



## **Assessment Criteria**

### **Land-based Service Engineering Technician**

### **Level 3 Apprenticeship Standard**

### **ST0243/AP03**

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IMI, Fanshaws, Brickendon, Hertford SG13 8PQ



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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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## Land-based Service Engineering Technician Level 3

### Assessments

The assessments for this Standard combine various assessment styles/methodologies in order to suit the level and units contained within it.

The table below outlines the groups that form each of the knowledge assessments and when these are to be assessed.

Knowledge Assessment ST0243-LBTGW1K	Online Assessment - Multiple Choice Questions				
	Duration	Number of Questions	Pass Mark	Merit	Distinction
Gateway 1	60 min	40	65-74%	75-89%	90%+
Note: The online test covers content from Groups 2-5					

Knowledge Assessment ST0243-LBTGW2K	Online Assessment - Multiple Choice Questions				
	Duration	Number of Questions	Pass Mark	Merit	Distinction
Gateway 2	60 min	40	65-74%	75-89%	90%+
Note: The online test covers content from Groups 6-10					

\*NOTE: Group 1 Soft Skills and Behaviours will not form part of the Gateway knowledge assessments. It is recommended that reviews take place between the Apprentice, training provider and mentor at Gateways, using a soft skills and behaviour assessment tool to ensure the requirements are met.

Knowledge Assessment ST0243/O3EPA1K	Online Assessment				
	Duration	Number of Questions	Pass	Merit	Distinction
EPA	90 minutes	30	65-74%	75-89%	90%+
Note: The online test covers content from Groups 2-13 under the topics of:					
Health, Safety and Legislation					
Tools and Equipment					
Information, Reporting and Communication					
Inspection and Maintenance					
Fault Diagnosis and Repair					
Fabrication and Repair					
Preparation and Handover					



GROUP 1

GROUP TITLE: SOFT SKILLS AND BEHAVIOURS

**Rationale:** This group sets out the soft skills and behaviours and provides the framework that will provide the basis for the approach to assessment. This group will be assessed at each of the gateways through the behaviours assessment involving the apprentice, the employer and the training provider. There is no requirement for separate assessment whilst on the programme, however the apprentice should be aware of the criteria they will have to meet.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Apprentice will:	The Apprentice can:
1. Understand the importance of working with others and building relationships	1.1 Routinely collaborate with others to achieve targets 1.2 Maintain positive working relationships even though the other person may be very different 1.3 Accept the tasks given, and quickly recognise whether they have the ability to complete them and seek help appropriately 1.4 Demonstrate honesty when working as part of a team 1.5 Carry out tasks with consideration for others 1.6 Seek support and help from colleagues when appropriate 1.7 Provide feedback to others at the appropriate moment and support it with relevant evidence 1.8 Actively contribute to team goals
2. Understand the importance of complying with both legislative and company procedures	2.1 Use systems and processes relevant to the role 2.2 Use materials efficiently in order to minimise waste and the impact on the environment 2.3 Comply with all legislation relevant to role 2.4 Contribute to improving the workshop's overall efficiency 2.5 Complete documentation with a clear understanding of its purpose 2.6 Prioritise the tasks ahead and react appropriately to the unexpected 2.7 Operate safely without the need for reminders



	2.8 Flag up difficulties in sufficient time to take remedial action
3. Communicate effectively with colleagues and stakeholders on a range of topics that support the process of maintaining and repairing land-based machinery	<p>3.1 Use a clear voice and polite tone</p> <p>3.2 Speak confidently and use different types of questions appropriately</p> <p>3.3 Complete internal documentation as required using legible, grammatically correct written communication for internal e-mails/repair order completion</p> <p>3.4 Exhibit appropriate body language and attitude when dealing with colleagues, manufacturers and customers</p> <p>3.5 Converse with others regarding technical issues explaining technical terminology when asked</p> <p>3.6 Approach colleagues and stakeholders with respect and follow the appropriate procedures when dealing with a problem</p> <p>3.7 Quickly refer difficult issues to others</p> <p>3.8 Take a systematic approach to problem solving. Know their limitations and when best to escalate issues</p> <p>3.9 Confidently break down complex tasks and allocate time and resources appropriately</p>
4. Understand how to be an effective team member taking responsibility, accountability and ownership of own actions	<p>4.1 Share their knowledge and skills when requested</p> <p>4.2 Provide reports on progress when asked</p> <p>4.3 Contribute ideas, think them through in detail and their implications, and present them clearly</p>
5. Understand the need to continually self-develop knowledge and skills and mentor less experienced colleagues	<p>5.1 Independently and regularly reflect on progress and set goals and priorities for future development</p> <p>5.2 Demonstrate an interest in learning and actively use the opportunities to extend their knowledge and skills that are put in front of them</p>
6. Understand the need for a strong work ethic and understand the need to be reliable and flexible, diligent and a good timekeeper	<p>6.1 Be punctual and routinely meet deadlines</p> <p>6.2 Wear appropriate clothes at all times and present a clean appearance especially when meeting customers and stakeholders</p>



GROUP 2

**GROUP TITLE: HEALTH, SAFETY AND GOOD HOUSEKEEPING IN THE LAND-BASED ENGINEERING ENVIRONMENT**

**Rationale:** This group enables the apprentice to develop understanding, knowledge and skills in routine maintenance and cleaning of the land-based engineering environment. They will be able to demonstrate an understanding of using resources economically, health and safety legislation and duties of everyone in the work environment. This unit will provide an appreciation of significant risks in the land-based engineering environment and how to identify and deal with them. Once completed the apprentice will be able to identify hazards and evaluate and reduce risk.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
<b>The Apprentice will:</b>	<b>The Apprentice can:</b>
1. Understand the correct personal and machinery protective equipment to be used within the land-based engineering environment	1.1 Explain the types of personal protective equipment (PPE) required for a range of land-based engineering maintenance and repair activities 1.2 Identify machinery protective equipment for a range of maintenance and repair activities 1.3 Explain the machinery and personal safety considerations when working in the land-based environment
2. Understand effective housekeeping practices in the land-based engineering environment	2.1 Describe why the land-based engineering environment should be properly cleaned and maintained 2.2 Describe requirements and systems which may be put in place to ensure a clean land-based engineering environment 2.3 Describe how to minimise waste when using utilities and consumables 2.4 State the procedures and precautions necessary when cleaning and maintaining a land-based engineering environment 2.5 Describe the selection and use of cleaning equipment when dealing with general cleaning, spillages and leaks in the land-based engineering environment 2.6 Describe procedures for correct disposal of waste materials from a land-based engineering environment



	<p>2.7 Describe procedures for starting and ending the working day which ensure effective housekeeping practices are followed</p>
<p>3. Understand key health and safety requirements relevant to the land-based engineering environment</p>	<p>3.1 List the main health and safety legislation relating to the land-based engineering environment</p> <p>3.2 Describe the general legal duties of employers and employees required by current health and safety legislation</p> <p>3.3 Describe key and current health and safety requirements relating to the land-based engineering environment</p> <p>3.4 Describe why workplace policies and procedures relating to health and safety are important</p>
<p>4. Understand about hazards and potential risks relevant to the land-based engineering environment</p>	<p>4.1 Identify key hazards and risks in a land-based engineering environment</p> <p>4.2 Describe policies and procedures for reporting hazards, risks, and health and safety matters in the land-based engineering environment</p> <p>4.3 State precautions which need to be taken and procedures which need to be adhered to when working with machinery, associated materials, tools and equipment</p>
<p>5. Understand personal responsibilities for maintaining a safe working environment</p>	<p>5.1 Explain the importance of personal conduct in maintaining the health and safety of the individual and others</p> <p>5.2 Explain the importance of personal presentation in maintaining health safety and welfare</p>
<p>6. Be able to use correct personal and machinery protection within the land-based engineering environment</p>	<p>6.1 Select and 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>6.2 Select and use machinery protective equipment throughout all activities</p>





<p>7. Be able to carry out effective housekeeping practices in the land-based engineering environment</p>	<p>7.1 Select and use cleaning equipment which is of the right type and suitable for the task</p> <p>7.2 Use utilities and appropriate consumables, avoiding waste</p> <p>7.3 Use materials and equipment to carry out cleaning and maintenance duties in allocated work areas, following land-based engineering work</p> <p>7.4 Perform housekeeping activities safely and in a way which minimises inconvenience to customers and staff</p> <p>7.5 Keep the work area clean and free from debris and waste materials</p> <p>7.6 Keep tools and equipment fit for purpose by regular cleaning and keeping tidy</p> <p>7.7 Dispose of used cleaning agents, waste materials and debris to comply with legal and workplace requirements</p>
<p>8. Be able to recognise and deal with dangers in order to work safely within the land-based engineering workplace</p>	<p>8.1 Name and locate the responsible persons for health and safety in their relevant workplace</p> <p>8.2 Identify and report working practices and hazards which could be harmful to themselves or others</p> <p>8.3 Carry out safe working practices whilst working with equipment, materials and products in the land-based engineering environment</p> <p>8.4 Rectify health and safety risks encountered at work, within the scope and capability of their job role</p>
<p>9. Be able to conduct themselves responsibly</p>	<p>9.1 Show personal conduct in the workplace which does not endanger the health and safety of themselves or others</p> <p>9.2 Display suitable personal presentation at work which ensures the health and safety of themselves and others at work</p>



## GROUP 3

GROUP TITLE: TOOLS AND EQUIPMENT, MATERIALS AND FABRICATION  
USED IN LAND-BASED ENGINEERING WORK ENVIRONMENT

**Rationale:** This group enables the apprentice to develop an understanding, knowledge and skills regarding the correct selection, care and use of key tools and equipment, measuring devices for modification, fabrication and repair in the land-based engineering environment, the correct preparation and use of common land-based engineering equipment, the correct selection and fabrication of materials used when modifying and repairing, and the correct application of land-based engineering fabrication and fitting principles.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
<b>The Apprentice will:</b>	<b>The Apprentice can:</b>
1. Understand how to select, use and care for tools used in the repair and maintenance of land-based machinery	<ul style="list-style-type: none"><li>1.1 Identify and explain the use of common types of tools used in the repair and maintenance of land-based machinery</li><li>1.2 Identify and explain the use of common measuring devices used in the repair and maintenance of land-based machinery</li><li>1.3 Describe how to select, prepare and maintain tools and measuring devices used in the repair and maintenance of land-based machinery</li><li>1.4 State the limitations of common hand tools and measuring devices used in the repair and maintenance of land-based machinery</li><li>1.5 Explain how common hand tools and measuring devices used in the repair and maintenance of land-based machinery should be stored and maintained</li><li>1.6 Identify common electrical measuring tools used in the repair of machinery and components</li><li>1.7 Explain the preparation and safe and correct use of common electrical tools when measuring voltage, current and resistance</li></ul>
2. Understand how to prepare and use common workshop equipment	<ul style="list-style-type: none"><li>2.1 Identify and explain the use of common equipment used in fabrication and repair of land-based machinery</li><li>2.2 Describe how to select and prepare equipment used in the repair and maintenance of land-based machinery</li></ul>



	<p>2.3 Describe the safe use of workshop equipment used in the repair and maintenance of land-based machinery</p> <p>2.4 Explain the term: safe working load</p>
<p>3. Understand materials used for fabricating, modifying and repairing machinery and fitting components</p>	<p>3.1 Describe the properties, application and limitations of ferrous and non-ferrous metals, including their safe use</p> <p>3.2 Describe the properties, application and limitations of common non-metallic materials, including their safe use</p> <p>3.3 Define common terms relating to the properties of materials used in repair and maintenance to include:</p> <ul style="list-style-type: none"><li>a. ferrous</li><li>b. non ferrous</li><li>c. plastics</li><li>d. lubricants</li></ul>
<p>4. Understand how to apply land-based engineering, fabrication and fitting principles when modifying and repairing machinery and components</p>	<p>4.1 Describe how to tap threads, file, cut and drill plastics and metals when modifying or repairing machinery</p> <p>4.2 Describe how to measure, mark out, shape and join materials when fabricating</p> <p>4.3 Describe the selection and fitting procedures of the following:</p> <ul style="list-style-type: none"><li>a. gaskets and seals</li><li>b. sealants and adhesives</li><li>c. fittings and fasteners</li><li>d. electrical circuit components</li></ul> <p>4.4 Identify locking, fastening and fixing devices</p> <p>4.5 State the importance of correct operating specifications for limits, fits and tolerances in the land-based engineering environment</p>
<p>5. Be able to select, maintain and use hand tools and measuring devices in the land-based engineering environment</p>	<p>5.1 Select, maintain and use suitable hand tools safely when fabricating and fitting in the land-based engineering workplace</p> <p>5.2 Select, maintain and use suitable measuring devices safely when fabricating and fitting in the land-based engineering environment</p>



	<p>5.3 Select, maintain and use suitable PPE and MPE for fabrication, repair and fitting in the land-based engineering environment</p> <p>5.4 Select, maintain and use suitable electrical measuring tools safely when repairing machinery and components</p>
<p>6. Be able to prepare and use common workshop equipment</p>	<p>6.1 Use suitably maintained workshop equipment safely</p> <p>6.2 Use correct interpretation of 'safe working load' on lifting and supporting equipment</p> <p>6.3 Report any faulty or damaged tools and equipment to the relevant persons clearly and promptly</p> <p>6.4 Store work tools and equipment in a safe manner, which permits ease of access and identification for use</p>
<p>7. Be able to apply land-based engineering, fabrication and fitting principles when modifying and repairing machinery and components</p>	<p>7.1 Use correct procedures when:</p> <ul 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><li>e. fitting</li></ul> <p>7.2 Use appropriate techniques when fabricating, repairing and modifying machinery and components</p> <p>7.3 Apply appropriate modification and repair techniques to land-based engineering electrical circuits</p> <p>7.4 Select and use:</p> <ul style="list-style-type: none"><li>a. gaskets</li><li>b. seals</li><li>c. sealants</li><li>d. fittings and fasteners</li></ul> <p>7.5 Select and use locking, fixing and fastening devices</p>



GROUP 4

GROUP TITLE: EFFECTIVE WORKING RELATIONSHIPS WITH COLLEAGUES

**Rationale:** This group enables the apprentice to develop an understanding, knowledge and skills regarding the importance of developing and maintaining good working relationships with all colleagues in the land-based engineering work environment. The group also covers the typical organisational structures used by land-based engineering employers and how to use effective communication and support skills.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
<b>The Apprentice will:</b>	<b>The Apprentice can:</b>
1. Understand key organisational structures, functions and roles within the land-based engineering work environment	1.1 Identify the purpose of different sections of a typical land-based engineering work environment 1.2 Explain organisational structures and lines of communication within the land-based engineering work environment 1.3 Explain levels of responsibility within specific job roles in the land-based engineering workplace. To include: a. trainee b. skilled technician c. supervisor d. manager
2. Understand communication requirements when carrying out machinery repairs in the land-based engineering work environment	2.1 Explain how to report using written and verbal communication 2.2 Explain the importance of documenting information relating to work carried out in the land-based engineering environment 2.3 Explain the importance of working to agreed timescales
3. Understand how to develop good working relationships with colleagues and customers in the land-based engineering workplace	3.1 Describe how to develop positive working relationships with colleagues and customers 3.2 Explain the importance of developing positive working relationships 3.3 Explain the importance of accepting other people's views and opinions 3.4 Explain the importance of making and honouring realistic commitments to colleagues and customers



4. Be able to work effectively within the organisational structure of the land-based engineering work environment	4.1 Respond promptly and willingly to requests for assistance from customers and colleagues 4.2 Refer customers and colleagues to the correct person should requests fall outside their responsibility and capability
5. Be able to obtain and use information in order to support their job role within the land-based engineering work environment	5.1 Select and use legal and technical information, in a land-based engineering work environment
6. Be able to communicate with and support colleagues and customers effectively within the land-based engineering work environment	6.1 Use methods of communication with customers and colleagues which meet their needs 6.2 Give customers and colleagues accurate information 6.3 Make requests for assistance from or to customers and colleagues clearly and courteously
7. Be able to develop and keep good working relationships in the land-based engineering work environment	7.1 Contribute to team work by initiating ideas and co-operating with customers and colleagues 7.2 Treat customers and colleagues in a way which shows respect for their views and opinions 7.3 Make and keep achievable commitments to customers and colleagues 7.4 Inform colleagues promptly of anything likely to affect their own work



<b>GROUP 5</b>	<b>GROUP TITLE: CONDUCT ROUTINE INSPECTIONS AND SYSTEM TESTING TO LAND-BASED ENGINEERING MACHINERY AND EQUIPMENT</b>
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**Rationale:** This group enables the apprentice to develop the understanding, knowledge and skills required to carry out machinery and equipment inspection and system testing in the land-based engineering work environment. It also covers: how to record and compare tests, make recommendations and the importance of completing inspections to meet with both company and legal requirements.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
<b>The Apprentice will:</b>	<b>The Apprentice can:</b>
1. Understand how to carry out inspections and system testing to land-based engineering machinery using prescribed methods	1.1 Explain the difference between the various prescribed machinery inspection methods to include: <ol style="list-style-type: none"> <li>a. pre-delivery and pre-purchase</li> <li>b. daily vehicle checks</li> <li>c. scheduled safety inspection</li> <li>d. pre- and post-rental inspection</li> <li>e. pre- and post-repair / operational</li> </ol> 1.2 Identify the different systems to be inspected and tested during scheduled inspections           1.3 Identify the procedures involved to carry out the systematic inspection and testing of machinery systems and components           1.4 Explain how to record and complete the inspection results in the format required           1.5 Compare test and inspection results against machinery specification           1.6 Identify the recommendations that can be made based on the results of machinery inspections and testing           1.7 Explain the implications to an organisation of failing to carry out machinery inspection and system testing activities correctly           1.8 Explain the implications of signing workplace documentation and machinery records           1.9 Explain the procedure for reporting damage to machinery components and units outside normal operating specifications



	1.10 Explain the importance of inspecting the machinery following any repairs
2. Be able to work safely when carrying out land-based machinery inspections and system testing using prescribed methods	2.1 Use suitable personal protective equipment and suitable coverings when carrying out machinery inspections and system testing  2.2 Work in a way which minimises the risk of damage or injury to the machinery, people and the environment  2.3 Ensure the machinery and the work area is safe prior to commencing with any scheduled safety inspection and system testing
3. Be able to use relevant information to carry out the task	3.1 Select suitable sources of technical information to support machinery inspection and system testing activities including: a. machinery technical data b. inspection and testing procedures c. legal requirements d. regional inspection manuals  3.2 Use technical information to support machinery inspection and system testing activities
4. Be able to use appropriate tools and equipment	4.1 Select the appropriate tools and equipment necessary for carrying out a scheduled safety inspection and system testing on machinery  4.2 Ensure that equipment has been calibrated to meet manufacturer's requirements  4.3 Use the tools and equipment in the way specified by manufacturers when carrying out a scheduled safety inspection and system testing on machinery
5. Be able to carry out land-based scheduled safety inspections and system testing using prescribed methods	5.1 Carry out machinery inspections and system testing using prescribed methods, adhering to the specifications and tolerances for the machine and following: a. the manufacturer's approved inspection and testing methods b. recognised inspection methods c. industry health and safety requirements d. prescribed documentation  5.2 Ensure that the inspected machinery conforms to the machine operating specification and any legal requirements





	<p>5.3 Ensure any comparison of the machine against specification accurately identifies any:</p> <ul style="list-style-type: none"><li>a. differences from the machinery specification</li><li>b. machine appearance and condition faults</li></ul> <p>5.4 Use suitable system testing methods to evaluate the performance of the inspected system</p> <p>5.5 Carry out a visual inspection, to ensure the machinery meets legal requirements, following any repairs</p>
<p>6. Be able to carry out land-based scheduled safety inspections and system testing using prescribed methods</p>	<p>6.1 Carry out machinery inspections and system testing using prescribed methods, adhering to the specifications and tolerances for the machine and following:</p> <ul style="list-style-type: none"><li>a. the manufacturer's approved inspection and testing methods</li><li>b. recognised inspection methods</li><li>c. industry health and safety requirements</li><li>d. prescribed documentation</li></ul> <p>6.2 Ensure that the inspected machinery conforms to the machine operating specification and any legal requirements</p> <p>6.3 Ensure any comparison of the machine against specification accurately identifies any:</p> <ul style="list-style-type: none"><li>a. differences from the machinery specification</li><li>b. machine appearance and condition faults</li></ul> <p>6.4 Use suitable system testing methods to evaluate the performance of the inspected system</p> <p>6.5 Carry out a visual inspection to ensure the machinery meets legal requirements following any repairs</p>
<p>7. Be able to record information and make suitable recommendations</p>	<p>7.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>7.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>7.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>



<b>GROUP 6</b>	<b>GROUP TITLE: LAND-BASED ENGINE MECHANICAL AND LUBRICATION SYSTEM UNITS AND COMPONENTS</b>
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**Rationale:** This group allows the learner to develop the skills, knowledge and understanding required to maintain, remove and replace land-based engine mechanical and lubrication system components. It also covers the evaluation of the performance of the replaced units and systems.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Apprentice will:	The Apprentice can:
<p>1. Understand how land-based engine mechanical systems operate</p>	<p>1.1 Identify engine mechanical system components</p> <p>1.2 Describe the construction and operation of engine mechanical systems</p> <p>1.3 Compare key engine mechanical system components and assemblies against alternatives to identify differences in construction and operation</p> <p>1.4 Identify the key engineering principles that are related to engine mechanical systems:</p> <ul style="list-style-type: none"> <li>a. compression ratios</li> <li>b. cylinder capacity</li> <li>c. power</li> <li>d. torque</li> </ul> <p>1.5 Explain common terms used in engine mechanical system design:</p> <ul style="list-style-type: none"> <li>a. tdc</li> <li>b. bdc</li> <li>c. stroke</li> <li>d. bore</li> </ul>
<p>2. Understand how land-based engine lubrication systems operate</p>	<p>2.1 Identify engine lubrication system components</p> <p>2.2 Describe the construction and operation of engine lubrication components and systems</p> <p>2.3 Compare key engine lubrication system components and assemblies to identify differences in construction and operation</p> <p>2.4 Identify the key engineering principles that are related to engine lubrication systems:</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>



	2.5 State common terms used in engine lubrication system design
3. Understand how to maintain, remove, replace and test land-based engine mechanical and lubrication system units and components	<p>3.1 Describe how to maintain, remove and replace engine mechanical and lubrication system units and components</p> <p>3.2 Describe common types of testing methods used to check the operation of engine mechanical and lubrication systems and their purpose</p> <p>3.3 Describe how to test and evaluate the performance of replacement units against machinery specification</p> <p>3.4 Identify common faults found in engine mechanical and lubrication systems and their causes</p>
4. Be able to work safely when carrying out maintenance and repair activities	4.1 Use suitable personal protective equipment and machinery coverings throughout all engine maintenance and repair activities
5. Be able to use relevant information to carry out the task	<p>5.1 Select suitable sources of technical information to support engine unit and component maintenance, removal and replacement activities including:</p> <ul style="list-style-type: none"><li>a. machinery technical data</li><li>b. removal and replacement procedures</li><li>c. legal requirements</li></ul> <p>5.2 Use technical information to support engine maintenance, unit and component removal and replacement activities</p>
6. Be able to use appropriate tools and equipment	<p>6.1 Select the appropriate tools and equipment necessary for the maintenance, removal and replacement activity</p> <p>6.2 Ensure that equipment has been calibrated to meet manufacturer's and legal requirements</p> <p>6.3 Use the correct tools and equipment in the way specified by manufacturers</p>
7. Be able to carry out maintenance, removal and replacement of land-based engine mechanical and lubrication system units and components	<p>7.1 Maintain, remove and replace the engine mechanical and lubrication system units and components, adhering to the correct specifications and tolerances for the machinery and following:</p> <ul style="list-style-type: none"><li>a. the manufacturer's approved maintenance, removal and replacement methods</li><li>b. recognised maintenance and repair methods</li><li>c. health and safety requirements</li></ul>



	<p>7.2 Ensure that replacement engine mechanical and lubrication units and components conform to the machinery operating specification and any legal requirements</p> <p>7.3 Use suitable testing methods to evaluate the performance of the maintained and reassembled system</p> <p>7.4 Ensure that the maintained and reassembled engine systems perform to the machinery operating specification and meet any legal requirements</p>
<p>8. Be able to record information and make suitable recommendations</p>	<p>8.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>8.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>8.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>



<b>GROUP 7</b>	<b>GROUP TITLE: LAND-BASED FUEL, IGNITION, AIR SUPPLY AND EXHAUST SYSTEM UNITS AND COMPONENTS</b>
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**Rationale:** This group allows the learner to develop the skills, knowledge and understanding required to maintain, remove and replace land-based fuel, ignition, air and exhaust system units and components. It also covers the evaluation of the performance of the replaced units and systems.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Apprentice will:	The Apprentice can:
1. Understand how land-based engine fuel systems operate	1.1 Identify land-based engine fuel system components  1.2 Describe the construction and operation of land-based engine fuel systems  1.3 Compare key land-based engine fuel system components and assemblies against alternatives to identify differences in construction and operation  1.4 Identify the key engineering principles that are related to land-based engine fuel systems: a. properties of fuels b. combustion processes c. exhaust gas constituents  1.5 State common terms used in land-based engine fuel system design
2. Understand how land-based engine ignition systems operate	2.1 Identify land-based engine ignition system components  2.2 Describe the construction and operation of land-based engine ignition systems  2.3 Compare key land-based engine ignition system components and assemblies against alternatives to identify differences in construction and operation  2.4 Identify the key engineering principles that are related to land-based engine ignition systems: a. flame travel b. ignition timing



<p>3. Understand how land-based engine air supply and exhaust systems operate</p>	<p>3.1 Identify land-based engine air supply and exhaust system components</p> <p>3.2 Describe the construction and operation of land-based engine air supply and exhaust systems:</p> <ul style="list-style-type: none"><li>a. turbo charging</li><li>b. exhaust gas recirculation (EGR)</li><li>c. diesel particulate filters</li></ul> <p>3.3 Identify the key engineering principles that are related to land-based engine air supply and exhaust systems:</p> <ul style="list-style-type: none"><li>a. sound absorption</li><li>b. reduction of harmful emissions</li></ul> <p>3.4 State common terms used in key land-based engine air supply and exhaust system design</p>
<p>4. Understand how to check, replace and test land-based fuel, ignition, air supply and exhaust system units and components</p>	<p>4.1 Describe how to remove and replace fuel and ignition system units and components</p> <p>4.2 Describe how to remove and replace air supply and exhaust system units and components</p> <p>4.3 Describe common types of testing methods used to check the operation of fuel, ignition, air supply and exhaust systems and their purpose</p> <p>4.4 Describe how to test and evaluate the performance of replacement units against machinery specification</p> <p>4.5 Identify common faults found in land-based fuel and ignition systems and their causes</p> <p>4.6 Identify common faults found in land-based air and exhaust systems and their causes</p>
<p>5. Be able to work safely when carrying out removal and replacement activities</p>	<p>5.1 Use suitable personal protective equipment and machinery coverings throughout all fuel, air and exhaust system unit and component removal and replacement activities</p> <p>5.2 Work in a way which minimises the risk of damage or injury to the machine, people and the environment</p>
<p>6. Be able to use relevant information to carry out the task</p>	<p>6.1 Select suitable sources of technical information to support land-based fuel, ignition, air and exhaust system unit and component removal and replacement activities including:</p> <ul style="list-style-type: none"><li>a. machinery technical data</li><li>b. removal and replacement procedures</li><li>c. legal requirements</li></ul>



	<p>6.2 Use technical information to support land-based fuel, ignition, air and exhaust system unit and component removal and replacement activities</p>
<p>7. Be able to use appropriate tools and equipment</p>	<p>7.1 Select the appropriate tools and equipment necessary for the removal and replacement activity</p> <p>7.2 Ensure that equipment has been calibrated to meet <b>manufacturer's and legal requirements</b></p> <p>7.3 Use the correct tools and equipment in the way specified by manufacturers</p>
<p>8. Be able to carry out removal and replacement of land-based fuel, air supply and exhaust system units and components</p>	<p>8.1 Remove and replace land-based fuel, ignition, air supply and exhaust system units and components, adhering to the correct specifications and tolerances for the machinery and following:</p> <ul style="list-style-type: none"><li>a. <b>the manufacturer's approved removal and replacement methods</b></li><li>b. recognised repair methods</li><li>c. health and safety requirements</li></ul> <p>8.2 Ensure that replacement units and components conform to the machinery operating specification and any legal requirements</p> <p>8.3 Use suitable testing methods to evaluate the performance of the reassembled system</p> <p>8.4 Ensure that the reassembled land-based system performs to the machinery operating specification and meets any legal requirements</p>
<p>9. Be able to record information and make suitable recommendations</p>	<p>9.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>9.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>9.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>



<b>GROUP 8</b>	<b>GROUP TITLE: LAND-BASED HEATING AND COOLING SYSTEM UNITS AND COMPONENTS</b>
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**Rationale:** This group allows the learner to develop the skills, knowledge and understanding required to maintain, remove and replace land-based machinery heating and cooling system units and components. It also covers the evaluation of the performance of the replaced units and systems.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Apprentice will:	The Apprentice can:
<p>1. Understand how land-based machinery engine cooling, heating and ventilation systems operate</p>	<p>1.1 Identify land-based machinery engine cooling, heating and ventilation system components</p> <p>1.2 Describe the construction and operation of land-based machinery engine cooling, heating and ventilation systems</p> <p>1.3 Compare key land-based machinery engine cooling, heating and ventilation system components and assemblies against alternatives to identify differences in construction and operation</p> <p>1.4 Identify the key engineering principles that are related to land-based machinery engine cooling, heating and ventilation systems:</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>1.5 State common terms used in key land-based machinery engine cooling, heating and ventilation system design</p>
<p>2. Understand how to check, replace and test land-based machinery heating and cooling system units and components</p>	<p>2.1 Describe how to remove and replace heating and cooling system units and components</p> <p>2.2 Describe common types of testing methods used to check the operation of heating and cooling systems and their purpose</p> <p>2.3 Describe how to test and evaluate the performance of replacement units against machinery specification</p> <p>2.4 Identify common faults found in land-based machinery heating and cooling systems and their causes</p>





3. Be able to work safely when carrying out removal and replacement activities	3.1 Use suitable personal protective equipment and machinery coverings throughout all land-based machinery heating and cooling system unit and component removal and replacement activities
4. Be able to use relevant information to carry out the task	4.1 Select suitable sources of technical information to support land-based machinery heating and cooling system unit and component removal and replacement activities including: a. machinery technical data b. removal and replacement procedures c. legal requirements  4.2 Use technical information to support land-based machinery heating and cooling system unit and component removal and replacement activities
5. Be able to use appropriate tools and equipment	5.1 Select the appropriate tools and equipment necessary for the removal and replacement activity  5.2 Ensure that equipment has been calibrated to meet <b>manufacturer's and legal requirements</b>  5.3 Use the correct tools and equipment in the way specified by manufacturers
6. Be able to carry out removal and replacement of land-based machinery heating and cooling units and components	6.1 Remove and replace land-based machinery heating and cooling system units and components, adhering to the correct specifications and tolerances for the machinery and following: a. <b>the manufacturer's approved removal and replacement methods</b> b. recognised repair methods c. health and safety requirements  6.2 Ensure that replacement land-based machinery heating and cooling system units and components conform to the machinery operating specification and any legal requirements  6.3 Use suitable testing methods to evaluate the performance of the reassembled system  6.4 Ensure that the reassembled system performs to the machinery operating specification and meets any legal requirements



<p>7. Be able to record information and make suitable recommendations</p>	<p>7.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>7.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>7.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>
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GROUP 9

## GROUP TITLE: LAND-BASED ELECTRICAL SYSTEM UNITS AND COMPONENTS

**Rationale:** This group enables the apprentice to develop knowledge of the principles, construction and operation of land-based electrical systems and components; it also includes the maintenance and testing methods associated with electrical and electronic systems found on land-based machinery.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
<b>The Apprentice will:</b>	<b>The Apprentice can:</b>
1. Understand land-based machinery electrical and electronic principles	<ul style="list-style-type: none"><li>1.1 Identify electrical symbols and units found in land-based machinery circuits</li><li>1.2 Describe how to interpret land-based machinery wiring diagrams</li><li>1.3 Describe the operation of key land-based machinery circuit protection devices and why these are necessary</li><li>1.4 Describe earthing principles and earthing methods</li><li>1.5 Identify the use of different cables and connectors used in land-based machinery circuits</li><li>1.6 Describe the operation of electrical and electronic sensors and actuators and their application</li><li>1.7 Describe the key electrical and electronic control principles that are related to land-based machinery electrical circuits</li><li>1.8 State common terms used in land-based machinery electrical circuits</li></ul>
2. Understand how land-based machinery battery, starting and charging systems operate	<ul style="list-style-type: none"><li>2.1 Identify land-based machinery battery, starting and charging system components</li><li>2.2 Describe the construction and operation of land-based machinery battery, starting and charging system components</li><li>2.3 Describe how to remove and replace battery, starting and charging system units and components</li><li>2.4 Compare land-based machinery battery, starting and charging system components and assemblies against alternatives to identify differences in construction and operation</li></ul>



	2.5 State common terms used in conjunction with land-based machinery battery, starting and charging systems
3. Understand how land-based machinery auxiliary electrical systems operate	<p>3.1 Identify land-based machinery auxiliary system components</p> <p>3.2 Describe the construction and operation of land-based machinery auxiliary systems</p> <p>3.3 Compare key land-based machinery auxiliary system components and assemblies against alternatives to identify differences in construction and operation</p> <p>3.4 State common terms used in land-based machinery auxiliary system design</p>
4. Understand how to maintain, check, replace and test land-based machinery electrical systems and components	<p>4.1 Describe how to maintain, remove and replace land-based machinery electrical system units and components</p> <p>4.2 Describe common types of testing methods used to check the operation of land-based machinery electrical systems and components and their purpose</p> <p>4.3 Explain how to test and evaluate the performance of replacement units against specifications</p> <p>4.4 Explain common faults found in land-based machinery electrical systems and components</p>
5. Be able to work safely when working on land-based electrical systems	<p>5.1 Use suitable personal protective equipment and machinery coverings when working on land-based machinery, electrical systems and components</p> <p>5.2 Work in a way which minimises the risk of damage or injury to the machinery, people and the environment</p>
6. Be able to use relevant information to carry out the task	<p>6.1 Select suitable sources of technical information to support land-based machinery electrical unit and component removal and replacement activities including:</p> <ul style="list-style-type: none"><li>a. machinery technical data</li><li>b. removal and replacement procedures</li><li>c. legal requirements</li></ul> <p>6.2 Use technical information to support land-based machinery electrical unit and component removal and replacement activities</p>



<p>7. Be able to use appropriate tools and equipment</p>	<p>7.1 Select the appropriate tools and equipment necessary for removal and replacement of land-based machinery electrical system components</p> <p>7.2 Ensure that equipment has been calibrated to meet manufacturer's and legal requirements</p> <p>7.3 Use the tools and equipment in the way specified by manufacturers to remove and replace machinery electrical systems</p>
<p>8. Be able to carry out maintenance, removal and replacement of land-based machinery electrical units and components</p>	<p>8.1 Maintain, remove and replace electrical systems and components, adhering to specifications and tolerances for the machinery and following:</p> <ul style="list-style-type: none"><li>a. the manufacturer's approved methods</li><li>b. recognised repair methods</li><li>c. health and safety requirements</li></ul> <p>8.2 Ensure that replaced machinery electrical units and components conform to the machinery's operating specification and any legal requirements</p> <p>8.3 Use suitable testing methods to evaluate the performance of the reassembled system</p> <p>8.4 Ensure that the reassembled machinery electrical systems perform to the machinery operating specification and meet any legal requirements</p>
<p>9. Be able to record information and make suitable recommendations</p>	<p>9.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>9.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>9.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>



<b>GROUP 10</b>	<b>GROUP TITLE: LAND-BASED HYDRAULIC SYSTEM UNITS AND COMPONENTS</b>
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**Rationale:** This group enables the apprentice to develop knowledge of the principles, construction and operation of land-based hydraulic systems and components; it also includes the maintenance and testing methods associated with hydraulic systems found on land-based machinery.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Apprentice will:	The Apprentice can:
<p>1. Understand land-based machinery hydraulic system operating principles</p>	<p>1.1 Identify hydraulic symbols and units found in land-based machinery circuits</p> <p>1.2 Describe how to interpret land-based machinery hydraulic schematic diagrams</p> <p>1.3 Describe the operation of key land-based machinery hydraulic circuit protection devices and why these are necessary</p> <p>1.4 Identify the use of different hoses, pipes and connectors used in land-based hydraulic circuits</p> <p>1.5 Describe the operation of hydraulic system components and their application</p> <p>1.6 Describe the key hydraulic principles that are related to land-based machinery hydraulic circuits</p> <p>1.7 State common terms used in land-based machinery hydraulic circuits</p>
<p>2. Understand how to maintain, check, replace and test land-based machinery hydraulic system components</p>	<p>2.1 Describe how to maintain, remove and replace land-based machinery hydraulic system units and components</p> <p>2.2 Describe common types of testing methods used to check the operation of land-based machinery hydraulic systems and components</p> <p>2.3 Explain how to test and evaluate the performance of replacement units against specifications</p> <p>2.4 Explain common faults found in land-based machinery hydraulic systems and components</p>



<p>3. Be able to work safely when working on land-based hydraulic systems</p>	<p>3.1 Use suitable personal protective equipment and machinery coverings when working on land-based machinery hydraulic systems and components</p> <p>3.2 Work in a way which minimises the risk of damage or injury to the machinery, people and the environment</p>
<p>4. Be able to use relevant information to carry out the task</p>	<p>4.1 Select suitable sources of technical information to support land-based machinery hydraulic unit and component maintenance, removal and replacement activities including:</p> <ul style="list-style-type: none"><li>a. machinery technical data</li><li>b. removal and replacement procedures</li><li>c. legal requirements</li></ul> <p>4.2 Use technical information to support land-based machinery hydraulic unit and component maintenance, removal and replacement activities</p>
<p>5. Be able to use appropriate tools and equipment</p>	<p>5.1 Select the appropriate tools and equipment necessary for maintaining, removal and replacement of land-based machinery hydraulic system components</p> <p>5.2 Ensure that equipment has been calibrated to meet manufacturer's and legal requirements</p> <p>5.3 Use the tools and equipment in the way specified by manufacturers to maintain, remove and replace machinery hydraulic systems</p>
<p>6. Be able to carry out maintenance, removal and replacement of land-based machinery hydraulic units and components</p>	<p>6.1 Maintain, remove and replace hydraulic systems and components, adhering to specifications and tolerances for the machinery and following:</p> <ul style="list-style-type: none"><li>a. the manufacturer's approved methods</li><li>b. recognised repair methods</li><li>c. health and safety requirements</li></ul> <p>6.2 Ensure that replaced machinery hydraulic units and components conform to the machinery's operating specification and any legal requirements</p> <p>6.3 Use suitable testing methods to evaluate the performance of the reassembled system</p> <p>6.4 Ensure that the reassembled hydraulic systems perform to the machinery operating specification and meet any legal requirements</p>



<p>7. Be able to record information and make suitable recommendations</p>	<p>7.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>7.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>7.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>
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<b>GROUP 11</b>	<b>GROUP TITLE: DIAGNOSE AND RECTIFY LAND-BASED SELF-PROPELLED MACHINERY ENGINE SYSTEM FAULTS</b>
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**Rationale:** This group enables the Apprentice to develop an understanding, knowledge and skills in the diagnosis and rectification of engine mechanical, electrical, hydraulic and fluid systems. It also covers the testing of engine systems and the evaluation of their performance.

<b>LEARNING OUTCOMES</b>	<b>ASSESSMENT CRITERIA</b>
<b>The Apprentice will:</b>	<b>The Apprentice can:</b>
1. Understand how self-propelled machinery engine systems operate	1.1 Explain the construction and operation of engine systems to include: <ul style="list-style-type: none"><li>a. SI fuel systems</li><li>b. CI fuel systems</li><li>c. ignition systems</li><li>d. engine management</li><li>e. valve mechanisms</li><li>f. pressure charged induction systems</li><li>g. exhaust emission reduction systems</li><li>h. heating, ventilation and cooling</li></ul>
	1.2 Explain the interaction between electrical, electronic and mechanical engine components and systems
	1.3 Explain how electrical systems interlink and interact, including multiplexing and fibre optics
	1.4 Compare engine system components and assemblies against alternatives to identify differences in construction and operation
	1.5 Identify the engineering principles that are related to engine systems: <ul style="list-style-type: none"><li>a. volumetric efficiency</li><li>b. flame travel, pre ignition and detonation</li><li>c. fuel properties</li><li>d. composition of carbon fuels</li><li>e. combustion process</li><li>f. legal requirements for exhaust emissions</li></ul>



<p>2. Understand how to diagnose and rectify faults in self-propelled machinery engine systems</p>	<p>2.1 Describe how to analyse symptoms and causes of faults found in engine systems to include:</p> <ul style="list-style-type: none"><li>a. engine mechanical components</li><li>b. ignition systems</li><li>c. fuel systems</li><li>d. engine management systems</li><li>e. pressure charged induction systems</li><li>f. heating, ventilation and cooling systems</li></ul> <p>2.2 Explain systematic diagnostic techniques used in identifying engine system faults</p> <p>2.3 Explain how to examine, measure and make suitable adjustments to the components including:</p> <ul style="list-style-type: none"><li>a. settings</li><li>b. electrical measurements</li><li>c. pressures</li><li>d. condition</li><li>e. wear and performance</li></ul> <p>2.4 Explain how to carry out diagnosis and rectification activities in order to correct the faults in engine systems</p> <p>2.5 Explain how to select, prepare and use diagnostic and rectification equipment for engine systems</p> <p>2.6 Explain how to evaluate and interpret test results found when diagnosing engine system faults against machine manufacturer specifications and settings</p> <p>2.7 Explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance</p>
<p>3. Be able to work safely when carrying out self-propelled machinery engine diagnostic and rectification activities</p>	<p>3.1 Use suitable personal protective equipment and machine coverings when using diagnostic methods and carrying out rectification activities</p> <p>3.2 Work in a way which minimises the risk of damage or injury to the machine, people and the environment</p>
<p>4. Be able to use relevant information to carry out the task</p>	<p>4.1 Select suitable sources of technical information to support diagnostic and rectification activities including:</p> <ul style="list-style-type: none"><li>a. machine technical data</li><li>b. diagnostic test procedures</li></ul> <p>4.2 Use sufficient diagnostic information in a systematic way to enable an accurate diagnosis of engine system faults</p>



<p>5. Be able to use appropriate tools and equipment</p>	<p>5.1 Select the appropriate tools and equipment necessary for diagnostic and rectification activities</p> <p>5.2 Ensure that equipment has been calibrated to meet <b>manufacturers' and legal requirements</b></p> <p>5.3 Use the equipment required correctly and safely throughout all engine diagnostic and rectification activities</p>
<p>6. Be able to carry out self-propelled machinery engine diagnosis, rectification and test activities</p>	<p>6.1 Use diagnostic methods that are relevant to the symptoms presented</p> <p>6.2 Evaluate assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately</p> <p>6.3 Carry out all diagnostic and rectification activities following:</p> <ul style="list-style-type: none"><li>a. <b>manufacturers' instructions</b></li><li>b. recognised repair methods</li><li>c. workplace procedures</li><li>d. health and safety requirements</li></ul> <p>6.4 Ensure all repaired or replacement components and <b>units conform to the machine's operating specification</b> and any legal requirements</p> <p>6.5 Adjust components and units correctly to ensure that they operate to meet system requirements</p> <p>6.6 Use testing methods that are suitable for assessing the performance of the system rectified</p> <p>6.7 Ensure the rectified engine system performs to the <b>machine's operating specification</b> and any legal requirements</p>
<p>7. Be able to record information and make suitable recommendations</p>	<p>7.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>7.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>7.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>



<b>GROUP 12</b>	<b>GROUP TITLE: DIAGNOSE AND RECTIFY LAND-BASED SELF-PROPELLED MACHINERY ELECTRICAL FAULTS</b>
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**Rationale:** This group enables the Apprentice to develop an understanding, knowledge and skills in the diagnosis and rectification of faults in self-propelled machinery electrical systems and their units. It also covers the testing of electrical systems and the evaluation of their performance.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
The Apprentice will:	The Apprentice can:
1. Understand machinery electrical and electronic principles	1.1 Explain the principles of electrical inputs, outputs, voltages and oscilloscope patterns, digital and fibre optics  1.2 Explain the principles of sensor inputs, computer processing and actuator outputs  1.3 Identify sensor types (passive and active)  1.4 Identify the electrical principles that are related to machinery electrical circuits
2. Understand how complex self-propelled machinery auxiliary electrical systems operate	2.1 Identify complex land-based auxiliary electrical system components  2.2 Explain the construction and operation of complex land-based auxiliary electrical systems  2.3 Explain the interaction between electrical, electronic and mechanical components within the system defined  2.4 Explain the operation of the electrical and electronic systems for electric, hybrid and alternative fuel machines  2.5 Explain how electrical systems interlink and interact, including multiplexing and fibre optics  2.6 Compare complex land-based auxiliary electrical system components and assemblies against alternatives to identify differences in construction and operation
3. Understand how to diagnose and rectify complex faults in self-propelled machinery auxiliary electrical systems	3.1 Explain the symptoms and causes of faults found in machinery auxiliary electrical systems  3.2 Explain systematic diagnostic techniques used in identifying machinery auxiliary electrical system faults



	<p>3.3 Explain how to examine, measure and make suitable adjustments to components</p> <p>3.4 Explain how to carry out the rectification activities in order to correct complex faults in machine auxiliary electrical systems</p> <p>3.5 Explain how to select, prepare and use diagnostic and rectification equipment for complex auxiliary electrical systems</p> <p>3.6 Explain how to evaluate and interpret test results when diagnosing auxiliary electrical system faults against manufacturer specifications and settings</p> <p>3.7 Explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance</p>
<p>4. Be able to work safely when carrying out diagnostic and rectification activities to self-propelled machinery auxiliary electrical systems</p>	<p>4.1 Use suitable personal protective equipment and machine coverings when carrying out diagnostic and rectification activities to auxiliary electrical systems</p> <p>4.2 Work in a way which minimises the risk of damage or injury to the machine, people and the environment</p>
<p>5. Be able to use relevant information to carry out the task</p>	<p>5.1 Select suitable sources of technical information to support machine diagnostic and rectification activities including:</p> <ul style="list-style-type: none"><li>a. machine technical data</li><li>b. diagnostic test procedures</li></ul> <p>5.2 Use sufficient diagnostic information in a systematic way to enable an accurate diagnosis and rectification of machinery auxiliary electrical system faults</p>
<p>6. Be able to use appropriate tools and equipment</p>	<p>6.1 Select the appropriate tools and equipment necessary for diagnostic and rectification activities</p> <p>6.2 Ensure that equipment has been calibrated to meet manufacturers' and legal requirements</p> <p>6.3 Use the equipment required correctly and safely throughout all machinery auxiliary electrical diagnostic and rectification activities</p>



<p>7. Be able to carry out machinery auxiliary electrical diagnosis, rectification and test activities</p>	<p>7.1 Use diagnostic methods that are relevant to the symptoms presented</p> <p>7.2 Evaluate assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately</p> <p>7.3 Carry out all diagnostic and rectification activities following:</p> <ul style="list-style-type: none"><li>a. manufacturers' instructions</li><li>b. recognised repair methods</li><li>c. health and safety requirements</li></ul> <p>7.4 Ensure all repaired or replacement components and units conform to the machine's operating specification and any legal requirements</p> <p>7.5 Adjust components and units correctly to ensure that they operate to meet system requirements</p>
<p>8. Be able to record information and make suitable recommendations</p>	<p>8.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>8.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>8.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>



<b>GROUP 13</b>	<b>GROUP TITLE: DIAGNOSE AND RECTIFY LAND-BASED SELF-PROPELLED MACHINERY HYDRAULIC SYSTEM FAULTS</b>
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**Rationale:** This group enables the Apprentice to develop an understanding, knowledge and skills in diagnosis and rectification of faults in machinery hydraulic systems including their mechanical and electrical components. It also covers the testing of hydraulic systems and evaluation of their performance.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
<b>The Apprentice will:</b>	<b>The Apprentice can:</b>
1. Understand how self-propelled machinery hydraulic systems operate	1.1 Explain the construction and operation of hydraulic systems and components to include: <ul style="list-style-type: none"> <li>a. hydraulic pump drive mechanisms</li> <li>b. hydraulic motors</li> <li>c. transmission and driveline(s)</li> <li>d. electrical and electronic controls</li> <li>e. mechanical handling components and their limitations</li> <li>f. pneumatic system components</li> </ul> 1.2 Explain the interaction between electrical and electronic, pneumatic, mechanical and hydraulic components and systems 1.3 Explain how electrical systems interlink and interact, including multiplexing and fibre optics 1.4 Compare hydraulic system components and assemblies against alternatives to identify differences in construction and operation 1.5 Identify the engineering principles that are related to hydraulic systems: <ul style="list-style-type: none"> <li>a. <b>Pascal's law</b></li> <li>b. moments and levers</li> <li>c. pumps</li> <li>d. electric / hydraulic control valves</li> <li>e. electrical and pneumatic circuit control principles</li> <li>f. system layouts and schematics</li> <li>g. motors</li> <li>h. cylinders</li> <li>i. filters and coolers</li> </ul>



<p>2. Understand how to diagnose and rectify faults in self-propelled machinery hydraulic systems</p>	<p>2.1 Describe how to analyse symptoms and causes of faults found in hydraulic systems to include:</p> <ul style="list-style-type: none"><li>a. hydraulic components</li><li>b. mechanical components</li><li>c. electrical and electronic components</li><li>d. pneumatic system components</li></ul> <p>2.2 Explain systematic diagnostic techniques used in identifying hydraulic system faults</p> <p>2.3 Explain how to examine, measure and make suitable adjustments to the components including:</p> <ul style="list-style-type: none"><li>a. settings</li><li>b. input and output values</li><li>c. voltages</li><li>d. current consumption</li><li>e. resistance</li><li>f. pressures</li><li>g. condition</li><li>h. wear and performance</li></ul> <p>2.4 Explain how to carry out diagnosis and rectification activities in order to correct the faults in hydraulic systems</p> <p>2.5 Explain how to select, prepare and use diagnostic and rectification equipment for hydraulic systems</p> <p>2.6 Explain how to evaluate and interpret test results found when diagnosing hydraulic system faults against machine manufacturer specifications and settings</p> <p>2.7 Explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance</p>
<p>3. Be able to work safely when carrying out self-propelled machinery hydraulic diagnostic and rectification activities</p>	<p>3.1 Use suitable personal protective equipment and machine coverings when using diagnostic methods and carrying out rectification activities</p> <p>3.2 Work in a way which minimises the risk of damage or injury to the machine, people and the environment</p>
<p>4. Be able to use relevant information to carry out the task</p>	<p>4.1 Select suitable sources of technical information to support diagnostic and rectification activities including:</p> <ul style="list-style-type: none"><li>a. machine technical data</li><li>b. diagnostic test procedures</li></ul>





	<p>4.2 Use sufficient diagnostic information in a systematic way to enable an accurate diagnosis of hydraulic system faults</p>
<p>5. Be able to use appropriate tools and equipment</p>	<p>5.1 Select the appropriate tools and equipment necessary for diagnostic and rectification activities</p> <p>5.2 Ensure that equipment has been calibrated to meet <b>manufacturers' and legal requirements</b></p> <p>5.3 Use the equipment required correctly and safely throughout all hydraulic diagnostic and rectification activities</p>
<p>6. Be able to carry out self-propelled machinery hydraulic diagnosis, rectification and test activities</p>	<p>6.1 Use diagnostic methods that are relevant to the symptoms presented</p> <p>6.2 Evaluate assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately</p> <p>6.3 Carry out all diagnostic and rectification activities following:</p> <ul style="list-style-type: none"><li>a. <b>manufacturers' instructions</b></li><li>b. recognised repair methods</li><li>c. workplace procedures</li><li>d. health and safety requirements</li></ul> <p>6.4 Ensure all repaired or replacement components and <b>units conform to the machine's operating specification</b> and any legal requirements</p> <p>6.5 Adjust components and units correctly to ensure that they operate to meet system requirements</p> <p>6.6 Use testing methods that are suitable for assessing the performance of the system rectified</p> <p>6.7 Ensure the rectified hydraulic system performs to the <b>machine's operating specification</b> and any legal requirements</p>
<p>7. Be able to record information and make suitable recommendations</p>	<p>7.1 Produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required</p> <p>7.2 Make suitable and justifiable recommendations for cost effective repairs</p> <p>7.3 Record and report any additional faults noticed during the course of their work promptly in the format required</p>