



**INSTITUTE OF THE  
MOTOR INDUSTRY**

## **QUALIFICATION SPECIFICATION**

**IMI Level 2 Certificate in Service and Maintenance Engineering  
(VRQ)**

**OFQUAL NO: 601/0532/X**

**IMI Level 2 Diploma in Service and Maintenance Engineering  
(VRQ)**

**OFQUAL NO: 601/0542/2**

**September 2017 (v1)**

**Note:**

This guide should be read in conjunction with the:

- Candidate Assessment Summary (for the relevant qualification)
- Support Materials (for the relevant qualification)
- and the IMI Operating Manual for Approved Centres



## 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.

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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 Quality Assurer Name:	Internal Quality Assurer Name:
Internal Quality Assurer Signature:	Internal Quality Assurer Signature:



## Qualification Structures

### IMI Level 2 Certificate in Service and Maintenance Engineering (VRQ) Ofqual I.D No: 601/0532/X

In order to pass the qualification, learners must achieve the following:

**Group A:** All 4 Mandatory Units must be completed

**Group B:** The Core Unit must be completed

**Group C:** A minimum of 1 Self Development Unit must be completed

**Group D:** A minimum of 2 Specialist Units must be completed

### IMI Level 2 Diploma in Service and Maintenance Engineering (VRQ) Ofqual I.D No: 601/0542/2

In order to pass the qualification, learners must achieve the following:

**Group A:** All 4 Mandatory Units must be completed

**Group B:** The Core Unit must be completed

**Group C:** A minimum of 2 Self Development Units must be completed

**Group D:** A minimum of 3 Specialist Units must be completed

#### Key:

C = Combination Assessment (Practical Task and/or Written Assessment)

P = Project (Portfolio of Evidence)

T = On Line Test

#### Group A: Mandatory Units

Unit Ref:	Unit Title and ID Number	GLH	Unit Level	Assessments		
				C	P	T
ET211	Health and Safety Practices in an Engineering Maintenance Environment (T/505/4253)	40	2	M		M
ET212	Tools and Equipment Used in an Engineering Maintenance Environment (K/505/4251)	40	2	M		M
ET214	Mathematics and Science for Engineering Technicians (L/505/4260)	40	2	M		M
ET216	Supporting Job Roles in an Engineering Environment (A/505/4254)	30	2	M		M

#### Group B: Core Unit (Mandatory)

Unit Ref:	Unit Title and ID Number	GLH	Unit Level	Assessments		
				C	P	T
ET213	Undertake A Project in the Engineering Environment (A/505/4321)	30	2		M	



**Group C: Self Development Units (Optional)**

Unit Ref:	Unit Title and ID Number	GLH	Unit Level	Assessments		
				C	P	T
PSD01	Self Development (M/505/4090)	20	1	M		
PSD02	Solving Problems In Daily Life (T/505/4091)	20	1	M		
PSD05	Preparing for Work (Y/505/4262)	20	2	M		
PSD04	Knowledge of Environmental Issues (D/505/4263)	20	2	M		

**Group D: Specialist Units (Optional)**

Unit Ref:	Unit Title and ID Number	GLH	Unit Level	Assessments		
				C	P	T
ET217	Machining Engineering Materials (M/505/4266)	50	2	M		
ET218	Forming and Joining Engineering Materials (Y/505/4293)	33	2	M		
ET219	Electrical/ Electronic Systems Maintenance 12/ 24 Volt (M/505/4302)	40	2	M		
ET220	Mechanical Systems and their Maintenance (T/505/4303)	60	2	M		
ET221	Internal Combustion Engines, Components and Systems (L/505/4307)	55	2	M		
ET223	Computer Aided Drawing in an Engineering Environment (Y/505/4309)	40	2	M		
ET124	Cycle Construction and Routine Maintenance (Y/505/4245)	26	1	M		
ET225	Metal Inert Gas (MIG) Brazing Operations (T/505/4298)	30	2	M		
ET226	Metal Active Gas (MAG) Welding Techniques (A/505/4299)	30	2	M		
ET227	Tungsten Inert Gas (TIG) Welding Techniques (H/505/4300)	30	2	M		
ET228	Hydraulic and Pneumatic Systems Principles (A/505/4304)	40	2	M		
ET229	Routine Motorcycle Maintenance (F/505/4305)	40	2	M		
ET230	Routine Vehicle Maintenance (J/505/4306)	40	2	M		
ET231	Applying Fillers and Foundation Materials (H/505/4314)	60	2	M		
ET232	Preparing Metal and Pre-Painted Surfaces (M/505/4316)	60	2	M		
ET233	New Technologies in the Engineering Industry (A/505/4318)	30	2	M		
ET234	Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Vehicle Body Panels (K/505/4301)	30	2	M		
ET235	Repairing Minor Paint Defects in an Engineering Environment (T/505/4317)	60	2	M		
ET236	Electrically Propelled Vehicle Hazard Management (F/505/4319)	12	2	M		
ET237	Routine Maintenance Activities on Electrically Propelled Vehicles (T/505/4320)	16	2	M		



**Level 2 Service and Maintenance Engineering Qualifications Assessment Criteria**

<b>UNIT REF: ET211</b>	<b>UNIT TITLE: HEALTH AND SAFETY PRACTICES IN AN ENGINEERING MAINTENANCE ENVIRONMENT</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
<p>Rationale: This unit enables the learner to develop the skills and understanding necessary to use resources economically and perform in a safe manner in an engineering environment. It provides an understanding of health and safety legislation and the related duties of employers and employees and also an appreciation of significant risks and how to identify and deal with them.</p>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
<p>1. Understand and use correct personal protective equipment in an engineering environment</p>	<p>1.1. The importance of wearing the types of Personal Protective Equipment required for a range of engineering maintenance activities to include:</p> <ul style="list-style-type: none"> <li>a. welding</li> <li>b. sanding and grinding</li> <li>c. filling</li> <li>d. panel removal and replacement</li> <li>e. drilling</li> <li>f. cutting</li> <li>g. chiselling</li> <li>h. removal of broken glass</li> <li>i. removal of rubber seals from fire damaged vehicles</li> <li>j. removal of hypodermic needles</li> <li>k. servicing activities</li> <li>l. roadside recovery</li> </ul> <p>1.2. Use personal protective equipment throughout activities. To include appropriate protection of:</p> <ul style="list-style-type: none"> <li>a eyes</li> <li>b ears</li> <li>c head</li> <li>d skin</li> <li>e feet</li> <li>f hands</li> <li>g lungs</li> </ul>



<p>2. Understand and use effective housekeeping practices in an engineering environment</p>	<p>2.1. Procedures and precautions necessary when cleaning and maintaining an engineering environment to include:</p> <ul style="list-style-type: none"><li>a. typical maintenance log</li><li>b. cleaning procedures</li><li>c. filter maintenance</li><li>d. variation in glove types</li><li>e. air quality checks</li></ul> <p>2.2. Cleaning equipment which is of the right type and suitable for the task to include:</p> <ul style="list-style-type: none"><li>a. cleaning tools and equipment to maximise workplace efficiency.</li><li>b. requirement to carry out the housekeeping activities safely and in a way that minimises inconvenience to customers and staff.</li><li>c. risks involved when using solvents and detergents.</li><li>d. advantages of good housekeeping.</li></ul> <p>2.3. Minimise waste when using utilities and consumables to include:</p> <ul style="list-style-type: none"><li>a. grease</li><li>b. oils</li><li>c. split pins</li><li>d. locking and fastening devices .</li></ul> <p>2.4. Procedures for correct disposal of cleaning agents, waste materials and debris from an engineering environment to include:</p> <ul style="list-style-type: none"><li>a. relevance of safe systems of work to the storage and disposal of waste materials.</li><li>b. requirement to store and dispose of waste, used materials and debris correctly.</li><li>c. safe disposal of special / hazardous waste materials.</li><li>d. advantages of recycling waste materials.</li><li>e. dealing with spillages and leaks</li></ul> <p>2.5. Keep the work area clean and free from debris and waste materials using correct procedures which minimise inconvenience to others to include:</p> <ul style="list-style-type: none"><li>a. requirement to carry out the housekeeping activities safely and in a way that minimises inconvenience to customers and staff.</li><li>b. risks involved when using solvents and detergents.</li><li>c. advantages of good housekeeping</li></ul> <p>2.6. Keep tools and equipment fit for purpose by regular inspection, cleaning and maintenance to include</p> <ul style="list-style-type: none"><li>a. cleaning tools and equipment to maximise workplace efficiency.</li></ul>
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<p>3. Understand key health and safety requirements relevant to the engineering environment</p>	<p>3.1. The main legislation relating to health and safety in an engineering environment. to include:</p> <ul style="list-style-type: none"><li>a. HASAWA</li><li>b. COSHH</li><li>c. EPA</li><li>d. Manual Handling Operations Regulations 1992</li><li>e. PPE Regulations 1992</li></ul> <p>3.2. General legal duties of employers and employees required by current health and safety legislation to include:</p> <ul style="list-style-type: none"><li>a. Provision and Use of Work Equipment Regulations 1992.</li><li>b. Power Presses Regulations 1992.</li><li>c. Pressure Systems and Transportable Gas Containers Regulations 1989.</li><li>d. Electricity at Work Regulations 1989.</li><li>e. Noise at Work Regulations 1989.</li><li>f. Manual Handling Operations Regulations 1992.</li><li>g. Health and Safety (Display Screen Equipment) Regulations 1992.</li><li>h. Abrasive Wheel Regulations.</li><li>i. Safe Working Loads.</li><li>j. Working at Height Regulations (2005)</li></ul> <p>3.3. Key, current health and safety requirements relating to an engineering environment to include:</p> <ul style="list-style-type: none"><li>a. HASAWA</li><li>b. COSHH</li><li>c. EPA</li><li>d. Manual Handling Operations Regulations 1992</li><li>e. PPE Regulations 1992</li></ul> <p>3.4. Workplace policies and procedures relating to health and safety are important to include:</p> <ul style="list-style-type: none"><li>a Health and Safety (Display Screen Equipment) Regulations 1992</li><li>b Health and Safety (First Aid) Regulations 1981</li><li>c Health and Safety (Safety Signs and Signals) Regulations 1996</li><li>d Health and Safety (Consultation with Employees) Regulations 1996</li><li>e Employers Liability (Compulsory Insurance) Act 1969 and Regulations 1998</li><li>f Confined Spaces Regulations 1997</li><li>g Noise at Work Regulations 1989</li><li>h Electricity at Work Regulations 1989</li><li>i Electricity (Safety) Regulations 1994</li><li>j Fire Precautions Act 1971</li><li>k Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985</li><li>l Pressure Systems Safety Regulations 2000</li><li>m Waste Management 1991</li><li>n Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002</li><li>o Control of Asbestos at Work Regulations 2002</li></ul>
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<p>4. Understand and act upon hazards and potential risks in an engineering environment</p>	<p>4.1. Identify and report hazards and risks in an engineering environment to the responsible person(s) in the workplace to include:</p> <ul style="list-style-type: none"><li>a. the difference between a risk and a hazard.</li><li>b. the employee's responsibilities in identifying and reporting risks within their working environment.</li><li>c. the method of reporting risks that are outside your limits of authority.</li><li>d. potential causes of:<ul style="list-style-type: none"><li>i. fire</li><li>ii. explosion</li><li>iii. noise</li><li>iv. harmful fumes</li><li>v. slips</li><li>vi. trips</li><li>vii. falling objects</li><li>viii. accidents whilst dealing with broken down vehicles</li></ul></li></ul> <p>4.2. Policies and procedures for reporting hazards, risks and health and safety matters in an engineering environment.</p> <p>4.3. Precautions and procedures which need to be taken when working with engineering materials, tools and equipment to include</p> <ul style="list-style-type: none"><li>a. Potential risks resulting from:<ul style="list-style-type: none"><li>i. the use and maintenance of machinery or equipment</li><li>ii. the use of materials or substances</li><li>iii. accidental breakages and spillages</li><li>iv. unsafe behaviour</li><li>v. working practices that do not conform to laid down policies</li><li>vi. environmental factors</li><li>vii. personal presentation</li><li>viii. unauthorised personal, customers, contractors etc entering your work premises</li></ul></li></ul> <p>4.4. Fire extinguishers in common use and which types of fire they should be used on to include</p> <ul style="list-style-type: none"><li>a. Classification of fire types</li><li>b. Using a fire extinguisher effectively.</li><li>c. Types of extinguishers<ul style="list-style-type: none"><li>i. foam</li><li>ii. dry powder</li><li>iii. CO2</li><li>iv. water</li><li>v. fire blanket</li></ul></li></ul> <p>4.5. Key warning signs and their characteristics that are found in an engineering environment to include</p> <ul style="list-style-type: none"><li>a. colours used for warning signs:<ul style="list-style-type: none"><li>i. red</li><li>ii. blue</li><li>iii. green</li><li>iv. yellow</li></ul></li><li>b. shapes and meaning of warning signs:</li></ul>
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	<ul style="list-style-type: none"><li>i. round</li><li>ii. triangular</li><li>iii. square</li><li>c. the meaning of prohibitive warning signs in common use.</li><li>d. the meaning of mandatory warning signs in common use.</li><li>e. the meaning of warning notices in common use.</li><li>f. general design of safe place warning signs.</li></ul> <p>4.6. The meaning of common product warning labels used in an engineering environment to include</p> <ul style="list-style-type: none"><li>a. reasons for placing warning labels on containers.</li><li>b. warning labels in common use, to include:<ul style="list-style-type: none"><li>i. toxic</li><li>ii. corrosive</li><li>iii. poisonous</li><li>iv. harmful</li><li>v. irritant</li><li>vi. flammable</li><li>vii. explosive</li></ul></li></ul>
<p>5. Understand and act upon personal responsibilities</p>	<p>5.1. The importance of personal conduct and presentation in maintaining the health, safety and welfare of the individual and others</p> <p>5.2. Suitable personal conduct and presentation at work which ensures the health safety and welfare of themselves and others at work</p> <p>5.3. Safe working practices whilst working with equipment, materials and products in the engineering environment</p> <p>5.4. Health and safety risks encountered at work, within the scope and capability of their job role</p>



<b>UNIT REF: ET212</b>	<b>UNIT TITLE: TOOLS AND EQUIPMENT USED IN AN ENGINEERING MAINTENANCE ENVIRONMENT</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
<p>Rationale: This unit enables the learner to develop the skills and understanding necessary for the correct selection, care and use of hand tools and equipment when modification, fabrication and maintenance takes place in an engineering environment. It also supports the correct selection and application of materials used when fabricating, modifying or carrying out maintenance in an engineering context.</p>	

LEARNING OUTCOMES	CONTENT
<b>The Learner will:</b>	<b>The Learner should be taught</b>
<p>1. Be able to select, maintain and use hand tools and measuring devices in the engineering maintenance environment</p>	<p>1.1. Use and maintain suitable Personal Protective Equipment for fabrication and maintenance duties in the engineering environment to include:</p> <ul style="list-style-type: none"> <li>a. hydraulic jacks</li> <li>b. stands</li> <li>c. pillar drills</li> <li>d. air tools</li> <li>e. lifts</li> <li>f. cranes</li> <li>g. hoists</li> <li>h. electrical power tools</li> </ul> <p>1.2. The use of common types of hand tools used when fabricating and fitting in an engineering environment to include:</p> <ul style="list-style-type: none"> <li>a. files</li> <li>b. hacksaws and snips</li> <li>c. hammers</li> <li>d. screwdrivers</li> <li>e. pliers</li> <li>f. spanners</li> <li>g. sockets</li> <li>h. punches</li> <li>i. types of drill and drill bits</li> <li>j. taps and dies</li> <li>k. stud removers</li> <li>l. marking out tools</li> </ul> <p>1.3. Select, maintain and use suitable hand tools safely when fabricating and fitting in an engineering environment to include:</p> <ul style="list-style-type: none"> <li>a. files</li> <li>b. hacksaws and snips</li> <li>c. hammers</li> <li>d. screwdrivers</li> <li>e. pliers</li> <li>f. spanners</li> <li>g. sockets</li> <li>h. punches</li> <li>i. types of drill and drill bits</li> <li>j. taps and dies</li> <li>k. stud removers</li> <li>l. marking out tools</li> </ul> <p>1.4. The use of common measuring devices used when</p>



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	<p>fabricating and fitting in an engineering environment to include:</p> <ol style="list-style-type: none"> <li>a. rule/tape</li> <li>b. callipers</li> <li>c. feeler gauge</li> <li>d. volume measures</li> <li>e. micrometer</li> <li>f. dial gauges</li> <li>g. torque wrenches</li> <li>h. depth gauges</li> <li>i. verniers</li> </ol> <p>1.5. Select, maintain and use suitable measuring devices safely when fabricating and fitting in an engineering environment</p>
<p>2. Be able to understand, prepare and use common workshop equipment</p>	<p>2.1. Preparation and safe use of workshop equipment</p> <p>2.2. Suitably maintained workshop equipment safely</p> <p>2.3. Explain the term: 'safe working load'</p> <p>2.4. Faulty or damaged tools and equipment and report to the relevant person(s) promptly</p> <p>2.5. Store tools and equipment in a safe manner, which also permits ease of access and identification for use</p>
<p>3. Be able to select and use materials in an engineering environment</p>	<p>3.1. The properties, application and limitations of ferrous and non-ferrous metals, including their safe use</p> <p>3.2. The properties, application and limitations of common non-metallic materials, including their safe use</p> <p>3.3. Common terms relating to the properties of materials</p> <p>3.4. Select and use appropriate materials whilst completing maintenance and fitting operations in an engineering environment</p>
<p>4. Be able to understand and use engineering maintenance, fabrication and fitting principles</p>	<p>4.1. How to tap threads, file, cut and drill plastics and metals, when fabricating or fitting</p> <p>4.2. Correct procedures when:</p> <ol style="list-style-type: none"> <li>a. filing</li> <li>b. tapping threads</li> <li>c. cutting plastics and metals</li> <li>d. drilling plastics and metals.</li> </ol> <p>4.3. How to measure, mark out, shape and join materials when fabricating or fitting</p> <p>4.4. Appropriate techniques when fabricating, repairing and modifying vehicles and components</p> <p>4.5. The selection and fitting procedures of the following:</p> <ol style="list-style-type: none"> <li>a. gaskets and seals</li> <li>b. sealants and adhesives</li> <li>c. fittings and fasteners</li> <li>d. locking devices</li> </ol> <p>4.6. Select and use:</p>



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	<ul style="list-style-type: none"><li>a. gaskets and seals</li><li>b. sealants and adhesives</li><li>c. fittings and fasteners</li><li>d. locking devices</li></ul> <p>4.7. The importance of correct operating specifications for limits, fits and tolerances in the an engineering environment</p>
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<b>UNIT REF: ET213</b>	<b>UNIT TITLE: UNDERTAKE A PROJECT IN THE ENGINEERING ENVIRONMENT</b>
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<b>Level: 2</b>	<b>GLH: 30</b>
<p>Rationale: This unit will enable learners to develop the knowledge and skills necessary to research, plan and carry out a non complex project in an engineering environment. Whilst it is expected that learners will be able to undertake a project of interest to them it is also recognised that it must be achievable with regard to complexity, time and resource and as such, guidance will be needed from mentors in their centres as to suitability. It is also expected that mentors will be part of the project review process.</p>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Understand how to carry out and report on a project	<p>1.1. The purpose of identifying the stakeholders involved in a project to include</p> <ul style="list-style-type: none"> <li>a. Input to initial project brief</li> </ul> <p>1.2. The requirements of a project brief to include:</p> <ul style="list-style-type: none"> <li>a. written and graphical technique</li> <li>b. an overview of the project and existing problem</li> <li>c. who, what, when, where, why, and how</li> <li>d. what the project is expected to achieve and how it will improve the existing problem or situation</li> <li>e. record of agreement for future work.</li> <li>f. gives an overview of project aims and objectives</li> </ul> <p>1.3. The benefits and value of defining a project's purpose, scope, timescale, costs, aims and objectives to include</p> <ul style="list-style-type: none"> <li>a. common purpose with clear defined goals</li> </ul> <p>1.4. Project risks and the importance of developing contingency plans to include:</p> <ul style="list-style-type: none"> <li>a. typical risks involved with engineering projects</li> <li>b. examples of contingency arrangements for issues such as increase in cost, time etc due to unforeseen circumstances</li> </ul> <p>1.5. Examples of the tools that can be used to assist project planning and control to include:</p> <ul style="list-style-type: none"> <li>a. textbooks</li> <li>b. journals</li> <li>c. magazines</li> <li>d. internet</li> <li>e. trade literature</li> <li>f. television and radio</li> <li>g. subject experts</li> <li>h. validity and reliability</li> </ul>



<p>2. Be able to identify and research a suitable topic for a project in the engineering environment</p>	<p>2.1. Information sources relevant to the topic to be researched to include:</p> <ul style="list-style-type: none"><li>a. textbooks</li><li>b. journals</li><li>c. magazines</li><li>d. internet</li><li>e. trade literature</li><li>f. television and radio</li><li>g. subject experts</li><li>h. validity and reliability</li></ul> <p>2.2. Assess potential topics</p> <p>2.3. Select and describe a relevant project topic to include:</p> <ul style="list-style-type: none"><li>a. suitable project topic (e.g. trial or experiment, investigation of an issue important to the sector)</li><li>b. preparation of a plan, production of a structure or artefact, training programme</li><li>c. preparation for and participation in a competition</li><li>d. improving a process</li><li>e. investigation of a new product or service).</li><li>f. justify the selection of the project topic in relation to e.g. programme of study, interests and experience, future employment ambitions, comparison with alternative topics</li></ul> <p>2.4. Prepare a brief written proposal for the project and discuss this with their mentor, to include:</p> <ul style="list-style-type: none"><li>a. title</li><li>b. aims/ objectives</li><li>c. methodology</li><li>d. information sources</li><li>e. resources</li><li>f. justification of proposed project</li></ul>
<p>3. Be able to plan for a project in the engineering environment</p>	<p>3.1. Compile information and resources necessary to complete a project in the engineering environment</p> <p>3.2. Reasons for the resources selected</p> <p>3.3. The Health and Safety implications of the project to include:</p> <ul style="list-style-type: none"><li>a. health and safety</li><li>b. risk assessment</li><li>c. Personal Protective Equipment (PPE)</li><li>d. relevant regulations and legislation</li><li>e. welfare</li><li>f. codes of practice</li></ul>



<p>4. Be able to carry out and report on a project in the engineering environment</p>	<p>4.1. Carry out the selected project</p> <p>4.2. Monitor progress, working to deadlines to include:</p> <ul style="list-style-type: none"><li>a. interim review meetings</li><li>b. physical observation</li><li>c. progress reports</li><li>d. comparisons</li><li>e. diary or log of actions</li><li>f. monitoring of performance against schedule plan e.g. daily, weekly, monthly progress, budget</li><li>g. other appropriate measures for each resource or task</li><li>h. reasons and remedial actions if falling behind schedule etc.</li></ul> <p>4.3. Produce a written report on the project</p> <p>4.4. Positive and negative aspects of the project and outline areas for improvement to include</p> <ul style="list-style-type: none"><li>a. compare final outcome against aims and objectives in project brief</li><li>b. review interim reports</li><li>c. good and bad points for reference</li><li>d. discuss with stakeholders to gain their perspective</li><li>e. planning</li><li>f. implementation</li><li>g. methodology</li><li>h. results/findings</li></ul>
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<b>UNIT REF: ET214</b>	<b>UNIT TITLE: MATHEMATICS AND SCIENCE FOR ENGINEERING TECHNICIANS</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
<p>Rationale: This unit is intended to provide the learner with an appreciation of the aspects of science and mathematical knowledge that may be required, to solve problems found in the engineering environment. It is expected that some of the mathematical principles in this unit will be used to enhance understanding of the science element and that the science will be integrated with the mathematics in an engineering context. The aim is to broaden candidates understanding of science and mathematics, in order to support further studies.</p>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to use number in the engineering environment	<p>1.1. Solve problems involving fractions, decimals and ratios to include:</p> <ul style="list-style-type: none"> <li>a. solve engineering problems using:</li> <li>b. common or vulgar fractions.</li> <li>c. decimals</li> <li>d. ratios (compression, gear, fluid, area etc)</li> </ul> <p>1.2. Solve problems involving factors, powers and roots to include:</p> <ul style="list-style-type: none"> <li>a. prime and common factors</li> <li>b. simple powers e.g. <math>n^2</math>, <math>n^3</math>, <math>n^4</math>, <math>n^5</math></li> <li>c. simple roots e.g. square, cube.</li> </ul> <p>1.3. Define binary numbers to include:</p> <ul style="list-style-type: none"> <li>a. describe the binary number system.</li> <li>b. explain the meaning of bits and bytes</li> <li>c. express denary numbers (base 10) in binary e.g. 21 as a binary number = 10101.</li> <li>d. explain how binary numbers relate to vehicle computers and digital systems.</li> </ul>
2. Know how to use algebra in the engineering environment	<p>2.1. Common symbols and formulae used in engineering calculations:</p> <ul style="list-style-type: none"> <li>a. for areas, volumes, lengths, ratios etc.</li> <li>b. for rectangles, triangles, circles, annulus, cone, pyramid, sphere etc.</li> </ul> <p>2.2. Calculations using basic algebraic functions to include:</p> <ul style="list-style-type: none"> <li>a. common or vulgar fractions.</li> <li>b. decimals</li> <li>c. ratios (compression, gear, fluid, area etc)</li> </ul> <p>2.3. Apply simple formulae to engineering problems to obtain solutions:</p> <ul style="list-style-type: none"> <li>a. for areas, volumes, lengths, ratios etc.</li> <li>b. for rectangles, triangles, circles, annulus, cone, pyramid, sphere etc.</li> </ul>



<p>3. Know how to use geometry and mensuration in the engineering environment</p>	<p>3.1. Key aspects of co-ordinates</p> <p>3.2. Understanding of symmetry transformations and vectors to include:</p> <ul style="list-style-type: none"><li>a. lines of symmetry</li><li>b. reflection symmetry</li><li>c. rotation symmetry</li></ul> <p>3.3. Calculate lengths, perimeters, areas and volumes</p> <p>3.4. Qualities of common angles to include:</p> <ul style="list-style-type: none"><li>a. number of degrees in a circle, semi circle and right angle</li><li>b. types of angle – acute, obtuse, reflex</li><li>c. sum of the angles of a triangle and a quadrilateral</li></ul>
<p>4. Be able to interpret graphical and statistical data</p>	<p>4.1. Compare methods of presenting data to include:</p> <ul style="list-style-type: none"><li>a. tally charts</li><li>b. bar charts</li><li>c. pie charts</li><li>d. graphs</li></ul> <p>4.2. Assess graphical presentation of data to include:</p> <ul style="list-style-type: none"><li>a. tally charts</li><li>b. bar charts</li><li>c. pie charts</li><li>d. graphs</li></ul>
<p>5. Know and apply scientific principles related to the engineering environment</p>	<p>5.1. The principle of air / fuel ratios and their effect on combustion and emissions in internal combustion engines</p> <p>5.2. Define the terms ‘power’ and ‘torque’ as applied to engineering machines</p> <p>5.3. Determine internal combustion engine power and torque from graphical representation</p> <p>5.4. Define terms relating to friction</p> <p>5.5. Give examples, of how friction can be reduced in engineering machinery</p> <p>5.6. How gear ratios can be used to change speed and torque in machines</p> <p>5.7. Effects of temperature change on air pressure inside a sealed cylinder</p> <p>5.8. The relationship between thrust, pressure and area in hydraulic and pneumatic control circuits</p> <p>5.9. Define volts, amps, ohms and watts as used in electrical systems</p> <p>5.10. Demonstrate the relationship between volts, amps and ohms in an electrical circuit</p>



<b>UNIT REF:</b> ET216	<b>UNIT TITLE: SUPPORTING JOB ROLES IN AN ENGINEERING ENVIRONMENT</b>
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<b>Level: 2</b>	<b>GLH: 30</b>
Rationale: This unit enables the learner to develop knowledge and understanding of typical organisational structures, information gathering and how to keep good working relationships with customers and colleagues in an engineering work environment, by using effective communication and support skills.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know and understand key organisational structures, functions and roles within an engineering work environment	<p>1.1. The function of the main sections which may be found within a typical engineering work environment to include:</p> <ul style="list-style-type: none"> <li>a. reception</li> <li>b. manufacture / service / repair workshop</li> <li>c. parts</li> <li>d. sales</li> <li>e. administration</li> </ul> <p>1.2. Distinguish between and compare different types of organisational structures within an engineering work environment to include:</p> <ul style="list-style-type: none"> <li>a. flat</li> <li>b. matrix</li> <li>c. team</li> <li>d. hierarchical</li> </ul> <p>1.3. Problems related to staff misunderstanding levels of responsibility within job roles in an engineering environment. To include:</p> <ul style="list-style-type: none"> <li>a. trainee</li> <li>b. skilled technician</li> <li>c. supervisor</li> </ul>
2. Know the importance of obtaining, interpreting and using information in order to support their job role within the an engineering environment	<p>2.1. Different sources of information which would be used in an engineering environment to include:</p> <ul style="list-style-type: none"> <li>a. other staff</li> <li>b. manuals</li> <li>c. parts lists</li> <li>d. computer software / internet</li> <li>e. manufacturer</li> <li>f. diagnostic equipment</li> </ul> <p>2.2. The importance of obtaining correct information and working to recognised procedures and processes to include:</p> <ul style="list-style-type: none"> <li>a. recording maintenance and repairs</li> <li>b. machine specifications</li> <li>c. component specifications</li> <li>d. oil and fluid specifications</li> <li>e. equipment and tools</li> <li>f. identification codes</li> </ul> <p>2.3. Examples of when replacement units and components must meet the original equipment specification</p> <p>2.4. Typical identification codes, where they may be found and how they are used in an engineering environment</p>



<p>3. Know communication requirements when carrying out repairs in an engineering environment</p>	<p>3.1. Examples of when it is important to communicate with a supervisor whilst carrying out repairs in an engineering environment to include:</p> <ul style="list-style-type: none"><li>a. referral of problems</li><li>b. reporting delays</li><li>c. additional work identified during repair or maintenance</li><li>d. keep others informed of progress</li></ul> <p>3.2. The importance of keeping records of vehicle repair information to include:</p> <ul style="list-style-type: none"><li>a. reporting delays</li><li>b. additional work identified during repair or maintenance</li><li>c. keep informed of progress</li></ul> <p>3.3. Why it is important to work to agreed timescales</p> <ul style="list-style-type: none"><li>a. relationship between time and cost</li><li>b. customer expectation</li></ul>
<p>4. Be able to demonstrate good working relationships with colleagues and customers in an engineering work environment</p>	<p>4.1. Positive team work within an engineering environment to include:</p> <ul style="list-style-type: none"><li>a. importance of interest</li><li>b. enthusiasm, attendance</li><li>c. 'pulling own weight'</li><li>d. abiding by safe working practice and company rules and regulations</li><li>e. personal appearance and hygiene</li><li>f. lack of favouritism by supervisors</li><li>g. fair pay</li><li>h. respect</li><li>i. keeping commitments</li></ul> <p>4.2. The treatment of colleagues and customers in a way which shows respect for their views and opinions</p> <p>4.3. Give and keep achievable commitments to colleagues and customers</p> <p>4.4. Inform colleagues and customers promptly of anything likely to affect them to include:</p> <ul style="list-style-type: none"><li>a. reporting delays</li><li>b. additional work identified during repair or maintenance</li><li>c. keep informed of progress</li></ul>



<b>UNIT REF: PSD01</b>	<b>UNIT TITLE: SELF DEVELOPMENT</b>
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<b>Level: 1</b>	<b>GLH: 20</b>
Rationale: To introduce the learner to ways in which they can reflect on their own personal development and how their personal skills, abilities and behaviours can be improved.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Be able to take an active role in their self development	1.1. Personal strengths or abilities to include: <ul style="list-style-type: none"> <li>a thinking skills</li> <li>b physical strength</li> <li>c discipline</li> <li>d independence</li> <li>e decisiveness</li> <li>f supportive</li> <li>g patience</li> <li>h communication</li> <li>i enthusiastic</li> <li>j imaginative</li> <li>k determination</li> <li>l subject knowledge</li> <li>m creative</li> </ul> 1.2. Select an area for self development to include: <ul style="list-style-type: none"> <li>a. physical strength</li> <li>b. independence</li> <li>c. communication</li> <li>d. determination</li> <li>e. subject knowledge</li> </ul> 1.3. Why is this area is important for their self development to include: <ul style="list-style-type: none"> <li>a physical wellbeing</li> <li>b mental wellbeing</li> <li>c improve career prospects</li> <li>d improve knowledge</li> <li>e personal enjoyment</li> </ul>
2. Be able to plan for their self development	2.1. Prepare a plan for their identified area of self development to include: <ul style="list-style-type: none"> <li>a. specific</li> <li>b. measurable</li> <li>c. achievable</li> <li>d. realistic</li> <li>e. time-bound</li> </ul> 2.2. Activities, targets and timelines for their self development to include: <ul style="list-style-type: none"> <li>a. those agreed with tutor prior to beginning</li> <li>b. support required to meet objectives</li> </ul> 2.3. How to review progress towards achieving their targets to include: <ul style="list-style-type: none"> <li>a. review dates set prior to beginning development</li> <li>b. review meetings with tutor</li> </ul>



Assessment Criteria: Level 2 Service and Maintenance Engineering (VRQs)

	<p>2.4. Work through the agreed plan to include:</p> <ul style="list-style-type: none"><li>a. working through set objectives</li><li>b. keeping within timescales</li><li>c. adjusting plan as required</li><li>d. continuous review of progress towards target</li></ul>
<p>3. Know how to review their self development and plan for the future</p>	<p>3.1. Review their self development plan to include:</p> <ul style="list-style-type: none"><li>a. what was learned</li><li>b. how it was learned</li><li>c. what went well</li><li>d. what did not go well</li></ul> <p>3.2. Suggest improvements and amendments to the plan to include:</p> <ul style="list-style-type: none"><li>a. amendments to objectives</li><li>b. amendments to timelines</li><li>c. identification of further areas for development</li></ul> <p>3.3. Explain how they will continue with their self development in the future to include:</p> <ul style="list-style-type: none"><li>a. continuation of existing development</li><li>b. identification of new area for development</li><li>c. preferred styles of learning</li></ul>



<b>UNIT REF: PSD02</b>	<b>UNIT TITLE: SOLVING PROBLEMS IN DAILY LIFE</b>
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<b>Level: 1</b>	<b>Guided Learning Hours: 20</b>
<b>Rationale:</b> To introduce learners to the concept of problem solving and help them to develop skills to enable them to tackle problems in their daily lives	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to identify a straightforward problem and ways to deal with it	1.1. Identify a straightforward problem and describe its effects to include: <ol style="list-style-type: none"> <li>personal</li> <li>financial</li> <li>technical</li> </ol> 1.2. Suggest ways in which they might tackle the problem to include: <ol style="list-style-type: none"> <li>logical processes</li> <li>alternative methods including consideration of similar problems</li> <li>consider affects on themselves and other people</li> </ol> 1.3. Carry out a way to tackle the problem and agree it with an appropriate person to include: <ol style="list-style-type: none"> <li>consultation with their tutor</li> <li>identify the limits to what can be done</li> <li>consideration of health and safety rules.</li> </ol>
2. Be able to tackle a problem and plan a method to deal with it	2.1. Plan the method needed to tackle the problem to include: <ol style="list-style-type: none"> <li>methods and steps for working through the problem</li> <li>time-scales.</li> <li>knowing whom to ask when unsure about how to proceed</li> <li>what to do if things go wrong</li> </ol> 2.2. Identify resources to help tackle the problem to include: <ol style="list-style-type: none"> <li>materials</li> <li>tools</li> <li>equipment</li> </ol> 2.3. Carry out planned activities <ol style="list-style-type: none"> <li>following agreed plans</li> <li>amending plans if problems arise</li> <li>using appropriate support if required</li> </ol>



<p>3. Be able to carry out a review of their activities and the skills they used in dealing the problem</p>	<p>3.1. Review the approach used to deal with the problem to include:</p> <ul style="list-style-type: none"><li>a. review completed work with tutor</li></ul> <p>3.2. What went well and what did not go so well to include:</p> <ul style="list-style-type: none"><li>a. working to the plan</li><li>b. deviations from the plan</li><li>c. how the problem may have been solved differently</li></ul> <p>3.3. Identify whether the problem has been solved to include:</p> <ul style="list-style-type: none"><li>a visual inspections</li><li>b functional testing</li><li>c aural testing</li></ul>
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<b>UNIT REF: PSD04</b>	<b>UNIT TITLE: KNOWLEDGE OF ENVIRONMENTAL ISSUES</b>
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<b>Level: 2</b>	<b>Guided Learning Hours: 20</b>
Rationale: To introduce the learner to the impact that their actions have on the environment and how they can positively contribute to improving the environment.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Understand how an individual's actions affect the environment	1.1. A range of human activities that threaten the environment to include: <ul style="list-style-type: none"> <li>a burning fossil fuels</li> <li>b over population</li> <li>c pollution e.g. noise, water, air</li> <li>d excessive energy consumption</li> <li>e destruction of habitats</li> <li>f destroying animal life e.g. over fishing</li> </ul> 1.2. The effects that individual actions can have on the environment positively or negatively to include: <ul style="list-style-type: none"> <li>a reduced energy consumption</li> <li>b alternative fuels</li> <li>c recycling</li> <li>d reduced harmful emissions</li> <li>e consideration of others</li> </ul> 1.3. The effects of combined actions on the environment to include: <ul style="list-style-type: none"> <li>a education</li> <li>b promotion</li> <li>c protests</li> </ul>
2. Understand decisions that can be made in their own lives to help tackle environmental issues	2.1. A range of environmental issues relevant to their own lives to include: <ul style="list-style-type: none"> <li>a energy consumption e.g. leaving lights on, electrical appliance on standby</li> <li>b pollution e.g. noise, air, water</li> <li>c decreased wildlife</li> <li>d health issues</li> <li>e lost recreational areas e.g. building on green belt land</li> <li>f legislation</li> </ul> 2.2. Changes to their lifestyle that could help to tackle environmental issues to include: <ul style="list-style-type: none"> <li>a recycling</li> <li>b consideration of others</li> <li>c conscientious purchasing</li> <li>d focus groups</li> <li>e legislative changes</li> <li>f action groups</li> </ul>



<p>3. Be able to carry out activities which help to tackle environmental issues</p>	<p>3.1. A change that they have made to their lifestyle that is positive for the environment to include:</p> <ul style="list-style-type: none"><li>a recycling</li><li>b conscientious purchasing e.g fair trade products, safe cleaning products</li><li>c focus groups</li><li>d legislative changes</li><li>e action groups</li></ul> <p>3.2. Participate in a local project that has had a positive effect on the environment to include:</p> <ul style="list-style-type: none"><li>a cleaning up local areas</li><li>b recycling points</li><li>c planting trees</li></ul> <p>3.3. Positive effects that the project has had on the environment to include:</p> <ul style="list-style-type: none"><li>a improved health</li><li>b reduced costs</li><li>c increased wildlife</li><li>d Improved visually</li></ul>
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<b>UNIT REF: PSD05</b>	<b>UNIT TITLE: PREPARING FOR WORK</b>
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<b>Level: 2</b>	<b>Guided Learning Hours: 20</b>
Rationale: To encourage the learner to look at their own skills and qualities in relation to those needed at work and use this understanding to identify key personal and interpersonal information needed for the application process	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Understanding the skills and qualities needed for working life	<p>1.1. Skills and qualities desired by employers and explain why these are desirable to include:</p> <ul style="list-style-type: none"> <li>a. displaying positive body language</li> <li>b. showing interest, initiative and applying effort</li> <li>c. being confident about own efforts and contributions made by others</li> <li>d. being on-time and keeping to time schedules.</li> <li>e. promptly informing appropriate personnel of planned and unforeseen lateness</li> </ul> <p>1.2. Own skills, qualities and achievements to include</p> <ul style="list-style-type: none"> <li>a. displaying positive body language</li> <li>b. showing interest, initiative and applying effort</li> <li>c. being confident about own efforts and contributions made by others</li> <li>d. being on-time and keeping to time schedules.</li> <li>e. promptly informing appropriate personnel of planned and unforeseen lateness</li> </ul> <p>1.3. Employability skills and explain how these contribute to employability to include:</p> <ul style="list-style-type: none"> <li>a. hard working</li> <li>b. reliable</li> <li>c. willing to learn</li> <li>d. presentable</li> <li>e. positive attitude</li> </ul> <p>1.4. Skills they could develop to enhance their employability and describe how these skills might be developed</p>



<p>2. Be able to research personal career opportunities and progression routes</p>	<p>2.1. Employment options that match their skills</p> <p>2.2. Research a range of potential employment options which interest them and how they would access them to include:</p> <ul style="list-style-type: none"><li>a. light vehicle technician</li><li>b. heavy vehicle technician</li><li>c. motorcycle technician</li><li>d. parts advisor</li><li>e. sales person</li><li>f. valetor</li><li>g. body technician</li><li>h. painter</li></ul> <p>2.3. Employment progression routes in an area of their choice to include:</p> <ul style="list-style-type: none"><li>a apprentice</li><li>b foreman</li><li>c supervisor</li><li>d manager</li></ul> <p>2.4. Demonstrate the ability to complete the key information needed for an application or interview to include:</p> <ul style="list-style-type: none"><li>a. listen and understand people's views,</li><li>b. ask questions to confirm understanding.</li><li>c. identifying interests, experiences</li><li>d. skills and qualities</li><li>e. displaying positive body language</li><li>f. being on time and keeping to time schedules</li></ul>
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<b>UNIT REF: ET217</b>	<b>UNIT TITLE: MACHINING ENGINEERING MATERIALS</b>
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<b>Level: 2</b>	<b>GLH: 50</b>
<p>Rationale: In this unit learners will develop the knowledge and skills needed to recognise and select machine operating applications and procedures as used in the engineering environment. It includes shaping, drilling, turning, milling and grinding. It is expected that the learner will gain practical experience with more than one machining process. As this unit involves the use of tools, equipment or machinery it must be delivered in a secure and safe environment with learners being supervised at all times by competent and qualified staff. All tools, equipment or machinery will be maintained and presented in a safe and fit state.</p>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
<p>1. Know machine operating procedures and the extent of their capabilities</p>	<p>1.1. Common machining operations carried out in an engineering environment to include:</p> <ul style="list-style-type: none"> <li>a. milling</li> <li>b. turning</li> <li>c. grinding</li> <li>d. shaping</li> <li>e. drilling</li> </ul> <p>1.2. Different machining processes to include:</p> <ul style="list-style-type: none"> <li>a. health and safety issues around machining processes</li> <li>b. requirements for a simple risk assessment</li> <li>c. types</li> <li>d. function</li> <li>e. availability and condition of tools and equipment (including PPE)</li> <li>f. specification</li> <li>g. quantity and condition of the material to be machined</li> <li>h. importance of cleanliness in preparing for machining</li> <li>i. preparation of consumables used for machining</li> </ul> <p>1.3. The correct machining processes for given industrial applications</p> <p>1.4. Basic operating procedures for machines to include:</p> <ul style="list-style-type: none"> <li>a. milling</li> <li>b. turning</li> <li>c. grinding</li> <li>d. shaping</li> <li>e. drilling</li> </ul>



2. Know how to prepare for machining activities	2.1. The safety requirements necessary when using machining processes 2.2. The requirements of preparing the workplace 2.3. The importance of planning prior to carrying out machining operations. 2.4. The procedures for setting up machining equipment
3. Be able to prepare for machining activities	3.1. Appropriate resources and information to assist in preparing for machining activities 3.2. The tools and work holding equipment used for specific machining processes t
4. Be able to carry out machining activities	4.1. Different types of machining equipment 4.2. Safe machine operation when carrying out machining tasks
5. Know that machining activities are carried out correctly	5.1. Methods used to check machining has been carried out correctly 5.2. The importance of leaving the workplace and equipment in a safe and tidy condition
6. Be able to carry out basic checks on completed work	6.1. Perform checks for condition on a final product 6.2. Perform checks for accuracy and tolerance of a final product to recognised industrial



<b>UNIT REF: ET218</b>	<b>UNIT TITLE: FORMING AND JOINING ENGINEERING MATERIALS</b>
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<b>Level 2</b>	<b>GLH: 33</b>
<p>Rationale:          This unit will enable the learner to develop the knowledge and skills needed when working with tools and equipment used for a range of forming and mechanical and thermal joining applications with materials in the engineering environment. It is expected that learners carrying out practical activities will be supervised by competent staff at all times and that tools and equipment will be maintained and kept in safe condition.</p>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
<p>1. Understand the requirement for personal and environmental health and safety when forming and joining engineering materials</p>	<p>1.1. Personal protective equipment used when forming and joining engineering materials for a variety of industrial tasks to include:</p> <ul style="list-style-type: none"> <li>a. boots</li> <li>b. overalls</li> <li>c. aprons</li> <li>d. gloves</li> <li>e. headwear</li> <li>f. eye protection</li> <li>g. face masks</li> <li>h. hearing protection</li> </ul> <p>1.2. Equipment used to protect the environment and colleagues when forming and joining engineering materials for a variety of industrial tasks to include:</p> <ul style="list-style-type: none"> <li>a. screens</li> <li>b. fume extraction</li> <li>c. work area cleanliness</li> <li>d. lifting and work holding equipment</li> <li>e. disposal of waste materials</li> </ul> <p>1.3. Examples of health risks associated with bad practice when forming and joining engineering materials to include:</p> <ul style="list-style-type: none"> <li>a. Burns</li> <li>b. cuts and infection</li> <li>c. eye damage</li> <li>d. ultra violet rays</li> <li>e. lung damage</li> <li>f. industrial dermatitis</li> <li>g. zinc fume fever</li> <li>h. carcinogenic fume etc</li> </ul>
<p>2. Be able to work safely whilst forming and joining materials in an engineering environment</p>	<p>2.1. Assess risks prior to performing forming and joining operations</p> <p>2.2. Safe working practices at all times whilst performing forming and joining operations</p>



<p>3. Understand tools, equipment and processes used when forming and joining engineering materials</p>	<p>3.1. A range of forming equipment and hand tools used in the engineering environment to include:</p> <ul style="list-style-type: none"><li>a. pinch and pyramid rolls</li><li>b. guillotines</li><li>c. folding equipment</li><li>d. universal swaging machines</li><li>e. fly press</li><li>f. hammers</li><li>g. mallets</li><li>h. dollies</li><li>i. hand shears</li><li>j. G clamps</li><li>k. mole grips</li><li>l. files</li><li>m. drills</li><li>n. rules</li><li>o. squares</li><li>p. scribes</li><li>q. odd leg calipers</li><li>r. dividers</li></ul> <p>3.2. A range of joining equipment used in the engineering environment</p> <p>3.3. Compare a range of joining processes and the factors which effect their selection to include:</p> <ul style="list-style-type: none"><li>a. cost</li><li>b. fixing restrictions</li><li>c. type of material</li><li>d. permanence of joint</li><li>e. position of joint</li><li>f. joint operating conditions</li><li>g. equipment availability</li></ul>
<p>4. Be able to join engineering materials applicable to the task.</p>	<p>4.1. Demonstrate the MIG, MAG or TIG welding process to include:</p> <ul style="list-style-type: none"><li>a. gas cylinder</li><li>b. regulator / flow meter</li><li>c. welding torch</li><li>d. wire reel</li><li>e. pinch rollers</li><li>f. tensioner</li><li>g. drive motor</li><li>h. torch liner</li><li>i. contact tip</li><li>j. earth clamp</li><li>k. operating switch</li><li>l. voltage switch</li><li>m. wire speed potentiometer</li></ul> <p>4.2. Demonstrate Resistance Spot welding</p> <p>4.3. Apply joining techniques using adhesives.</p> <p>4.4. Assess completed material joining tasks for quality and functionality to include:</p> <ul style="list-style-type: none"><li>a. joint design</li><li>b. joint preparation</li><li>c. torch speed</li><li>d. torch angles</li><li>e. machine settings</li></ul>





<b>UNIT REF: ET219</b>	<b>UNIT TITLE: ELECTRICAL / ELECTRONIC SYSTEM MAINTENANCE 12 / 24 VOLT</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
<p>Rationale: This unit enables the learner to develop an understanding of the principles, construction and operation and testing methods of common electrical and electronic systems and components. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.</p>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Understand electrical and electronic principles	1.1. Identify electrical symbols and units found in low voltage circuits 1.2. Identify different electrical circuits; series, parallel and series/parallel 1.3. Describe how to interpret basic wiring diagrams 1.4. Describe the operation of circuit protection devices and why these are necessary 1.5. Describe earthing principles and earthing methods 1.6. Compare the use of cables and connectors in different low voltage circuits 1.7. Describe the operation of electrical and electronic sensors and actuators and their applications 1.8. Describe key electrical and electronic control principles related to circuits 1.9. State common terms used in low voltage circuits 1.10. Define the following terms in relation to electronic principles to include: <ul style="list-style-type: none"> <li>a. Binary code</li> <li>b. Bit</li> <li>c. CAN bus</li> <li>d. Logic gate</li> </ul> 1.11. Describe the principles of electrical inputs, outputs, voltages, oscilloscope patterns, digital and fibre optics. 1.12. Describe the principles of sensor inputs, computer processing and actuator outputs. 1.13. Identify sensor types (passive and active) 1.14. Describe how electrical / electronic systems interlink and interact, including multiplexing and fibre optics



<p>2. Understand how batteries, starting and charging systems operate in low voltage circuits</p>	<p>2.1. Identify batteries, starting and charging system components</p> <p>2.2. Describe the construction and operation of batteries, starting and charging system components</p> <p>2.3. Describe how to remove and replace batteries, starting and charging system units and components</p> <p>2.4. Compare batteries, starting and charging system components and assemblies against alternatives to identify differences in construction and operation</p> <p>2.5. State common terms used in conjunction with batteries, starting and charging systems</p>
<p>3. Be able to carry out testing, removal and replacement of components in low voltage circuits</p>	<p>3.1. Select and use a range of personal protective equipment and protective coverings throughout all activities</p> <p>3.2. Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment.</p> <p>3.3. Select the appropriate tools and equipment necessary for carrying out designated tasks</p> <p>3.4. Use the correct tools and equipment in the way specified by manufacturers</p> <p>3.5. Select and use a range of suitable sources of technical information to designated tasks, including:</p> <ul style="list-style-type: none"><li>a. technical data</li><li>b. maintenance procedures</li><li>c. legal requirements</li></ul> <p>3.6. Perform tests and removal and replacement activities on a range of components from low voltage systems following the manufacturer's current practice to include:</p> <ul style="list-style-type: none"><li>a. electro/mechanical devices</li><li>b. electronic sensors</li></ul> <p>3.7. Assess the performance of all replaced and adjusted components and systems accurately</p> <p>3.8. Complete work records and any further recommendations / additional faults found, in a suitable format</p>



**UNIT REF: ET220**

**UNIT TITLE: MECHANICAL SYSTEMS AND THEIR MAINTENANCE**

**Level: 2**

**GLH: 60**

Rationale: This unit will support the development of the knowledge and skills necessary for the learner to understand and maintain mechanical systems in the engineering environment.

LEARNING OUTCOMES	CONTENT
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know about bearings, seals and lubricants used in an engineering environment	1.1. Describe the adjustment procedures for taper roller bearings  1.2. Explain the meaning of the term 'preload' when applied to bearings  1.3. Describe static and dynamic methods of sealing mechanical components in an engineering environment to include: <ul style="list-style-type: none"> <li>a. gaskets</li> <li>b. lip seals</li> <li>c. 'o' rings</li> <li>d. Sealing compound</li> <li>e. Silicon gasket</li> </ul> 1.4. Describe how to identify the codes and grades of lubricants (where applicable) used for: to include: <ul style="list-style-type: none"> <li>a. internal combustion engines</li> <li>b. transmission units</li> <li>c. bushes and needle roller bearings</li> </ul> 1.5. Describe the function of additives used in modern engine and transmission oils to include: <ul style="list-style-type: none"> <li>a. anti-oxidants</li> <li>b. detergents</li> <li>c. viscosity index improvers</li> <li>d. extreme pressure additives</li> <li>e. friction reducers</li> </ul>



<p>2. Know about gearboxes and transmission systems used in an engineering environment</p>	<p>2.1. Describe the meaning of the following terms when applied to gearbox and transmission systems to include:</p> <ul style="list-style-type: none"><li>a. manual</li><li>b. automatic</li><li>c. continuously variable</li><li>d. hydrostatic</li><li>e. dual clutch</li><li>f. torque converter</li><li>g. centrifugal clutch</li><li>h. multi plate clutch</li></ul> <p>2.2. Describe the maintenance requirements of drive arrangements to include:</p> <ul style="list-style-type: none"><li>a. chain</li><li>b. belt</li><li>c. shaft</li></ul> <p>2.3. Understand compound gear ratios to include:</p> <ul style="list-style-type: none"><li>a. effects on ratios</li><li>b. shaft speeds</li><li>c. torque</li><li>d. direction</li><li>e. idler gears</li></ul>
<p>3. Know about braking systems used in an engineering environment</p>	<p>3.1. Describe the basic principle of operation of the following brake types to include:</p> <ul style="list-style-type: none"><li>a. friction</li><li>b. pumping</li><li>c. electromagnetic</li></ul> <p>3.2. Give the advantages of using hydraulic fluid over mechanical linkages when operating braking systems</p> <p>3.3. List the main characteristics and maintenance requirements of modern hydraulic brake fluids</p> <p>3.4. Describe the principles of operation of antilock braking as used on many modern vehicles.</p>
<p>4. Know about mechanical linkages used in an engineering environment</p>	<p>4.1. Describe types of mechanical linkages used on machines and assemblies in an engineering environment to transmit movement to include:</p> <ul style="list-style-type: none"><li>a. cables</li><li>b. rods</li><li>c. cams</li><li>d. cranks</li></ul> <p>4.2. Describe the use of linkages to:</p> <ul style="list-style-type: none"><li>a. convert linear movement to rotary motion</li><li>b. rotary motion to linear movement to include</li></ul> <p>4.3. Describe and give an example of the use of acute and obtuse angles in linkage assemblies to create differing angles of rotation</p> <p>4.4. Compare different methods of joining linkages and shafts to other mechanical components</p>



<p>5. Be able to carry out routine maintenance on systems used in an engineering environment</p>	<p>5.1. Use appropriate Personal Protective Equipment when working on mechanical systems</p> <p>5.2. Use safe working practices when working on mechanical systems</p> <p>5.3. Select appropriate information and technical data necessary to complete routine maintenance on mechanical systems</p> <p>5.4. Perform a fluid filter change on an internal combustion engine or hydraulic system</p> <p>5.5. Inspect and tension a drive belt or drive chain on an internal combustion engine or transmission system</p> <p>5.6. Replace the fluid in a hydraulic system</p>
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<b>UNIT REF: ET221</b>	<b>UNIT TITLE: INTERNAL COMBUSTION ENGINES, COMPONENTS AND SYSTEMS</b>
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<b>Level: 2</b>	<b>GLH: 55</b>
<p>Rationale: This unit enables the learner to develop an understanding of the construction and operation of common internal combustion engine mechanical, lubrication, cooling, fuel, ignition, air and exhaust systems. It also enables the learner to develop the skills required when removing and replacing system components and for the evaluation of their performance.</p>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
<p>1. Know internal combustion engine mechanical systems components and principles</p>	<p>1.1. Describe internal combustion engine mechanical systems and components</p> <p>1.2. Describe the construction and operation of internal combustion engine mechanical systems to include:</p> <ul style="list-style-type: none"> <li>a. four stroke</li> <li>b. spark ignition</li> <li>c. compression ignition</li> <li>d. rotary</li> </ul> <p>1.3. Compare key internal combustion engine mechanical system components and assemblies against alternatives to identify differences in construction and operation</p> <p>1.4. Define the following engine related terms to include:</p> <ul style="list-style-type: none"> <li>a. compression ratio</li> <li>b. cylinder capacity</li> <li>c. power</li> <li>d. torque</li> <li>e. tdc</li> <li>f. bdc</li> <li>g. stroke</li> <li>h. bore</li> </ul>
<p>2. Know internal combustion engine lubrication system components and principles</p>	<p>2.1. Describe internal combustion engine lubrication systems and components</p> <p>2.2. Describe the construction and operation of internal combustion engine lubrication components and systems to include:</p> <ul style="list-style-type: none"> <li>a. full flow</li> <li>b. by pass</li> <li>c. wet sump</li> <li>d. dry sump</li> </ul> <p>2.3. Compare key internal combustion engine lubrication system components and assemblies to identify differences in construction and operation</p> <p>2.4. Describe the key engineering principles that are related to internal combustion engine lubrication systems to include:</p> <ul style="list-style-type: none"> <li>a. classification of lubricants</li> <li>b. properties of lubricants</li> <li>c. methods of reducing friction</li> </ul>



<p>3. Know internal combustion engine cooling, heating and ventilation system components and principles</p>	<p>3.1. Describe internal combustion engine cooling, heating and ventilation systems and components</p> <p>3.2. Describe the construction and operation of internal combustion engine cooling, heating and ventilation systems</p> <p>3.3. Compare key internal combustion engine cooling, heating and ventilation system components and assemblies against alternatives to identify differences in construction and operation</p> <p>3.4. Define the following terms in relation to internal combustion engine cooling, heating and ventilation systems to include:</p> <ul style="list-style-type: none"><li>a. heat transfer</li><li>b. linear and cubical expansion</li><li>c. specific heat capacity</li><li>d. boiling point of liquids</li></ul>
<p>4. Know internal combustion engine fuel system components and principles</p>	<p>4.1. Describe a range of internal combustion engine fuel systems and components</p> <p>4.2. Describe the construction and operation of internal combustion engine fuel systems to include:</p> <ul style="list-style-type: none"><li>a. multi point injection</li><li>b. single point injection</li><li>c. direct injection</li><li>d. indirect injection</li></ul> <p>4.3. Compare key internal combustion engine fuel system components and assemblies against alternatives to identify differences in construction and operation</p> <p>4.4. Describe the key engineering principles that are related to internal combustion engine fuel systems to include:</p> <ul style="list-style-type: none"><li>a. properties of fuels</li><li>b. combustion processes</li><li>c. exhaust gas constituents</li></ul>
<p>5. Know internal combustion engine ignition system components and principles</p>	<p>5.1. Describe internal combustion engine ignition systems and components</p> <p>5.2. Describe the construction and operation of internal combustion engine ignition systems to include:</p> <ul style="list-style-type: none"><li>a. distributor ignition systems</li><li>b. distributor less ignition systems</li></ul> <p>5.3. Compare key internal combustion engine ignition system components and assemblies against alternatives to identify differences in construction and operation</p> <p>5.4. Describe the key engineering principles that are related to internal combustion engine ignition systems to include:</p> <ul style="list-style-type: none"><li>a. flame travel</li><li>b. ignition timing</li></ul>



<p>6. Know internal combustion engine air supply and exhaust system components and principles</p>	<p>6.1. Describe internal combustion engine air supply and exhaust systems and components</p> <p>6.2. Describe the construction and operation of internal combustion engine air supply and exhaust systems to include:</p> <ul style="list-style-type: none"><li>a. supercharging</li><li>b. turbo charging</li><li>c. exhaust gas re-circulation (EGR)</li><li>d. secondary air injection</li><li>e. catalytic converters</li></ul> <p>6.3. Compare key internal combustion engine air supply and exhaust system components and assemblies against alternatives to identify differences in construction and operation</p> <p>6.4. Describe the key engineering principles that are related to internal combustion engine air supply and exhaust systems to include:</p> <ul style="list-style-type: none"><li>a. sound absorption</li><li>b. reduction of harmful emissions</li></ul>
<p>7. Be able to remove, replace and test a range of internal combustion engine systems, units and components.</p>	<p>7.1. Use suitable personal protective equipment and vehicle coverings throughout all internal combustion engine system, unit and component removal and replacement activities</p> <p>7.2. Perform tasks in a way which minimises the risk of damage or injury to people and the environment</p> <p>7.3. Use a range of technical information to support internal combustion engine system, unit and component removal and replacement activities</p> <p>7.4. Use a range of correctly selected tools and equipment in the way specified by manufacturers to remove and replace internal combustion engine system, units and components</p> <p>7.5. Perform the removal and replacement of internal combustion engine systems, units and components, adhering to the correct specifications and tolerances, following to include:</p> <ul style="list-style-type: none"><li>a. the manufacturer's approved removal and replacement methods</li><li>b. recognised researched repair methods</li><li>c. health and safety requirements.</li></ul> <p>7.6. Ensure that replacement internal combustion engine systems, units and components conform to the vehicle operating specification and any legal requirements</p> <p>7.7. Demonstrate a range of suitable testing methods to evaluate the performance of the reassembled internal combustion engine systems and components</p> <p>7.8. Ensure that the reassembled internal combustion engine systems performs to the vehicle operating specification and meets any legal requirements</p> <p>7.9. Complete work records and further recommendations / additional faults found, in a suitable format</p>





<b>UNIT REF: ET223</b>	<b>UNIT TITLE: COMPUTER AIDED DRAWING IN AN ENGINEERING ENVIRONMENT</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
Rationale: This unit will enable the learner to develop the knowledge and skills necessary to produce basic engineering drawings to industry standards using a computer aided drawing system	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know the risk to Health and Safety resulting from the use of computer equipment	1.1. Identify the hazards associated with the use of visual display equipment and peripheral external devices to include: <ol style="list-style-type: none"> <li>a. electrical</li> <li>b. upper limb disorders</li> <li>c. screen glare</li> <li>d. eye strain</li> <li>e. muscular ailments</li> <li>f. posture</li> </ol> 1.2. Describe the requirements of a suitable workstation and working environment for the safe use of computer equipment to include: <ol style="list-style-type: none"> <li>a. seating</li> <li>b. lighting</li> <li>c. ventilation</li> <li>d. wrist/foot support</li> <li>e. working space</li> <li>f. ergonomic workstation design</li> </ol> 1.3. Describe the requirements of relevant health and safety legislation to include: <ol style="list-style-type: none"> <li>a. Health and Safety (Display Screen Equipment) Regulations 1992</li> </ol>
2. Know how to configure the computer aided drawing system to suit drawing requirements	2.1. State computer operating systems commonly used by computer aided drawing applications to include: <ol style="list-style-type: none"> <li>a. Windows based systems</li> <li>b. Apple-Mac based systems</li> <li>c. Other operating systems</li> </ol> 2.2. Describe the reasons for and typical content of system log-in procedures to include: <ol style="list-style-type: none"> <li>a. system security</li> <li>b. system allocation and monitoring</li> </ol> 2.3. Describe parameters that can be set by the user during system configuration to include: <ol style="list-style-type: none"> <li>a. drawing templates</li> <li>b. sheet sizes</li> <li>c. drawing limits and units</li> <li>d. scales</li> <li>e. line types</li> <li>f. text and dimensions styles</li> <li>g. screen displays</li> <li>h. drawing origin and datum</li> <li>i. drawing layers</li> <li>j. peripheral device input and output procedures</li> <li>k. customised menus</li> </ol>



	<p>2.4. Compare the benefits and limitations of the use of computer software in comparison to conventional drawing methods to include:</p> <ul style="list-style-type: none"><li>a. productivity and speed of drawing creation</li><li>b. accuracy of drawn components</li><li>c. uniformity of production</li><li>d. modification/editing</li><li>e. storage space required</li><li>f. standardised parts, symbols etc.</li><li>g. working practices</li><li>h. electronic data exchange and transfer</li></ul>
<p>3. Know the requirements to comply with national and international drawing standards</p>	<p>3.1. Describe the national and international standards and conventions that relate to engineering drawing practice</p> <p>3.2. Describe the features of a computer aided drawing that need to comply with national and international standards to include</p> <ul style="list-style-type: none"><li>a. drawing sheet sizes and layouts</li><li>b. projection - first and third angle</li><li>c. types of line</li><li>d. lettering and numbering</li><li>e. dimensioning</li><li>f. section cross hatching</li></ul> <p>3.3. Describe typical examples of standard symbols and representations used within computer aided drawing to include</p> <ul style="list-style-type: none"><li>a. welding symbols</li><li>b. electrical symbols</li><li>c. pneumatic symbols</li><li>d. mechanical symbols</li><li>e. standard representations</li></ul>
<p>4. Know how to use computer aided drawing software for the production of industry standard engineering drawings</p>	<p>4.1. State the requirements of drawing datum selection to include:</p> <ul style="list-style-type: none"><li>a. acting as a point of reference</li><li>b. ease of use</li><li>c. compatibility with other uses – e.g. CNC programming</li></ul> <p>4.2. Describe different co-ordinate input methods to include:</p> <ul style="list-style-type: none"><li>a. absolute</li><li>b. relative/incremental</li><li>c. polar</li></ul> <p>4.3. Describe methods of adding dimensions and text to drawn geometry to create a working drawing to include:</p> <ul style="list-style-type: none"><li>a. linear dimensions</li><li>b. radial dimensions</li><li>c. angular dimensions</li><li>d. leaders dimensions</li><li>e. text dimensions</li><li>f. tolerances dimensions</li><li>g. text location</li><li>h. text font type</li><li>i. text size</li><li>j. text orientation</li></ul> <p>4.4. State the types of geometry that can be drawn to include:</p>



	<ul style="list-style-type: none"><li>a. lines</li><li>b. circles</li><li>c. arcs</li><li>d. ellipses</li><li>e. splines</li></ul> <p>4.5. Describe the use of the drawing aids that are available to include:</p> <ul style="list-style-type: none"><li>a. coordinate grids and snaps</li><li>b. object snaps</li></ul> <p>4.6. State the benefits of using drawing templates</p> <p>4.7. Describe the type of devices available to produce hard copy of the completed drawing</p>
<p>5. Know how to use layers, copy, modify and manipulate drawn entries to maintain drawing efficiency</p>	<p>5.1. Describe layer definition and management</p> <p>5.2. Give advantages of entities that can be edited or modified to include:</p> <ul style="list-style-type: none"><li>a. size</li><li>b. position</li><li>c. orientation</li></ul> <p>5.3. State the ways in which entities can be modified/manipulated to aid drawing efficiency to include:</p> <ul style="list-style-type: none"><li>a. scaling</li><li>b. mirroring</li><li>c. rotating</li><li>d. trimming</li><li>e. moving/translating</li><li>f. corner filleting/chamfering</li><li>g. exploding</li><li>h. copying</li><li>i. arrays/patterns</li><li>j. extending</li><li>k. stretching</li><li>l. erasing</li></ul>



6. Be able to produce a computer aided drawing to industrial standard	<ul style="list-style-type: none"><li>6.1. Use computer equipment and external peripheral devices safely</li><li>6.2. Locate and load drawing software applications and log into the system using appropriate procedures</li><li>6.3. Respond to screen displays and system prompts</li><li>6.4. Set drawing parameters appropriate to the task</li><li>6.5. Use data input methods that are appropriate and available</li><li>6.6. Apply drawing parameters and settings to ensure compliance with BS, EN and ISO drawing standards</li><li>6.7. Devise suitable drawing layouts and sheets that meet recognised drawing standards and conventions</li><li>6.8. Use recognised standard symbols and representations appropriately within drawings</li><li>6.9. Use commands and menus to create drawn geometry and drawing aids to achieve accurate geometry creation and positioning</li><li>6.10. Dimension the drawn product appropriately and add suitable text where required by the task</li><li>6.11. Create and use drawing templates</li><li>6.12. Save partially and fully completed work at appropriate intervals</li><li>6.13. Set peripheral device parameters and produce hard copies of drawings</li><li>6.14. Create and use layers to aid drawing efficiency</li><li>6.15. Use commands and menus on entities to modify properties, copy to other locations, erase geometry and manipulate position and orientation</li><li>6.16. Close the software and computer system down in line with recognised procedures on completion of the task or work period</li></ul>
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<b>UNIT REF: ET124</b>	<b>UNIT TITLE: CYCLE CONSTRUCTION AND ROUTINE MAINTENANCE</b>
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<b>Level: 1</b>	<b>GLH: 26</b>
<p>Rationale: This unit will enable the learner to develop an understanding of:</p> <ul style="list-style-type: none"> <li>• fundamental principles of cycle construction</li> <li>• features associated with cycle design</li> <li>• Routine cycle maintenance activities</li> </ul>	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know the different types of cycles and design features	<p>1.1. Different types of cycles and their purpose to include:</p> <ol style="list-style-type: none"> <li>BMX</li> <li>racing</li> <li>mountain</li> <li>tourer</li> </ol> <p>1.2. The location of the main components to include:</p> <ol style="list-style-type: none"> <li>frame</li> <li>handlebars</li> <li>seat post</li> <li>gears</li> <li>brake components</li> <li>front and rear brake levers</li> <li>forks</li> <li>headset /yoke</li> <li>suspension</li> <li>chain and sprockets</li> </ol> <p>1.3. The operation of gears and the need for gear ratios to include:</p> <ol style="list-style-type: none"> <li>chains</li> <li>front sprockets</li> <li>rear sprockets</li> <li>derailleur types</li> <li>ratios</li> </ol>
2. Know about routine maintenance activities on cycles	<p>2.1. The need for routine maintenance on cycles to include:</p> <ol style="list-style-type: none"> <li>chain lubrication</li> <li>brake cable (level end) adjustment</li> <li>seat adjustment</li> <li>handlebar adjustment</li> <li>tyre condition and pressures</li> <li>cable condition and lubrication</li> </ol> <p>2.2. The regular checks that are required to maintain a cycle in good condition to include:</p> <ol style="list-style-type: none"> <li>chain lubrication</li> <li>brake cable (level end) adjustment</li> <li>seat adjustment</li> <li>handlebar adjustment</li> <li>tyre condition and pressures</li> <li>cable condition and lubrication</li> </ol>



<p>3. Carry out routine maintenance activities on cycles</p>	<p>3.1. Suitable personal protective equipment when working on cycles to include:</p> <ul style="list-style-type: none"><li>a. gloves</li><li>b. protective clothing</li><li>c. eyewear</li><li>d. footwear</li></ul> <p>3.2. Suitable sources of technical information to include:</p> <ul style="list-style-type: none"><li>a. manufacturer's instructions from distributors and websites</li><li>b. specific brand maintenance requirements</li><li>c. servicing criteria</li></ul> <p>3.3. Carry out the removal and replacement of cycle components required for routine maintenance to include:</p> <ul style="list-style-type: none"><li>a. frame</li><li>b. handlebars</li><li>c. seat post</li><li>d. gears</li><li>e. brake components</li><li>f. front and rear brake levers</li><li>g. forks</li><li>h. headset /yoke</li><li>i. suspension</li><li>j. chain and sprockets</li></ul> <p>3.4. Locate and repair a puncture to a cycle wheel and inner tube to include:</p> <ul style="list-style-type: none"><li>a. tyre removal, fitting and checking for damage</li><li>b. inner tube removal, fitting and checking for damage</li><li>c. finding holes in tubes and tyres</li><li>d. types and causes of punctures</li><li>e. repairing tubes</li><li>f. tyre inflation</li></ul> <p>3.5. Carry out basic adjustments to cycle components and systems to include:</p> <ul style="list-style-type: none"><li>a. frame</li><li>b. handlebars</li><li>c. seat post</li><li>d. gears</li><li>e. brake components</li><li>f. front and rear brake levers</li><li>g. forks</li><li>h. headset /yoke</li><li>i. suspension</li><li>j. chain and sprockets</li></ul>
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<b>UNIT REF: ET225</b>	<b>UNIT TITLE: METAL INERT GAS MIG BRAZING OPERATIONS</b>
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<b>Level: 2</b>	<b>GLH: 30</b>
Rationale: This unit enables the learner to develop the knowledge and skills required when joining materials using Metal Inert Gas (MIG) brazing operations, techniques and procedures	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to work safely whilst using MIG brazing techniques	1.1. Health, safety and legal requirements relating to the joining of materials using MIG brazing techniques to include: <ol style="list-style-type: none"> <li>Health and safety</li> <li>risk assessment</li> <li>Personal Protective Equipment (PPE)</li> <li>relevant regulations and legislation</li> <li>welfare</li> <li>codes of practice</li> </ol> 1.2. Importance of selecting, using and maintaining the appropriate personal protective equipment when joining materials using MIG brazing techniques 1.3. Use of suitable Personal Protective Equipment (PPE) and vehicle coverings throughout all vehicle body MIG brazing operations 1.4. Perform in a way which minimises the risk of damage or injury to the vehicle, people and the environment
2. Know how to select, check, use and maintain appropriate tools and equipment used in MIG brazing operations	2.1. Tools and equipment required to join materials using MIG brazing operations 2.2. Select, prepare and maintain the appropriate tools and equipment necessary for carrying out MIG brazing operations safely 2.3. Set up and safely use the correct tools and equipment in the way specified by manufacturers when carrying out MIG brazing operations 2.4. Clean and store PPE and equipment in the appropriate manner
3. Know how to carry out MIG brazing operations	3.1. The importance of correct surface preparation methods to ensure a good MIG brazing operation is achieved 3.2. The need for alignment/mating of materials and the best methods used to achieve this in MIG brazing operations 3.3. The processes, techniques and joints used for MIG brazing operations, to include: to include: <ol style="list-style-type: none"> <li>lap slot</li> <li>lap seam</li> <li>butt joint</li> </ol> 3.4. The faults and defects that can occur when carrying out MIG brazing operation



	<p>3.5. Common causes of faults and defects in the MIG brazing process</p> <p>3.6. the types of quality control checks that can to include be used to ensure correct joining of materials</p> <p>3.7. How to inspect and assess MIG brazing operation in accordance with Industry Standards</p> <p>3.8. Advantages and disadvantages of the MIG brazing operation over other welding methods</p>
<p>4. Be able to prepare for, carry out and test, MIG brazing operations</p>	<p>4.1. Suitable sources of technical information to support MIG brazing activities to include:</p> <ul style="list-style-type: none"><li>a. technical data</li><li>b. welding procedures</li><li>c. legal requirements</li></ul> <p>4.2. Surface preparation operations to ensure a correct MIG braze is achieved</p> <p>4.3. Apply alignment, and mating treatment to flanges to enable a suitable join to be achieved</p> <p>4.4. Perform MIG brazing operations on test pieces to include:</p> <ul style="list-style-type: none"><li>a. lap slot</li><li>b. lap seam</li><li>c. butt joint</li></ul> <p>4.5. Perform MIG brazing operations without damaging other systems, components, units, panels and surfaces in the surrounding work area, following to include</p> <ul style="list-style-type: none"><li>a. manufacturers processes, methods and procedures</li><li>b. test procedures, providing test coupons on equivalent material in accordance with Industry Standards</li><li>c. recognised researched repair methods</li></ul> <p>4.6. Dress the weld area without reducing material thickness and protect the area to inhibit corrosion where applicable</p> <p>4.7. Assess when the weld is not forming correctly and what action needs to be taken</p> <p>4.8. Assess all MIG brazing operations for quality and integrity in accordance with Industry Standards and manufacturers specification</p> <p>4.9. Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p>





<b>UNIT REF: ET226</b>	<b>UNIT TITLE: METAL ACTIVE GAS MAG WELDING TECHNIQUES</b>
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<b>Level: 2</b>	<b>GLH: 30</b>
Rationale: This unit enables the learner to develop the knowledge and skills required when joining carbon steels using Metal Active Gas Shielding (MAGS) welding techniques. It also covers the evaluation of the completed welded component	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to work safely when carrying out MAGS welding operations	1.1. Health, safety and legal requirements relating to the joining of carbon steels using MAGS welding techniques to include: <ol style="list-style-type: none"> <li>health and safety</li> <li>risk assessment</li> <li>Personal Protective Equipment (PPE)</li> <li>relevant regulations and legislation</li> <li>welfare</li> <li>codes of practice</li> </ol> 1.2. The importance of selecting, using and maintaining the appropriate personal protective equipment when joining carbon steels using MAGS welding techniques 1.3. The use of suitable Personal Protective Equipment (PPE) and coverings throughout all MAGS welding operations 1.4. Perform in a way which minimises the risk of damage or injury to people and the environment
2. Know how to select, check, use and maintain appropriate tools and equipment used in MAGS welding operations	2.1. The tools and equipment required to join carbon steels using MAGS welding techniques 2.2. Select, prepare and maintain the appropriate tools and equipment necessary for carrying out MAGS welding operations safely 2.3. Set up and safely use the correct tools and equipment in the way specified by manufacturers when carrying out MAGS welding 2.4. Clean and store PPE and equipment in the appropriate manner



<p>3. Know how to carry out MAGS welding operations</p>	<p>3.1. The importance of correct surface preparation methods to ensure a good MAGS weld is achieved</p> <p>3.2. The need for alignment / mating of carbon steels and the best methods used to achieve this in MAGS welding operations</p> <p>3.3. Processes, techniques and joints used in MAGS welding, to include:</p> <ul style="list-style-type: none"><li>a. plug</li><li>b. lap</li><li>c. butt</li><li>d. fillet</li></ul> <p>3.4. Faults and defects that can occur when MAGS welding</p> <p>3.5. Common causes of faults and defects in the MAGS welding process</p> <p>3.6. The types of quality control checks that can be used to ensure correct joining of materials</p> <p>3.7. How to inspect and assess MAGS welding in accordance with Industry Standards</p> <p>3.8. Advantages and disadvantages of MAGS welding over other welding methods</p>
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<p>4. Be able to prepare for, carry out and test MAG welding operations</p>	<p>4.1. Select and use suitable sources of technical information to support MAGS welding activities, including:</p> <ul style="list-style-type: none"><li>a. technical data</li><li>b. welding procedures</li><li>c. legal requirements</li></ul> <p>4.2. Perform surface preparation operations to ensure a correct MAGS weld is achieved</p> <p>4.3. Apply alignment, and mating treatment to flanges to enable a suitable join to be achieved</p> <p>4.4. Perform MAGS welding operations on test pieces, to include:</p> <ul style="list-style-type: none"><li>a. lap plug</li><li>b. lap seam</li><li>c. butt joint</li><li>d. fillet joint</li></ul> <p>4.5. Perform MAGS welding operations without damaging other systems, components, units, panels and surfaces in the surrounding work area, following:</p> <ul style="list-style-type: none"><li>a. manufacturers processes, methods and procedures</li><li>b. test procedures, providing test coupons on equivalent material in accordance with Industry Standards</li><li>c. recognised researched repair methods</li></ul> <p>4.6. Dress the weld area without reducing material thickness and protect the area to inhibit corrosion where applicable</p> <p>4.7. Assess when the weld is not forming correctly and what action needs to be taken</p> <p>4.8. Assess all MAGS welding operations for quality and integrity in accordance with Industry Standards and manufacturers specification</p> <p>4.9. Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p>
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**UNIT REF: ET227**

**UNIT TITLE: TUNGSTEN INERT GAS TIG WELDING TECHNIQUES**

**Level: 2**

**GLH: 30**

Rationale: This unit enables the learner to develop the knowledge and skills required when joining metal using Tungsten Inert Gas (TIG) welding techniques. It also covers the evaluation of the completed weld

LEARNING OUTCOMES	CONTENT
The Learner will:	The Learner should be taught
<p>1. Know how to work safely when carrying out TIG welding operations</p>	<p>1.1. Describe the health, safety and legal requirements relating to the joining of metals using TIG welding techniques to include:</p> <ul style="list-style-type: none"> <li>a. health and safety</li> <li>b. risk assessment</li> <li>c. Personal Protective Equipment (PPE)</li> <li>d. relevant regulations and legislation</li> <li>e. welfare</li> <li>f. codes of practice</li> </ul> <p>1.2. Describe the importance of selecting, using and maintaining the appropriate personal protective equipment when joining metals using TIG welding techniques</p> <p>1.3. Demonstrate the use of suitable Personal Protective Equipment (PPE) and coverings throughout all TIG welding operations</p> <p>1.4. Perform in a way which minimises the risk of damage or injury to people and the environment</p>
<p>2. Know how to select, check, use and maintain appropriate tools and equipment used in TIG welding operations</p>	<p>2.1. Describe the tools and equipment required to join metal using TIG welding techniques</p> <p>2.2. Select, prepare and maintain the appropriate tools and equipment necessary for carrying out TIG welding operations safely</p> <p>2.3. Set up and safely use the correct tools and equipment in the way specified by manufacturers when carrying out TIG welding operations</p> <p>2.4. Clean and store PPE and equipment in the appropriate manner</p>
<p>3. Know how to carry out TIG welding operations</p>	<p>3.1. Explain the importance of correct surface preparation methods to ensure a good TIG weld is achieved</p> <p>3.2. Identify the need for alignment / mating of carbon steels and the best methods used to achieve this in TIG welding operations</p> <p>3.3. Describe the processes, techniques and joints used in TIG welding, to include:</p> <ul style="list-style-type: none"> <li>a. plug</li> <li>b. lap</li> <li>c. butt</li> <li>d. fillet</li> <li>e. spot</li> </ul>



	<p>3.4. Describe the faults and defects that can occur when TIG welding</p> <p>3.5. Describe common causes of faults and defects in the TIG welding process</p> <p>3.6. Describe the types of quality control checks that can be used to ensure correct joining of materials</p> <p>3.7. Describe how to inspect and assess TIG welding in accordance with Industry Standards</p> <p>3.8. Give advantages and disadvantages of TIG welding over other welding methods</p>
<p>4. Be able to prepare for, carry out and test TIG welding operations</p>	<p>4.1. Select and use suitable sources of technical information to support TIG welding activities, including:</p> <ul style="list-style-type: none"><li>a. technical data</li><li>b. welding procedures</li><li>c. legal requirements</li></ul> <p>4.2. Perform surface preparation operations to ensure a correct TIG weld is achieved</p> <p>4.3. Apply alignment, and mating treatment to flanges to enable a suitable join to be achieved</p> <p>4.4. Perform TIG welding operations on test pieces to include:</p> <ul style="list-style-type: none"><li>a. lap plug</li><li>b. lap seam</li><li>c. butt joint</li><li>d. fillet joint</li></ul> <p>4.5. Perform TIG welding operations without damaging other systems, components, units, panels and surfaces in the surrounding work area, following to include:</p> <ul style="list-style-type: none"><li>a. manufacturers processes, methods and procedures</li><li>b. test procedures, providing test coupons on equivalent material in accordance with Industry Standards</li><li>c. recognised researched repair methods</li></ul> <p>4.6. Dress the weld area without reducing material thickness and protect the area to inhibit corrosion where applicable</p> <p>4.7. Assess when the weld is not forming correctly and what action needs to be taken</p> <p>4.8. Assess all TIG welding operations for quality and integrity in accordance with Industry Standards and manufacturers specification</p> <p>4.9. Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p>



<b>UNIT REF: ET228</b>	<b>UNIT TITLE: HYDRAULIC AND PNEUMATIC PRINCIPLES</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
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Rationale: This unit will enable the learner to develop the knowledge and skills needed when working with hydraulic and pneumatic diagrams, circuits and components in an engineering environment.

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know hydraulic principles when applied in an engineering environment	1.1. Select hydraulic circuit components from standard symbols used in circuit diagrams  1.2. Describe the function of a range of hydraulic circuit components to include: <ul style="list-style-type: none"> <li>a. pumps</li> <li>b. compressors</li> <li>c. motors</li> <li>d. valves</li> <li>e. accumulators</li> <li>f. filters</li> </ul> 1.3. Describe principles of hydraulic circuits operation to include: <ul style="list-style-type: none"> <li>a. fluid storage</li> <li>b. pressure generation</li> <li>c. flow</li> <li>d. return and control</li> <li>e. actuation</li> <li>f. indication</li> </ul> 1.4. Differentiate between similar types of hydraulic system components.  1.5. Describe common hydraulic system faults to include: <ul style="list-style-type: none"> <li>a. noise</li> <li>b. air ingress</li> <li>c. external fluid leaks</li> <li>d. overheating</li> <li>e. internal leaks</li> <li>f. seizure</li> </ul> 1.6. Describes the hazards involved when working with hydraulic systems to include: <ul style="list-style-type: none"> <li>a. skin contamination</li> <li>b. high pressures</li> <li>c. incorrect disconnection of system</li> <li>d. incorrect use of tools and test equipment</li> </ul> 1.7. Describe safety procedures necessary prior to and whilst working on hydraulic systems to include: <ul style="list-style-type: none"> <li>a. PPE</li> <li>b. personal injury</li> <li>c. waste disposal</li> <li>d. spillage</li> </ul>



<p>2. Know pneumatic principles when applied in an engineering environment</p>	<p>2.1. Select pneumatic circuit components from standard symbols used in circuit diagrams</p> <p>2.2. Describe the function of a range of pneumatic circuit components to include:</p> <ul style="list-style-type: none"><li>a. pumps</li><li>b. compressors</li><li>c. motors</li><li>d. valves</li><li>e. accumulators</li><li>f. filters</li></ul> <p>2.3. Describe common aspects of pneumatic circuits.</p> <p>2.4. Differentiates between similar types of pneumatic system components.</p> <p>2.5. Describe common pneumatic system faults to include:</p> <ul style="list-style-type: none"><li>a. air leaks</li><li>b. actuator failure</li><li>c. control valve seizure</li><li>d. low pressure faults</li></ul> <p>2.6. Describes the hazards involved when working with pneumatic systems to include:</p> <ul style="list-style-type: none"><li>a. high pressures</li><li>b. incorrect disconnection of system</li><li>c. incorrect use of tools and test equipment</li></ul> <p>2.7. Describe safety procedures necessary prior to and whilst working on pneumatic systems to include:</p> <ul style="list-style-type: none"><li>a. PPE</li><li>b. personal injury</li><li>c. waste disposal</li></ul>
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<p>3. Be able to remove, replace and test components from non-complex systems</p>	<p>3.1. Use suitable personal protective equipment and coverings throughout all component removal and replacement activities</p> <p>3.2. Perform tasks in a way which minimises the risk of damage or injury to the unit, people and the environment</p> <p>3.3. Use a range of technical information to support component removal and replacement activities</p> <p>3.4. Use a range of correctly selected tools and equipment in the way specified by manufacturers to remove and replace components.</p> <p>3.5. Perform the removal and replacement of components, adhering to the correct specifications and tolerances for and following to include:</p> <ul style="list-style-type: none"><li>a. the manufacturer's approved removal and replacement methods</li><li>b. recognised researched repair methods</li><li>c. health and safety requirements.</li></ul> <p>3.6. Ensure that replacement components conform to the operating specification and any legal requirements</p> <p>3.7. Demonstrate a range of suitable testing methods to evaluate the performance of the reassembled system and components</p> <p>3.8. Ensure that the reassembled system conforms to the operating specification and meets any legal requirements</p> <p>3.9. Complete work records and further recommendations / additional faults found, in a suitable format</p>
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<b>UNIT REF: ET229</b>	<b>UNIT TITLE: ROUTINE MOTORCYCLE MAINTENANCE</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
Rationale: This unit enables the learner to develop the knowledge and skills needed to carry out routine maintenance, adjustment and replacement activities as part of the periodic servicing of motorcycles.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to carry out routine motorcycle maintenance	1.1. Describe how to conduct a scheduled motorcycle routine examination and assessment against the motorcycle manufacturers specification, legal and road safety requirements  1.2. Give examples of the different systems to be inspected while carrying out motorcycle routine maintenance to include: <ol style="list-style-type: none"> <li>a. filters</li> <li>b. drive belts</li> <li>c. cables</li> <li>d. brake linings</li> <li>e. pads</li> <li>f. ignition components</li> <li>g. hoses</li> <li>h. tyres</li> <li>i. lights</li> <li>j. chain and sprockets</li> <li>k. steering and suspension</li> <li>l. battery charging</li> </ol> 1.3. Describe adjustments that need to be carried out on a motorcycle during routine maintenance
2. Know the procedures required to carry out routine motorcycle maintenance	2.1. Describe the procedures used for checking the condition and serviceability of motorcycle systems and components  2.2. Describe the procedures used for checking gaps and clearances to include: <ol style="list-style-type: none"> <li>a. ignition components</li> <li>b. carburettor</li> <li>c. valve clearances</li> <li>d. clutch</li> <li>e. drive train</li> <li>f. brakes</li> </ol> 2.3. Describe the procedures for checking and replenishing fluid levels to include: <ol style="list-style-type: none"> <li>a. oil</li> <li>b. water</li> <li>c. hydraulic fluid</li> <li>d. greases</li> </ol> 2.4. Describe the procedures for checking and replacing lubricants to include: <ol style="list-style-type: none"> <li>a. replace oil filters</li> <li>b. check levels</li> <li>c. types of oil</li> <li>d. cleanliness</li> </ol>



Assessment Criteria: Level 2 Service and Maintenance Engineering (VRQs)

	<p>e. disposal of old oil and filters</p> <p>2.5. Describe the procedure for reporting cosmetic damage to motorcycle components and units outside normal service items</p> <p>2.6. Give examples of operating specifications for the systems being checked while carrying out motorcycle routine maintenance</p>
<p>3. Be able to work safely, with the appropriate tools and equipment when carrying out motorcycle routine maintenance</p>	<p>3.1. Select and use a range of personal protective equipment and motorcycle coverings throughout all motorcycle routine maintenance activities</p> <p>3.2. Work in a way which minimises the risk of damage or injury to the motorcycle, people and the environment.</p> <p>3.3. Select the appropriate tools and equipment necessary for carrying out routine maintenance</p> <p>3.4. Use the correct tools and equipment in the way specified by manufacturers when carrying out routine maintenance</p>
<p>4. Be able to carry out motorcycle routine inspection and maintenance</p>	<p>4.1. Select and use a range of suitable sources of technical information to support motorcycle routine maintenance activities including:</p> <ul style="list-style-type: none"><li>a. motorcycle technical data</li><li>b. maintenance procedures</li><li>c. legal requirements</li></ul> <p>4.2. Perform motorcycle inspections using prescribed methods, adhering to the correct specifications and tolerances for the motorcycle and following:</p> <ul style="list-style-type: none"><li>a. the manufacturer's approved inspection methods to include</li><li>b. recognised researched inspection methods</li><li>c. health and safety requirements</li></ul> <p>4.3. Compare inspection results with correct specifications and record any motorcycle system and / or component problems.</p> <p>4.4. Perform adjustments, replacement of motorcycle components and replenishment of consumable materials following the manufacturer's current specification</p> <p>4.5. Ensure that the motorcycle conforms to the motorcycle operating specification and any legal requirements</p> <p>4.6. Use a range of testing methods to evaluate the performance of all replaced and adjusted components and systems accurately</p> <p>4.7. Complete work records and further recommendations / additional faults found, in a suitable format</p>



<b>UNIT REF: ET230</b>	<b>UNIT TITLE: ROUTINE VEHICLE MAINTENANCE</b>
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<b>Level: 2</b>	<b>GLH: 40</b>
Rationale: This unit enables the learner to develop the knowledge and skills needed to carry out routine maintenance, adjustment and replacement activities as part of the periodic servicing of vehicles.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to carry out routine vehicle maintenance	1.1. Describe how to conduct a scheduled vehicle routine examination and assessment against the vehicle manufacturers specification, legal and road safety requirements.  1.2. Give examples of the different systems to be inspected while carrying out vehicle routine maintenance to include: <ol style="list-style-type: none"> <li>a. filters</li> <li>b. drive belts</li> <li>c. wiper blades</li> <li>d. brake linings</li> <li>e. pads</li> <li>f. hoses</li> <li>g. tyres</li> <li>h. lights</li> <li>i. steering and suspension</li> <li>j. exhaust</li> </ol> 1.3. Describe adjustments that need to be carried out on a vehicle during routine maintenance
2. Know the procedures required to carry out routine vehicle maintenance	2.1. Describe the procedures used for checking the condition and serviceability of vehicle systems and components  2.2. Describe the procedures used for checking gaps and clearances to include: <ol style="list-style-type: none"> <li>a. ignition components</li> <li>b. valve clearances</li> <li>c. clutch</li> <li>d. drive train</li> <li>e. brakes</li> </ol> 2.3. Describe the procedures for checking and replenishing fluid levels to include: <ol style="list-style-type: none"> <li>a. oil</li> <li>b. water</li> <li>c. hydraulic fluid</li> <li>d. greases</li> </ol> 2.4. Describe the procedures for checking and replacing lubricants to include: <ol style="list-style-type: none"> <li>a. oil</li> <li>b. coolant</li> <li>c. hydraulic fluid</li> <li>d. greases</li> </ol> 2.5. Describe the procedure for reporting cosmetic damage to vehicle components and units outside normal service items



	2.6. Give examples of operating specifications for the systems being checked while carrying out vehicle routine maintenance
3. Be able to work safely, with the appropriate tools and equipment when carrying out routine vehicle maintenance	3.1. Select and use a range of personal protective equipment and vehicle protective coverings throughout all vehicle routine maintenance activities 3.2. Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment. 3.3. Select the appropriate tools and equipment necessary for carrying out routine maintenance 3.4. Use the correct tools and equipment in the way specified by manufacturers when carrying out routine maintenance
4. Be able to carry out routine vehicle inspection and maintenance	4.1. Select and use a range of suitable sources of technical information to support vehicle routine maintenance activities including: a. vehicle technical data b. maintenance procedures c. legal requirements 4.2. Perform vehicle inspections using prescribed methods, adhering to the correct specifications and tolerances for the vehicle and following to include: a. the manufacturer's approved inspection methods b. recognised researched inspection methods c. health and safety requirements 4.3. Compare inspection results with correct specifications and record any vehicle system and / or component problems 4.4. Perform adjustments, replacement of vehicle components and replenishment of consumable materials following the manufacturer's current specification 4.5. Ensure that the vehicle conforms to the manufacturers operating specification and any legal requirements 4.6. Use a range of testing methods to evaluate the performance of all replaced and adjusted components and systems accurately 4.7. Complete work records and further recommendations / additional faults found, in a suitable format



**UNIT REF: ET231**

**UNIT TITLE: APPLYING FILLERS AND FOUNDATION MATERIALS**

**Level: 2**

**GLH: 60**

Rationale: This unit enables the learner to develop the knowledge and skills necessary for identifying substrates, mixing and adjusting the viscosity of fillers and foundation materials and applying fillers and foundation materials following guidelines and procedures.

LEARNING OUTCOMES	CONTENT
The Learner will:	The Learner should be taught
<p>1. Know how to recognise surfaces requiring the application of foundation materials in the refinishing process</p>	<p>1.1. Describe the types of substrate likely to be found in the refinishing process to include:</p> <ul style="list-style-type: none"> <li>a. steel</li> <li>b. aluminium</li> <li>c. all plastics</li> <li>d. coated steels</li> <li>e. high bake Enamels ( O E finishes )</li> <li>f. 2 K Paints</li> <li>g. 1K Paints</li> <li>h. clear over bases</li> <li>i. polyester fillers</li> <li>j. repaired panels</li> <li>k. primed panels (E coat)</li> </ul> <p>1.2. Describe the main methods used to determine the substrate to include:</p> <ul style="list-style-type: none"> <li>a. workshop tests to determine substrates to include:               <ul style="list-style-type: none"> <li>i. visual test for aluminium, plastics</li> <li>ii. magnet test for steel</li> </ul> </li> <li>b. for determination of paint type:               <ul style="list-style-type: none"> <li>i. compound small area</li> <li>ii. solvent wipe test (1k or 2k)</li> <li>iii. colour of flattening sludge (straight colour or C O B)</li> </ul> </li> </ul> <p>1.3. Compare the properties of types of substrate found in the refinishing process</p> <p>1.4. Describe why the substrate will determine the selection of a suitable foundation material</p>
<p>2. Know how to prepare for, mix and apply fillers and foundation materials in the refinishing process</p>	<p>2.1. Describe the choice and use of surface cleaning agents, fillers and foundation materials</p> <p>2.2. Describe how to condition and clean surfaces prior to the application of foundation coatings to ensure adequate adhesion</p> <p>2.3. Describe how to mix and check the viscosity of fillers and foundation materials to include:</p> <ul style="list-style-type: none"> <li>a. etch primers</li> <li>b. anti-stone chip primers</li> <li>c. surfacers</li> <li>d. wash fillers</li> <li>e. primer fillers</li> <li>f. plastic adhesion promoters</li> <li>g. elastic primers</li> <li>h. sealers</li> </ul>



	<ul style="list-style-type: none"><li>i. spraying polyester fillers</li><li>2.4. Describe the importance of viscosity and its effects on the surface finish to include:<ul style="list-style-type: none"><li>a. build</li><li>b. surface finish</li><li>c. speed of application</li><li>d. describe the procedure for checking viscosity</li><li>e. describe the effects on viscosity of:</li><li>f. temperature</li><li>g. additions of thinner/reducer</li></ul></li><li>2.5. Describe the properties of the foundation materials</li><li>2.6. Describe the principles of filler and paint mixing, the importance of the right additive (hardener or thinner) in the correct ratio</li><li>2.7. Describe the curing and drying recommendations for the various fillers and foundation materials</li><li>2.8. Describe how to apply foundation coatings</li><li>2.9. Describe how to find and interpret sources of information relevant to the mixing and application of foundation coatings</li><li>2.10. Describe how to avoid application defects</li><li>2.11. Describe the masking procedures, methods and techniques for part of or a whole assembly to include<ul style="list-style-type: none"><li>a. masking paper</li><li>b. plastic sheeting</li><li>c. masking tape</li><li>d. foam tape</li><li>e. wheel covers</li><li>f. liquid masking</li><li>g. roll-back masking</li></ul></li><li>2.12. Describe how to carry out masking procedures to avoid material wastage and contamination for each stage of the process</li><li>2.13. Identify the requirements for protecting the unit / assembly and contents from damage before, during and after preparing and applying foundation materials</li></ul>
<p>3. Be able to use appropriate tools and equipment</p>	<ul style="list-style-type: none"><li>3.1. Select the appropriate tools and equipment necessary for carrying out preparation and application of foundation materials</li><li>3.2. Use equipment which has been calibrated to meet manufacturers requirements</li><li>3.3 Use the correct tools and equipment in the way specified by manufacturers when carrying out preparation and application of foundation materials</li><li>3.4. Apply correct cleaning techniques to all application equipment and leave in a clean and serviceable condition</li></ul>



<p>4. Be able to carry out preparation and application of foundation materials in a safe manner</p>	<p>4.1. Use a range of suitable personal protective equipment and coverings throughout all preparation and application of foundation materials used in refinishing</p> <p>4.2. Perform in a way which minimises the risk of damage or injury to people and the environment</p> <p>4.3. Select suitable sources of technical information to support preparation and application of foundation materials</p> <p>4.4. Assess the type of substrate prior to</p> <p>4.5. Use a range surface cleaning agents, fillers and foundation materials</p> <p>4.6. Perform mixing and the viscosity adjustment of fillers and foundation materials</p> <p>4.7. Apply foundation materials</p> <p>4.8. Perform drying and curing procedures on foundation materials</p> <p>4.9. Assess the quality of completed repairs against the required standard and complete work records ready for the next process</p>
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<b>UNIT REF: ET232</b>	<b>UNIT TITLE: PREPARING METAL AND PRE-PAINTED SURFACES</b>
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<b>Level: 2</b>	<b>GLH: 60</b>
Rationale: This unit enables the learner to develop the knowledge and skills necessary for preparing a wide variety of different panels and component surfaces to accept foundation/paint topcoat materials.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to recognise surfaces requiring the application of foundation/paint topcoat materials in the refinishing process	1.1. Describe the types of substrate likely to be found in the refinishing process  1.2. Describe the main methods used to determine the substrate to include: <ol style="list-style-type: none"> <li>solvent wipe test (1k or 2k)</li> <li>colour of flattening sludge (straight colour or C O B)</li> <li>identification plates</li> </ol> 1.3. Compare the properties of types of substrate found in the refinishing process to include: <ol style="list-style-type: none"> <li>type of paint</li> <li>steel</li> <li>aluminium</li> <li>plastic</li> <li>coated steels</li> <li>repaired panels</li> <li>OE finish</li> <li>Primed panels (including E-Coat)</li> </ol>
2. Know how to prepare new and repaired panels for the application of foundation/paint topcoat materials in the refinishing process	2.1. Describe the choice and use of surface cleaning agents, including wax and grease remover to ensure adequate adhesion  2.2. Describe the types of materials used to prepare the surface and the factors governing their use  2.3. Describe how to prepare new and repaired panels  2.4. Describe the factors governing the choice of panel preparation methods  2.5. Describe how to prepare panels and parts adjacent to the area being painted  2.6. Describe methods of protecting panels and parts adjacent to the areas being painted and the circumstances in which they should be used  2.7. Identify the requirements for protecting assemblies and contents from damage before, during and after preparing panel surfaces





<p>3. Be able to use appropriate tools and equipment</p>	<p>3.1. Select the appropriate tools and equipment necessary for carrying out the preparation of metal and pre-painted surfaces</p> <p>3.2. Use equipment which has been calibrated to meet manufacturers requirements</p> <p>3.3 Use the correct tools and equipment in the way specified by manufacturers when carrying the preparation of metal and pre-painted surfaces</p> <p>3.4. Apply correct cleaning techniques to application equipment and leave in a clean and serviceable condition</p>
<p>4. Be able to carry out the preparation of metal and pre-painted surfaces to accept foundation materials and paint topcoats</p>	<p>4.1. Use a range of suitable personal protective equipment and coverings throughout the preparation of metal and pre-painted surfaces</p> <p>4.2. Perform in a way which minimises the risk of damage or injury to the vehicle, people and the environment</p> <p>4.3. Select suitable sources of technical information to support the preparation of metal and pre-painted surfaces</p> <p>4.4. Assess the type of substrate prior to work</p> <p>4.5. Demonstrate the use of surface cleaning agents and protect all surfaces adjacent to those being prepared using the specified method</p> <p>4.6. Demonstrate careful removal and safe storage for any components likely to be affected by the preparation process</p> <p>4.7. Apply preparation techniques to all panel surfaces required, following to include: a manufacturer's technical data b product data c recognised methods and techniques</p> <p>4.8. Use correct methods to keep the work area clean and tidy with waste disposal to conforming to legal requirements</p> <p>4.9. Assess the quality of completed preparation against the required standard and ensure that it is free from contamination.</p> <p>4.10 Complete work records ready for the next process</p>



<b>UNIT REF: ET233</b>	<b>UNIT TITLE: NEW TECHNOLOGIES IN THE ENGINEERING INDUSTRY</b>
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<b>Level: 2</b>	<b>GLH: 30</b>
Rationale: This unit will provide the learner with the opportunity to investigate and acquire knowledge of new technologies in the engineering industry. It may also be used to inform aspects of self development and may be used in combination with other units.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know of new technologies in the engineering industry	1.1. Select three areas of the engineering industry in which the use of technology is evident to include: <ol style="list-style-type: none"> <li>transport</li> <li>communications</li> <li>computing</li> <li>electrical</li> <li>energy generation</li> <li>manufacture</li> <li>domestic appliances and any other suitable.</li> </ol> 1.2. Compare aspects of new technology with old in the areas selected above           1.3. Give positive and negative aspects of the development and use of new technologies in the engineering industry <ol style="list-style-type: none"> <li>financial</li> <li>environmental</li> <li>personal</li> <li>global and any other suitable</li> </ol>
2. Understand a new technology used in the engineering industry	2.1. Perform research in order to gain knowledge and understanding of one area of new technology in the engineering industry to include: <ol style="list-style-type: none"> <li>internet</li> <li>books</li> <li>magazine articles</li> <li>interviews</li> <li>requests to industry and any other suitable.</li> </ol> 2.2. Provide documented evidence of research from more than one source, of new technology in the engineering industry           2.3. the function and basic principles of operation of the one area of new technology chosen, in a written report.           2.4. Illustrate the written report in order to enhance understanding to include: <ol style="list-style-type: none"> <li>pictures,</li> <li>diagrams</li> <li>sketches</li> <li>artefacts</li> </ol>



<b>UNIT REF: ET234</b>	<b>UNIT TITLE: REMOVING AND FITTING BASIC LIGHT VEHICLE MECHANICAL, ELECTRICAL AND TRIM (MET) COMPONENTS AND NON PERMANENTLY FIXED VEHICLE BODY PANELS</b>
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<b>Level: 2</b>	<b>GLH: 30</b>
Rationale: This unit enables the learner to develop the knowledge and skills needed to 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	CONTENT
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to carry out removal and fitting of basic light vehicle mechanical, electrical and trim (MET) components	1.1. Describe the procedures involved in carry out the systematic removal, storage and fitting of basic light vehicle MET components to the standard required including: <ol style="list-style-type: none"> <li>a. bumpers</li> <li>b. headlamp units</li> <li>c. road wheels</li> <li>d. batteries</li> <li>e. bonnet and boot trim</li> <li>f. interior trim components</li> <li>g. exterior trim components</li> </ol> 1.2. Describe the procedures involved in working with supplementary safety systems when fitting basic light vehicle MET components           1.3. Describe the procedures involved in working with gas discharge headlamp systems when fitting basic light vehicle MET components           1.4. Compare and give reasons for the use of different types of fastenings and fixings used when removing and fitting light vehicle MET components, to include: <ol style="list-style-type: none"> <li>a. pop rivet</li> <li>b. plastic rivet</li> <li>c. plastic capture nut</li> <li>d. nut and bolt</li> <li>e. shoulder bolt</li> <li>f. 'Nyloc' type nuts</li> <li>g. washers</li> <li>h. 'spring' type washers</li> <li>i. self tapping screws and bolts</li> <li>j. quick release plastic trim fastenings</li> <li>k. trim tapes</li> <li>l. adhesives and sealers</li> </ol> 1.5. Describe the procedures, methods and quality checks for ensuring correct alignment of light vehicle MET components           1.6. Describe the procedure for reporting cosmetic damage to light vehicle MET components and units



<p>2. Know the procedures required to carry out the removal and fitting of basic light vehicle non permanently fixed vehicle body panels</p>	<p>2.1. Describe the procedures involved in carrying 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"><li>a. wings</li><li>b. doors</li><li>c. bonnets</li><li>d. boot lids and tailgates</li><li>e. bumper bars, covers and components</li></ul> <p>2.2. Describe the procedures involved in working with supplementary safety systems when fitting basic light vehicle non-welded, non-structural body panels</p> <p>2.3. Describe the methods and procedures for storing removed light vehicle non-welded, non-structural body panels</p> <p>2.4. Compare and give reasons for the different types of fastenings and fixings used when removing and fitting light vehicle non-welded, non-structural body panels</p> <p>2.5. Describe the procedures, methods and quality checks for ensuring correct alignment of light vehicle non-welded, non-structural body panels</p> <p>2.6. Describe the procedure for reporting cosmetic damage to light vehicle non-welded, non-structural body panels</p>
<p>3. Be able to work safely, with the appropriate tools and equipment when carrying out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels</p>	<p>3.1. Select and 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</p> <p>3.2. Work in a way which minimises the risk of damage or injury to the vehicle, people and the environment</p> <p>3.3. 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</p> <p>3.4. Use the correct tools and equipment in the way specified by manufacturers when carrying out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels</p>



<p>4. Be able to carry out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels</p>	<p>4.1. Select and use suitable sources of technical information to support light vehicle removal and fitting activities including:</p> <ul style="list-style-type: none"><li>a. vehicle technical data</li><li>b. removal and fitting procedures</li><li>c. legal requirements</li></ul> <p>4.2. Perform the removal and fitting of basic MET components and non-permanently fixed light vehicle body panels</p> <p>4.3. Demonstrate the removal and fitting of basic MET components and non-permanently fixed light vehicle body panels to conform with the vehicle operating specification and any legal requirements</p> <p>4.4. Perform the removal and fitting of basic MET components and non-permanently fixed light vehicle body panels without damaging other components</p> <p>4.5. Demonstrate safe and correct component and panel storage</p> <p>4.6. Assess correct conformity of vehicle systems against light vehicle specification and legal requirements on completion</p> <p>4.7. Complete work records and further recommendations / additional faults found, in a suitable format</p>
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<b>UNIT REF: ET235</b>	<b>UNIT TITLE: REPAIRING MINOR PAINT DEFECTS IN AN ENGINEERING ENVIRONMENT</b>
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<b>Level: 2</b>	<b>GLH: 60</b>
Rationale: This unit enables the learner to develop the knowledge and skills required to recognise and rectify minor paint defects across a range of applications in the engineering environment.	

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know how to identify the surface requiring the rectification of minor paint defects	1.1. Identify the existing paint surface finish on which the minor paint defect has occurred to include: <ol style="list-style-type: none"> <li>a. compound small area</li> <li>b. solvent wipe test (1k or 2k)</li> <li>c. colour of flatting sludge (straight colour or c o b)</li> <li>d. Identification plate codes</li> </ol> 1.2. Compare minor paint defects, their causes and methods of rectification suitable for the paint finish to include: <ol style="list-style-type: none"> <li>a. scratches</li> <li>b. chips</li> <li>c. dents</li> <li>d. corrosion</li> <li>e. contamination</li> <li>f. blisters (including micro-blisters)</li> <li>g. fading</li> <li>h. loss of gloss</li> <li>i. chalking</li> </ol>
2. Know how to repair minor paint defects	2.1. Carry out flattening, burnishing, polishing and touch in techniques to correct minor paint defects 2.2. Use polishing machines, de-nibbing blocks and flattening equipment to include: <ol style="list-style-type: none"> <li>a. flattening block</li> <li>b. squeegee</li> <li>c. leather</li> <li>d. trimming knife</li> <li>e. masking dispensers</li> <li>f. sander</li> <li>g. DA random orbital</li> <li>h. orbital flat bed</li> <li>i. belt sander</li> <li>j. polishing equipment</li> <li>k. spray guns</li> <li>l. sealer guns</li> <li>m. air dusters</li> <li>n. vacuum extraction</li> <li>o. compressed air systems</li> </ol> 2.3. Use compounds, flattening papers, polishes, pre-prepared paints and glazes 2.4. Compare factors affecting the choice and use of materials in the rectification of minor paint defects to include: <ol style="list-style-type: none"> <li>a. type of surface defect to be repaired</li> <li>b. severity of defect</li> <li>c. size of area to be repaired</li> </ol>



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	<ul style="list-style-type: none"> <li>d. equipment available</li> <li>e. expertise of operator</li> <li>f. customer preference</li> </ul> <p>2.5. How to prevent further paint damage during rectification</p> <p>2.6. The importance of proper cleaning to the vehicle and work area prior to and after rectification work</p> <p>2.7. The importance of keeping equipment and materials clean and free from contamination during rectification work</p> <p>2.8. The requirements for protecting the vehicle and contents from damage before, during and after repairing minor paint defects</p>
<p>3. Be able to use appropriate tools and equipment to repair minor paint defects in an engineering environment</p>	<p>3.1. The appropriate tools and equipment necessary for carrying out the repair of minor paint defects</p> <p>3.2. The correct tools and equipment in the way specified by manufacturers when carrying out preparation for and repair of minor paint defects</p> <p>3.3. Correct cleaning techniques to all repair equipment and leave in a clean and serviceable condition</p>
<p>4. Be able to carry out preparation and repair of minor paint defects in a safe manner</p>	<p>4.1. Suitable personal protective equipment and coverings throughout all preparation and repair procedures</p> <p>4.2. Perform in a way which minimises the risk of damage or injury to people and the environment</p> <p>4.3. Suitable sources of technical information to support preparation and repair procedures</p> <p>4.4. The type of surface prior to work</p> <p>4.5. Perform surface preparation techniques and repair procedures to the required industrial standard</p> <p>4.6. The quality of completed repairs against the required standard and complete work records ready for the next process</p>



<b>UNIT REF: ET236</b>	<b>UNIT TITLE: ELECTRICALLY PROPELLED VEHICLE HAZARD MANAGEMENT</b>
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<b>Level: 2</b>	<b>GLH: 12</b>
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**Mapping: Based on IMI SSC Electric Vehicle NOS 2011**

Rationale: This unit is designed for those people who may encounter accident damaged or broken down electric and hybrid vehicles, e.g. emergency services and roadside recovery operators. It contains the *knowledge* required to work safely around a vehicle that may have had damage to its high and/or low energy electrical system.  
 Note: *This is a knowledge unit only and does not deem someone competent to work on the high energy electrical system.*

<b>LEARNING OUTCOMES</b>	<b>CONTENT</b>
<b>The Learner will:</b>	<b>The Learner should be taught</b>
1. Know about the types of electrically propelled vehicles available	1.1. Identify electrically propelled vehicles to include: <ul style="list-style-type: none"> <li>a. construction</li> <li>b. badging</li> </ul> 1.2. Examples of the electrically propelled vehicles that are currently available to include: <ul style="list-style-type: none"> <li>a. hybrid incl. plug in</li> <li>b. electric</li> <li>c. two wheel moped/scooters</li> <li>d. commercial vehicles</li> <li>e. passenger transport</li> <li>f. car</li> </ul> 1.3. The main differences between hybrid and electric vehicles to include: <ul style="list-style-type: none"> <li>a. layouts</li> <li>b. components</li> <li>c. batteries</li> <li>d. motors</li> </ul>
2. Know about electrically propelled vehicle systems	2.1 Examples of the typical voltages used for a range of electrically propelled and assisted vehicles to include: <ul style="list-style-type: none"> <li>a. 100-650V</li> </ul> 2.2 The typical location of high energy electrical cables and components on electrically propelled vehicles to include: <ul style="list-style-type: none"> <li>a. provide examples from various manufacturers</li> </ul> 2.3 Identify high energy electrical cabling and associated components to include <ul style="list-style-type: none"> <li>a. colouring</li> <li>b. warning symbols</li> </ul> 2.4 The differences between alternating and direct current to include <ul style="list-style-type: none"> <li>a. definitions of ac/dc -alternating current/direct current</li> <li>b. voltage comparisons</li> <li>c. current flow</li> </ul>





<p>3. Understand the hazards surrounding electrically propelled vehicles</p>	<p>3.1. The basic hazards associated with high energy electricity to include:</p> <ul style="list-style-type: none"><li>a. electric shock</li><li>b. burns</li><li>c. arc flash</li><li>d. arc blast</li><li>e. fire</li><li>f. explosion</li><li>g. chemicals</li><li>h. gases/fumes</li></ul> <p>3.2. Levels of current and voltage that present a hazard for both alternating and direct current systems to include:</p> <ul style="list-style-type: none"><li>a. contact time</li><li>b. AC/DC current and voltage levels</li><li>c. factors affecting resistance to current flow</li></ul> <p>3.3. The potential hazards that may be present when an electrically propelled vehicle has been damaged by fire or impact to include:</p> <ul style="list-style-type: none"><li>a. electric shock</li><li>b. burns</li><li>c. arc flash</li><li>d. arc blast</li><li>e. fire</li><li>f. explosion</li><li>g. chemicals</li><li>h. gases/fumes</li></ul> <p>3.4. The effects of alternating and direct current on humans</p>
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<p>4. Know how to reduce the risk of injury when encountering electrically propelled vehicles</p>	<p>4.1. The methods that vehicle manufacturers use to provide protection from high energy electrical cabling and components to include:</p> <ul style="list-style-type: none"><li>a. direct protection- enclosure, insulation, location</li><li>b. indirect protection- fuse, RCD, RCBO, MCB</li></ul> <p>4.2. Who may be at risk in the event of electrically propelled vehicle incidents to include:</p> <ul style="list-style-type: none"><li>a. occupants</li><li>b. on-lookers</li><li>c. recovery personnel</li><li>d. emergency services</li></ul> <p>4.3. How to make an initial assessment of the extent of vehicle damage and or faults to include:</p> <ul style="list-style-type: none"><li>a. risk assessment</li><li>b. personal protection</li><li>c. visual inspection</li></ul> <p>4.4. How to take steps to secure the safety of themselves and others at incident scenes involving electrically propelled vehicles to include:</p> <ul style="list-style-type: none"><li>a. evacuation procedures</li><li>b. site protection</li></ul> <p>4.5. The precautions that can be taken to reduce risks by those encountering damaged electrically propelled vehicles to include:</p> <ul style="list-style-type: none"><li>a. overalls with non conductive fasteners</li><li>b. gloves</li><li>c. protective footwear; rubberised soles; non-metallic protective toe caps</li><li>d. goggles</li><li>e. dealing with leakage from battery packs</li><li>f. isolation of high energy electrical system; vehicle shut down procedures</li><li>g. risk assessment</li></ul>
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<b>UNIT REF: ET237</b>	<b>UNIT TITLE: ROUTINE MAINTENANCE ACTIVITIES ON ELECTRICALLY PROPELLED VEHICLES</b>
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<b>Level: 2</b>	<b>GLH: 16</b>
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**Mapping: Based on IMI SSC Electric Vehicle NOS 2011**

Rationale: This unit introduces learners to electric and hybrid vehicle technology including, and in particular, the safety requirements of working on these types of vehicles, e.g. whilst carrying out servicing, or general repairs that are not related to the high energy electrical system.  
 Note: *This unit does not prove that someone is competent to work on the high energy electrical system, and assumes an already good level of electrical understanding. This unit does not cover commercial or domestic electrical installations including charging equipment and cables.*

LEARNING OUTCOMES	CONTENT
<b>The Learner will:</b>	<b>The Learner should be taught:</b>
1. Know about electrically propelled vehicle system components and operation	1.1. Components that make up the high energy electrical drive train system to include: <ol style="list-style-type: none"> <li>a. batteries/stack, pod, module.</li> <li>b. motors</li> <li>c. cabling;</li> <li>d. relays/control units</li> <li>e. charger and charging points</li> <li>f. isolators</li> <li>g. inverter</li> <li>h. battery management interface</li> <li>i. ignition/key-on control switch</li> <li>j. driver display panel</li> <li>k. multi-battery server unit</li> </ol> 1.2. The construction and function of battery modules to include: <ol style="list-style-type: none"> <li>a. types; lead-acid; sodium-nickel chloride; lithium-ion derivatives; nickel-cadmium (Ni-Cad); nickel-ion (Ni-Fe); nickel-metal-hydride</li> <li>b. capacities; primary/secondary cells; power density; energy density</li> <li>c. housings; materials used</li> <li>d. reactive materials; positive/ negative potential</li> <li>e. connections; shape; material; position charging process; fast/slow charge; higher and lower voltages</li> <li>f. location; effects on cooling, ease of maintenance, space, weight transfer; removing and refitting.</li> </ol> 1.3. The construction and function of electric motors to include: <ol style="list-style-type: none"> <li>a. principle of DC/AC types; permanent magnet; induction, brushed, brushless, single/three phase</li> <li>b. connections; screwed; push; integrity; security</li> <li>c. power rating/output</li> <li>d. housing materials/insulation</li> <li>e. armatures</li> <li>f. windings</li> <li>g. principle of regenerative braking</li> </ol> 1.4. The construction and function of associated high energy electrical components including circuit protection and cabling to include: <ol style="list-style-type: none"> <li>a. cabling; materials; colour coding; routing; insulation;</li> </ol>



	<ul style="list-style-type: none"><li>cross-sectional area</li><li>b. circuit protection; fuses; thermal cut outs; insulation</li><li>c. relay/control units; battery management interface; inverter;</li><li>d. distribution units</li><li>e. electrical symbols and terminology; circuit protection methods.</li><li>f. circuit theory; interaction between voltage, current, resistance (ohm`s law);power equation to</li><li>g. calculate power dissipated in a circuit</li><li>h. conductors, insulators; earth return, insulated return</li></ul> <p>1.5. Identify high energy electrical cabling and associated components to include:</p> <ul style="list-style-type: none"><li>a. using wiring diagrams</li><li>b. wiring colour</li><li>c.wiring size/cross-sectional area</li><li>d. warning signs</li><li>e. using voltmeters/measuring equipment correctly</li></ul>
<p>2. Understand the hazards surrounding electrically propelled vehicles</p>	<p>2.1 The basic hazards associated with high energy electricity to include:</p> <ul style="list-style-type: none"><li>a. electric shock</li><li>b. burns</li><li>c. arc flash</li><li>d. arc blast</li><li>e. fire</li><li>f. explosion</li><li>g. chemicals</li><li>h. gases/fumes</li></ul> <p>2.2 The levels of current and voltage that present a hazard for both alternating and direct current systems to include:</p> <ul style="list-style-type: none"><li>a. contact time</li><li>b. AC/DC current and voltage levels</li><li>c. factors affecting resistance to current flow</li></ul> <p>2.3 The potential hazards that may be present when an electrically propelled vehicle has been damaged by fire, impact or overcharging to include:</p> <ul style="list-style-type: none"><li>a. electric shock</li><li>b. burns</li><li>c. arc flash</li><li>d. arc blast</li><li>e. fire</li><li>f. explosion</li><li>g. chemicals</li><li>h. gases/fumes</li></ul> <p>2.4. The effects of alternating and direct current on humans</p>



<p>3. Know how to reduce the risks to yourself and others when working on electrically propelled vehicles</p>	<p>3.1. The methods that vehicle manufacturers use to provide protection from high energy electrical cabling and components</p> <p>3.2. Safety precautions to be taken to reduce risks to self and others before carrying out routine maintenance and repairs on electrically propelled vehicles</p> <p>3.3. The specific personal protective equipment required to work on electrically propelled vehicles to include:</p> <ul style="list-style-type: none"><li>a. overalls with non conductive fasteners</li><li>b. gloves</li><li>c. protective footwear; rubberised soles; non-metallic protective toe caps</li><li>d. goggles</li><li>e. precautions when using electrical equipment; differentiating between low/high energy</li><li>f. disposal of waste materials; recycling obligations</li><li>g. dealing with leakage from battery packs</li><li>h. isolation of high energy electrical system; vehicle shut down procedures</li><li>i. risk assessment</li></ul> <p>3.4. The precautions required prior to working near high energy electrical components to include:</p> <ul style="list-style-type: none"><li>a. overalls with non conductive fasteners</li><li>b. gloves</li><li>c. protective footwear; rubberised soles; non-metallic protective toe caps</li><li>d. goggles</li><li>e. precautions when using electrical equipment; differentiating between low/high energy</li><li>f. disposal of waste materials; recycling obligations</li><li>g. dealing with leakage from battery packs</li><li>h. isolation of high energy electrical system; vehicle shut down procedures</li><li>i. risk assessment</li></ul>
<p>4. Know how to safely prepare the vehicle when carrying out maintenance and routine repair activities on electrically propelled vehicles</p>	<p>4.1. The possibility of the high energy electrical system affecting repairs on other vehicle systems</p> <p>4.2. The procedures required to make safe the high energy electrical system before carrying out maintenance and repair activities</p> <p>4.3. The precautions taken prior to removing and replacing high energy electrical components</p> <p>4.4. Appropriate methods to re-instate vehicles after repairs affecting high energy electrical</p> <p>4.5. Additional tools and equipment required to carry out work on electrically propelled vehicles</p> <p>4.6. How to connect an external power source to an electrically propelled vehicle</p>



<p>5. Be able to work safely on an electrically propelled vehicle</p>	<p>5.1. Suitable personal protective equipment at all times whilst working on electrically propelled vehicles</p> <p>5.2. Suitable sources of information to support the work being carried out to include</p> <ul style="list-style-type: none"><li>a. technical manuals</li><li>b. safety cards</li><li>c. vehicle data</li><li>d. risk assessments</li><li>e. manufacturer's specific data</li></ul> <p>5.3. Carry out the safe isolation of the high energy electrical system, following the vehicle manufacturers instructions</p> <p>5.4. The correct methods to safely re-instate the vehicle following the vehicle manufacturers instructions</p> <p>5.5. The correct procedures to connect an alternative power source to an electrically propelled vehicle</p>
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**Appendix A to Service and Maintenance Engineering Qualification Specification Document**

**LEVEL 2 CROSS MAPPING FOR SYNOPTIC ASSESSMENT EVIDENCE**

**MANDATORY UNITS**

	ET211					ET212				ET214					ET216			
	Learning Outcome					Learning Outcome				Learning Outcome					Learning Outcome			
	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	4
ET213 L01										X					X	X	X	X
ET213 L02									X								X	
ET213 L03		X	X	X		X						X			X		X	
ET213 L04										X		X		X	X	X	X	X

**SELF DEVELOPMENT UNITS**

	PSD01			PSD02			PSD04			PSD05	
	Learning Outcome			Learning Outcome			Learning Outcome			Learning Outcome	
	1	2	3	1	2	3	1	2	3	1	2
ET213 L01	X	X	X	X	X		X			X	
ET213 L02	X			X			X	X	X		X
ET213 L03		X		X	X	X				X	
ET213 L04	X		X			X					X

**SPECIALIST UNITS**

	ET217						ET218				ET225				ET226				ET227				ET234			
	Learning Outcome						Learning Outcome				Learning Outcome				Learning Outcome				Learning Outcome				Learning Outcome			
	1	2	3	4	5	6	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
ET213 L01																										
ET213 L02	X	X						X	X	X		X	X			X	X			X	X			X	X	
ET213 L03					X			X			X				X				X				X			
ET213 L04		X			X		X			X			X	X			X	X			X	X	X	X		X



Assessment Criteria: Level 2 Service and Maintenance Engineering (VRQs)

	ET219			ET220					ET228			ET229				ET230				ET221						
	Learning Outcome			Learning Outcome					Learning Outcome			Learning Outcome				Learning Outcome				Learning Outcome						
	1	2	3	1	2	3	4	5	1	2	3	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7
ET213 L01								X																		
ET213 L02	X	X		X	X	X	X		X	X		X	X			X	X			X	X	X	X	X	X	
ET213 L03											X			X				X								X
ET213 L04	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X

	ET124			ET223						ET231				ET232				ET235				ET233		
	Learning Outcome			Learning Outcome						Learning Outcome				Learning Outcome				Learning Outcome				Learning Outcome		
	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	1	2	3	4	1	2	
ET213 L01				X																				
ET213 L02	X	X			X	X	X	X	X	X	X			X	X			X	X			X	X	
ET213 L03			X	X		X	X	X				X	X			X	X			X	X			
ET213 L04	X	X			X	X	X	X	X		X		X		X		X		X		X		X	X

	ET236				ET237				
	Learning Outcome				Learning Outcome				
	1	2	3	4	1	2	3	4	5
ET213 L01									
ET213 L02	X	X	X	X	X	X	X	X	
ET213 L03			X			X	X	X	X
ET213 L04	X	X	X	X		X	X	X	X





**Appendix B: Project Grading Criteria ET213 – Undertake a Project in the Engineering Environment**

PASS	Tick (✓)	MERIT	Tick (✓)	DISTINCTION	Tick (✓)
In order to achieve a Pass grade the candidate must produce evidence that shows they have met the following Pass criteria		In order to achieve a Merit grade the candidate must complete all pass criteria and produce evidence that shows they have met the following Merit criteria		In order to achieve a Distinction grade the candidate must complete all pass and merit criteria and produce evidence that shows they have met the following Distinction criteria	
Identifies and describe the key stakeholders required for the project		Explain the importance of producing a project plan and diary and how this links to the project aims and objectives		Analyse the effectiveness of the project plan and the resources used to help in the completion of the project	
Describe the project requirements including scope, timescales, aims and objectives					
Produce a project plan and project diary					
Describe the resources required for completion of the project		Explain how the resources available will help monitor the project through to completion and the consequences of not monitoring the project			
Describe how the project will be monitored and the importance of this process					
Describe the methods of communication used during the project and how effective they were					
Produce a written report on the project with some detail and a conclusion		Produce a detailed written report on the project with a clear conclusion and recommendations		Produce a comprehensive written report on the project with a clear evaluation of what went well and any areas for improvement. A clear and concise conclusion and detailed recommendations	