify individual learning needs

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

What factors are likely to prevent learning, to include:

a. language barriers
b. physical barriers
c. specialist knowledge
d. pace of learning
e. method of delivery
f. environmental factors
g. teaching styles
h. dyslexia.

How to check learner's understanding and progress

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

How to organise information and prepare materials

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

Instructional techniques

a. Types of instructional techniques to include:
    i. lectures
    ii. handouts
    iii. team teaching
    iv. peer teaching
    v. discussion - individual, group and peer
    vi. question and answer
    vii. Multimedia
    viii. seminars
    ix. case studies
    x. project/assignments.

Environmental factors that affect learning

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

Health and safety factors that affect learning

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

Analysis of demonstration/instruction to include:

i. feedback from students
ii. feedback from colleagues
iii. organisational quality assessment
iv. feedback from external organisations
v. awarding body requirements.

Developments in learning To include:

a. multimedia based materials
b. web based materials
c. interactive materials.

How to choose and prepare appropriate materials. To include:

a. putting information in order
b. deciding whether the language used is appropriate
c. type of material i.e. paper and technology based etc.

Unit 058 Knowledge of how to identify and agree motor vehicle customer service needs

Level:	**6**
Credit value:	5
Relationship to NOS:	This unit is linked to G8 Identify and agree the motor vehicle customer needs.
Aim:	This unit enables the learner to develop an understanding of how to gain: information from customers on their perceived needs; give advice and information and agree a course of action; contract for the agreed work and complete all necessary records and instructions.

Learning outcome	**The learner will:**
1. understand legislative and organisational requirements and procedures	
Assessment criteria	
The learner can: 1.1 describe the fundamental legal requirements of current consumer legislation and the consequences of their own actions in respect of this legislation 1.2 describe the content and limitations of company and product warranties for the vehicles dealt with by their company 1.3 explain the limits of their own authority for accepting vehicles 1.4 explain the importance of keeping customers informed of progress 1.5 describe their workplace requirements for the completion of records 1.6 explain how to complete and process all the necessary documentation.	

Learning outcome	**The learner will:**
2. understand how to communicate and care for customers	
Assessment criteria	
The learner can: 2.1 explain how to communicate effectively with customers 2.2 describe how to adapt their language when explaining technical matters to non-technical customers 2.3 explain how to use effective questioning techniques 2.4 describe how to care for customers and achieve customer satisfaction.	

Learning outcome	The learner will:
3. understand company products and services	
Assessment criteria	
The learner can: 3.1 describe the range of options available to resolve vehicle problems 3.2 describe the range and type of services offered by their company 3.3 explain the effect of resource availability upon the receipt of customer vehicles and the completion work 3.4 explain how to access costing and work completion time information.	

Unit 058 Knowledge of how to identify and agree motor vehicle customer service needs

Supporting information

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

Organisational requirements

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

Principles of customer communication and care

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

Company products and services

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

Vehicle information systems, servicing and repair requirements

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

Consumer legislation to include:

a. consumer protection
b. sale of goods
c. data protection
d. product liability
e. health and safety
f. discrimination.

Unit 201 Skills in conducting routine heavy vehicle maintenance

Level:	**5**
Credit value:	3
Relationship to NOS:	This unit is linked to HV01 Carry Out Routine Motor Vehicle Maintenance.
Aim:	This unit allows the learner to demonstrate they can carry out heavy vehicle routine maintenance, adjustments and replacement activities as part of the periodic servicing of vehicles.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out heavy vehicle routine maintenance	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings throughout when carrying out heavy vehicle routine maintenance 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy vehicle routine maintenance activities including: a. vehicle technical data b. maintenance procedures c. legal requirements 2.2 use technical information to support heavy vehicle inspection activities.	

Learning outcome	The learner will:
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 routine maintenance 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers when carrying out routine maintenance.	

Learning outcome	The learner will:
4. be able to carry out heavy vehicle routine maintenance	
Assessment criteria	
The learner can: 4.1 carry out heavy vehicle maintenance using prescribed methods, adhering to the correct specifications and tolerances for the vehicle and following: a. the manufacturer's approved inspection methods b. recognised researched inspection methods c. health and safety requirements 4.2 carry out adjustments, replacement of vehicle components and replenishment of consumable materials following the manufacturer's current specification for: a. the particular service interval b. working methods and procedures c. use of equipment d. the tolerances for the vehicle 4.3 ensure the examination methods identify accurately any vehicle system and or component problems falling outside the maintenance schedule are specified 4.4 ensure that the vehicle conforms to the vehicle operating specification and any legal requirements 4.5 ensure any comparison of the vehicle against specification accurately identifies any: a. differences from the vehicle specification b. vehicle appearance and condition faults 4.6 use suitable testing methods to evaluate the performance of all replaced and adjusted components and systems accurately.	

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 and in the format required.	

Unit 202 Skills in removing and replacing heavy vehicle engine units and components

Level:	**5**
Credit value:	5
Relationship to NOS:	This unit is linked to HV02 Remove and Replace Motor Vehicle Engine Units and Components.
Aim:	This unit allows the learner to develop the skills to remove and replace heavy vehicle 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	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when working on heavy vehicle engine units 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy vehicle engine 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 heavy 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 the appropriate tools and equipment necessary for removal and replacement of heavy vehicle engine systems 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers to remove and replace heavy vehicle engine systems.	

Learning outcome	The learner will:
4. be able to carry out removal and replacement of heavy vehicle engine units and components	
Assessment criteria	
The learner can: 4.1 remove and replace the heavy vehicle's engine systems and components, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved removal and replacement methods b. recognised researched repair methods c. health and safety requirements 4.2 ensure that replaced heavy 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 ensure that the reassembled heavy vehicle engine systems perform to the vehicle operating specification and meets any legal requirements.	

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 and in the format required.	

Unit 203 Skills in removing and replacing heavy vehicle electrical units and components

Level:	**5**
Credit value:	5
Relationship to NOS:	This unit is linked to HV03 Remove and Replace Commercial Motor Vehicle Electrical Auxiliary Units and Components.
Aim:	This unit allows the learner to develop the skills to remove and replace motor vehicle electrical 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	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when working on heavy vehicle electrical systems and components 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy 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 heavy vehicle electrical 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 the appropriate tools and equipment necessary for removal and replacement of motor vehicle electrical systems components 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers to remove and replace motor vehicle electrical systems.	

Learning outcome	The learner will:
4. be able to carry out removal and replacement of heavy vehicle electrical units and components	
Assessment criteria	
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: a. the manufacturer's approved removal and replacement methods b. recognised researched repair methods c. health and safety requirements 4.2 ensure that replaced motor vehicle electrical 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 motor vehicle electrical systems perform to the vehicle operating specification and meets any legal requirements.	

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 and in the format required.	

Unit 204 Skills in removing and replacing heavy vehicle chassis units and components

Level:	**5**
Credit value:	5
Relationship to NOS:	This unit is linked to HV04 Remove and Replace Commercial Motor Vehicle Chassis Units and Components.
Aim:	This unit allows the learner to develop the skills to remove and replace heavy vehicle steering, suspension and braking units (including wheels and tyres). 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	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when working on heavy vehicle chassis systems and components 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy 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 heavy vehicle chassis 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 the appropriate tools and equipment necessary for removal and replacement of heavy vehicle chassis systems 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers to remove and replace heavy vehicle chassis systems.	

Learning outcome	The learner will:
4. be able to carry out removal and replacement of heavy vehicle chassis units and components	
Assessment criteria	
The learner can: 4.1 remove and replace the heavy vehicle's chassis 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 researched repair methods c. health and safety requirements 4.2 ensure that replaced heavy 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 heavy vehicle chassis system performs to the vehicle operating specification and meets any legal requirements.	

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 and in the format required.	

Unit 207 Skills in diagnosing and rectifying heavy vehicle engine faults

Level:	**7**
Credit value:	5
Relationship to NOS:	This unit is linked to HV07 Diagnose and Rectify Motor Vehicle Engine and Component Faults.
Aim:	This unit allows the learner to develop the skills required to diagnose and rectify heavy vehicle engine mechanical, electrical, hydraulic and fluid systems faults.

Learning outcome	The learner will:
1. be able to work safely when carrying out heavy vehicle engine diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when carrying out heavy vehicle engine diagnosis and rectification 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	The learner will:
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy vehicle diagnostic and rectification activities including: a. vehicle technical data b. diagnostic test procedures 2.2 use sufficient diagnostic information in a systematic way to enable an accurate diagnosis of heavy vehicle engine system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select the appropriate tools and equipment necessary for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the equipment required safely throughout all heavy vehicle engine diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out heavy vehicle engine diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate their assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. manufacturers' instructions b. recognised researched repair methods c. workplace procedures d. health and safety requirements 4.4 ensure all repaired and replaced components and units conform to the vehicle operating specification and any legal requirements 4.5 adjust components and units correctly to ensure that they operate to meet system requirements 4.6 use testing methods that are suitable for assessing the performance of the system rectified 4.7 ensure the heavy vehicle engine system rectified performs to the vehicle operating specification and any legal requirements.	

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 and in the format required.	

Unit 208 Skills in diagnosing and rectifying heavy vehicle chassis system faults

Level:	**7**
Credit value:	5
Relationship to NOS:	This unit is linked to HV08 Diagnose and Rectify Motor Vehicle Chassis System Faults.
Aim:	This unit allows the learner to demonstrate they can diagnose and rectify heavy vehicle braking steering and suspension systems faults. It also covers the evaluation of performance of the replaced or repaired units and systems.

Learning outcome	The learner will:
1. be able to work safely when carrying out heavy vehicle chassis diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when working on heavy vehicle chassis units 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	The learner will:
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy vehicle diagnostic and rectification activities including: 2.2 vehicle technical data 2.3 diagnostic test procedures 2.4 use sufficient diagnostic information in a systematic way to enable an accurate diagnosis of heavy vehicle chassis system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select the appropriate tools and equipment necessary for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the equipment required safely throughout all heavy vehicle chassis diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out heavy vehicle chassis diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate their assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. manufacturers' instructions b. recognised researched repair methods c. workplace procedures d. health and safety requirements 4.4 ensure all repaired and replaced components and units conform to the vehicle operating specification and any legal requirements 4.5 adjust components and units correctly to ensure that they operate to meet system requirements 4.6 use testing methods that are suitable for assessing the performance of the system rectified 4.7 ensure the heavy vehicle chassis system rectified performs to the vehicle operating specification and any legal requirements.	

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 and in the format required.	

Unit 209 Skills in inspecting heavy vehicles to comply with legal requirements

Level:	**6**
Credit value:	2
Relationship to NOS:	This unit is linked to HV05 Conduct Pre and Post Work Motor Vehicle Inspections.
Aim:	This unit allows the learner to develop the skills required to carry out a range of inspections on heavy vehicles using a variety of prescribed testing and inspection methods.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out heavy vehicle inspections using prescribed methods	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when carrying out heavy vehicle inspections using prescribed methods 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy vehicle inspection activities including: a. vehicle technical data b. inspection procedures c. legal requirements d. heavy vehicle inspection manual 2.2 use technical information to support heavy vehicle inspection activities.	

Learning outcome	The learner will:
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 a range of inspections on heavy vehicle systems including: a. pre-MOT inspection b. scheduled safety inspections (PMI) 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers when carrying out a range of inspections on heavy vehicle systems.	

Learning outcome	The learner will:
4. be able to carry out heavy vehicle inspections using prescribed methods	
Assessment criteria	
The learner can: 4.1 carry out heavy vehicle inspections using prescribed methods, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved inspection methods b. recognised researched inspection methods c. health and safety requirements d. workplace procedures 4.2 ensure that the inspected heavy vehicle conforms to the vehicle operating specification and any legal requirements 4.3 use suitable testing methods to evaluate the performance of the inspected systems.	

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 and in the format required.	

Unit 212 Skills in removing and replacing heavy vehicle transmission and driveline units and components

Level:	**5**
Credit value:	5
Relationship to NOS:	This unit is linked to HV12 Remove and Replace Commercial Motor Vehicle Transmission and Driveline Units and Components
Aim:	This unit allows the learner to develop the skills required to remove and replace heavy 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 heavy vehicle transmission and driveline system component removal and replacement activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings throughout when working on heavy vehicle transmission and driveline systems 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate)	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy 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 heavy 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 the appropriate tools and equipment necessary for removal and replacement of heavy vehicle transmission and driveline systems 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers to remove and replace heavy vehicle transmission and driveline systems.	

Learning outcome	The learner will:
4. be able to carry out removal and replacement of heavy vehicle transmission and driveline units and components	
Assessment criteria	
The learner can: 4.1 remove and replace the heavy vehicle's transmission and driveline systems and components, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved removal and replacement methods b. recognised researched repair methods c. health and safety requirements 4.2 ensure that replaced heavy 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 ensure that the reassembled heavy vehicle transmission and driveline system performs to the vehicle operating specification and meets any legal requirements.	

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 213 Skills in diagnosing and rectifying heavy vehicle transmission and driveline faults

Level:	**7**
Credit value:	5
Relationship to NOS:	This unit is linked to HV13 Diagnose and Rectify Motor Vehicle Transmission and Driveline Faults.
Aim:	This unit allows the learner to develop the skills to diagnose and rectify heavy vehicle gearboxes, hubs and bearings, driveline shafts, clutches, differentials and final drive unit faults. It also covers the evaluation of performance of the replaced or repaired units and systems.

Learning outcome	The learner will:
1. be able to work safely when carrying out heavy vehicle transmission and driveline diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings throughout when working on heavy vehicle transmission and driveline systems and components 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	The learner will:
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support heavy vehicle diagnostic and rectification activities including: a. vehicle technical data b. diagnostic test procedures 2.2 use sufficient diagnostic information in a systematic way to enable an accurate diagnosis of heavy vehicle transmission and driveline system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select the appropriate tools and equipment necessary for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the equipment required safely throughout all heavy vehicle transmission and driveline diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out heavy vehicle transmission and driveline diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate their assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. manufacturers' instructions b. recognised researched repair methods c. workplace procedures d. health and safety requirements 4.4 ensure all repaired and replaced components and units conform to the vehicle operating specification and any legal requirements 4.5 adjust components and units to ensure that they operate to meet system requirements 4.6 use testing methods that are suitable for assessing the performance of the system rectified 4.7 ensure the heavy vehicle transmission and driveline system rectified performs to the vehicle operating specification and any legal requirements.	

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 214 Skills in overhauling heavy vehicle engine mechanical units

Level:	**7**
Credit value:	4
Relationship to NOS:	This unit is linked to HV11 Overhaul Motor Vehicle Mechanical Units.
Aim:	This unit allows the learner to demonstrate skills in order to overhaul engines. It also covers the evaluation of performance of the overhauled units and systems.

Learning outcome	**The learner will:**
1. be able to work safely when overhauling heavy vehicle engine mechanical units	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when overhauling heavy vehicle engine units 1.2 work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support the overhauling of heavy vehicle engine units including: a. vehicle technical data b. overhaul procedures c. legal requirements 2.2 use technical information to support the overhauling of heavy vehicle engine units.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select the appropriate tools and equipment necessary for overhauling heavy vehicle engine units 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers to overhaul heavy vehicle engine units.	

Learning outcome	The learner will:
4. be able to carry out the overhauling of heavy vehicle engine mechanical units	
Assessment criteria	
The learner can: 4.1 carry out all overhauling of heavy vehicle engine mechanical units, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved removal and replacement methods b. recognised researched repair methods c. health and safety requirements d. workplace procedures 4.2 ensure the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul 4.3 inform the relevant person(s) promptly where an overhaul is uneconomic or unsatisfactory to perform 4.4 use testing methods that comply with the manufacturer's requirements 4.5 adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements 4.6 ensure the overhauled units and assemblies conform to the vehicle operating specification and any legal requirements.	

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 223 Skills in overhauling heavy vehicle transmission units

Level:	**7**
Credit value:	4
Relationship to NOS:	This unit is linked to HV11.
Aim:	This unit allows the learner to demonstrate skills in order to overhaul gearboxes and final drive assemblies. It also covers the evaluation of performance of the overhauled units and systems.

Learning outcome	**The learner will:**
1. be able to work safely when overhauling heavy vehicle Transmission units	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when overhauling heavy vehicle transmission units 1.2 work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate)	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support the overhauling of heavy vehicle transmission units including: a. vehicle technical data b. overhauling procedures c. legal requirements 2.2 use technical information to support the overhauling of heavy vehicle transmission units.	

Learning outcome	**The learner will:**
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select the appropriate tools and equipment necessary for overhaul of heavy vehicle transmission systems 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements	

3.3 use the tools and equipment in the way specified by manufacturers to overhaul heavy vehicle transmission systems.	
Learning outcome	**The learner will:**
4. be able to carry out overhauling of heavy vehicle transmission units	
Assessment criteria	
The learner can: 4.1 carry out all overhauling of heavy vehicle transmission units, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved overhauling methods b. recognised researched repair methods c. health and safety requirements d. workplace procedures 4.2 ensure the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul 4.3 inform the relevant person(s) promptly where an overhaul is uneconomic or unsatisfactory to perform 4.4 use testing methods that comply with the manufacturer's requirements 4.5 adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements 4.6 ensure the overhauled units and assemblies conform to the vehicle operating specification and any legal requirements.	

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 232 Skills in overhauling heavy vehicle steering and suspension units

Level:	**7**
Credit value:	4
Relationship to NOS:	This unit is linked to HV11 Overhaul Motor Vehicle Mechanical Units.
Aim:	This unit allows the learner to develop the skills to overhaul engines, gearboxes, final drive assemblies, steering and suspension units. It also covers the evaluation of performance of the overhauled units and systems.

Learning outcome	**The learner will:**
1. be able to work safely when overhauling heavy vehicle steering and suspension units	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings when overhauling heavy vehicle steering and suspension units 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support the overhauling of heavy vehicle steering and suspension units including: a. vehicle technical data b. removal and replacement procedures c. legal requirements 2.2 use technical information to support the overhauling of heavy vehicle steering and suspension units.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select the appropriate tools and equipment necessary for overhauling heavy vehicle steering and suspension units 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the tools and equipment in the way specified by manufacturers for overhauling heavy vehicle steering and suspension units.	

Learning outcome	The learner will:
4. be able to carry out removal and replacement of heavy vehicle chassis units and components	
Assessment criteria	
The learner can: 4.1 carry out all overhauling of heavy vehicle steering and suspension units, adhering to the correct specifications and tolerances for the vehicle and following: a. the manufacturer's approved removal and replacement methods b. recognised researched repair methods c. health and safety requirements d. work place procedures 4.2 ensure the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul 4.3 inform the relevant person(s) promptly where an overhaul is uneconomic or unsatisfactory to perform 4.4 use testing methods that comply with the manufacturer's requirements 4.5 adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements 4.6 ensure the overhauled units and assemblies conform to the vehicle operating specification and any legal requirements.	

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 and in the format required.	

Unit 252 Knowledge of heavy vehicle engine mechanical, lubrication and cooling system units and components

Level:	**5**
Credit value:	3
Relationship to NOS:	This unit is linked to HV02 Remove and Replace Motor Vehicle Engine Units and Components.
Aim:	This unit enables the learner to develop an understanding of the construction and operation of common engine mechanical, lubrication and cooling 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 the main heavy vehicle engine mechanical systems operate	
Assessment criteria	
The learner can: 1.1 identify heavy vehicle engine mechanical system components 1.2 describe the construction and operation of heavy vehicle compression ignition engine mechanical systems 1.3 compare key heavy vehicle 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 heavy vehicle engine mechanical systems: a. compression ratios b. cylinder capacity c. power d. torque 1.5 state common terms used in heavy vehicle engine mechanical systems: a. tdc b. bdc c. stroke d. bore.	

Learning outcome	The learner will:
2. understand how heavy vehicle engine lubrication systems operate	
Assessment criteria	
The learner can: 2.1 identify heavy vehicle engine lubrication system components 2.2 describe the construction and operation of heavy vehicle engine lubrication system components 2.3 compare key heavy 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 heavy vehicle engine lubrication systems: a. classification of lubricants b. properties of lubricants c. methods of reducing friction 2.5 state common terms used in heavy vehicle engine lubrication system design.	

Learning outcome	The learner will:
3. understand how heavy vehicle engine cooling, heating and ventilation systems operate	
Assessment criteria	
The learner can: 3.1 identify heavy vehicle engine cooling, heating and ventilation system components 3.2 describe the construction and operation of heavy vehicle engine cooling, heating and ventilation systems 3.3 compare key heavy 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 heavy 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 heavy vehicle engine cooling, heating and ventilation system design.	

Learning outcome	The learner will:
4. understand how to check, replace and test engine mechanical, lubrication and cooling systems system units and components	
Assessment criteria	
The learner can: 4.1 describe how to remove and replace engine mechanical, lubrication and cooling system units and components 4.2 describe common types of testing methods used to check the operation of engine mechanical, lubrication and cooling systems and their purpose 4.3 describe how to test and evaluate the performance of replacement units against vehicle specification 4.4 identify common faults found in heavy vehicle engine mechanical, lubrication and cooling systems and their causes 4.5 Describe the hazards associated with high energy electrical vehicle components.	

Unit 252 Knowledge of heavy 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. The following information has been provided by IMI SSC and 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 cycle for compression ignition engines
   v. naturally aspirated, turbo-charged and turbo-charged aftercooled engines
   vi. alternative fuel engines
   vii. hybrid arrangements where applicable.

b. Key engineering principles related to engine mechanical systems
   i. compression ratios
   ii. volumetric efficiency
   iii. cylinder capacity
   iv. power
   v. torque

c. Terms used in engine mechanical systems
   i. tdc
   ii. bdc
   iii. stroke
   iv. bore.

d. Relative advantages and disadvantages of different engine types and configurations.

e. Engine components and layouts:
   i. side camshaft and overhead camshaft
   ii. single and multi cylinder
   iii. wet and dry liners
   iv. crankshaft dampers.

f. Cylinder head layout and design, combustion chamber and piston design.

g. Calculate compression ratios from given data.

h. The procedures used when inspecting engines.

i. The procedures to assess:
   i. serviceability
   ii. wear
   iii. condition
   iv. clearances
   v. settings
   vi. linkages
   vii. joints
   viii. fluid systems
   ix. adjustments
   x. operation and functionality
   xi. security.

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

Lubrication

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

g. The procedures used when inspecting lubrication system.
h. The construction and operation of heavy vehicle engine lubrication systems and components, to include:
    i. full flow
    ii. by pass
    iii. wet sump
    iv. dry sump.

Cooling, **heating and ventilation**

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

General

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

Unit 253 Knowledge of heavy vehicle electrical units and components

Level:	**5**
Credit value:	6
Relationship to NOS:	This unit is linked to HV03 Remove and Replace Commercial Motor Vehicle Electrical Auxiliary Units and Components.
Aim:	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 heavy vehicle electrical and electronic principles	
Assessment criteria	
The learner can: 1.1 identify electrical symbols and units found in heavy vehicle circuits 1.2 describe how to interpret heavy vehicle wiring diagrams 1.3 describe the operation of key heavy vehicle circuit protection devices and why these are necessary 1.4 describe earthing principles and earthing methods 1.5 identify the use of different cables and connectors used in heavy vehicle circuits 1.6 describe the operation of electrical and electronic sensors and actuators and their application 1.7 describe the key electrical and electronic control principles that are related to heavy vehicle electrical circuits 1.8 state common terms used in heavy vehicle electrical circuits.	

Learning outcome	**The learner will:**
2. understand how heavy vehicle batteries, starting and charging systems operate	
Assessment criteria	
The learner can: 2.1 identify heavy vehicle batteries, starting and charging system components 2.2 describe the construction and operation of heavy vehicle batteries, starting and charging system components 2.3 describe how to remove and replace batteries, starting and charging system units and components 2.4 compare heavy vehicle batteries, starting and charging system components and assemblies against alternatives to identify differences in construction and operation 2.5 state common terms used in conjunction with heavy vehicle batteries, starting and charging systems.	

Learning outcome	The learner will:
3. understand how heavy vehicle auxiliary electrical systems operate	
Assessment criteria	
The learner can: 3.1 identify heavy vehicle auxiliary system components 3.2 describe the construction and operation of heavy vehicle auxiliary systems 3.3 compare key heavy vehicle auxiliary system components and assemblies against alternatives to identify differences in construction and operation 3.4 state common terms used in heavy vehicle auxiliary system design.	

Learning outcome	The learner will:
4. understand how to check, replace and test heavy vehicle electrical systems and components	
Assessment criteria	
The learner can: 4.1 describe how to remove and replace heavy vehicle electrical system units and components 4.2 describe common types of testing methods used to check the operation of heavy vehicle electrical systems and components and their purpose 4.3 explain how to test and evaluate the performance of replacement units against specifications 4.4 explain common faults found in heavy vehicle electrical systems and components 4.5 Describe the hazards associated with high energy electrical vehicle components.	

Unit 253 Knowledge of heavy vehicle electrical units and components

Supporting information

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

Electrical and Electronic Principles

a. Electrical units:
   i. volt (electrical pressure)
   ii. ampere (electrical current)
   iii. ohm (electrical resistance)
   iv. watt (power).
b. The requirements for an electrical circuit:
   i. battery
   ii. cables
   iii. switch
   iv. current consuming device
   v. continuity.
c. The direction of current flow and electron flow.
d. Series and parallel circuits to include:
   i. current flow
   ii. voltage
   iii. volt drop
   iv. resistance
   v. the effect on circuit operation of open circuit component(s).
e. Earth and insulated return systems.
f. Cable sizes and colour codes.
g. Different types of connectors, terminals and circuit protection devices.
h. Common electrical and electronic symbols.
i. The meaning of:
   i. short circuit
   ii. open circuit
   iii. bad earth
   iv. high resistance
   v. electrical capacity.
j. The principles of vehicle electronic systems and components.
k. Interpret vehicle wiring diagrams to include:
   i. vehicle lighting
   ii. auxiliary circuits
   iii. indicators
   iv. starting and charging systems.

l. Function and construction of electrical components including:
    i. circuit relays
    ii. bulb types
    iii. fan and heater
    iv. circuit protection.

m. The safety precautions when working on electrical and electronic systems to include:
    i. disconnection and connection of battery
    ii. avoidance of short circuits
    iii. power surges
    iv. prevention of electric shock
    v. protection of electrical and electronic components
    vi. protection of circuits from overload or damage.

n. The set-up and use of:
    i. digital and analogue multi-meters
    ii. voltmeter
    iii. ammeter
    iv. ohmmeter
    v. oscilloscope
    vi. manufacturer's dedicated test equipment.

o. Electrical and electronic checks for electrical and electronic systems to include:
    i. connections
    ii. security
    iii. functionality
    iv. performance to specifications
    v. continuity, open circuit
    vi. short circuit
    vii. high resistance
    viii. volt drop
    ix. current consumption
    x. output patterns (oscilloscope).

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

Battery and Charging

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

Starting

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

Lighting

a. Function and construction of electrical components including:
    i. front, tail and number plate lamps
    ii. main and dip beam headlamps
    iii. fog and spot lamps
    iv. lighting switches including main/dip switch
    v. directional indicators
    vi. hazard warning.
b. The circuit diagram and operation of components for:
    i. side tail and marker lamps
    ii. headlamps
    iii. interior lamps
    iv. fog, high-intensity rear and spot lamps
    v. direction indicators.
c. The statutory requirements for vehicle lighting when using a vehicle on the road.
d. Headlamp adjustment and beam setting.

Auxiliary Systems

a. Auxiliary systems to include:
    i. lighting
    ii. wiper
    iii. security and alarm
    iv. comfort and convenience
    v. information and entertainment
    vi. telephone and two way communication
    vii. electric window.
b. Function and construction of electrical components including:
    i. central door locking
    ii. anti theft devices
    iii. manual locking and dead lock systems
    iv. window winding
    v. demisting systems
    vi. door mirror operation mechanisms
    vii. interior lights and switching.
c. The circuit diagram and operation of components for:
    i. central door locking
    ii. anti theft devices
    iii. manual locking and dead lock systems
    iv. window winding
    v. demisting systems
    vi. door mirror operation mechanisms.
d. Comfort and convenience systems to include:
    i. heated seats
    ii. electrically adjusted seats
    iii. heated screens
    iv. electric mirrors
    v. heating
    vi. climate control
    vii. air conditioning
    viii. monitoring and instrumentation.

General

a. The preparation, testing and use of:
    i. tools and equipment
    ii. electrical meters and equipment used for dismantling
    iii. removal and replacement of electrical and electronic systems and components.
b. Appropriate safety precautions:
    i. PPE
    ii. vehicle protection when dismantling
    iii. removal and replacing electrical and electronic components and systems
c. The importance of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.
e. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance, safety requirements.
f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.

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

Unit 254 Knowledge of heavy vehicle chassis units and components

Level:	**5**
Credit value:	6
Relationship to NOS:	This unit is linked to HV04 Remove and Replace Commercial Motor Vehicle Chassis Units and Components.
Aim:	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) on heavy vehicles. 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 heavy vehicle steering systems operate	
Assessment criteria	
The learner can: 1.1 identify heavy vehicle steering system components 1.2 describe the construction and operation of heavy vehicle steering systems 1.3 compare key heavy vehicle steering system components and assemblies against alternatives to identify differences in construction and operation 1.4 identify the key engineering principles that are related to heavy vehicle steering systems a. steering angles b. hydraulic forces c. stress and strain.	

Learning outcome	**The learner will:**
2. understand how heavy vehicle suspension systems operate	
Assessment criteria	
The learner can: 2.1 identify heavy vehicle suspension system components 2.2 describe the construction and operation of heavy vehicle suspension systems 2.3 compare key heavy vehicle suspension system components and assemblies against alternatives to identify differences in construction and operation 2.4 identify the key engineering principles that are related to heavy vehicle suspension systems a. suspension hydraulic damping b. stress and strain 2.5 state common terms used in heavy vehicle suspension system design.	

Learning outcome	The learner will:
3. understand how heavy vehicle braking systems operate	
Assessment criteria	
The learner can: 3.1 identify heavy vehicle braking system components 3.2 describe the construction and operation of heavy vehicle braking systems 3.3 compare key heavy vehicle braking system components and assemblies against alternatives to identify differences in construction and operation 3.4 identify the key engineering principles that are related to heavy vehicle braking systems a. laws of friction b. hydraulics c. pneumatics d. properties of fluids e. properties of air f. braking efficiency 3.5 state common terms used in heavy vehicle braking system design.	

Learning outcome	The learner will:
4. understand how heavy vehicle wheel and tyre systems operate	
Assessment criteria	
The learner can: 4.1 identify heavy vehicle wheel and tyre components 4.2 describe the construction and operation of heavy vehicle wheels and tyres 4.3 compare key heavy vehicle wheel and tyre components and assemblies against alternatives to identify differences in construction and operation 4.4 identify the key engineering principles that are related to heavy vehicle wheel and tyre systems a. friction b. un-sprung weight c. dynamic and static balance 4.5 state common terms used in heavy vehicle wheel and tyre design.	

Learning outcome	The learner will:
5. understand the health and safety aspects when working on loaded vehicles	
Assessment criteria	
The learner can: 5.1 identify types of hazards when working on loaded heavy vehicles.	

Learning outcome	The learner will:
6. understand how to check, replace and test heavy vehicle chassis units and components	
Assessment criteria	
The learner can: 6.1 describe how to remove and replace chassis units and components 6.2 describe common types of testing methods used to check the operation of chassis units and components and their purpose 6.3 explain how to evaluate the performance of replacement units against vehicle specification 6.4 identify common faults found in heavy vehicle chassis units and components 6.5 describe the hazards associated with high energy electrical vehicle components.	

Unit 254 Knowledge of heavy vehicle chassis units and components

Supporting information

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

Chassis layouts

i. types of chassis
ii. axle configurations
iii. rear steered axles
iv. self-steered axles.

Steering

a. Key engineering principles related to steering:
   i. geometry
   ii. angles
   iii. damping
   iv. stress and strain.
b. The construction and operation of steering systems
   i. power and non-assisted steering
   ii. multi axle steering arrangements
   iii. heavy vehicle steering units and components.
c. The action and purpose of steering geometry:
   i. castor angle
   ii. camber angle
   iii. kingpin or swivel pin inclination
   iv. negative offset
   v. wheel alignment (tracking) (toe in and toe out)
   vi. toe out on turns
   vii. steered wheel geometry
   viii. multi axle steered wheel geometry.
d. The following terms associated with steering:
   i. Ackerman principle
   ii. slip angles
   iii. self-aligning torque oversteer and understeer
   iv. neutral steer
   v. rear steer
   vi. self-steer.
e. The components and layout of hydraulic power assisted steering systems:
   i. piston and power cylinders
   ii. drive belts and pumps
   iii. control valve (rotary, spool and flapper type)
   iv. hydraulic fluid.
f. The advantages of power assisted steering.
g. The operation of hydraulic power assisted steering.
h. The principles of electronic power steering systems.
i. The procedures used for inspecting the serviceability and condition of:
   i. manual steering
   ii. power assisted steering.

j. Steering system defects to include:
    i. uneven tyre wear
    ii. wear on outer edge of tyre
    iii. wear on inner edge of tyre
    iv. uneven wear
    v. flats on tread
    vi. steering vibrations
    vii. wear in linkage
    viii. damaged linkage
    ix. incorrect wheel alignment
    x. incorrect steering geometry.

Suspension

a. Types of suspension:
    i. non independent suspension
    ii. independent suspension
    iii. air suspension
    iv. electronically controlled air suspension (ECAS)
    v. steel suspension
    vi. lifting axles.
b. The layout and components of suspension systems:
    i. non-independent suspensions
    ii. independent front suspension (IFS)
    iii. air suspension
    iv. electronically controlled air suspension (ECAS)
    v. rubber suspension
    vi. tandem axle suspension
    vii. lifting axles.
c. The operation of suspension systems and components:
    i. leaf and coil springs
    ii. torsion bar
    iii. air springs
    iv. air suspension levelling mechanism (mechanical and electronic)
    v. dampers
    vi. trailing arms
    vii. ball joints
    viii. bump stops
    ix. anti-roll bars
    x. stabiliser bars
    xi. swinging arms
    xii. parallel link
    xiii. transverse link
    xiv. 'A' frame axle location
    xv. suspension damping
    xvi. stress and strain.
d. The advantages of different systems including:
    i. non-independent
    ii. independent suspension (IFS)
    iii. air suspension (mechanical)
    iv. air suspension (electronically controlled)
    v. lifting axles.
e. The principles of electronically controlled air suspension systems.
f. The forces acting on suspension systems during braking, driving and cornering.
g. The methods of locating the road wheels against braking, driving and cornering forces.
h. The methods of controlling cornering forces by fitting anti-roll torsion members.

i. Suspension terms:
    i. rebound
    ii. bump
    iii. yaw
    iv. dive
    v. pitch
    vi. roll
    vii. compliance.
j. The procedures used for inspecting the serviceability and condition of the suspension system.
k. Suspension system defects:
    i. wheel hop
    ii. ride height (unequal and low)
    iii. wear
    iv. noises under operation
    v. fluid leakage
    vi. excessive travel
    vii. excessive tyre wear
    viii. bounce
    ix. poor vehicle handling
    x. worn dampers
    xi. worn joints
    xii. damaged linkages
    xiii. vehicle “crabbing”.

Brakes

a. Key principles relating to braking systems:
    i. laws of friction
    ii. hydraulics
    iii. pneumatics
    iv. properties of fluids
    v. properties of air
    vi. braking efficiency.
b. The construction and operation of braking systems:
    i. air brakes
    ii. air-over-hydraulic brakes
    iii. electronic brakes including Anti-lock Braking Systems and Anti-Slip Regulation
    iv. endurance (retarding) systems.
c. The construction and operation of drum brakes:
    i. leading and trailing shoe construction
    ii. self-servo action
    iii. slack adjusters
    iv. cam expanders
    v. wedge expanders
    vi. automatic adjusters
    vii. backing plates
    viii. parking brake system
    ix. wear indicators and warning lamps.

d. The construction and operation of disc brakes:
    i. disc pads
    ii. calliper
    iii. brake disc
    iv. ventilated disc
    v. disc pad retraction
    vi. parking brake system
    vii. wear indicators and warning lamps.
e. The construction and operation of the hydraulic braking system:
    i. line layout
    ii. master cylinders
    iii. wheel cylinders
    iv. disc brake callipers and pistons
    v. brake pipe
    vi. brake servo
    vii. warning lights
    viii. parking brakes
    ix. equalising valves.
f. The construction and operation of the air braking system
    i. air compressors
    ii. air dryers
    iii. air processing units
    iv. pressure regulating valves
    v. circuit protection valves
    vi. air reservoirs
    vii. control valves (foot, park and hand)
    viii. relay valves
    ix. load sensing valves (mechanical and automatic)
    x. brake actuators
    xi. parking brake mechanisms
    xii. trailer control valves
    xiii. two-line trailer brake system
    xiv. warning light/buzzer systems
    xv. air pipes
    xvi. valve port numbering.
g. The construction and operation of the air-over-hydraulic braking system:
    i. air supply and storage
    ii. air control valves
    iii. conversion from pneumatic pressure to hydraulic pressure
    iv. hydraulic control valves.
h. The requirements and hazards of brake fluid:
    i. boiling point
    ii. hygroscopic action
    iii. manufacturer’s change periods
    iv. fluid classification and rating
    v. potential to damage paint surfaces.
i. Terms associated with braking systems:
    i. braking efficiency
    ii. brake fade
    iii. brake balance.
j. The procedures used for inspecting the serviceability and condition of the braking system.

k. 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/air leaks
    vii. pulling to one side
    viii. poor braking efficiency
    ix. lack of assistance
    x. loss of air pressure
    xi. brake drag
    xii. brake grab
    xiii. brake fade.

Endurance Brakes

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

ABS and ASR

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

Wheel and tyres

a. The engineering principles for wheels and tyres
    i. friction
    ii. un-sprung weight
    iii. dynamic and static balance.
b. The construction of different types of tyre:
    i. radial
    ii. cross ply
    iii. bias belted
    iv. tread patterns
    v. tyre mixing regulations
    vi. tyre applications
    vii. wheel construction
    viii. Tyre cutting.

c. Tyre markings:
    i. tyre and wheel size markings
    ii. speed rating
    iii. direction of rotation
    iv. profile
    v. load rating
    vi. ply rating
    vii. tread-wear indicators.
d. Wheel construction:
    i. alloy
    ii. pressed steel
    iii. one-piece rims
    iv. two-piece rims
    v. three piece rims.
e. Wheel retention:
    i. conical seating
    ii. spherical seating
    iii. spigot mounted.
f. Types of wheel bearing arrangements:
    i. non-driving and driven wheels
    ii. fully floating
    iii. three quarter floating.
g. Types of bearing used for wheel bearing arrangements and their adjustment:
    i. taper roller
    ii. angular contact ball
    iii. integrated.
h. The procedures used for inspecting the serviceability and condition of:
    i. tyres and wheels
    ii. bearings.
i. The defects associated with tyres and wheels:
    i. abnormal tyre wear
    ii. cuts
    iii. side wall damage
    iv. wheel vibrations
    v. loose wheel retainers
    vi. tyre over heating
    vii. tread separation.

Hazards when loading heavy vehicles:

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

General

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

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

Unit 257 Knowledge of diagnosis and rectification of heavy vehicle engine faults

Level:	**7**
Credit value:	6
Relationship to NOS:	This unit is linked to HV07 Diagnose and Rectify Commercial Motor Vehicle Engine and Component Faults.
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of engine mechanical, electrical, hydraulic and fluid systems.

Learning outcome	**The learner will:**
1. understand how heavy vehicle engine systems operate	
Assessment criteria	
The learner can: 1.1 explain the construction and operation of heavy vehicle engine systems 1.2 explain the interaction between electrical, electronic and mechanical components within heavy vehicle engine systems 1.3 explain how electrical systems interlink and interact, including multiplexing and fiber optics 1.4 compare heavy vehicle engine system components and assemblies against alternatives to identify differences in construction and operation 1.5 explain the engineering principles that are related to heavy vehicle engine systems a. volumetric efficiency b. flame travel, pre ignition and detonation c. fuel properties d. composition of carbon fuels e. combustion process f. legal requirements for exhaust emissions.	

Learning outcome	The learner will:
2. understand how to diagnose and rectify faults in heavy vehicle engine systems	
Assessment criteria	
The learner can: 2.1 describe how to analyse symptoms and causes of faults found in heavy vehicle engine systems 2.2 explain systematic diagnostic techniques used in identifying engine system faults 2.3 explain how to examine, measure and make suitable adjustments to the components 2.4 explain how to carry out the diagnosis and rectification activities in order to correct the faults in the heavy vehicle engine systems 2.5 explain how to select, prepare and use diagnostic and rectification equipment for heavy vehicle engine systems 2.6 explain how to evaluate and interpret test results found in diagnosing heavy vehicle engine system faults against vehicle manufacturer specifications and settings 2.7 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance 2.8 describe the hazards associated with high energy electrical vehicle component.	

Unit 257 Knowledge of diagnosis and rectification of heavy vehicle engine faults

Supporting information

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

The construction and operation of engine systems

a. Electronic diesel control systems (EDC).
b. Common rail fuel systems.
c. Unit injection fuel systems.
d. Engine management.
e. Pressure charged induction systems.
f. Exhaust emission reduction systems.
g. Mechanical fuel injection systems.
h. Valve mechanisms.
i. Heating, ventilation and cooling.

Common rail and unit injection systems

a. The operation and construction of common rail and unit injection systems including:
    i. types of air flow sensor
    ii. fuel supply system
    iii. fuel pump
    iv. filter
    v. fuel regulator
    vi. injectors
    vii. main injection
    viii. pre injection
    ix. post injection
    x. electronic control unit (ECU)
    xi. injector pulse width
    xii. sensors.
b. The operation of each system under various operating conditions including:
    i. cold starting
    ii. warm up
    iii. hot starting
    iv. acceleration
    v. deceleration
    vi. cruising
    vii. full load.

Engine management

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

Pressure charged induction systems

a. The meaning of volumetric efficiency; explain the effect of volumetric efficiency on engine performance, torque and power.
b. The methods used to improve volumetric efficiency:
    i. variable geometry turbo-charging
    ii. turbo-charging
    iii. supercharging
    iv. aftercoolers (intercooler)
c. The operation of turbo-chargers and the purpose of:
    i. turbo-charging
    ii. supercharging
    iii. aftercoolers (intercooler)
    iv. waste gates
    v. exhaust gas recirculation
d. Advantages and disadvantages of pressure charging induction systems.

Terms associated with combustion

a. Phases of combustion, flame travel, pre-injection and diesel knock.
b. Fuel properties:
    i. cetane rating
    ii. flash point
    iii. fire point
    iv. volatility
    v. composition of petrol and diesel fuels
    vi. hydro-carbon content.
c. Composition of carbon fuels:
    i. % hydrogen and carbon
    ii. composition of air.
d. The by-products of combustion for compression ignition engines:
    i. carbon monoxide
    ii. carbon dioxide
    iii. oxides of nitrogen
    iv. particulates.

Diesel exhaust emission control

a. Describe the legal requirements for exhaust emissions:
    i. MOT requirements
    ii. EU regulations.
b. The operation and construction of Selective Catalytic Reduction systems.
c. The operation and construction of Exhaust Gas Recirculation systems.

Assessment, repair and restoration of mechanical engine components

a. How engine mechanical components are assessed and measured for wear and serviceability:
    i. cylinder bores and liners
    ii. pistons
    iii. cylinder heads
    iv. crankshaft journals
    v. valve faces
    vi. valve guides
    vii. valve seats
    viii. camshafts.
b. The methods used for the repair and restoration of engine components.

Symptoms and faults in engine mechanical systems and components

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

Diagnosis of faults in engine mechanical systems and components

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

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

Faults and symptoms in electronic diesel injection systems

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

Faults and symptoms in engine management systems

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

Diagnosis of faults in electronic diesel injection and engine management systems

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

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

Faults and symptoms in vehicle comfort systems

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

Diagnosis of faults in vehicle comfort systems

a. Locate and interpret information for:
    i. diagnostic tests
    ii. manufacturer's vehicle and equipment specifications
    iii. use of equipment
    iv. testing procedures
    v. test plans
    vi. fault codes
    vii. legal requirements.
b. The preparation of tools and equipment for use in diagnostic testing and assessment.
c. Conduct systematic assessment and testing of comfort systems including:
    i. component condition and performance
    ii. component settings
    iii. component values
    iv. electrical and electronic values
    v. system performance and operation
    vi. drive belts
    vii. controls
    viii. compressors
    ix. condensers
    x. receivers
    xi. dryers
    xii. connections
    xiii. valve
    xiv. hoses
    xv. thermostats and refrigerants
    xvi. sensors
    xvii. speed controls
    xviii. control systems
    xix. servomotors.

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

Unit 258 Knowledge of diagnosis and rectification of heavy vehicle chassis faults

Level:	7
Credit value:	6
Relationship to NOS:	This unit is linked to HV08 Diagnose and Rectify Commercial Motor Vehicle Chassis System Faults.
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of braking steering and suspension systems. It also covers advanced heavy vehicle chassis systems and the evaluation of their performance.

Learning outcome	**The learner will:**
1. understand how the heavy vehicle chassis systems operate	
Assessment criteria	
The learner can: 1.1 explain the construction and operation of heavy vehicle chassis systems 1.2 explain the interaction between electrical, electronic and mechanical components within heavy vehicle chassis systems 1.3 explain how heavy vehicle chassis electrical systems interlink and interact, including multiplexing 1.4 compare heavy vehicle chassis system components and assemblies against alternatives to identify differences in construction and operation 1.5 explain the engineering principles that are related to heavy vehicle chassis systems a. inertia force, mass and acceleration b. laws of friction c. statics (springs and torsion bars) d. hydraulic machines.	

Learning outcome	**The learner will:**
2. understand how to diagnose and rectify faults in heavy vehicle chassis systems	
Assessment criteria	
The learner can: 2.1 explain symptoms and causes of faults found in heavy vehicle chassis systems 2.2 explain systematic diagnostic techniques used in identifying chassis system faults 2.3 explain how to examine, measure and make suitable adjustments to the components 2.4 explain how to carry out the diagnosis and rectification activities in order to correct the faults in the heavy vehicle chassis systems 2.5 explain how to select, prepare and use diagnostic and rectification equipment for heavy vehicle chassis systems 2.6 explain how to evaluate and interpret test results found in diagnosing heavy vehicle chassis system faults against vehicle manufacturer specifications and settings 2.7 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance 2.8 describe the hazards associated with high energy electrical vehicle component.	

Unit 258 Knowledge of diagnosis and rectification of heavy vehicle chassis faults

Supporting information

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

Chassis system operation:

a. Construction and operation of heavy vehicle chassis systems to include:
   i. Anti-lock Braking Systems (ABS)
   ii. Electronic Braking Systems (EBS)
   iii. Electronic Brake-force Distribution (EBD)
   iv. Anti-Slip Regulation / Traction Control (ASR)
   v. Electronic Stability Programme (ESP)
   vi. Rear wheel steer
   vii. Power assisted steering
   viii. Electronically Controlled Air Suspension (ECAS)
b. The Engineering principle relating to heavy vehicle chassis systems:
   i. inertia force, mass and acceleration
   ii. laws of friction
   iii. statics (springs and torsion bars)
   iv. hydraulic and pneumatic principles
c. Make suitable adjustments to components including:
   i. settings
   ii. input and output values
   iii. voltages
   iv. current consumption
   v. resistance
   vi. output patterns with oscilloscope
   vii. pressures
   viii. condition
   ix. wear and performance

Electrical and electronic principles of heavy vehicle chassis systems

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

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

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

Steering geometry for advanced heavy vehicle applications

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

Components and operation of electronically controlled air suspension

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

Symptoms and faults in braking systems

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

Diagnosis and faults in braking systems

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

Symptoms and faults associated with steering systems

a. symptoms and faults associated with steering systems:
    i. mechanical
    ii. hydraulic
    iii. electrical and electronic
    iv. steering boxes (rack and pinion, worm and re-circulating ball)
    v. steering arms and linkages
    vi. steering joints and bushes
    vii. idler gears
    viii. bearings
    ix. steering columns (collapsible and absorbing)
    x. power assisted steering system

Diagnosis and faults in steering systems

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

Symptoms and faults associated with suspension systems

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

Diagnosis and faults in suspension systems

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

Unit 259 Knowledge of inspecting heavy vehicles to comply with legal requirements

Level:	**5**
Credit value:	4
Relationship to NOS:	This unit is linked to HV05 Conduct Pre and Post Work Motor Vehicle Inspections and HV06 Inspect Commercial Motor Vehicles.
Aim:	This unit enables the learner to develop an understanding of carrying out a range of inspections on heavy vehicles using a variety of equipment and testing methods.

Learning outcome	**The learner will:**
1. understand how to carry out inspections on heavy vehicles using prescribed methods	
Assessment criteria	
The learner can: 1.1 explain the difference between the various prescribed heavy vehicle inspection methods to include: a. pre-delivery and pre-purchase b. pre MOT c. daily vehicle checks d. scheduled safety inspection e. pre and post rental inspection 1.2 identify the different systems to be inspected when using the prescribed inspection methods 1.3 identify the procedures involved to carry out the systematic inspection of the prescribed inspection methods on heavy vehicles 1.4 identify conformity of vehicle systems and condition on heavy vehicle inspections 1.5 compare test and inspection results against heavy vehicle specification and legal requirements 1.6 explain how to record and complete the inspection results in the format required 1.7 identify the recommendations that can be made based on results of the heavy vehicle inspections 1.8 explain the implications of failing to carry out heavy vehicle inspection activities correctly 1.9 explain the implications of signing workplace documentation and vehicle records 1.10 explain the procedure for reporting damage to heavy vehicle components and units outside normal inspection items 1.11 describe the hazards associated with high energy electrical vehicle components.	

Unit 259 Knowledge of inspecting heavy vehicles

Supporting information

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

Different types of heavy vehicle inspection

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

Vehicle inspections and maintenance records

a. The purpose and scope of the different types of vehicle inspection.
b. Vehicle inspection techniques for different types of inspection including:
   i. systematic inspections
   ii. aural
   iii. visual and functional assessments on engine
   iv. engine systems
   v. chassis systems
   vi. wheels and tyres
   vii. transmission and driveline system
   viii. electrical and electronic systems
   ix. exterior vehicle body
   x. vehicle interior.
c. The procedure for inspection of the vehicle for damage, corrosion, fluid leaks, wear, security, mounting. Security and condition to include:
   i. engines and engine systems
   ii. chassis systems
   iii. brakes
   iv. transmission and driveline
   v. steering
   vi. suspension
   vii. wheels
   viii. tyres
   ix. body panels (structural and none structural)
   x. electrical and electronic systems and components
   xi. vehicle seating and vehicle interior
   xii. instruments.

d. Preparation and use of appropriate inspection equipment and tools including:
    i. emission testing
    ii. brake testing
    iii. headlamp alignment
    iv. wheel alignment
    v. torque setting
    vi. specialist diagnostic equipment
    vii. tyre tread depth gauges.
e. Inspection procedures following inspection checklists.
f. Checking conformity to manufacturer's specifications and legal requirements.
    i. workshop manuals
    ii. heavy goods vehicle inspection manual.
g. Testing and operation of vehicle systems and vehicle condition including workshop based tests and road tests.
h. The completion and maintenance of:
    i. documentation
    ii. defect reports
    iii. inspection records
    iv. job cards
    v. vehicle records.
i. Make recommendations based on results of vehicle inspections.
j. The implications of not carrying out vehicle inspections correctly including:
    i. legal aspects (impact on Operator License and Operator Compliance Risk Score)
    ii. safety aspects
    iii. financial aspects
    iv. customer retention
    v. customer relationships.

The need for vehicle protection prior to carrying out vehicle inspection

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

Unit 262 Knowledge of heavy vehicle transmission and driveline units and components

Level:	**5**
Credit value:	6
Relationship to NOS:	This unit is linked to HV12 Remove and Replace Commercial Motor Vehicle Transmission and Driveline Units and Components.
Aim:	This unit enables the learner to develop an understanding of the construction and operation of common manual 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 heavy vehicle clutch systems operate	
Assessment criteria	
The learner can: 1.1 identify heavy vehicle clutch system components 1.2 describe the construction and operation of heavy vehicle clutch systems 1.3 compare key heavy vehicle clutch system components and assemblies against alternatives to identify differences in construction and operation 1.4 identify the key engineering principles that are related to heavy vehicle clutch systems a. principles of friction b. principle of levers c. torque transmission 1.5 state common terms used in heavy vehicle clutch system design.	

Learning outcome	**The learner will:**
2. understand how heavy vehicle gearbox systems operate	
Assessment criteria	
The learner can: 2.1 identify heavy vehicle gearbox system components 2.2 describe the construction and operation of heavy vehicle gearbox systems 2.3 compare key heavy vehicle 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 heavy vehicle gearbox systems a. gear ratios b. torque multiplication 2.5 state common terms used in heavy vehicle manual gearbox system design.	

Learning outcome	The learner will:
3. understand how heavy vehicle driveline systems operate	
Assessment criteria	
The learner can: 3.1 identify heavy vehicle driveline component 3.2 describe the construction and operation of heavy vehicle driveline systems 3.3 compare key heavy vehicle driveline components and assemblies against alternatives to identify differences in construction and operation 3.4 identify the key engineering principles that are related to heavy vehicle driveline systems a. final drive and overall gear ratios b. simple stresses 3.5 state common terms used in heavy vehicle driveline design.	

Learning outcome	The learner will:
4. understand how heavy vehicle gear selection mechanisms operate	
Assessment criteria	
The learner can: 4.1 identify heavy vehicle gear selection mechanism components 4.2 describe the construction and operation of heavy vehicle gear selection systems 4.3 compare key heavy vehicle gear selection mechanism components and assemblies against alternatives to identify differences in construction and operation 4.4 identify the key engineering principles that are related to heavy vehicle gear selection systems 4.5 state common terms used in heavy vehicle gear selection systems.	

Learning outcome	The learner will:
5. understand how to check, replace and test transmission and driveline units and components	
Assessment criteria	
The learner can: 5.1 describe how to remove and replace transmission and driveline system units and components 5.2 describe common types of testing methods used to check the operation of transmission and driveline systems and their purpose 5.3 explain how to evaluate the performance of replacement units against vehicle specification 5.4 identify common faults found in heavy vehicle transmission and driveline systems and their causes.	

Unit 262 Knowledge of heavy 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 has been provided by IMI SSC and is included to support centres in terms of teaching and delivery.

Key principles related to clutch systems

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

The operation of clutch operating systems

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

The operation of friction clutches

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

Gearbox systems

a. Construction and operation of gearbox systems including:
    i. gearshift control systems
    ii. manual gearbox
    iii. automatic gearbox.
b. Key principles relating to gearbox systems:
    i. gear ratios
    ii. input and output ratios
    iii. torque multiplication.

The operation of manual gearboxes

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

The operation of automatic gearboxes

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

The construction and operation of driveline systems and components

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

The construction and operation of gear selector systems

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

The testing and inspection techniques used for heavy vehicle transmission systems

a. The techniques and procedures used for inspecting and testing clutches and clutch mechanisms including:
    i. clearances
    ii. pedal and lever settings
    iii. cables & linkages
    iv. hydraulic system
    v. leaks (fluid and air)
    vi. adjustments
    vii. travel.
b. The techniques and procedures used for inspecting and testing gearboxes including:
    i. leaks
    ii. gear selection
    iii. synchromesh operation
    iv. abnormal noise.
c. The techniques and procedures used for inspecting and testing drive line systems (prop and drive shafts, couplings and centre bearings) including:
    i. security
    ii. serviceability
    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 (propshaft, drive shaft, universal and constant velocity joints)
    iv. universal joint alignment
    v. final drive faults
    vi. gear selection faults.
b. Faults and symptoms to include mechanical, electrical and hydraulic systems.

Components

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

Unit 263 Knowledge of diagnosis and rectification of heavy vehicle transmission and driveline faults

Level:	**7**
Credit value:	6
Relationship to NOS:	This unit is linked to HV13 Diagnose and Rectify Commercial Motor Vehicle Transmission and Driveline System Faults.
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of heavy vehicle gearboxes, hubs and bearings, driveline shafts, clutches, differentials and final drive units. It also covers the evaluation of performance of the systems.

Learning outcome	**The learner will:**
1. understand how the heavy vehicle transmission and driveline systems operate	
Assessment criteria	
The learner can: 1.1 explain the construction and operation of heavy vehicle transmission and driveline systems 1.2 explain the interaction between electrical, electronic and mechanical components within heavy vehicle transmission and driveline systems 1.3 explain how electrical systems interlink and interact, including multiplexing 1.4 compare heavy vehicle transmission and driveline system components and assemblies against alternatives to identify differences in construction and operation 1.5 identify the engineering principles that are related to heavy vehicle transmission and driveline systems a. friction b. torque transmission c. materials d. fluids and energy e. potential and kinetic energy.	

Learning outcome	The learner will:
2. understand how to diagnose and rectify faults in heavy vehicle transmission and driveline systems	
Assessment criteria	
The learner can: 2.1 explain the symptoms and causes of faults found in heavy vehicle transmission and driveline systems 2.2 explain systematic diagnostic techniques used in identifying transmission and driveline system faults 2.3 explain how to examine, measure and make suitable adjustments components 2.4 explain how to carry out the rectification activities in order to correct the faults in the heavy vehicle transmission and driveline systems 2.5 explain how to select, prepare and use diagnostic and rectification equipment for heavy vehicle transmission and driveline systems 2.6 explain how to evaluate and interpret test results found in diagnosing heavy vehicle transmission and driveline system faults against vehicle manufacturer specifications and settings 2.7 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance 2.8 describe the hazards associated with high energy electrical vehicle component.	

Unit 263 Knowledge of diagnosis and rectification of heavy vehicle transmission and driveline faults

Supporting information

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

The construction and operation of transmission and driveline systems

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

Electrical and electronic principles related to heavy vehicle transmission systems

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

The operation heavy vehicle clutches and fluid couplings

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

The operation of heavy vehicle transmissions and driveline systems

a. the construction and operation of manual gearboxes:
    i. multi-speed gearboxes
    ii. gear arrangements
    iii. shaft and bearing arrangements
    iv. synchromesh devices
    v. interlock mechanisms
    vi. linkages
    vii. overdrive
    viii. lubrication
b. the construction and operation of automatic gearboxes including hydraulic and electronic control systems: operations of epicyclic gears (sun, planet, annulus and carrier), method for achieving different gear ratios using epicyclic gearing; hydraulic control systems, components and operation; electronic control system, components and operation.
c. the construction and operation of the electronically controlled gearshift systems
d. the construction and operation of final drive systems including:
    i. conventional crown wheel and pinion
    ii. differential gears
    iii. differential lock
e. the construction and operation of heavy vehicle tandem drive systems including third differential and differential locks.
f. the operation of heavy vehicle traction control systems and launch control.
g. the construction and operation of heavy vehicle hub arrangements.
h. the construction and operation of:
    i. drive shafts
    ii. prop shafts including flexible joints and couplings
    iii. universal joints
    iv. constant velocity joints
    v. sliding joints

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

a. clutch and coupling faults:
    i. abnormal noises
    ii. vibrations
    iii. fluid leaks
    iv. slip
    v. judder
    vi. grab
    vii. failure to release

b. gearbox faults:
    i. abnormal noises
    ii. vibrations
    iii. loss of drive
    iv. difficulty engaging or disengaging gears
    v. automatic gear box types
    vi. abnormal noises
    vii. vibrations
    viii. loss of drive
    ix. failure to engage gear
    x. failure to disengage gear
    xi. leaks
    xii. failure to operate
    xiii. incorrect shift patterns
    xiv. electrical and electronic faults
c. final drive faults:
    i. abnormal noises
    ii. vibrations
    iii. loss of drive
    iv. oil leaks
    v. failure to operate
    vi. electrical and electronic faults
d. drive-lines and couplings:
    i. abnormal noises
    ii. vibrations
    iii. loss of drive.

Faults in heavy vehicle transmission systems

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

Transmission units and components

a. friction clutches
b. fluid couplings
c. multi speed gearboxes
d. fully automatic - including electronic control
e. electronically controlled gearshift systems
f. hub reduction
g. final drive units
h. hubs and shafts

Measurements and settings

a. settings
b. input and output values
c. voltages
d. current consumption
e. resistance
f. output patterns with oscilloscope
g. pressures
h. condition
i. wear and performance

Unit 264 Knowledge of overhauling heavy vehicle engine units

Level:	**7**
Credit value:	4
Relationship to NOS:	This unit is linked to HV11 overhauling heavy vehicle engine units.
Aim:	This unit enables the learner to develop an understanding of the construction and operation and overhaul of engines, gearboxes, final drive assemblies, steering and suspension units.

Learning outcome	**The learner will:**
1. understand how to overhaul heavy vehicle engine units	
Assessment criteria	
The learner can: 1.1 identify heavy vehicle engine unit components 1.2 describe the construction and operation of heavy vehicle engine units 1.3 explain how to prepare, use and assess all of the overhauling equipment 1.4 explain how heavy vehicle engine units are dismantled, overhauled and reassembled 1.5 explain common symptoms, causes and faults found in heavy vehicle engine units 1.6 explain methods used to identify engine unit faults 1.7 explain how to examine, measure and make suitable adjustments to heavy vehicle engine components 1.8 explain how to evaluate and interpret test results found in diagnosing heavy vehicle engine unit faults and compare with manufacturers specifications and settings 1.9 explain how to evaluate the operation of components and systems following overhauling units to confirm system performance 1.10 describe the hazards associated with high energy electrical vehicle components identify heavy vehicle engine fuel system components.	

Unit 264 Knowledge of overhauling heavy vehicle engine mechanical units

Supporting information

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

How the units and assemblies being overhauled operate

a. identify unit components
b. understand unit construction
c. describe unit operation

How units are dismantled and reassembled

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

Unit and assembly testing and evaluation procedures

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

Faults associated with units and assemblies being overhauled

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

Unit 272 Knowledge of heavy vehicle fuel, air supply and exhaust system units and components

Level:	**5**
Credit value:	3
Relationship to NOS:	This unit is linked to HV02 Remove and Replace Motor Vehicle Engine Units and Components.
Aim:	This unit enables the learner to develop an understanding of the construction 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 heavy vehicle engine fuel systems operate	
Assessment criteria	
The learner can: 1.1 identify heavy vehicle engine fuel system components 1.2 describe the construction and operation of heavy vehicle engine fuel systems 1.3 compare key heavy vehicle engine fuel system components and assemblies against alternatives to identify differences in construction and operation 1.4 identify the key engineering principles that are related to heavy vehicle engine fuel systems a. properties of fuels b. combustion processes c. exhaust gas constituents 1.5 state common terms used in heavy vehicle engine fuel system design.	

Learning outcome	The learner will:
2. understand the legal requirements relating to European Emission Standards applicable to commercial vehicles	
Assessment criteria	
The learner can: 2.1 describe legal requirements relating to the production of exhaust emissions from heavy vehicle engines (EU requirements) 2.2 describe the effects of regulated pollutants.	

Learning outcome	The learner will:
3. understand how heavy vehicle exhaust emission control systems operate	
Assessment criteria	
The learner can: 3.1 identify heavy vehicle exhaust emission control system components 3.2 describe the construction and operation of heavy vehicle exhaust emission control systems 3.3 compare key heavy vehicle exhaust emission control system components and assemblies against alternatives to identify differences in construction and operation 3.4 identify the key engineering principles that are related to heavy vehicle exhaust emission control systems a. flame travel b. injection timing c. fuel pressure d. combustion chamber design 3.5 state common terms used in key heavy vehicle engine exhaust emission control design.	

Learning outcome	The learner will:
4. understand how heavy vehicle engine air supply and exhaust systems operate	
Assessment criteria	
The learner can: 4.1 identify heavy vehicle engine air supply and exhaust system components 4.2 describe the construction and operation of heavy vehicle engine air supply and exhaust systems 4.3 identify the key engineering principles that are related to heavy vehicle engine air supply and exhaust systems a. sound absorption b. reduction of harmful emissions 4.4 state common terms used in key heavy vehicle engine air supply and exhaust system design.	

Learning outcome	The learner will:
5. understand how to check, replace and test engine fuel, air supply and exhaust system units and components	
Assessment criteria	
5.1 describe how to remove and replace engine fuel, air supply and exhaust system units and components 5.2 describe common types of testing methods used to check the operation of engine fuel, air supply and exhaust system systems and their purpose 5.3 explain how to evaluate the performance of replacement units against vehicle specification 5.4 explain common faults found in heavy vehicle fuel, air supply and exhaust systems and their causes 5.5 Describe the hazards associated with high energy electrical vehicle components.	

Unit 272 Knowledge of heavy vehicle fuel, air supply and exhaust system units and components

Supporting information

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

Mechanical injection systems

a. The layout and construction of inline and rotary diesel systems. To include governor control.
b. The principles and requirements of compression ignition engines.

Combustion chambers (direct and indirect injection)

a. The function and operation of diesel fuel injection components:
    i. fuel filters
    ii. sedimenters
    iii. injector types (direct and indirect injection)
    iv. fuel pipes
    v. cold start systems
    vi. manifold heaters
    vii. cut-off systems.

Electronic diesel control

a. The function and operation of common Electronic Diesel Control components:
    i. air mass sensor
    ii. throttle potentiometer
    iii. idle speed control
    iv. coolant sensor
    v. fuel pressure sensor
    vi. flywheel and camshaft sensors
    vii. electronic control units.

Electronic common rail systems

a. The layout and construction of Common Rail diesel systems.
b. The function and operation of Common Rail diesel fuel injection components:
    i. low and high pressure pumps
    ii. rail pressure regulator
    iii. rail pressure sensor
    iv. electronic injector.

Electronic unit injector systems

a. The layout and construction of Electronic Unit Injector diesel systems.
b. The function and operation of Electronic Unit Injector diesel fuel injection components:
    i. low pressure pump
    ii. electronic unit injector.

Forced induction

a. The purpose, construction and operation of:
    i. superchargers
    ii. turbochargers
        1) waste-gate controlled
        2) variable geometry
    iii. after-coolers.
b. Explain the procedures for injection pump timing and bleeding the system.
c. The procedures used when inspecting the diesel system.

Fuel

a. Key engineering principles related to engine fuel systems:
    i. properties of fuels
    ii. combustion processes
    iii. exhaust gas constituents.
b. The meaning of terms related to:
    i. hydro-carbon fuels
    ii. volatility
    iii. calorific value
    iv. flash point
    v. cetane value.
c. The composition of hydro-carbon fuels:
    i. % hydrogen and carbon in compression ignition fuels.
d. The composition of air.
e. Symptoms and faults associated with diesel fuel systems:
    i. air in fuel system, water in fuel, filter blockage leaks, difficult starting, erratic running, excessive smoke (black, blue, white), engine knock, turbocharger, faults

Air supply and exhaust systems

a. The construction and purpose of air filtration systems.
b. The operating principles of air filtration systems.
c. The construction and operation of air supply and exhaust systems to include:
    i. supercharging
    ii. turbo charging.
d. The construction and purpose of the exhaust emission control systems including:
    i. exhaust gas recirculation (EGR)
    ii. selective catalytic reduction (SCR)
    iii. particulate trap (filter).
e. The operating principles of the systems.
f. Exhaust system design to include silencers and vertical stacks.
g. The procedures used when inspecting induction, air filtration and exhaust systems.

h. Symptoms and faults associated with air and exhaust systems
    i. exhaust gas leaks
    ii. air leaks.
i. Regulated pollutants to include:
    i. Hydrocarbons (HC)
    ii. Particulate matter (PM)
    iii. Oxides of Nitrogen (NOx)
    iv. Carbon Monoxide (CO).
j. Key principles in exhaust emission control systems to include:
    i. flame travel
    ii. injection timing
    iii. fuel pressure
    iv. combustion chamber design.

General

k. The preparation, testing and use of tools and equipment used for:
    i. dismantling
    ii. removal and replacement of engine units and components.
l. Appropriate safety precautions:
    i. PPE
    ii. vehicle protection when dismantling
    iii. removal and replacing engine units and components.
m. The importance of logical and systematic processes.
n. The inspection and testing of engine units and components.
o. The preparation of replacement units for re-fitting or replacement.
p. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance and safety requirements.
q. Refitting procedures.
r. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
s. 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.

Unit 273 Knowledge of overhauling heavy vehicle transmission units

Level:	**7**
Credit value:	4
Relationship to NOS:	This unit is linked to HV11.
Aim:	This unit enables the learner to develop knowledge of the construction and operation and overhaul of gearboxes and final drive assemblies.

Learning outcome	**The learner will:**
1. understand how to overhaul heavy vehicle gearbox and final drive units	
Assessment criteria	
The learner can: 1.1 identify heavy vehicle gearbox and final dive unit components 1.2 describe the construction and operation of heavy vehicle gearbox and final drive units 1.3 explain how to prepare, use and assess all of the overhauling equipment 1.4 explain how heavy vehicle gearbox and final drive units are dismantled, overhauled and reassembled 1.5 explain common symptoms, causes and faults found in heavy vehicle gearbox and final drive unit 1.6 explain methods used to identify gearbox and final drive unit faults 1.7 explain how to examine, measure and make suitable adjustments to heavy vehicle gearbox and final drive components 1.8 explain how to evaluate and interpret test results found in diagnosing heavy vehicle gearbox and final drive unit faults and compare with manufacturers specifications and settings 1.9 explain how to evaluate the operation of components and systems following overhauling units to confirm system performance 1.10 describe the hazards associated with high energy electrical vehicle component.	

Unit 273 Knowledge of overhauling heavy vehicle transmission units

Supporting information

How the units and assemblies being overhauled operate

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

How units are dismantled and reassembled

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

Unit and assembly testing and evaluation procedures

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

Faults associated with units and assemblies being overhauled

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

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

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

Unit 282 Knowledge of overhauling heavy vehicle steering and suspension units

Level:	**7**
Credit value:	4
Relationship to NOS:	This unit is linked to HV11 Overhaul Motor Vehicle Mechanical Units.
Aim:	This unit enables the learner to develop an understanding of the construction and operation and overhaul of engines, gearboxes, final drive assemblies, steering and suspension units.

Learning outcome	**The learner will:**
1. understand how to overhaul heavy vehicle steering and suspension units	
Assessment criteria	
The learner can: 1.1 identify heavy vehicle steering and suspension unit components 1.2 describe the construction and operation of heavy vehicle steering and suspension units 1.3 explain how to prepare, use and assess all of the overhauling equipment 1.4 explain how heavy vehicle steering and suspension units are dismantled, overhauled and reassembled 1.5 explain common symptoms, causes and faults found in heavy vehicle steering and suspension units 1.6 explain methods used to identify steering and suspension unit faults 1.7 explain how to examine, measure and make suitable adjustments to heavy vehicle steering and suspension components 1.8 explain how to evaluate and interpret test results found in diagnosing heavy vehicle steering and suspension unit faults and compare with manufacturers specifications and settings 1.9 explain how to evaluate the operation of components and systems following overhauling units to confirm system performance 1.10 describe the hazards associated with high energy electrical vehicle components	

Unit 282 Knowledge of overhauling heavy vehicle steering and suspension units

Supporting information

How the units and assemblies being overhauled operate

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

How units are dismantled and reassembled

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

Unit and assembly testing and evaluation procedures

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

Faults associated with units and assemblies being overhauled

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

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

a. The preparation, testing and use of:
    i. tools and equipment
    ii. removal and replacement of electrical and electronic systems and components
b. Appropriate safety precautions:
    i. PPE
    ii. vehicle protection when dismantling
    iii. removal and replacing electrical and electronic components and systems
c. The importance of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement of 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.

Unit 291 Knowledge of conducting routine heavy vehicle maintenance

Level:	**5**
Credit value:	3
Relationship to NOS:	This unit is linked to HV01 Carry Out Routine Motor Vehicle Maintenance.
Aim:	This unit enables the learner to develop an understanding of conducting routine maintenance, adjustment and replacement activities as part of the periodic servicing of heavy vehicles.

Learning outcome	**The learner will:**
1. understand how to carry out routine heavy vehicle maintenance	
Assessment criteria	
The learner can: 1.1 explain how to conduct a scheduled heavy vehicle routine examination and assessment against the vehicle manufacturers specification 1.2 identify the assessment methods used to check for conformity 1.3 identify the different systems to be inspected while carrying out heavy vehicle routine maintenance 1.4 describe the procedures used for checking the condition and serviceability of heavy vehicle units and components 1.5 describe the procedures for checking and replenishing fluid levels 1.6 describe the procedures for the replacement of lubricants and fluids 1.7 identify adjustments that need to be carried out on a heavy vehicle routine maintenance 1.8 explain the procedure for reporting cosmetic damage to vehicle components and units outside normal service items 1.9 identify the operating specifications for the systems being checked while carrying out heavy vehicle routine maintenance 1.10 describe the hazards associated with high energy electrical vehicle components.	

Learning outcome	The learner will:
2. understand the legal requirements applicable to carrying out heavy vehicle maintenance	
Assessment criteria	
The learner can: 2.1 describe the requirements of heavy vehicle maintenance arrangements as part of the Operator License criteria 2.2 describe the legal requirement relating to the retention of heavy vehicle maintenance records.	

Unit 291 Knowledge of conducting routine heavy vehicle maintenance

Supporting information

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

Vehicle maintenance, adjustment and record findings

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

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

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

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

e. Procedures for replacement of lubricants and filters to include chassis systems:
    i. replace oil filters
    ii. types of oil
    iii. cleanliness
    iv. disposal of old oil and filters.
f. Procedures for carrying out adjustments on vehicle systems or components:
    i. clearances
    ii. settings
    iii. alignment
    iv. operational performance (engine idle, exhaust gas).
g. Procedures for checking electrical systems:
    i. operation
    ii. security
    iii. performance.
h. Importance and process of detailed inspection procedures:
    i. following inspection checklists
    ii. checking conformity to manufacturer's specifications
    iii. legal requirements as applicable.
i. Importance and process of completing all relevant documentation relating to routine maintenance:
    i. inspection records
    ii. job cards
    iii. vehicle repair records
    iv. in-vehicle service history.

The need to use vehicle protection prior to repair

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

The need to check the vehicle following routine maintenance

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

Unit 406 Skills in diagnosing and rectifying vehicle auxiliary electrical faults

Level:	**7**
Credit value:	5
Relationship to NOS:	This unit is linked to AE06 Diagnose and Rectify Motor Electrical Units and Component Faults.
Aim:	This unit will help the learner to develop the skills required to demonstrate they can diagnose and rectify automotive vehicle auxiliary electrical system faults. It also covers the evaluation of performance of the replaced or repaired units and systems. This includes SI, CI, Hybrid and Alternative fuel vehicles.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out automotive vehicle auxiliary electrical diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle coverings throughout when carrying out auxiliary electrical diagnostic and rectification activities 1.2 Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment (including waste disposal) 1.3 prepare the vehicle systems and work area for safe working procedures (where appropriate).	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support automotive vehicle diagnostic and rectification activities including: a. vehicle technical data b. diagnostic test procedures 2.2 use sufficient diagnostic information in a systematic way to enable an accurate diagnosis of automotive auxiliary electrical system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select the appropriate tools and equipment necessary for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the equipment required, correctly and safely throughout all automotive auxiliary electrical diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out automotive vehicle auxiliary electrical diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate your assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. manufacturers' instructions b. recognised researched repair methods c. health and safety requirements 4.4 ensure all repaired or replacement components and units conform to the vehicle operating specification and any legal requirements 4.5 adjust components and units correctly to ensure that they operate to meet system requirements 4.6 use testing methods that are suitable for assessing the performance of the system rectified 4.7 ensure the rectified automotive auxiliary electrical system performs to the vehicle operating specification and any legal requirements.	

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 456 Knowledge of diagnosis and rectification of vehicle auxiliary electrical faults

Level:	**7**
Credit value:	6
Relationship to NOS:	This unit is linked to AE06 Diagnose and Rectify Motor Electrical Units and Component Faults.
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of vehicle auxiliary electrical systems and their units. It also covers the evaluation of performance of the systems. This includes SI, CI, Hybrid and Alternative fuel vehicles.

Learning outcome	**The learner will:**
1. understand vehicle electrical and electronic principles	
Assessment criteria	
The learner can: 1.1 explain the principles of electrical inputs, outputs, voltages and oscilloscope patterns, digital and fibre optics 1.2 explain the principles of sensor inputs, computer processing and actuator outputs 1.3 identify sensor types (passive and active) 1.4 identify the electrical principles that are related to light vehicle electrical circuits.	

Learning outcome	**The learner will:**
2. understand how light vehicle auxiliary electrical systems operate	
Assessment criteria	
The learner can: 2.1 identify advanced automotive auxiliary electrical system components 2.2 explain the construction and operation of automotive auxiliary electrical systems 2.3 explain the interaction between electrical, electronic and mechanical components within the system defined 2.4 explain the operation of the electrical and electronic systems for electric, hybrid and alternative fuel vehicles including regenerative braking systems 2.5 explain how electrical systems interlink and interact, including multiplexing and fibre optics 2.6 compare automotive auxiliary electrical system components and assemblies against alternatives to identify differences in construction and operation.	

Learning outcome	The learner will:
3. understand how to diagnose and rectify faults in auxiliary electrical systems	
Assessment criteria	
The learner can: 3.1 explain the symptoms and causes of faults found in automotive auxiliary electrical systems 3.2 explain systematic diagnostic techniques used in identifying automotive auxiliary electrical system faults 3.3 explain how to examine, measure and make suitable adjustments to components 3.4 explain how to carry out the rectification activities in order to correct the faults in the automotive auxiliary electrical systems 3.5 explain how to select, prepare and use diagnostic and rectification equipment for automotive auxiliary electrical systems 3.6 explain how to evaluate and interpret test results found in diagnosing automotive auxiliary electrical system faults against vehicle manufacturer specifications and settings 3.7 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance.	

Unit 456 Knowledge of diagnosis and rectification of vehicle auxiliary electrical faults

Supporting information

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

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

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

Battery and charging

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

Starting

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

Lighting systems and technology

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

Lighting circuits and the relationship between each circuit

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

Common faults and testing methods associated with external lighting system

a. Fault diagnosis for:
    i. lighting systems failing to operate correctly
    ii. switches
    iii. relays
    iv. bulbs failing to operate.

The operating principles of external lighting systems and multiplexing systems

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

The different types of electric windows and mirror systems and components

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

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

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

The operating principles of electric windows and mirror systems

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

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

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

The different types of screen heating systems and components

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

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

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

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

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

The different types of I.C.E. systems and components

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

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

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

The operating principles of I.C.E. systems

a. Operation of entertainment systems speaker and aerial systems.

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

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

The different types of integrated security/warning systems and components

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

The function of component parts in integrated security and warning systems

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

The operating principles of integrated security and warning systems

a. Operation of alarm systems and audible warning units.

The relevant legislation relevant to security and warning systems

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

Common faults and testing methods associated with security and warning systems

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

The different wiper system components

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

The function of component wiper and washer components

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

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

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

The different heater, cooling system components and air con.

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

The function of component heater, cooling parts and air conditioning

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

The operating principles of heater, cooling systems and air conditioning

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

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

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

The different types of locking system components

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

The function of component parts in the locking system

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

The operating principles of locking systems

a. Doors and cabs.

Common faults and testing methods associated with locking systems

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

The different types of Supplementary Restraint and Airbag systems

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

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

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

The operating principles of Supplementary Restraint and Airbag systems

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

Common faults and testing methods associated Supplementary Restraint and Airbag systems

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

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

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

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

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

Appendix 1 Relationships to other qualifications

Links to other qualifications

Centres are responsible for checking the different requirements of all qualifications they are delivering and ensuring that candidates meet requirements of all units/qualifications.

This qualification has connections to the 5310 SVQ in Heavy Vehicle Maintenance and Repair at SCQF Level 5/7.

Appendix 2 Sources of general information

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

City & Guilds Centre Manual contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

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

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

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- SQA Accreditation Regulatory Principles (2021) and Regulatory Principles Directives
- NVQ Code of Practice (2006)

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

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

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

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

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Useful contacts

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

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

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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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