



INSTITUTE
OF THE MOTOR
INDUSTRY

IMI QUALIFICATION



Assessment Criteria for

IMI Level 2 Subsidiary Diploma in Heavy Vehicle Maintenance and Repair Technology

I.D: 600/9485/0

*To be used in conjunction with Candidate Assessment Summary,
Practical Assessments and Written Assessments*

For assessor use only: Assessor Verifier Guidance

CENTRE INFORMATION

Please be aware that any **legislation** referred to in this qualification may be subject to amendment/s during the life of this qualification. Therefore IMI Approved Centres must ensure they are aware of and comply with any amendments, e.g. to health and safety legislation and employment practices.

Please be aware that **vehicle technologies** referred to in this qualification reflect current practice, but may be subject to amendment/s, updates and replacements during the life of this qualification. Therefore IMI Approved Centres must ensure they are aware of the latest developments and emerging technologies to ensure the currency of this qualification.

Please note: the relevance of the information contained in the **unit content** will vary depending upon the vehicle types being worked upon. The unit content is for guidance only and is not meant to be prescriptive.

© 2015 IMI

All rights reserved. No part of this publication may be reproduced, stored in retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of IMI

Requests should be made in writing and addressed to:
Institute of the Motor Industry (IMI)
Fanshaws, Brickendon, Hertford SG13 8PQ



CONTACT SHEET

Learner Name:	
Learner Registration No:	
Learner Address:	
Learner Tel No:	
Learner Email:	
Employer Contact:	
Employer Name & Address:	
Employer Tel No:	

Please complete as appropriate:	
Witness Name:	Witness Name:
Witness Job Title:	Witness Job Title:
Witness Signature:	Witness Signature:
Witness Name:	Witness Name:
Witness Job Title:	Witness Job Title:
Witness Signature:	Witness Signature:
Assessor Name:	Assessor Name:
Assessor Signature:	Assessor Signature:
Assessor Name:	
Assessor Signature:	
Internal Verifier Name:	Internal Verifier Name:
Internal Verifier Signature:	Internal Verifier Signature:



**IMI Level 2 Subsidiary Diploma in Heavy Vehicle Maintenance and Repair Technology I.D.:
600/9485/0**

In order to pass the qualification, learners must achieve a minimum of 46 credits from the following groups:

Group A: A minimum of 4 credits must be achieved.

Group B: A minimum of 4 credits must be achieved.

Groups C: A minimum of 27 credits must be achieved.

Groups D: A minimum of 11 credits must be achieved

TQT = 460

Please note that every knowledge unit has an online test and the test number is the same as the 'set ref'.

Note: Assessments :

The assessments for this qualification combine various assessment styles/methodologies in order to suit the levels of units contained within it.

The table below clarifies what IMI assessments are available for each unit, and whether these assessments are mandatory (M) or optional (O) for the selected unit.

The key below details the style of assessment/s:

C = Combination assessments (task based)

W = Written Assessments / Assignments

P = Practical Assessments

T = On-line tests

Group A Health and Safety Units

Unit Ref:	Unit Title and ID Number	GLH	Unit Level	Credit Value	Assessments			
					C	W	P	T
L101	L101 - Health and Safety Practices in Vehicle Maintenance (A/600/3296)	30	1	4	M			M
G0102K	G0102K - Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment (D/601/6171)	30	2	3		O		M
G0102S	G0102S - Skills in Health and Safety and Good Housekeeping in the Automotive Environment (Y/601/7254)	60	2	7			M	
Minimum Totals		30		4				

Group B Foundation Units

Unit Ref:	Unit Title and ID Number	GLH	Unit Level	Credit Value	Assessments			
					C	W	P	T
L102	L102 - Tools, Equipment and Materials for Vehicle Maintenance (F/600/3297)	30	1	4	M			M
G4K	G4K - Knowledge of Materials, Fabrication, Tools and Measuring Devices used in the Automotive Environment (K/601/6237)	40	2	4		O		M
G4S	G4S - Skills in Materials, Fabrication, Tools and Measuring Devices used in the Automotive Environment (Y/601/6279)	60	2	7			M	
Minimum Totals		30		4				



GROUP C: Specialist Units

Set/Unit Ref:	Unit Ref, Unit Title and ID Number	GLH	Unit Level	Credit Value	Assessments			
					C	W	P	T
HV01	HV01K – Knowledge of Conducting Routine Heavy Vehicle Maintenance (J/601/4933)	20	2	2		0		M
	HV01S – Skills Required to Conduct Routine Heavy Vehicle Maintenance (K/601/4973)	20	2	3			M	
HV02.1	HV02.1K – Knowledge of Heavy Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components (D/601/4937)	20	2	3		0		M
HV02.2	HV02.2K – Knowledge of Heavy Vehicle Fuel, Air Supply and Exhaust System Units and Components (T/601/4944)	20	2	3		0		M
HV02	HV02S – Skills Required to Remove and Replace Heavy Vehicle Engine Units and Components (A/601/4976)	45	2	5			M	
HV04	HV04K – Knowledge of Heavy Vehicle Removing and Replacing Chassis Units and Components (L/601/4951)	45	2	6		0		M
	HV04S – Skills Required to Remove and Replace Heavy Vehicle Chassis Units and Components (L/601/4979)	45	2	5			M	
	Total	215		27				



GROUP D Optional Units

Set/Unit Ref:	Unit Ref, Unit Title and ID Number	GLH	Unit Level	Credit Value	Assessments			
					C	W	P	T
G3	G3K – Knowledge of Support for Job Roles in the Automotive Environment (T/601/6175)	20	3	3		M		M
	G3S – Skills in Supporting Job Roles in the Automotive Environment (J/601/6262)	40	3	5			M	
G8	G8K – Knowledge of How to Identify and Agree Motor Vehicle Customer Service Needs (R/601/6247)	45	3	5		M		M
	G8S – Skills to Identify and Agree Motor Vehicle Customer Service Needs (M/601/6286)	40	3	5			M	
HV03	HV03K – Knowledge of Removing and Replacing Heavy Vehicle Electrical Units and Components (J/601/4947)	45	2	6		O		M
	HV03S – Skills Required to Remove and Replace Heavy Vehicle Electrical Units and Components (F/601/4977)	45	2	5			M	
HV0506K	HV0506K – Knowledge of Inspecting Heavy Vehicles (Y/601/4967)	40	2	4		O		M
HV05S	HV05S – Skills Required to Inspect Heavy Vehicles Using Prescribed Methods (F/601/4980)	20	2	2			M	
HV12	HV12K – Knowledge of Heavy Vehicle Transmission and Driveline Units and Components (F/601/4963)	45	2	6		O		M
	HV12S – Skills Required to Remove and Replace Heavy Vehicle Transmission and Driveline Units and Components (J/601/4995)	45	2	5			M	
BP18	BP18K – Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Vehicle Body Panels (F/601/3747)	20	2	2		O		M
	BP18S – Skills in Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Vehicle Body Panels (K/601/3869)	20	2	3			O	
EE2	EE2 - Vehicle Electrical and Electronics 2 (F/503/1283)	36	2	6		M		M
ICT2	ICT2 - Information Communication and Technology for Vehicle Repair 2 (F/503/1302)	36	2	6		M		M
M2	M2 - Vehicle Mathematics 2 (Y/503/1306)	36	2	6		M		M
S2	S2 - Vehicle Science 2 (H/503/1308)	36	2	6		M		M
Minimum Totals		76		11				

GLH = 351 with mandatory and optional units

Minimum Credit Value = 46



UNIT REF: L101	UNIT TITLE: HEALTH AND SAFETY PRACTICES IN VEHICLE MAINTENANCE
-----------------------	---

Level: 1	Credit Value: 4	GLH: 30
-----------------	------------------------	----------------

Mapping: This unit is partly mapped to the IMI NOS

Rationale: This unit introduces learners to the health and safety requirements when carrying out simple vehicle maintenance and other related tasks in vehicle workshops. Outcome 1 covers the general requirements of health and safety in vehicle workshops including personal responsibilities, common risks and hazards and health and safety information. The unit also covers the use of health and safety practices and equipment, safe manual handling procedures, COSHH procedures and fire prevention and emergency procedures

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Know health and safety requirements and information in motor vehicle workshops	1.1 State their personal responsibilities for health and safety in vehicle workshops 1.2 Identify common risks and hazards when working in vehicle workshops 1.3 Identify the need to be aware of the actions of others in the working environment 1.4 Locate the main health and safety information and notices provided in vehicle workshops
2. Be able to use appropriate health and safety practices and equipment	2.1 Use appropriate safe and healthy working practices when carrying out vehicle maintenance and repair 2.2 Use appropriate PPE and VPE when working in vehicle workshops 2.3 Demonstrate good housekeeping practices when working in vehicle workshops
3. Be able to use safe manual handling procedures	3.1 Identify safe manual handling practices and procedures 3.2 Identify common manual handling equipment used in vehicle workshops 3.3 Use appropriate manual handling equipment and procedures when carrying or lifting during vehicle maintenance and repair
4. Be able to use COSHH procedures	4.1 Identify the main substances hazardous to health in vehicle maintenance and repair 4.2 Use appropriate methods to dispose of waste materials in vehicle maintenance
5. Know about fire prevention and emergency procedures	5.1 Identify the THREE elements that produce a fire 5.2 Identify different types of fire extinguisher and their uses 5.3 State the procedures to follow in an emergency and the evacuation of the premises

Content to include:
1.1. Personal responsibilities to include:

- a following health and safety notices and instructions
- b complying with employer's instructions and procedures
- c using PPE and VPE equipment
- d behaving responsibly and safely
- e being aware of others

1.2. Common risks and hazards associated with:

- a. electrical equipment and trailing leads
- b. air lines and air powered tools
- c. vehicle fuels and hazardous substances used in vehicle maintenance
- d. movement of vehicles
- e. waste materials
- f. loose tools and equipment
- g. lifting, jacking and supporting vehicles
- h. inappropriate behaviour
- i. failing to use appropriate PPE

1.3 Awareness of others to include:

- a the risk posed by the action and conduct of colleagues in immediate vicinity
- b the possible risks to others posed by your own actions and conduct
- c the risks posed by the type of work being carried out by colleagues

1.4 Main health and safety information and notices to include:

- a. fire and emergency exits
- b. actions in the event of a fire or emergency
- c. health and safety instructions
- d. use of health and safety equipment

2.1. Health and safety practices to include:

- a immobilising vehicle and engine, removal of ignition key, ensuring handbrake is applied
- b use of PPE and VPE
- c use of axle stands and vehicle supporting aids
- d location of fire extinguishers
- e following safety instructions
- f correct use of tools and equipment

2.2. PPE and VPE to include:

- a. PPE - overalls, gloves, aprons, goggles, helmets, safety footwear appropriate to task
- b. VPE - wing covers, seat covers, carpet protection

2.3 Check and use appropriate tools and equipment to include:

- a. electrical equipment - blown fuses, damaged cables
- b. identifying unsafe hand tools - damaged hand tools
- c. identifying unsafe equipment - leaking jacks

Content to include: contd

- 2.4. Good housekeeping practices to include:
- a. prompt disposal of waste materials
 - b. prompt cleaning of spillages
 - c. regular cleaning of work area
 - d. storage of tools and equipment
- 3.1. Safe manual handling practices and procedures to include:
- a. use of PPE
 - b. correct lifting technique
 - c. carrying technique
- 3.2. Manual handling equipment to include:
- a. jacks
 - b. cranes
 - c. hoists
 - d. chains, slings and wire ropes
- 3.3. Safe use of lifting equipment to include:
- a. use of PPE
 - b. need to ensure lifting aid capacity
 - c. care when moving of load over uneven surfaces
 - d. avoiding obstructions and floor based obstacles – cables, leads
 - e. need to keep load stable when moving
- 4.1. Common hazardous substances include:
- a. liquids – petrol, diesel, oil, brake fluid, cleaners
 - b. gases – welding and heating equipment
 - c. solids – old components
- 4.2. Procedures for disposing of waste materials to include:
- a. waste oil and filters
 - b. old units and components
 - c. cleaning materials
 - d. volatile materials – petrol filters, petrol engine components
- 5.1. THREE elements necessary for a fire – oxygen, fuel and a source of ignition
- 5.2. Fire extinguishers to include:
- a. water
 - b. powder
 - c. gas – CO₂
- 5.3. Procedures to follow in an emergency to include:
- a. in the event of a colleague suffering an electric shock
 - b. in the event of a serious accident
 - c. sounding alarm
 - d. use of appropriate fire extinguisher
 - e. evacuation of premises



UNIT REF: G0102K	UNIT TITLE: KNOWLEDGE OF HEALTH, SAFETY AND GOOD HOUSEKEEPING IN THE AUTOMOTIVE ENVIRONMENT
-------------------------	--

Level: 2	Route: Knowledge	Credit Value: 3	GLH: 30
-----------------	-------------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS G1 and G2

Rationale: This unit enables the learner to develop an understanding of routine maintenance and cleaning of the automotive environment and using resources economically and 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand the correct personal and vehicle protective equipment to be used within the automotive environment	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
2. Understand effective housekeeping practices in the automotive environment	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



3. Understand key health and safety requirements relevant to the automotive environment	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
4. Understand about hazards and potential risks relevant to the automotive environment	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.
5. Understand personal responsibilities	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

Content:
Economic use of resources

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

Requirement to maintain work area effectively

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

Spillages, leaks and waste materials

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

Basic legislative requirements

- a. Provision and Use of Work Equipment Regulations 1992.
- b. Power Presses Regulations 1992.
- c. Pressure Systems and Transportable Gas Containers Regulations 1989.
- d. Electricity at Work Regulations 1989.
- e. Noise at Work Regulations 1989.
- f. Manual Handling Operations Regulations 1992.
- g. Health and Safety (Display Screen Equipment) Regulations 1992.
- h. Abrasive Wheel Regulations.
- i. Safe Working Loads.
- j. Working at Height Regulations (2005)

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 manufacturer's 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

Content: Contd
General regulations to include an awareness of:

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

Legislative duties:

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

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

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

Content: Contd
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, to include:
 - i. toxic
 - ii. corrosive
 - iii. poisonous
 - iv. harmful
 - v. irritant
 - vi. flammable
 - vii. explosive

Content: contd
Warning signs and notices

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

Hazards and risks to include:

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

Personal responsibilities

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

Content: contd
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 REF: G0102S	UNIT TITLE: SKILLS IN HEALTH, SAFETY AND GOOD HOUSEKEEPING IN THE AUTOMOTIVE ENVIRONMENT
-------------------------	---

Level: 2	Route: Skills	Credit Value: 7	GLH: 60
-----------------	----------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS G1 and G2

Rationale: This unit will enable the learner to develop the skills required to carry out day to day work area cleaning, clearing away, dealing with spillages and disposal of waste, used materials and debris. Identify hazards and risks in the automotive environment and complying with relevant legislation and good practice and work safely at all times within the automotive environment, both as an individual and with others.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to use correct personal and vehicle protection within the automotive environment	1.1. Select and use personal protective equipment throughout activities. To include appropriate protection of: <ul style="list-style-type: none"> a eyes b ears c head d skin e feet f hands g lungs 1.2.. Select and use vehicle protective equipment throughout all activities
2. Be able to carry out effective housekeeping practices in the automotive environment	2.1. Select and use cleaning equipment which is of the right type and suitable for the task 2.2. Use utilities and appropriate consumables, avoiding waste 2.3. Use materials and equipment to carry out cleaning and maintenance duties in allocated work areas, following automotive work environment policies, schedules and manufacturers instructions 2.4. Perform housekeeping activities safely and in a way which minimises inconvenience to customers and staff 2.5. Keep the work area clean and free from debris and waste materials 2.6. Keep tools and equipment fit for purpose by regular cleaning and keeping tidy 2.7. Dispose of used cleaning agents, waste materials and debris to comply with legal and workplace requirements



<p>3. Be able to recognise and deal with dangers in order to work safely within the automotive workplace</p>	<p>3.1. Name and locate the responsible persons for health and safety in their relevant workplace</p> <p>3.2. Identify and report working practices and hazards which could be harmful to themselves or others</p> <p>3.3. Carry out safe working practices whilst working with equipment, materials and products in the automotive environment</p> <p>3.4. Rectify health and safety risks encountered at work, within the scope and capability of their job role</p>
<p>4. Be able to conduct themselves responsibly</p>	<p>4.1. Show personal conduct in the workplace which does not endanger the health and safety of themselves or others</p> <p>4.2. Display suitable personal presentation at work which ensures the health and safety of themselves and others at work</p>



EVIDENCE REQUIREMENTS

1. You must produce evidence of use of personal and vehicle protection, cleaning the work environment and disposal of waste on 2 separate occasions .
2. You must produce evidence of identifying risks which may result from at least 2 of the items listed below:
<ul style="list-style-type: none">• the use and maintenance of machinery or equipment
<ul style="list-style-type: none">• the use of materials or substances
<ul style="list-style-type: none">• working practices which do not conform to laid down policies
<ul style="list-style-type: none">• unsafe behaviour
<ul style="list-style-type: none">• accidental breakages and spillages
<ul style="list-style-type: none">• environmental factors
3. You must produce evidence of identifying risks.
4. You must produce evidence of following at least 2 of the workplace policies listed below:
<ul style="list-style-type: none">• the use of safe working methods and equipment
<ul style="list-style-type: none">• the safe use of hazardous substances
<ul style="list-style-type: none">• smoking, eating, drinking and drugs
<ul style="list-style-type: none">• what to do in the event of an emergency
<ul style="list-style-type: none">• personal presentation

ASSESSOR SIGNATURE:

DATE:



UNIT REF: L102	UNIT TITLE: TOOLS, EQUIPMENT AND MATERIALS FOR VEHICLE MAINTENANCE
-----------------------	---

Level: 1
Credit Value: 4
Guided Learning Hours: 30
Rationale: This unit introduces learners to the tools, equipment and materials that are used for vehicle maintenance and covers being able to work safely when using these items. The unit covers common hand tools used for vehicle maintenance, the equipment used during vehicle maintenance and materials used for vehicle construction and maintenance.

<p>LEARNING OUTCOMES</p> <p>The learner will:</p> <ol style="list-style-type: none"> 1. Be able to work safely 2. Be able to use and maintain hand tools for vehicle maintenance 3. Be able to and use workshop equipment for vehicle maintenance 4. Be able to use materials when carrying out vehicle maintenance
--

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely	1.1 Select and use appropriate PPE when using tools and equipment for vehicle maintenance 1.2 Use safe methods of working when using tools and equipment 1.3 Identify common defects in basic tools
2. Be able to use and maintain hand tools for vehicle maintenance	2.1 Identify and select appropriate hand tools for vehicle maintenance 2.2 Prepare and use hand tools correctly 2.3 Maintain hand tools in a safe condition
3. Be able to use workshop equipment for vehicle maintenance	3.1 Identify and select appropriate workshop equipment for vehicle maintenance 3.2 Prepare and use common workshop equipment correctly 3.3 Carryout basic care and maintenance of common workshop equipment
4. Be able to use materials when carrying out vehicle maintenance	4.1 Identify common materials in the construction of vehicles 4.2 Identify common materials and consumables used for vehicle maintenance 4.3 Select and use appropriate materials and consumables for vehicle maintenance

Content to include:
1.1 PPE to include:

overalls, gloves, aprons, goggles, helmets, safety footwear appropriate to task

1.2 Safe methods of working to include:

examining tools for defects and damage, correctly preparing tools for use, using tools safely and correctly, carrying out cleaning and basic maintenance of tools

1.3 Defective tools and those requiring maintenance to include:

bent or distorted tools, cracks, rough edges, mushroomed chisels, loose hammer heads, damaged screwdrivers, slipping ratchet wrenches, damaged sockets

2.1 Hand tools to include:

- a spanners – open end, ring, combination, speed and ratchet types)
- b screwdrivers – flat blade, Phillips, pozidrive
- c hammers – ball pein, lump, copper/hide, rubber, neoprene
- d chisels
- e saws – hacksaw, junior hacksaw
- f steel rule and tape measure
- g allen keys
- h vice grips
- i socket sets – different drive sizes, specialist socket and screw bits, stud remover adaptor
- j pliers and grips – long nose, engineers, side snips/cutters, pipe grips, mole grips
- k torque wrench
- l feeler blades
- m tyre tread depth gauges

2.2 Prepare and use hand tools correctly to include:

- a. holding tools correctly
- b. selecting correct tool for task
- c. stance when using tool
- d. adjusting tools correctly i.e. torque wrench setting, hacksaw blade tension
- e. preparing tool correctly i.e. fitting hacksaw blade correctly
- f. using appropriate PPE i.e. goggles and gloves when necessary

2.3 Maintain hand tools to include:

- a. cleaning tools
- b. removing mushroom end from chisels
- c. resetting torque wrench after use
- d. inspecting tools for damage
- e. storing tools after use

3.1 Equipment to include:

- a. lifting equipment – jacks, ramps, lifts, axle stands
- b. air tools – air lines, tyre inflator/gauge, wrenches, hammers, blow guns
- c. bench tools – grindstone, pillar drill
- d. portable electric tools – hand drills, extension leads, component cleaners
- e. specialist tools – tracking gauges, filter removal straps, waste oil drainers, exhaust extraction
- f. select appropriate and necessary equipment for task

Content to include: contd
3.2 Prepare and use equipment correctly to include when appropriate:

- a. adjust settings
- b. set pressure
- c. zero readings
- d. examine for defects
- e. locate correctly – axle stands and jacks
- f. use when appropriate – exhaust extraction when engine is running

3.3 Basic care and maintenance to include:

- a. check equipment for defects or damage – blown fuse, exposed electrical leads, leaking fluid
- b. clean and store equipment after use
- c. report defects or damage

4.1 Common materials used for vehicle construction to include:

- a. metals – ferrous and non-ferrous
- b. glass
- c. plastic
- d. glass fibre
- e. rubber
- f. fluids – lubricants, hydraulic oils, anti-freeze, brake fluid

4.2 Common materials used for vehicle maintenance to include:

- a. lubricants
- b. coolants
- c. fluids
- d. adhesives and cements
- e. sealers
- f. filters
- g. aerosol sprays
- h. gaskets
- i. cleaners

4.3 Select appropriate materials to include:

- a. correct specifications – lubricants and fluids
- b. correct quantity - lubricants
- c. correct mixture – anti freeze
- d. when appropriate to replace – manufacturer’s maintenance schedule
- e. work safely when using materials



UNIT REF: G4K	UNIT TITLE: KNOWLEDGE OF MATERIALS, FABRICATION, TOOLS AND MEASURING DEVICES USED IN THE AUTOMOTIVE ENVIRONMENT
---------------	--

Level: 2	Route: Knowledge	Credit Value: 4	GLH: 40
----------	------------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS G4

Rationale: 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 automotive environment equipment, the correct selection and fabrication of materials used when modifying and repairing and the correct application of automotive engineering fabrication and fitting principles

LEARNING OUTCOMES	ASSESSMENT CRITERIA
<p>The Learner will:</p> <p>1. Understand how to select, use and care for hand tools and measuring devices in the automotive environment</p>	<p>The Learner can:</p> <p>1.1. Identify and explain the use of common types of hand tools used for fabricating and fitting in the automotive environment</p> <p>1.2. Identify and explain the use of common measuring devices used for fabrication and fitting in the automotive environment</p> <p>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</p> <p>1.4. State the limitations of common hand tools and measuring devices used for fabricating, repair and fitting in the automotive workplace</p> <p>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</p> <p>1.6. Identify common electrical measuring tools used in the repair of vehicles and components</p> <p>1.7. Explain the preparation and safe and correct use of common electrical tools when measuring voltage, current and resistance</p>
<p>2. Understand how to prepare and use common workshop equipment</p>	<p>2.1. Describe the preparation and safe use of workshop equipment</p> <p>2.2. Explain the term: safe working load</p>



<p>3. Understand how to select materials when fabricating, modifying and repairing vehicles and fitting components</p>	<p>3.1. Describe the properties, application and limitations of ferrous and non-ferrous metals, including their safe use.</p> <p>3.2. Describe the properties, application and limitations of common non-metallic materials, including their safe use</p> <p>3.3. Define common terms relating to the properties of materials</p>
<p>4. Understand how to apply automotive engineering, fabrication and fitting principles when modifying and repairing vehicles and components</p>	<p>4.1. Describe how to tap threads, file, cut and drill plastics and metals when modifying or repairing vehicles</p> <p>4.2. Describe how to measure, mark out, shape and join materials when fabricating</p> <p>4.3. Describe the selection and fitting procedures of the following:</p> <ul style="list-style-type: none">a. gaskets and sealsb. sealants and adhesivesc. fittings and fastenersd. electrical circuit components <p>4.4. Identify locking, fastening and fixing devices</p> <p>4.5. State the importance of correct operating specifications for limits, fits and tolerances in the automotive environment</p>



UNIT REF: G4S	UNIT TITLE: SKILLS IN MATERIALS, FABRICATION, TOOLS AND MEASURING DEVICES USED IN THE AUTOMOTIVE ENVIRONMENT
----------------------	---

Level: 2	Route: Skills	Credit Value: 7	GLH: 60
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS G4

Rationale: 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 and the correct application of automotive engineering fabrication and fitting principle

LEARNING OUTCOMES	ASSESSMENT CRITERIA	Ref No	Date
The Learner will:	The Learner can:		
1. Be able to select, maintain and use hand tools and measuring devices in the automotive environment	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		
2. Be able to prepare and use common workshop equipment	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.		
3. Be able to select materials when fabricating, modifying and repairing vehicles and fitting components	3.1. Select and use appropriate materials whilst constructing, fitting, modifying or repairing vehicles and components.		



<p>4. Be able to apply automotive engineering, fabrication and fitting principles when modifying and repairing vehicles and components</p>	<p>4.1. Use correct procedures when:</p> <ul style="list-style-type: none"> a. filing, b. tapping threads c. cutting plastics and metals d. drilling plastics and metals. e. fitting <p>4.2. Use appropriate techniques when fabricating, repairing and modifying vehicles and components</p> <p>4.3. Select and use:</p> <ul style="list-style-type: none"> a. gaskets b. seals c. sealants d. fittings and fasteners <p>4.4. Apply modification and repair techniques to automotive electrical circuits</p> <p>4.5. Select and use locking, fixing and fastening devices</p>		
--	---	--	--

EVIDENCE REQUIREMENTS

<p>1. You must produce evidence of undertaking basic routine checks of hand tools, measuring devices and workshop equipment covering all of those listed below:</p>
<ul style="list-style-type: none"> • electrical
<ul style="list-style-type: none"> • mechanical
<ul style="list-style-type: none"> • pneumatic
<ul style="list-style-type: none"> • hydraulic
<p>2. You must produce evidence of fabricating at least 1 item from suitable materials to known tolerances, which includes the following processes</p>
<ul style="list-style-type: none"> • filing
<ul style="list-style-type: none"> • tapping threads
<ul style="list-style-type: none"> • cutting
<ul style="list-style-type: none"> • drilling
<ul style="list-style-type: none"> • joining
<p>3. You must be observed by your assessor carrying out routine checks and during stages of fabrication</p>



UNIT REF: HV01K	UNIT TITLE: KNOWLEDGE OF CONDUCTING ROUTINE HEAVY VEHICLE MAINTENANCE
------------------------	--

Level: 2	Route: Knowledge	Credit Value: 2	GLH: 20
-----------------	-------------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS HV01

Rationale: This unit enables the learner to develop knowledge in order to conduct routine maintenance, adjustment and replacement activities as part of the servicing of heavy vehicles.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand how to carry out routine heavy vehicle maintenance	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
2. Understand the legal requirements applicable to carrying out heavy vehicle maintenance	2.1. Describe the requirements of heavy vehicle maintenance arrangements as part of the Operator Licence criteria 2.2. Describe the legal requirement relating to the retention of heavy vehicle maintenance records

Content:
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
- d. Procedures for checking and replenishing where applicable:
 - i. oil (engine, gearbox, final drive, hub reduction)
 - ii. water (coolant and screenwash)
 - iii. hydraulic fluids (brake and clutch)
 - iv. engine emission additives (Urea)
 - v. pneumatic systems
- e. Procedures for replacement of lubricants and filters (to include chassis systems):
 - i. replace oil filters
 - ii. types of oil
 - iii. cleanliness
 - iv. disposal of old oil and filters
- f. Procedures for carrying out adjustments on vehicle systems or components:
 - i. clearances
 - ii. settings
 - iii. alignment
 - iv. operational performance (engine idle, exhaust gas)
- g. Procedures for checking electrical systems:
 - i. operation
 - ii. security
 - iii. performance
- h. Importance and process of detailed inspection procedures:
 - i. following inspection checklists
 - ii. checking conformity to manufacturer's specifications
 - iii. legal requirements as applicable
- i. Importance and process of completing all relevant documentation relating to routine maintenance:
 - i. inspection records
 - ii. job cards
 - iii. vehicle repair records
 - iv. in-vehicle service history



Content:

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

The need to inspect the vehicle following routine maintenance:

- i. professional presentation of vehicle
- ii. customer perceptions

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 REF: HV01S	UNIT TITLE: SKILLS REQUIRED TO CONDUCT ROUTINE HEAVY VEHICLE MAINTENANCE
------------------------	---

Level: 2	Route: Skills	Credit Value: 3	GLH: 20
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV01

Rationale: This unit allows the learner to demonstrate skills in order to carry out heavy vehicle routine maintenance, adjustments and replacement activities as part of the servicing of vehicles.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely when carrying out heavy vehicle routine maintenance	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
2. Be able to use relevant information to carry out the task	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
3. Be able to use appropriate tools and equipment	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
4. Be able to carry out heavy vehicle routine maintenance	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.



	<p>4.4. Ensure that the vehicle conforms to the vehicle operating specification and any legal requirements</p> <p>4.5. Ensure any comparison of the vehicle against specification accurately identifies any:</p> <ul style="list-style-type: none">a. differences from the vehicle specificationb. vehicle appearance and condition faults <p>4.6. Use suitable testing methods to evaluate the performance of all replaced and adjusted components and systems accurately</p>
5. Be able to record information and make suitable recommendations	<p>5.1. Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>5.2. Make suitable and justifiable recommendations for cost effective repairs</p> <p>5.3. Record and report any additional faults noticed during the course of their work promptly in the format required</p>

EVIDENCE REQUIREMENTS

- | |
|---|
| <p>1. You must produce evidence of carrying out servicing activities based on routine checks and inspections on at least 1 vehicle which must cover the Learning Outcomes.</p> |
|---|



UNIT REF: HV02.1K	UNIT TITLE: KNOWLEDGE OF HEAVY VEHICLE ENGINE MECHANICAL, LUBRICATION AND COOLING SYSTEM UNITS AND COMPONENTS
--------------------------	--

Level: 2	Route: Knowledge	Credit Value: 3	GLH: 20
----------	------------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV02

Rationale: This unit enables the learner to develop knowledge in order to carry out 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 OUTCOMES	ASSESSMENT CRITERIA
<p>The Learner will:</p> <p>1. Understand how the main heavy vehicle engine mechanical systems operate</p>	<p>The Learner can:</p> <p>1.1. Identify heavy vehicle engine mechanical system components</p> <p>1.2. Describe the construction and operation of heavy vehicle compression ignition engine mechanical systems</p> <p>1.3. Compare key heavy vehicle engine mechanical system components and assemblies against alternatives to identify differences in construction and operation</p> <p>1.4. Identify the key engineering principles that are related to heavy vehicle engine mechanical systems</p> <ul style="list-style-type: none"> a compression ratio's b cylinder capacity c power d torque <p>1.5. State common terms used in heavy vehicle engine mechanical systems</p> <ul style="list-style-type: none"> a tdc b bdc c stroke d bore
<p>2. Understand how heavy vehicle engine lubrication systems operate</p>	<p>2.1. Identify heavy vehicle engine lubrication system components</p> <p>2.2. Describe the construction and operation of heavy vehicle engine lubrication system components</p> <p>2.3 Compare key heavy vehicle engine lubrication system components and assemblies to identify differences in construction and operation</p> <p>2.4. Identify the key engineering principles that are related to heavy vehicle engine lubrication systems</p> <ul style="list-style-type: none"> a. classification of lubricants b. properties of lubricants c. methods of reducing friction <p>2.5. State common terms used in heavy vehicle engine lubrication system design</p>



<p>3. Understand how heavy vehicle engine cooling, heating and ventilation systems operate</p>	<p>3.1. Identify heavy vehicle engine cooling, heating and ventilation system components</p> <p>3.2. Describe the construction and operation of heavy vehicle engine cooling, heating and ventilation systems</p> <p>3.3. Compare key heavy vehicle engine cooling, heating and ventilation system components and assemblies against alternatives to identify differences in construction and operation</p> <p>3.4. Identify the key engineering principles that are related to heavy vehicle engine cooling, heating and ventilation systems</p> <ul style="list-style-type: none">a. heat transferb. linear and cubical expansionc. specific heat capacityd. boiling point of liquids <p>3.5. State common terms used in key heavy vehicle engine cooling, heating and ventilation system design</p>
<p>4. Understand how to check, replace and test engine mechanical, lubrication and cooling systems system units and components</p>	<p>4.1. Describe how to remove and replace engine mechanical, lubrication and cooling system units and components</p> <p>4.2. Describe common types of testing methods used to check the operation of engine mechanical, lubrication and cooling systems and their purpose</p> <p>4.3. Describe how to test and evaluate the performance of replacement units against vehicle specification</p> <p>4.4. Identify common faults found in heavy vehicle engine mechanical, lubrication and cooling systems and their causes</p>

Content:**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

Content: contd

- a. Relative advantages and disadvantages of different engine types and configurations.
- b. Engine components and layouts:
 - i. side camshaft and overhead camshaft
 - ii. single and multi cylinder
 - iii. wet and dry liners
 - iv. crankshaft dampers
- c. Cylinder head layout and design, combustion chamber and piston design.
- d. Calculate compression ratios from given data.
- e. The procedures used when inspecting engines
- f. The procedures to assess:
 - i. serviceability
 - ii. wear
 - iii. condition
 - iv. clearances
 - v. settings
 - vi. linkages
 - vii. joints
 - viii. fluid systems
 - ix. adjustments
 - x. operation and functionality
 - xi. security
- g. Symptoms and faults associated with mechanical engine operation:
 - i. poor performance
 - ii. abnormal or excessive mechanical noise
 - iii. erratic running
 - iv. low power
 - v. exhaust emissions
 - vi. abnormal exhaust smoke
 - vii. unable to start
 - viii. exhaust gas leaks to cooling system
 - ix. exhaust gas leaks

Lubrication

- a. 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

Content: contd

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

Cooling, Heating and Ventilation

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



Content: contd

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 REF: HV02.2K	UNIT TITLE: KNOWLEDGE OF HEAVY VEHICLE FUEL, AIR SUPPLY AND EXHAUST SYSTEM UNITS AND COMPONENTS
--------------------------	--

Level: 2	Route: Knowledge	Credit Value: 3	GLH: 20
-----------------	-------------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS HV02

Rationale: This unit enables the learner to develop knowledge in order to carry out the construction and operation of common fuel, 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand how heavy vehicle engine fuel systems operate	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 <ul style="list-style-type: none"> a. properties of fuels b. combustion processes c. exhaust gas constituents 1.5. State common terms used in heavy vehicle engine fuel system design
2. Understand the legal requirements relating to European Emission Standards applicable to commercial vehicles	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
3. Understand how heavy vehicle exhaust emission control systems operate	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 <ul style="list-style-type: none"> 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



4. Understand how heavy vehicle engine air supply and exhaust systems operate	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
5. Understand how to check, replace and test engine fuel, air supply and exhaust system units and components	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

Content:**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
 - i. combustion chambers (direct and indirect injection)
- c. 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. fuel 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

Content: contd
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 (NO_x)
 - 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

Content: contd**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 REF: HV02S	UNIT TITLE: SKILLS REQUIRED TO REMOVE AND REPLACE HEAVY VEHICLE ENGINE UNITS AND COMPONENTS
-----------------	--

Level: 2	Route: Skills	Credit Value: 5	GLH: 45
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV02

Rationale: This unit allows the learner to demonstrate skills in order to the remove and replace heavy vehicle engine system components. It also covers the evaluation of performance of the replaced units and systems.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely when carrying out removal and replacement activities	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
2. Be able to use relevant information to carry out the task	2.1. Select suitable sources of technical information to support heavy vehicle engine unit and component removal and replacement activities including: <ul style="list-style-type: none"> 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
3. Be able to use appropriate tools and equipment	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
4. Be able to carry out removal and replacement of heavy vehicle engine units and components.	4.1. Remove and replace the heavy vehicle's engine systems and components, adhering to the specifications and tolerances for the vehicle and following: <ul style="list-style-type: none"> 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 performs to the vehicle operating specification and meets any legal requirements



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

EVIDENCE REQUIREMENTS

1. You must produce evidence of carrying out the removal and replacement of engine mechanical units and components from 3 different systems out of the 5 listed below not including standard external filters:
engine mechanical systems
cooling systems
air supply and exhaust systems
fuel systems
lubrication systems



UNIT REF: HVO4K	UNIT TITLE: KNOWLEDGE OF REMOVING AND REPLACING HEAVY VEHICLE CHASSIS UNITS AND COMPONENTS
------------------------	---

Level: 2	Route: Knowledge	Credit Value: 6	GLH: 45
-----------------	-------------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS HV04

Rationale: 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand how heavy vehicle steering systems operate	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 <ul style="list-style-type: none"> a. steering angles b. hydraulic forces c. stress and strain 1.5. State common terms used in heavy vehicle steering system design
2. Understand how heavy vehicle suspension systems operate	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 <ul style="list-style-type: none"> a. suspension hydraulic damping b. stress and strain 2.5. State common terms used in heavy vehicle suspension system design



<p>3. Understand how heavy vehicle braking systems operate</p>	<p>3.1. Identify heavy vehicle braking system components</p> <p>3.2. Describe the construction and operation of heavy vehicle braking systems</p> <p>3.3. Compare key heavy vehicle braking system components and assemblies against alternatives to identify differences in construction and operation</p> <p>3.4. Identify the key engineering principles that are related to heavy vehicle braking systems</p> <ul style="list-style-type: none"> a. laws of friction b. hydraulics c. pneumatics d. properties of fluids e. properties of air f. braking efficiency <p>3.5. State common terms used in heavy vehicle braking system design</p>
<p>4. Understand how heavy vehicle wheel and tyre systems operate</p>	<p>4.1. Identify heavy vehicle wheel and tyre components</p> <p>4.2. Describe the construction and operation of heavy vehicle wheels and tyres</p> <p>4.3. Compare key heavy vehicle wheel and tyre components and assemblies against alternatives to identify differences in construction and operation</p> <p>4.4. Identify the key engineering principles that are related to heavy vehicle wheel and tyre systems</p> <ul style="list-style-type: none"> a. friction b. un-sprung weight c. dynamic and static balance <p>4.5. State common terms used in heavy vehicle wheel and tyre design</p>
<p>5. Understand the health and safety aspects when working on loaded vehicles</p>	<p>5.1. Identify types of hazards when working on loaded heavy vehicles</p>
<p>6. Understand how to check, replace and test heavy vehicle chassis units and components</p>	<p>6.1. Describe how to remove and replace chassis units and components</p> <p>6.2. Describe common types of testing methods used to check the operation of chassis units and components and their purpose</p> <p>6.3. Explain how to evaluate the performance of replacement units against vehicle specification</p> <p>6.4. Identify common faults found in heavy vehicle chassis units and components</p>

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

Content: contd
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 suspensions systems.
- f. The forces acting on suspension systems during braking, driving and cornering.
- g. The methods of locating the road wheels against braking, driving and cornering forces.
- h. The methods of controlling cornering forces by fitting anti-roll torsion members
- i. Suspension terms:
 - i. rebound
 - 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

Content: contd

- 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. caliper
 - 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 caliper & pistons
 - v. brake pipe
 - vi. brake servo
 - vii. warning lights
 - viii. parking brakes
 - ix. equalising valves

Content: contd

- 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 (retarder) brakes:
 - i. exhaust brake
 - ii. compression (engine) brake
 - iii. hydraulic retarder
 - iv. electro-magnetic retarder

Content:
ABS and ASR

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

Wheel and Tyres

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

Content: contd

- h. The defects associated with tyres and wheels:
 - i. abnormal tyre wear
 - ii. cuts
 - iii. side wall damage
 - iv. wheel vibrations
 - v. loose wheel retainers
 - vi. tyre over heating
 - vii. tread separation
- i. 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 REF: HVO4S	UNIT TITLE: SKILLS REQUIRED TO REMOVE AND REPLACE HEAVY VEHICLE CHASSIS UNITS AND COMPONENTS
------------------------	---

Level: 2	Route: Skills	Credit Value: 5	GLH: 45
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV04

Rationale: This unit allows the learner to demonstrate skills in order 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely when carrying out removal and replacement activities	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
2. Be able to use relevant information to carry out the task	2.1. Select suitable sources of technical information to support heavy vehicle chassis unit and component removal and replacement activities including: <ul style="list-style-type: none"> 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
3. Be able to use appropriate tools and equipment	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
4. Be able to carry out removal and replacement of heavy vehicle chassis units and components.	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: <ul style="list-style-type: none"> 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



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

EVIDENCE REQUIREMENTS

1. You must produce evidence of carrying out the removal and replacement of 2 different units or components – from 2 of the systems below. Your evidence must include demonstration of skill in each aspect of mechanical and hydraulic or pneumatic unit or component removal and replacement
steering
suspension
braking



UNIT REF: G3K	UNIT TITLE: KNOWLEDGE OF SUPPORT FOR JOB ROLES IN THE AUTOMOTIVE WORK ENVIRONMENT
----------------------	--

Level: 3	Route: Knowledge	Credit Value: 3	GLH: 20
-----------------	-------------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS G3

Rationale: 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand key organisational structures, functions and roles within the automotive work environment	1.1. Identify the purpose of 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 automotive workplace. To include: a. trainee b. skilled technician c. supervisor d. manager
2. Understand the importance of obtaining, interpreting and using information in order to support their job role within the automotive work environment	2.1. Explain the importance of different sources of information in a 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
3. Understand the importance of different types of communication within the automotive work environment	3.1. Explain where different methods of communication would be used within the automotive environment 3.2. Explain the factors which can determine your choice of communication. 3.3. Explain how the communication of information can change with the target audience to include uninformed and informed people



4. Understand communication requirements when carrying out vehicle repairs in the automotive work environment	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
5. Understand how to develop good working relationships with colleagues and customers in the automotive workplace	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.

Content:**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
- b. Sources of information
 - i. other staff
 - ii. manuals
 - iii. parts lists
 - iv. computer software and the internet
 - v. manufacturer
 - vi. 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



Content: contd

Methods of communication

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

Organisational & customer requirements:

- a Importance of time scales to customer and organisation
- b Relationship between time and costs
- c Meaning of profit

Choice of communication

- a. Distance
- b. Location
- c. Job responsibility

Importance of maintaining positive working relationships:

- a Morale
- b Productivity
- c Company image
- d Customer relationships
- e Colleagues



UNIT REF: G3S	UNIT TITLE: SKILLS IN SUPPORTING JOB ROLES IN THE AUTOMOTIVE WORK ENVIRONMENT
----------------------	--

Level: 3	Route: Skills	Credit Value: 5	GLH: 40
-----------------	----------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS G3

Rationale: 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work effectively within the organisational structure of the automotive work environment	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
2. Be able to obtain and use information in order to support their job role within the automotive work environment	2.1. Select and use legal and technical information, in an automotive work environment
3. Be able to communicate with and support colleagues and customers effectively within the automotive work environment	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
4. Be able to develop and keep good working relationships in the automotive work environment	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



EVIDENCE REQUIREMENTS

- | |
|---|
| 1. You must produce witness testimony from your peers and supervisor or tutor that you have worked well with others. |
| 2. You must produce evidence carrying out the above whilst performing your normal duties. |



UNIT REF: G8K	UNIT TITLE: KNOWLEDGE OF HOW TO IDENTIFY AND AGREE MOTOR VEHICLE CUSTOMER SERVICE NEEDS
----------------------	--

Level: 3	Route: Knowledge	Credit Value: 5	GLH: 45
-----------------	-------------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS G8

Rationale: 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand legislative and organisational requirements and procedures	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
2. Understand how to communicate and care for customers	2.1. Explain how to communicate effectively with customers 2.2. Describe how to adapt your 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
3. Understand company products and services	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

Content:
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. 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.



Content: contd

Consumer legislation: To include:

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



UNIT REF: G8S	UNIT TITLE: SKILLS TO IDENTIFY AND AGREE MOTOR VEHICLE CUSTOMER SERVICE NEEDS
---------------	---

Level: 3	Route: Skills	Credit Value: 5	GLH: 40
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS G8

Rationale: This unit helps the learner to develop 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 OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to obtain relevant information from the customer	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
2. Be able to provide relevant information to the customer	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
3. Be able to agree work undertaken with the customer	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
4. Be able to ensure recording systems are implemented correctly	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.

EVIDENCE REQUIREMENTS

1. You must produce evidence, including records, to show that you have dealt with 3 different customers .
2. You must be observed by your assessor on at least 1 occasion

Evidence from real activity **or role-play is acceptable** for this unit



UNIT REF: HV03K	UNIT TITLE: KNOWLEDGE OF REMOVING AND REPLACING HEAVY VEHICLE ELECTRICAL UNITS AND COMPONENTS
------------------------	--

Level: 2	Route: Knowledge	Credit Value: 6	GLH: 45
----------	------------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV03

Rationale: This unit enables the learner to develop knowledge of the principles, construction and operation and testing methods of common electrical and electronic systems and components found on heavy vehicles.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand heavy vehicle electrical and electronic principles	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
2. Understand how heavy vehicle batteries, starting and charging systems operate	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



3. Understand how heavy vehicle auxiliary electrical systems operate	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
4. Understand how to check, replace and test heavy vehicle electrical systems and components	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

Content:**Electrical and Electronic Principles**

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

Content: contd

- k. Interpret vehicle wiring diagrams to include:
 - i. vehicle lighting
 - ii. auxiliary circuits
 - iii. indicators
 - iv. starting and charging systems
- l. Function and construction of electrical components including:
 - i. circuit relays
 - ii. bulb types including LED's and alternative lighting systems
 - iii. fan and heater
 - iv. circuit protection
- m. The safety precautions when working on electrical and electronic systems to include:
 - i. disconnection and connection of battery
 - ii. avoidance of short circuits
 - iii. power surges
 - iv. prevention of electric shock
 - v. protection of electrical and electronic components
 - vi. protection of circuits from overload or damage
- n. The set-up and use of:
 - i. digital and analogue multi-meters
 - ii. voltmeter
 - iii. ammeter
 - iv. ohmmeter
 - v. oscilloscope
 - vi. manufacturer's dedicated test equipment
- o. Electrical and electronic checks for electrical and electronic systems to include:
 - i. connections
 - ii. security
 - iii. functionality
 - iv. performance to specifications
 - v. continuity, open circuit
 - vi. short circuit
 - vii. high resistance
 - viii. volt drop
 - ix. current consumption
 - x. output patterns (oscilloscope)
- p. Symptoms and faults associated with electrical and electronic systems to include:
 - i. high resistance
 - ii. loose and corroded connections
 - iii. short circuit
 - iv. excessive current consumption
 - v. open circuit
 - vi. malfunction
 - vii. poor performance
 - viii. battery faults to include flat battery
 - ix. failure to hold charge
 - x. low state of charge
 - xi. overheating
 - xii. poor starting

Battery and Charging

- a. The construction and operation of vehicle batteries including:
 - i. low maintenance and maintenance free
 - ii. battery cell construction

Content: contd

- 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

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

Content: contd

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 REF: HV03S	UNIT TITLE: SKILLS REQUIRED TO REMOVE AND REPLACE HEAVY VEHICLE ELECTRICAL UNITS AND COMPONENTS
-----------------	--

Level: 2	Route: Skills	Credit Value: 5	GLH: 45
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV03

Rationale: This unit allows the learner to demonstrate skills in order to remove and replace motor vehicle electrical system components. It also covers the evaluation of performance of the replaced units and systems.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely when carrying out removal and replacement activities	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
2. Be able to use relevant information to carry out the task	2.1. Select suitable sources of technical information to support heavy vehicle electrical unit and component removal and replacement activities including: <ul style="list-style-type: none"> 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
3. Be able to use appropriate tools and equipment	3.1. Select the appropriate tools and equipment necessary for removal and replacement of motor vehicle electrical system components 3.2. Ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3. Use the tools and equipment in the way specified by manufacturers to remove and replace motor vehicle electrical systems, including:
4. Be able to carry out removal and replacement of heavy vehicle electrical units and components.	4.1. Remove and replace the motor vehicle's electrical systems and components, adhering to the specifications and tolerances for the vehicle and following: <ul style="list-style-type: none"> 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



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

EVIDENCE REQUIREMENTS

1. You must produce evidence of carrying out the removal and replacement of vehicle electrical units and components from:
engine starting systems
engine charging systems
PLUS 2 different systems out of the 7 listed below:
lighting
wiper
security and alarm
comfort and convenience
telephone and two-way communication
electric window systems
monitoring and instrumentation systems



UNIT REF: HV0506K	UNIT TITLE: KNOWLEDGE OF INSPECTING HEAVY VEHICLES
-----------------------------	---

Level: 2	Route: Knowledge	Credit Value: 4	GLH: 40
----------	------------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV05 and HV06

Rationale: This unit enables the learner to develop knowledge in order to carry out a range of inspections on heavy vehicles using a variety of testing and inspection methods

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand how to carry out inspections on heavy vehicles using prescribed methods	1.1. Explain the difference between the various prescribed heavy vehicle inspection methods to include: <ul style="list-style-type: none"> 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

Content:
Different types of heavy vehicle inspection

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

Vehicle inspections and maintenance records

- a. The purpose and scope of the different types of vehicle inspection.
- b. Vehicle inspection techniques for different types of inspection including:
 - i. systematic inspections
 - ii. aural
 - iii. visual and functional assessments on engine
 - iv. engine systems
 - v. chassis systems
 - vi. wheels and tyres
 - vii. transmission and driveline system
 - viii. electrical and electronic systems
 - ix. exterior vehicle body
 - x. vehicle interior
- c. The procedure for inspection of the vehicle for damage, corrosion, fluid leaks, wear, security, mounting security and condition to include;
 - i. engines and engine systems
 - ii. chassis systems
 - iii. brakes
 - iv. transmission and driveline
 - v. steering
 - vi. suspension
 - vii. wheels
 - viii. tyres
 - ix. body panels (structural and non-structural)
 - x. electrical and electronic systems and components
 - xi. vehicle seating and vehicle interior
 - xii. instruments
- d. Preparation and use of appropriate inspection equipment and tools including:
 - i. emission testing
 - ii. brake testing
 - iii. headlamp alignment
 - iv. wheel alignment
 - v. torque setting
 - vi. specialist diagnostic equipment
 - vii. tyre tread depth gauges
- e. Inspection procedures following inspection checklists.
- f. Checking conformity to manufacturer's specifications and legal requirements.
 - i. workshop manuals
 - ii. heavy goods vehicle inspection manual
- g. Testing and operation of vehicle systems and vehicle condition including workshop based tests and road tests.
- h. The completion and maintenance of:
 - i. documentation
 - ii. defect reports
 - iii. inspection records
 - iv. job cards
 - v. vehicle records
- i. Make recommendations based on results of vehicle inspections.

Content: contd

- j. The implications of not carrying out vehicle inspections correctly including:
 - i. legal aspects (impact on Operator Licence)
 - ii. safety aspects
 - iii. financial aspects
 - iv. customer retention
 - v. customer relationships

The need for vehicle protection prior to carrying out vehicle inspection

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



UNIT REF:HV05S	UNIT TITLE: SKILLS REQUIRED TO INSPECT HEAVY VEHICLES USING PRESCRIBED METHODS
-----------------------	---

Level: 2	Route: Skills	Credit Value: 2	GLH: 20
-----------------	----------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS HV05

Rationale: This unit allows the learner to demonstrate skills in order to carry out a range of inspections on heavy vehicles using a variety of prescribed testing and inspection methods.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely when carrying out heavy vehicle inspections using prescribed methods	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
2. Be able to use relevant information to carry out the task	2.1. Select suitable sources of technical information to support heavy vehicle inspection activities including: <ul style="list-style-type: none"> a. vehicle technical data b. inspection procedures c. legal requirements 2.2. Use technical information to support heavy vehicle inspection activities
3. Be able to use appropriate tools and equipment	3.1. Select the appropriate tools and equipment necessary for carrying out a range of inspections on heavy vehicle systems including: <ul style="list-style-type: none"> a. pre-delivery and pre-purchase b. daily vehicle checks c. pre and post rental inspections 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



<p>4. Be able to carry out heavy vehicle inspections using prescribed methods</p>	<p>4.1. Carry out heavy vehicle inspections using prescribed methods, adhering to the specifications and tolerances for the vehicle and following:</p> <ul style="list-style-type: none">a. the manufacturer’s approved inspection methodsb. recognised researched inspection methodsc. health and safety requirementsd. prescribed documentation <p>4.2. Ensure that the inspected heavy vehicle conforms to the vehicle operating specification and any legal requirements</p> <p>4.3. Ensure any comparison of the vehicle against specification accurately identifies any:</p> <ul style="list-style-type: none">a. differences from the vehicle specificationb. vehicle appearance and condition faults <p>4.4. Use suitable testing methods to evaluate the performance of the inspected system</p>
<p>5. Be able to record information and make suitable recommendations</p>	<p>5.1. Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>5.2. Make suitable and justifiable recommendations for cost effective repairs</p> <p>5.3. Record and report any additional faults noticed during the course of their work promptly in the format required</p>

EVIDENCE REQUIREMENTS

<p>1. You must produce evidence of carrying out at least 2 different inspections from the following:</p>
<p>pre-delivery and pre-purchase</p>
<p>daily vehicle checks</p>
<p>pre and post rental inspections</p>
<p>pre and post work inspection</p>



UNIT REF: HV12K	UNIT TITLE: KNOWLEDGE OF REMOVING AND REPLACING HEAVY VEHICLE TRANSMISSION AND DRIVELINE UNITS
------------------------	---

Level: 2	Route: Knowledge	Credit Value: 6	GLH: 45
-----------------	-------------------------	------------------------	----------------

Mapping: This unit is mapped to the IMI NOS HV12

Rationale: This unit enables the learner to develop knowledge of the construction and operation of common transmission and driveline systems. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand how heavy vehicle clutch systems operate	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 <ul style="list-style-type: none"> a. principles of friction b. principle of levers c. torque transmission 1.5. State common terms used in heavy vehicle clutch system design
2. Understand how heavy vehicle gearbox systems operate	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 <ul style="list-style-type: none"> a. gear ratios b. torque multiplication 2.5. State common terms used in heavy vehicle manual gearbox system design



3. Understand how heavy vehicle driveline systems operate	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
4. Understand how heavy vehicle gear selection mechanisms operate	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
5. Understand how to check, replace and test transmission and driveline units and components	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 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

Content:
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.

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

Types of friction materials used in clutch construction:

- i. organic
- ii. ceramic

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.

Content: contd

- 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

- b. The reasons for using automatic gearboxes over manual (urban use, stop/start applications)
- c. The construction and operation automatic gearboxes to include:
 - i. epicyclic geartrain
 - ii. brake bands
 - iii. fluid couplings and torque converters
- d. 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
- a. The layout and construction of propshafts and drive shafts used in multi-axle drive systems.
- b. The reasons for using flexible couplings and sliding joints in transmissions systems.
- c. The reason for using constant velocity joints in drive shafts incorporating steering mechanisms.
- d. The construction and operation of:
 - i. universal joints
 - ii. sliding couplings
 - iii. constant velocity joints
 - iv. centre bearings
- e. The simple stresses applied to shafts: torsional, bending and shear. fg. 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
- g. The reasons for fitting differential/s

Content: contd

- h. Calculate final drive gear ratios.
- i. Calculate the overall gear ratio from given data (gearbox ratio x final drive ratio).

The construction and operation of gear selector systems

- a. including:
 - ii. remote linkages
 - iii. servo-assistance
 - iv. range change selection
 - v. splitter selection
 - vi. 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 synchronisation

The testing and inspection techniques used for heavy vehicle transmission systems

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

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

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



UNIT REF: HV12S	UNIT TITLE: SKILLS REQUIRED TO REMOVE AND REPLACE HEAVY VEHICLE TRANSMISSION AND DRIVELINE UNITS AND COMPONENTS
-----------------	--

Level: 2	Route: Skills	Credit Value: 5	GLH: 45
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS HV12

Rationale: This unit allows the learner to demonstrate skills in order to remove and replace heavy vehicle transmission and driveline units. It also covers the evaluation of performance of the replaced units and systems.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely when carrying out heavy vehicle transmission and driveline system component removal and replacement activities	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
2. Be able to use relevant information to carry out the task	2.1. Select suitable sources of technical information to support heavy component removal and replacement activities including: <ul style="list-style-type: none"> 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
3. Be able to use appropriate tools and equipment	3.1. Select the appropriate tools and equipment necessary for removal and replacement of heavy vehicle transmission and driveline systems 3.2. Ensure that the 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,
4. Be able to carry out removal and replacement of heavy vehicle transmission and driveline units and components.	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: <ul style="list-style-type: none"> 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



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

EVIDENCE REQUIREMENTS

1. You must produce evidence of carrying out the removal and replacement of 1 unit or component from 2 of the areas as listed below (on 2 separate occasions):
clutch
gearbox
drive line (shafts, couplings, hubs and bearings)
final drive



UNIT REF: BP18K	UNIT TITLE: KNOWLEDGE OF REMOVING AND FITTING BASIC LIGHT VEHICLE MECHANICAL, ELECTRICAL AND TRIM (MET) COMPONENTS AND NON PERMANENTLY FIXED VEHICLE BODY PANELS
------------------------	---

Level: 2	Route: Knowledge	Credit Value: 2	GLH: 20
Mapping: This unit is mapped to the IMI NOS BP18			
Rationale: This unit enables the learner to develop an understanding of carrying out a range of removal and fitting of basic mechanical, electrical and trim (MET) components and non-permanently fixed light vehicle body panels. It also covers the evaluation of the operation of the components when fitted			

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand how to carry out removal and fitting of basic light vehicle mechanical electrical and trim (MET) components	1.1. Identify the procedures involved in carry out the systematic removal and fitting of basic light vehicle MET components to the standard required including: <ul style="list-style-type: none"> a. bumpers b. headlamp units c. road wheels d. batteries e. bonnet and boot trim f. interior trim components g. exterior trim components 1.2. Identify the procedures involved in working with supplementary safety systems when fitting basic light vehicle MET components 1.3. Identify the procedures involved in working with gas discharge headlamp systems when fitting basic light vehicle MET components 1.4. Explain the methods and procedures for storing removed light vehicle MET components 1.5. Identify the different types of fastenings and fixings used when removing and fitting light vehicle MET components 1.6. Explain the reasons for the use of different types of fastenings and fixings used in light vehicle MET components 1.7. Explain the procedures, methods and reasons for ensuring correct alignment of light vehicle MET components 1.8. Identify the quality checks that can be used to ensure correct alignment and operation of light vehicle MET components 1.9. Identify correct conformity of vehicle systems against light vehicle specification and legal requirements on completion 1.10. Explain the procedure for reporting cosmetic damage to light vehicle MET components and units



<p>2. Understand how to carry out removal and fitting of basic light vehicle non permanently fixed vehicle body panels</p>	<p>2.1. Identify the procedures involved in carry out the systematic removal and fitting of basic light vehicle non-welded, non-structural body panels to the standard required including:</p> <ul style="list-style-type: none">a. wingsb. doorsc. bonnetsd. boot lids and tailgatese. bumper bars, covers and components <p>2.2. Identify the procedures involved in working with supplementary safety systems when fitting basic light vehicle non-welded, non-structural body panels</p> <p>2.3. Explain the methods and procedures for storing removed light vehicle non-welded, non-structural body panels</p> <p>2.4. Identify the different types of fastenings and fixings used when removing and fitting light vehicle non-welded, non-structural body panels</p> <p>2.5. Explain the reasons for the use of different types of fastenings and fixings used in light vehicle non-welded, non-structural body panels</p> <p>2.6. Explain the procedures, methods and reasons for ensuring correct alignment of light vehicle non-welded, non-structural body panels</p> <p>2.7. Identify the quality checks that can be used to ensure correct alignment and operation of light vehicle non-welded, non-structural body panels</p> <p>2.8. Identify correct conformity of vehicle systems against light vehicle specification and legal requirements on completion</p> <p>2.9. Explain the procedure for reporting cosmetic damage to light vehicle non-welded, non-structural body panels</p>
--	---

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

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

The processes involved when handling batteries

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

Types of clips and fixings

- a. The following types of clips and identify reasons and limitations for their use:
 - i. speed
 - ii. 'c'
 - iii. 'd'
 - iv. 'j' type captive nut
 - v. 'r'
 - vi. 'u' type captive nut
 - vii. cable clip
 - viii. trim clips
- b. The following types of fixings and identify reasons and limitations for their use:
 - i. pop rivet
 - ii. plastic rivet
 - iii. plastic capture nut
 - iv. nut and bolt
 - v. shoulder bolt
 - vi. 'Nyloc' type nuts
 - vii. washers
 - viii. 'spring' type washers
 - ix. self tapping screws and bolts
 - x. quick release plastic trim fastenings
 - xi. trim tapes
 - xii. adhesives and sealers

Content: contd
The processes involved when carrying out quality checks

- a. Items that may have been 'workshop' soiled and describe processes for rectifying:
 - i. door cards
 - ii. seats
 - iii. carpets
 - iv. boot and bonnet trims
- b. Methods for checking gaps.
- c. The process for checking and aligning headlamps:
 - i. address handling procedures for halogen bulbs
 - ii. address handling and health and safety issues relating to xenon bulbs and systems
- d. Operational checks and rectification methods to include:
 - i. lights
 - ii. washers and wipers
 - iii. SRS systems (checking not rectification)
 - iv. charging system (checking not rectification)
 - v. horn
 - vi. fluid levels
 - vii. interior switches
 - viii. operation of door lock mechanisms

Removing and Fitting Non-Structural Body Panels

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



UNIT REF: BP18S	UNIT TITLE: SKILLS IN REMOVING AND FITTING OF BASIC LIGHT VEHICLE MECHANICAL, ELECTRICAL AND TRIM (MET) COMPONENTS AND NON-PERMANENTLY FIXED VEHICLE BODY PANELS
------------------------	---

Level: 2	Route: Skills	Credit Value: 3	GLH: 20
----------	---------------	-----------------	---------

Mapping: This unit is mapped to the IMI NOS BP18

Rationale: This unit allows the learner to demonstrate they can carry out a range of removal and fitting of basic mechanical, electrical and trim (MET) components and non-permanently fixed light vehicle body panels. It also covers the evaluation of the operation of the components when fitted

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to work safely when carrying out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels	1.1. Use suitable personal protective equipment and vehicle coverings throughout all light vehicle removal and fitting of basic MET components and non-permanently fixed light vehicle body panels 1.2. Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment
2. Be able to use relevant information to carry out the task	2.1. Select suitable sources of technical information to support light vehicle removal and fitting activities including: a. vehicle technical data b. removal and fitting procedures c. legal requirements 2.2. Use technical information to support light vehicle removal and fitting activities
3. Be able to use appropriate tools and equipment	3.1. Select the appropriate tools and equipment necessary for carrying out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels 3.2. Ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3. Use the correct tools and equipment in the way specified by manufacturers when carrying removal and fitting of basic MET components and non-permanently fixed light vehicle body panels



4. Be able to carry out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels	4.1. Remove and fit basic MET components and non-permanently fixed light vehicle body panels 4.2. Ensure that the removal and fitting of basic MET components and non-permanently fixed light vehicle body panels conforms to the vehicle operating specification and any legal requirements 4.3. Ensure no damage occurs to other components when removal and fitting of basic MET components and non-permanently fixed light vehicle body panels 4.4. Ensure all components and panels are stored safely and in the correct location
5. Be able to record information and make suitable recommendations	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

EVIDENCE REQUIREMENTS

1. You must be observed by your assessor removing and replacing 4 of the 12 units or components from the list below on at least 2 separate occasions .
• bumpers
• headlamp units
• road wheels
• batteries
• bonnet fittings
• interior trim components
• exterior trim components
• wings
• doors
• bonnets
• boot lids and tailgates
• bumper bars, covers and component



UNIT REF: EE2	UNIT TITLE: VEHICLE ELECTRICAL AND ELECTRONIC 2
----------------------	--

Level: 2	Credit Value: 6	GLH: 36
<p>Rationale: This unit further develops the electrical and electronic principles introduced at level 2. It aims to broaden and develop candidates understanding of electrical principles to support their study of other units in the Level 2 National. The unit also introduces candidates to the principles of electronic science to support their studies of electronic components and systems found on modern vehicles. To promote interest and understanding calculations should be applied to motor vehicle applications wherever possible. Candidates should solve problems in each topic to develop their understanding of basic principles and gain confidence with solving electrical and electronic problems. The unit will provide a progression route to the Level 3 National Diploma</p>		

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand electronic principles	1.1. Describe the principle of semi-conductors and electron theory 1.2. Describe the operation of diodes 1.3. Describe the operation of transistors 1.4. Outline the principle of micro-electronics
2. Understand charging and starting systems	2.1. Describe the principles of vehicle batteries 2.2. Define the Laws of magnetism 2.3. Describe the operating principle of vehicle alternators 2.4. Describe the operating principle of vehicle starter motors
3. Understand electronic ignition principles	3.1. Describe the principle of pulse generators 3.2. Describe the principle of control modules 3.3. Describe the operating principle of programmed and distributor less ignition systems
4. Understand vehicle lighting systems	4.1 Describe the operation of vehicle lighting circuits 4.2. Compare vehicle lamps and bulbs 4.3. Give examples of fault finding procedures for vehicle lighting

Content:
1.1 Explain the principle of semi-conductors and electron theory

- a. Describe the basic structure of atoms comprising of a nucleus (protons and neutrons) and electrons.
- b. Identify that protons are positively charged, that electrons are negatively charged and that neutrons have no charge.
- c. Explain why some materials are good conductors of electricity i.e. loosely bound electrons.
- d. Explain why some materials are not good conductors of electricity i.e. no loosely bound electrons.
- e. Explain the principle of semi-conductors and state popular semi-conductor materials e.g. silicon.
- f. Describe the principle of electron flow and “hole” theory.
- g. Explain N-type materials e.g. materials with a surplus of negatively charged electrons.
- h. Explain P-type materials e.g. materials with a positive charge.

1.2 Explain the principle of diodes

- a. Describe the basic principle of a diode and the PN junction.
- b. Explain the basic operating principle of a diode and how it would operate in a simple circuit comprising of a battery, lamp and diode.
- c. Recognise the symbol used for a diode
- d. Identify a vehicle component that includes a diode e.g. an alternator.
- e. Explain the basic operating principle of a Zener diode
- f. Identify a vehicle component that includes a Zener e.g. voltage regulator.
- g. Explain the basic principle of a light emitting diode (LED) and identify a vehicle application e.g. digital display or counter.

1.3 The principle of transistors

- a. Describe the basic principle and switching action of a transistor.
- b. Explain the principle of NPN and PNP materials.
- c. Recognise the symbol for a transistor.
- d. Identify the connections on a transistor i.e. base, emitter and collector.
- e. Identify a vehicle component that includes a transistor e.g. voltage regulator.
- f. Explain the basic principles of other types of transistor in common use - phototransistor, thyristor.

1.4 The principle of micro-electronics

- a. Explain the basic concept of micro-electronic circuits.
- b. Explain the basic concept of an integrated circuit (IC) that includes transistors, diodes, and resistors.
- c. Identify vehicle applications where IC chips are used e.g. engine management system.
- d. Describe the difference between analogue and digital signals.
- e. Describe basic gate theory using OR, AND, NOT gates.
- f. Explain the operation of simple circuits incorporating OR, AND, NOT gates.
- g. Describe the precautions and procedures when working on electronic circuits.

2.1 The principles of vehicle batteries

- a. Describe the construction of the lead acid battery, electrolyte, cells, plates and separators.
- b. Describe the construction of nickel alkaline battery.
- c. Explain the action of a lead acid battery during charging and discharging.
- d. State the density of the electrolyte at various states of charge e.g. fully charged, half charged and discharged.
- e. Explain how the density of electrolyte can be measured using a hydrometer.
- f. Explain the meaning of battery capacity.
- g. Explain the effect on voltage and capacity of connecting batteries in series and in parallel.
- h. Describe the methods and precautions when charging a vehicle battery using an external power source.
- i. Describe the methods used to check a battery’s condition and state of charge.
- j. Describe the methods and precautions when disconnecting and re-connecting a vehicle battery.
- k. Measure the nominal voltage of a battery and compare to the starting and charging voltage e.g. when being heavily discharged (during starting) and when under charge by the alternator.

Content
2.2 The Laws of magnetism

- a. Describe the principle of simple bar magnets and how like poles repel and unlike poles attract.
- b. Describe how the direction of current through a wire determines the direction of the magnetic field surrounding the wire (Maxwell's Screw Rule).
- c. Describe the principle of magnetic induction.
- d. Describe how the voltage induced depends on the number of turns in the coil.
- e. Describe the principle of a simple generator i.e. the production of an emf in a wire loop when it is rotating in a magnetic field.
- f. Describe Fleming's right-hand rule (generator rule).
- g. Describe the principle of a simple motor i.e. where a wire loop is made to rotate by a magnetic field.
- h. Describe Fleming's left-hand rule (motor rule).

2.3 The operating principle of vehicle alternators

- a. Identify the component parts and internal wiring of a vehicle alternator; stator, rotor, diode pack.
- b. Explain the operation of the alternator and how a three-phase alternating current is produced.
- c. Explain how full phase rectification is achieved using a six diode pack.
- d. Explain the self-excited field system using a 9 diode pack.
- e. Explain the basic operation of a voltage regulator incorporating transistors and Zener diode.
- f. Draw the external wiring circuit for a vehicle alternator.
- g. Conduct fault finding tests on the alternator circuit using meters.
- h. Check the output of a vehicle alternator under load using meters e.g. with headlamps and other loads switched on.

2.4 The operating principle of vehicle starter motors

- a. Identify the component parts and internal wiring of a light vehicle pre-engaged starter motor i.e. armature, field coils, solenoid, one way clutch, pinion.
- b. Describe the action of the pre-engaged starter motor during engine starting.
- c. State the purpose and action of a roller one-way clutch.
- d. Draw the external wiring circuit for the starter motor.
- e. Conduct tests on the starter circuit using a voltmeter i.e. to establish the volt drop across connections (poor battery connections, earth connections, starter connections etc) and the voltage supply to solenoid.
- f. Explain the concept of heavy vehicle starter motors e.g. axial and coaxial motors.

3.1 The principle of pulse generators

- a. Describe the principle of pulse generators; inductive, Hall effect and optical.
- b. Describe the principle of switching the primary circuit and creating the secondary output voltage.
- c. Recognise typical patterns for secondary voltage when measured using a cathode ray oscilloscope (CRO).

3.2 The principle of control modules

- a. Describe the function of control modules in electronic ignition systems.
- b. Explain the principle of pulse shaping, dwell control, voltage stabilisation, primary switching, secondary output control, ignition amplifier and electronic spark advance.
- c. Explain an ignition advance map.
- d. Explain the use of ROM's and EPROM's in relation to electronic ignition systems.
- e. Explain the principle of knock control.

3.3 The principle of programmed and distributor less ignition systems

- a. Describe the principle of programmed electronic ignition systems.
- b. Describe the principle of distributor less ignition systems.
- c. Describe the operating principles of the components in programmed ignition and distributor less ignition; ECU, map sensor, crankshaft or camshaft sensor, engine temperature sensor, knock sensor and air temperature sensor.

Content:**4.1 Vehicle lighting circuits**

- a. Describe and interpret vehicle lighting circuits; side and rear lamps, stop lamps, rear fog lamps, reverse lamps, dip and main beam headlamps, interior lamps and front fog lamps.
- b. Explain the operation and purpose of relays in vehicle lighting circuits.
- c. Describe the necessity and location of fuses and circuit protection devices in lighting circuits.

4.2 Vehicle lamps and bulbs

- a. Describe the types of bulb used in vehicle lighting circuits e.g. cap and cap less, tungsten filament, halogen bulbs.
- b. Describe the construction and principles of vehicle headlamps; headlamp lens, reflectors, methods of achieving dip, main beam and beam patterns.
- c. Carryout headlamp alignment on a vehicle to check compliance with MOT regulations.

4.3 Fault finding procedures for vehicle lighting

- a. Use meters to find faults in vehicle lighting circuits e.g. open circuit, short circuit, high resistance connections, high resistance switches, poor earth connection and blown fuse.
- b. Use meters to check the operation of switches and relays.
- c. Use meters to check current draw in lighting circuits and the suitability of fuses.



UNIT REF: ICT2	UNIT TITLE: INFORMATION, COMMUNICATION AND TECHNOLOGY FOR VEHICLE REPAIR 2
-----------------------	---

Level: 2	Credit Value: 6	GLH: 36
-----------------	------------------------	----------------

Rationale: This unit builds on the Level 1 ICT for Vehicle Repair unit. It aims to develop and broaden further candidates understanding of the principles of ICT, to support their study of other units in the Level 2 extended diploma. The content also strongly supports the development of the Key Skills Information Technology or Functional Skills ICT unit. To promote interest and understanding the use of ICT should be applied to motor vehicle applications wherever possible. Candidates should use computers to develop their understanding of the principles and gain confidence with applications and ICT terminology. The unit will provide a progression route to the Level 3 extended diploma.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to use a word processing and spreadsheet applications	1.1. Perform basic word processing functions 1.2. Apply advanced word processing functions
2. Be able to use a spreadsheet application	2.1. Perform basic spreadsheet functions 2.2. Apply advanced spreadsheet functions
3. Be able to use a presentation application	3.1. Perform basic presentation functions 3.2. Apply advanced presentation functions
4. Be able to use a database application	4.1. Demonstrate basic database functions 4.2. Demonstrate tables within a database 4.3. Demonstrate forms within a database 4.4. Perform the retrieving of information from a database 4.5. Carry out the creation of database reports 4.6. Perform the printing of reports, tables and queries

Content:
1.1 Basic word processing functions

- a. Create a memo, brochure and agenda documents.
- b. Display and hide built-in toolbars.
- c. Use the 'Save As' function.
- d. Save a document with another file extension e.g. a 'doc' file saved as 'rtf'
- e. Change between page view modes.
- f. Change document orientation.
- g. Change the margins of an entire document.
- h. Use the zoom tools.
- i. Use the cut, paste, copy, drag and drop functions.
- j. Use the undo/redo commands.

1.2 Advanced word processing functions

- a. Cut copy and paste text/clip art between two documents.
- b. Use the find/replace functions to replace text within a document.
- c. Change text formatting and appearance. Copy text formatting to another piece of text.
- d. Use left, centre, right and full justification on text.
- e. Adjust line spacing e.g. single to 1.5 line spacing.
- f. Apply spacing above and below paragraphs.
- g. Add/remove shading to a paragraph.
- h. Apply bullets to a single level list and change between the style of bullets.
- i. Insert special characters or symbols.
- j. Insert at least two clip art pictures into a single document.
- k. Alter clip art formatting to include:
 - i. wrapping
 - ii. border style
 - iii. picture caption
 - iv. ungroup a clip art object
- l. Group several objects together.
- m. Insert and remove a document page break.
- n. Add the following fields to a header/footer:
 - i. date.
 - ii. page number.
 - iii. file location.
- o. Insert a table into a document and then carry out the following:
 - i. add and remove columns/rows.
 - ii. modify column width and row height.
 - iii. modify cell border width, style and colour.
 - iv. add shading to table cells.
 - v. merge table.

2.1 Basic spreadsheet functions

- a. Create a new workbook.
- b. Use the 'Save As' function.
- c. Insert a new worksheet into a workbook.
- d. Rename a worksheet.
- e. Change between page view modes.
- f. Change document orientation.
- g. Change the margins of an entire document.
- h. Use the zoom tools.
- i. Use the cut, paste and copy functions.
- j. Delete cell contents.
- k. Use the undo/redo commands.
- l. Insert and resize a clip art picture into a document.
- m. Use the spell checking function.
- n. Preview and print out a document.
- o. Explain the print output options.

Content:
2.2 Advanced spreadsheet functions

- a. Insert data into a spreadsheet containing at least 4 columns and 4 rows.
- b. Use the Auto fill tool to increment a data series.
- c. Select a column, row and adjacent cells.
- d. Select non-adjacent cells.
- e. Insert a row and a column.
- f. Delete a row and a column.
- g. Modify column width and row height.
- h. Sort data in a column ascending/descending.
- i. Apply formatting to cells to include:
 - i. shading
 - ii. border
 - iii. cell alignment
 - iv. alternative font style
- j. Copy a worksheet within a spreadsheet. (Workbook).
- k. Copy a worksheet between two spreadsheets (workbooks).
- l. Generate formulas using the following functions:
 - i. +, -, /, X
 - ii. SUMIF
 - iii. COUNT
 - iv. DATE/TIME (e.g. NOW)
 - v. IF
 - vi. OR
 - vii. AND
- m. Format cells to display:
 - i. a date style
 - ii. a currency symbol
 - iii. numbers displayed to 2 decimal places
 - iv. numbers displayed as percentages
- n. Apply text wrapping to contents within a cell.
- o. Align the contents of a cell:
 - i. left, centre, right, top and bottom
- p. Centre a title across merged cells.
- q. Adjust text orientation in a cell to 45°.
- r. Create at least two different types of chart e.g. bar, column, pie, line
- s. Add a title to the chart.
- t. Resize and delete the chart.
- u. Change the font size on the chart axes/title.
- v. Change the chart background and chart segments colours.
- w. Adjust the page 'set-up' to fit worksheet contents onto one page or a specific number of pages.
- x. Add; modify text in Headers, Footers in a worksheet.

3.1 Basic presentation functions

- a. Create a new presentation based upon the default template.
- b. Create a new presentation using a wizard.
- c. Use the Save As function.
- d. Display and hide built-in toolbars.
- e. Change between page view modes.
- f. Change document orientation.
- g. Change the margins of an entire document.
- h. Use the zoom tools.
- i. Use the cut, paste, copy, drag and drop functions.
- j. Use the undo/redo commands.
- k. Insert and resize a clip art picture into a presentation.
- l. Use the spell checking function.
- m. Preview and print out a document.
- n. Explain the print output options.
- o. Explain the importance of proof reading documents.



Content:
3.2 Advanced presentation functions

- a. Add a new slide with a specific slide layout e.g. title slide, bulleted list
- b. Explain the importance of using different slide layouts.
- c. Change between slide design templates.
- d. Change slide background colours.
- e. Delete a slide.
- f. Insert a duplicate slide.
- g. Insert text and a clip art image into the master slide.
- h. Apply automatic slide numbering to a series of slides.
- i. Insert a text box into a presentation.
- j. Change text appearance i.e. size and type.
- k. Align text in a text box, left, right and centre.
- l. Cut and copy text/clip art image between slides.
- m. Use the word art function.
- n. Delete text, a text box and a clipart image.
- o. Insert and modify a chart/graph into a slide.
- p. Change the chart/graph colours, fonts and type.
- q. Create an organisational chart using the built-in organisational chart feature.
- r. Add remove managers, co-workers etc in an organisational chart,
- s. Add different types of drawing objects to a slide.
- t. Rotate and flip drawing objects.
- u. Change the order of drawing objects e.g. front to back
- v. Add animation effects to a slide presentation
- w. Add transition effects between slides.
- x. Select appropriate output formats for slide presentations e.g. handouts, notes pages.
- y. Rearrange the slide order.
- z. Start a slide show

4.1 Basic database functions

- a. Explain the purpose of a database.
- b. Create a new database.
- c. Save a database.
- d. Use the 'Save As' function.
- e. Change between view modes.
- f. Identify the different parts of a database e.g. primary key, table, records, fields and cells etc.
- g. State the difference between a table, queries, form and report.

4.2 Tables within a database

- a. Create and save a table.
- b. Use different field data types i.e. text, number, date/time and currency.
- c. Define a primary key.
- d. State the relevance of indexing a field.
- e. Create a simple validation rule for number, text, date/time and currency.
- f. Insert data into a table.
- g. Add, delete records in a table.
- h. Add a field to an existing table.
- i. Alter a table column width.
- j. Move a column within a table.
- k. Navigate to different records in a table.
- l. Delete a table.
- m. Sort data ascending/descending within a table.
- n. Create/delete a one-to-one, one-to-many relationship between tables.

4.3 Forms within a database

- a. Open a form.
- b. Create a form using a wizard.
- c. Save a form.
- d. Use a form to enter, modify, and delete records.
- e. Navigate between records in a form.

Content:**4.4 Information from a database**

- a. Apply a filter to a table, form.
- b. Remove a filter from a table, form.
- c. Create and save a single table query.
- d. Add criteria to a query including < (less than), > (greater than), = (equals), <> (not equal to), <=(less than or equals), >= (greater than or equals).
- e. Edit a query by adding and removing criteria.
- f. Run a query.
- g. Delete a query.
- f. Save and close a query.

4.5 Database reports

- a. Create and save a report based on a table, query.
- b. Create a report using a wizard.
- c. Modify the data fields and headings within a report layout.
- d. Add; modify text in headers and footers in a report.
- e. Delete a report.

4.6 Reports, table and queries

- a. Preview a table, form and report.
- b. Change page orientation: portrait, landscape
- c. Print out:
 - i. table
 - ii. query
 - iii. report



UNIT REF: M2	UNIT TITLE: VEHICLE MATHEMATICS 2
---------------------	--

Level: 2	Credit Value: 6	GLH: 36
<p>Rationale: This unit provides and develops the mathematical principles introduced at level 1 this is only partially true – for example there is nothing on areas and volumes, which are a substantial part of Level 1 and many topics which are present at level 1 are not even in a simplified form. It aims to broaden candidates understanding of mathematics to support their study of other units in the Level 2 extended diploma. The content also strongly supports the development of the Key Skills Application of Number or Functional Skills Maths. To promote interest and understanding calculations should be applied to motor vehicle applications wherever possible. Candidates should solve problems in each topic, both with and without the use of calculators, to develop their understanding of basic principles and gain confidence with mathematical tasks. The unit will provide a progression route to Level 3 extended diploma.</p>		

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Understand numbers, simple powers and roots	1.1. Differentiate between real numbers, directed numbers, factors and multiples 1.2. Define binary numbers 1.3. Solve problems involving simple powers and roots
2. Be able to solve simple equations	2.1. Perform calculations using basic algebraic functions 2.2. Solve problems using simple formulae
3. Understand right-angled triangles angles	3.1. Describe angular measurements 3.2. Identify types of triangle 3.3. Describe the properties of a triangle 3.4. State the Pythagoras' theorem. 3.5. Use the Pythagoras' theorem to solve right-angled triangles related to vehicle situations 3.6. Solve problems using trigonometry
4. Be able to interpret graphical and statistical data	4.1. Construct a straight line graph from given data. 4.2. Interpret the results from a straight line graph. 4.3. Construct a graph involving simple curves. 4.4. Interpret the results from a graph involving simple curves. 4.5. Use a range of statistical data to create statistical charts and diagrams 4.6. Compare statistical averages.

Content:
1.1. Real numbers, directed numbers, factors and multiples

- a. Explain and give examples of real numbers i.e. integers, common or vulgar fractions etc.
- b. Explain rational numbers i.e. numbers that can be written as a vulgar or common fraction
- c. Explain irrational numbers i.e. numbers that cannot be written as a vulgar fraction (π).
- d. Carryout vehicle related calculations involving rational and irrational numbers.
- e. Estimate answers to calculations.
- f. Use rough checks to establish accuracy of answers to calculations.
- g. Explain positive and negative numbers
- h. Carryout vehicle related calculations involving positive and negative numbers
- i. Understand common factors
- j. Identify the highest common factor (HCF) of two numbers e.g. the HCF of 12 and 18 = 6
- k. Explain prime factors
- l. Factorise simple numbers into prime factors

1.2. Binary numbers

- a. Describe the binary number system.
- b. Explain the meaning of bits and bytes
- c. Express denary numbers (base 10) in binary e.g. 21 as a binary number = 10101.
- d. Explain how binary numbers relate to vehicle computers and digital systems.

1.3. Simple powers and roots

- a. Explain the meaning of standard index form
- b. Convert numbers to standard index form
- c. Describe the principle of simple powers e.g. n^3 , n^4 , n^5 where the power value is an integer
- d. Explain that $n^3 = n \times n \times n$ and that this is n raised to the power of 3.
- e. Explain that the power value is known as the index number e.g. n^4 where 4 is known as the index
- f. Use a calculator to find the value of numbers with a simple power index e.g. $1.2^3 = 1.728$
- g. Use a calculator to carryout calculations using simple powers.
- h. Describe the principle of simple roots where the root is an integer e.g. cube root, fourth root, fifth root etc
- i. Use a calculator to find the root of a number e.g. the cube root of $1.728 = 1.2$

2.1. Basic algebra

- a. Explain how letters, symbols and numbers are used to represent quantities.
- b. Explain how written statements can be translated into algebraic symbols.
- c. Find the numeric value of an algebraic expression by substituting given values.
- d. Explain that y^5 is $y \times y \times y \times y \times y$.
- e. Simplify algebraic expressions containing the same terms i.e. $7x + 11x = 18x$.
- f. Solve simple equations i.e. $7x = 35$ and $7x + 3 = 5x + 17$.
- g. Solve simple algebraic equations involving, addition, subtraction, multiplication and division of single terms and equations of two or more terms.

2.2. Formulae

- a. Explain that a formula is an equation giving the relationship between two or more quantities e.g. $V = I R$.
- b. Find the values of simple vehicle related equations e.g. $V=IR$, $V=S/T$ & $P=F/A$
- c. State the rules for transposition of simple formulae involving +, -, \times , \div , brackets and simple roots and powers.
- d. Transpose simple vehicle related formulae involving +, -, \times , \div , brackets, powers and roots e.g. $V = u + at$

3.1 Angular measurements

- a. Recognise that an angle can be represented as the amount of rotation measured in degrees, minutes and seconds.
- b. State the symbols for degrees, minutes and seconds e.g. $^\circ$ is the degree symbol.
- c. Convert revolutions into degrees e.g. 1.5 revolutions = 540 degrees.
- d. Convert degrees into linear measurement e.g. for a given diameter of flywheel find the number of millimetres 12 degrees represents.
- e. Explain that the radian as an angular measurement.
- f. Describe the relationship between radians and degrees i.e. 1 radian = 57.3 $^\circ$ and 1 degree = 2π radians
- g. Identify types of angle e.g. right angle, acute, reflex, and obtuse.

Content:
3.2. Triangles

- a. Identify and describe types of triangle e.g. right angled, isosceles, equilateral, acute and obtuse.
- b. Describe the properties of a triangle; the sum of the angles = 180 o, the longest side is known as the hypotenuse.
- c. Identify the standard notation of a triangle e.g. angles labelled A, B, C and sides labelled a, b, c.
- d. State that side a is opposite angle A, that side b is opposite angle B, and side c is opposite angle C.
- e. Explain Pythagoras' theorem.
- f. Use Pythagoras' theorem to solve right-angled triangles related to vehicle situations e.g. steering, crankshaft and connecting rod and piston movement.

3.3. Trigonometry

- a. State the main trigonometric ratios; sine, cosine and tangent.
- b. Use a calculator or tables to identify the sine, cosine and tangent of angles from 0 - 90 o.
- c. Use the main trigonometric ratios to solve vehicle related problems e.g. steering, crankshaft and connecting rod angles and piston displacement.

4.1. Straight line graphs

- a. Produce straight line graphs of typical vehicle related data.
- b. Correctly label axes and identify scales.
- c. Explain the law of a straight line graph is $y = mx + c$ and that c and m are constants.
- d. Explain the meaning of the elements y, m, x, c.
- f. Find the law of typical straight line graphs, which have different values of m and c.
- g. Explain the gradient of a straight line graph is y/x .
- h. Find the gradient of straight line graphs.

4.2. Graphs involving simple curves

- a. Use suitable measuring instruments to collect non-linear vehicle data e.g. valve lift and camshaft rotation or piston movement and crankshaft rotation.
- b. Produce graphs of non-linear data vehicle related data e.g. valve lift, and piston movement.
- c. Interpret graphs of non-linear vehicle data and relate to acceleration and velocity of the components.
- d. Explain the gradient of a curve at any point is given by the gradient of the tangent to the curve at that point.
- e. Relate gradients of curves for vehicle data to velocity and acceleration.
- f. Use the mid-ordinate rule to find the area under a simple curve.

4.3. Statistical data

- a. Sort raw data using a tally chart.
- b. Recognise that data in a tally chart is a frequency distribution.
- c. Produce and interpret information in simple and grouped frequency distributions.
- d. Produce simple frequency distribution curves for ungrouped data e.g. the height of candidates in a group.
- e. Recognise the shape of the standard frequency distribution curve and that this is the common shape for many types of data e.g. height, weight, life expectancy and failure of components etc.
- f. Calculate the range of simple data.
- g. Calculate the upper quartile, lower quartile and inter-quartile range of simple data.

4.4. Statistical charts and diagrams

- a. Produce a cumulative frequency curve (ogive) for ungrouped data and recognise the standard shape curve.
- b. Interpret and produce simple, %, compound and composite bar charts for statistical data.
- c. Recognise the advantages and limitations of the different types of bar chart.
- d. Produce a pie chart for simple data and recognise the advantages and limitations of this type of chart.
- e. Recognise other types of chart used in statistics e.g. line graphs, Gantt and scatter graph

4.5. Statistical averages.

- a. Explain the statistical averages, mean, median and mode.
- b. Find the mean, median and mode for simple ungrouped data.
- c. Recognise that the mean, median and mode occur at the same point in the standard frequency distribution curve.
- d. Identify the relative position of the mean, median and mode in positive and negative skewed frequency distribution curves.



UNIT REF: S2

UNIT TITLE: VEHICLE SCIENCE 2

Level: 2

Credit Value: 6

GLH: 36

Rationale: This unit develops and broadens the aspects of motor vehicle science introduced at Level 1. It covers the main aspects of vehicle science required to support other units in the extended diplomas programme. The content covers aspects involving force, heat, linear motion, work and power. To promote interest and assist learning the content should be delivered in the context of motor vehicles and be related to the appropriate vehicle technology units of the technical certificate where possible. The unit will provide a progression route to the Level 3 extended diploma

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Learner will:	The Learner can:
1. Be able to solve problems involving moments, machines and stress	1.1. Describe the principle of moments 1.2. Solve simple problems using the principles of moments 1.3. Describe the meaning of equilibrium 1.4. Define centre of gravity. 1.5. Use moments to find the centre of gravity of vehicle components and motor vehicles 1.6. Solve problems involving machines and transmissions 1.7. Solve problems involving stress and strain of materials
2. Understand problems involving heat	2.1. Define specific heat capacity and latent heat 2.2. Define linear expansion of materials 2.3. Define Gas Laws
3. Be able to solve problems involving linear motion	3.1. Solve problems using equations of linear motion 3.2. Define inertia, momentum and accelerating force
4. Understand problems involving work and power	4.1. Define work and power 4.2. Describe work done in rotation

Content:
1.1. The principles of moments

- a. Explain the principle of moments; a moment is the turning effect of a force, moment of force = force x perpendicular distance, moments are measured in Nm.
- b. Explain the meaning of equilibrium; forces acting clockwise = forces acting anti-clockwise.
- c. Solve vehicle related problems using moments e.g. brake problems, weight on axles, levers.
- d. Explain centre of gravity.
- e. Use moments to find the centre of gravity of vehicle components and motor vehicles.

1.2. Machines and transmissions

- a. Explain the formulae for calculating the force ratio, movement ratio and efficiency of machines.
- b. Use relevant formulae to solve vehicle related problems involving machines e.g. jacks, hoists, vehicle lifts, and pulleys.
- c. State the formula for calculating simple gear ratios e.g. number of teeth on driven gear / number of teeth on driving gear.
- d. Explain the effect of gear ratios on speed of rotation and torque transmitted e.g. low ratios reduce speed and increase torque.
- e. Explain how compound gearbox ratios are calculated.
- f. Calculate the gear ratios of a typical 5-speed gearbox e.g. 1st, 2nd, 3rd, 4th and 5th gear.
- g. Calculate the overall gear ratio of a vehicle e.g. gearbox ratio x final drive ratio.
- h. Explain the effect of transmission efficiency on torque transmitted and state typical values for light vehicles e.g. approximately 90%.
- i. Calculate the speed (rpm) and torque of the road wheels in various gears for a given engine speed and torque.
- j. Convert road wheel speed (rpm) to linear velocity for the vehicle expressed as m/min and km/h.

1.3. Stress and strain of materials

- a. Explain the properties of materials e.g. elasticity, ductility, hardness, brittleness and strength.
- b. Describe that materials subjected to a load are under stress.
- c. Describe the main types of stress e.g. tensile, compressive, torsional and shear.
- d. Identify vehicle components that are subject to tensile, compressive, torsional and shear stress.
- e. State the formula for calculating the stress in a material e.g. Stress = Load/Area
- f. State the units of stress as the pascal (Pa).
- g. Explain how the change of shape caused by a load is known as strain.
- h. Recognise that strain is a ratio and has no units.
- i. Define the meaning of elasticity in relation to materials.
- j. Explain the importance of the elastic limit of a material and the relationship to the torque settings of bolts and studs.
- k. State Hooke's Law e.g. Stress/Strain.
- l. Explain Young's Modulus of Elasticity and compare the accepted values for common materials e.g. steel, cast iron, copper and brass.
- m. Solve vehicle related problems involving stress, strain and Young's Modulus of Elasticity.

Content:
2.1. Specific heat capacity and latent heat

- a. Distinguish between sensible and latent heat.
- b. Give examples of latent heat in vehicle situations e.g. the freezing of water, boiling of water, vaporisation of petrol.
- c. Explain the meaning of specific heat capacity of a substance
- d. State the unit of measurement for specific heat capacity.
- e. Compare the specific heat capacity of common substances associated with vehicles e.g. water, petrol, aluminium, steel, copper and aluminium etc.
- f. Calculate the heat given out or received by a substance.
- g. Solve vehicle related problems involving specific heat capacity.

2.2. Linear expansion of materials

- a. Describe how materials expand by different amounts for the same temperature rise.
- b. Compare the coefficient of linear expansion for common materials e.g. steel, copper, brass, aluminium and lead.
- c. State the formula for calculating linear expansion.
- d. Solve vehicle related problems involving linear expansion.

2.3. Gas Laws

- a. Describe the units of pressure e.g. N/m², Pa, Bar.
- b. Describe atmospheric pressure and state the approximate value at sea level i.e. 101.3kN/m² or 101.3kPa.
- c. Describe the relationship between gauge and absolute pressure.
- d. Describe the meaning of absolute temperature and state the absolute temperature scale i.e. Kelvin
- e. Explain Boyle's Law i.e. $PV = C$
- f. Explain Charles' Law i.e. $V/T = C$
- g. Recognise the need to use absolute units of pressure and temperature when solving gas law problems.
- h. State the general gas law equation i.e. $P_1V_1/T_1 = P_2V_2/T_2$.
- i. Solve vehicle related gas law problems using the general gas law equation.

3.1. Equations of linear motion

- a. Describe velocity and understand its unit of measurement is the metre per second (m/s).
- b. Describe acceleration and understand its unit of measurement is the metre per second (m/s²).
- c. Understand the terms uniform (constant) velocity and variable velocity.
- d. Explain Newton's laws of motion.
- e. State the letters used to represent values in equations of motion i.e. s = distance (metres), t = time (seconds), a = acceleration (m/s²), u = initial velocity (m/s), v = final velocity (m/s), g = gravity.
- f. State the equations of motion i.e. $s = ut$, $s = (u + v \div 2) t$, $v = u + at$, $s = ut + \frac{1}{2} at^2$, $v^2 - u^2 = 2as$.
- g. Explain braking efficiency and the formula used to calculate its value i.e. $a/g \times 100$.
- h. Solve vehicle related problems involving velocity, acceleration, and braking efficiency using the equations of motion.

3.2. Inertia, momentum and accelerating force

- a. Define inertia as the tendency of a body to maintain a state of rest or of uniform motion.
- b. Define momentum as the tendency for a body to keep moving at the same velocity.
- c. State the formula for calculating momentum as momentum = mv.
- d. Explain the relationship between force, mass and acceleration i.e. $F = ma$
- e. Solve vehicle related problems involving momentum, and accelerating force.

4.1. Work and power

- a. Explain that work done = force x distance moved
 - b. Explain that work is a form of energy measured in Nm.
 - c. Explain that 1 Nm = 1 joule (J)
 - d. Explain that work done per second is Nm/s = 1 Joule/s
 - e. Explain that power is the rate of doing work and is measured in watts (W) i.e. (force x distance) ÷ time
 - f. Explain that 1 Nm/s = 1 joule/s = 1 watt
- Solve vehicle related problems involving work done and power.

4.2. Work done in rotation

- a. Explain that work done in rotation = force x circular distance = force x $2\pi r$.
- b. Explain that power (W) = $2\pi NT$ where N = rev/s and T = torque (Nm).
- c. Solve vehicle related problems involving work done in rotation and power.

