

# **ELEC303 - Repairs, Rework and High Voltage Component Replacement on Automotive Electric Vehicles**

## **Scheme of Work**

# ELEC303 Repairs, Rework and High Voltage Component Replacement on Automotive Electric Vehicles

## Scheme of Work

Course/Qualification: Vehicle Electrification

Tutor's Name: \_\_\_\_\_

Number of Sessions:

Delivery Hours: 16

Venue: \_\_\_\_\_ Group: \_\_\_\_\_

### Learning Outcomes

1. Know how to carry out repairs on high energy electrical systems.
2. Be able to select and use appropriate information, tools and equipment to carry out the task.
3. Demonstrates the ability to work safely on an electric/hybrid vehicle.
4. Carry out repairs on high energy electrical systems correctly.
5. Be able to record information detailing the repair in line with company processes.
6. Understand the required safety protocols when working with high voltage systems. Identify high voltage components and assemble these into a high voltage system.

Session	Learning Outcome No.	Activities and Resources	Assessment
Day 1 Session 1 (AM)  2.5 hours	<p><b>LO1</b> - Know how to carry out repairs on high energy electrical systems.</p> <p><b>LO6</b> - Understand the required safety protocols when working with high voltage systems. Identify high voltage components.</p>	<p>Learners to complete the following slides/e-learning modules: 5-33</p> <p><b>Assessment Criteria:</b></p> <ol style="list-style-type: none"> <li>1) Understand the risks of working with electric and hybrid vehicles and what the safety priorities are.</li> <li>2) Know how to work on high voltage electrical systems safely.             <ol style="list-style-type: none"> <li>a) Working with electric and hybrid vehicles.</li> <li>b) Using electric storage batteries safely.</li> <li>c) Knowledge of the different regulations:                 <ul style="list-style-type: none"> <li>• EAWR-89</li> <li>• (UN) ECE – R100 rev 2</li> <li>• GS38</li> <li>• HSE</li> <li>• RIDDOR</li> <li>• PPE.</li> </ul> </li> </ol> </li> <li>3) High voltage components (Unit 2) – re-cap.</li> <li>4) Isolation, de-energising, and lockout (Unit 2) – re-cap.</li> <li>5) Electric vehicle safe isolation and test for dead (Unit 2) – re-cap.</li> <li>6) Be able to identify and use ‘test equipment’ specifically for high voltage re-work/repair.</li> <li>7) Understand voltage measurement/potential difference.</li> <li>8) Understand energy components in ‘series’ and in ‘parallel.’</li> <li>9) Understand ‘resistance’ and how to test ‘resistance/insulation.’</li> </ol>	<p>Completion of e-learning</p> <p>Professional discussion sheet</p>

Session	Learning Outcome No.	Activities and Resources	Assessment
		<p>10) Be able to 'confidently' use test equipment – in the main, a multimeter.</p> <p>*Discuss the hazard/risk implications around motor vehicle high energy electrical systems.</p> <p>**Look at the guidance material from the various legislative bodies.</p> <p>*** Analysis of safety risk assessments related to electrification.</p> <p>**** Re-cap carefully the main points from unit 2 – isolation/lockout and re-energising of automotive electric vehicles.</p> <p><b>*Cover/Demonstrate - Test Equipment.</b></p>	
<p>Day 1 Session 2 (AM)</p> <p>1.5 hours</p>	<p><b>LO2</b> - Be able to select and use the appropriate information, tools and equipment to carry out the task.</p>	<p><b>**Practical</b></p> <p><b>Assessment Criteria:</b></p> <p>1.Learners to work safely through the 'Battery Booklet' tasks. 2.Learners to demonstrate competence in use and understanding of a 'multimeter and its functions.'</p>	<p>Completion of battery booklet task</p>
<p>Day 1 Session 3</p>	<p><b>LO1, LO2 and LO6</b> (cont.)</p>	<p>Learners to complete the following slides/e-learning modules: 25-52</p>	<p>Completion of e-learning /</p>

Session	Learning Outcome No.	Activities and Resources	Assessment
(PM)  1.5 hours		<p><b>Assessment Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Understand how to confirm a problem or fault.</li> <li>2. Be able to use technical information relating to an electric or hybrid vehicle.</li> <li>3. Understand how to perform fault-finding preliminary steps.</li> <li>4. Have a basic understanding of troubleshooting – fuses, multimeter tests, etc.</li> <li>5. Understand how to perform a repair. (Replace always in HV wiring).</li> <li>6. Have a basic understanding of automotive and HV connectors.</li> <li>7. Have a basic understanding of glands, clips, wrap and conduit.</li> <li>8. Understand the different methods of stripping a wire.</li> <li>9. Have a basic understanding of ferrules, connectors, and crimping.</li> <li>10. Have a basic understanding of cable types and thickness.</li> </ol> <p>*Learners to be shown basic insulated tools and equipment.</p> <p>**Learners to be shown a selection of made-up cables and connectors.</p>	question sheet  Professional discussion sheet

Session	Learning Outcome No.	Activities and Resources	Assessment
		***Allow 20 mins for the question sheet.	
Day 1 Session 4 (PM)  2.5 hours	<p><b>**Practical</b></p> <p><b>LO4</b> - Carry out repairs on high energy electrical systems correctly.</p> <p>Automotive and HV connectors, stripping wires, connectors/ferrules and crimping.</p>	<p><b>**Practical</b></p> <p><b>Assessment Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Demonstrate (video if available) on how to make and assemble cables (ferrules/connectors and crimping).</li> <li>2. Learners to carry out ferrule/connectors and crimping tasks.</li> <li>3. Learners to produce cables of various specification.</li> <li>4. Learners to carry out a (short) HV cable build. Crimp ends and hydraulic crimping.</li> </ol> <p>*This is a practical activity based on the number of learners in the group: 1-10 should take around 1.5 hours and 10-20 around 2.5 hours (max.).</p> <p>** Ensure all learners are carrying out the tasks and are performing the operations in a safe and controlled manner.</p> <p><b>*Cover/Demonstrate - Technical Equipment.</b></p>	<p><b>Practical assessment / Task document</b></p>
Day 2 Session 1 (AM)  1 hour	<p><b>LO1</b> - Know how to carry out repairs on high energy electrical systems.</p> <p><b>LO4</b> - Carry out repairs on high energy electrical systems correctly.</p>	<p>Learners to complete the following slides/e-learning modules: 56-65</p> <p><b>Assessment Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Understanding of what 're-work' and 'repair' is.</li> <li>2. Know and understand the steps to be taken to carry out PCB 'work' and 're-work'.</li> </ol>	<p>Completion of e-learning</p> <p>Professional discussion sheet</p>

Session	Learning Outcome No.	Activities and Resources	Assessment
		<ol style="list-style-type: none"> <li>3. Understand the tools and equipment used in PCB 'work' and 're-work.'</li> <li>4. Basic understanding of: <ul style="list-style-type: none"> <li>• electrostatic discharge</li> <li>• electrical overstress</li> <li>• safe work areas.</li> </ul> </li> <li>5. Understanding of how to perform 'surface contaminants' cleaning.</li> <li>6. Understanding of how to perform re-work—replace components that are at fault.</li> <li>7. Know how to read a schematic and have a basic understanding of components and symbols: IEC 60617; BS3939.</li> </ol> <p>*Learners to be shown electric vehicle wiring diagrams/Perform work throughs.</p> <p><b>**Learners to be shown PCB task equipment.</b> (Electronics room/studio – if available).</p>	
Day 2 Session 2 (AM)  3 hours	<b>**Practical</b> <b>LO1, LO4 and LO6</b> (cont.)	<b>**Practical</b> PCB work and re-work.  <b>Assessment Criteria:</b> <ol style="list-style-type: none"> <li>1. Be able to set up a soldering station.</li> <li>2. Be able to work and re-work components.</li> <li>3. Be able to carry out the tasks in a safe, controlled <i>and logical</i> manner.</li> </ol>	<b>Practical assessment / Task document</b>

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		<p>*PCB kits to be used, e.g., Kitronik/Locktronics.  <a href="https://kitronik.co.uk/collections/electronic-project-kits">https://kitronik.co.uk/collections/electronic-project-kits</a>  <a href="https://www.techsoft.co.uk/products/electronics/locktronics">https://www.techsoft.co.uk/products/electronics/locktronics.</a></p> <p>**Learners can perform carousels, picking up work from a previous peer. Examination – work and re-work can be carried out until the project boards work, etc.</p> <p>***Ensure all learners are carrying out the tasks and are performing the operations in a safe and controlled manner.</p> <p><b>*'Chunk down' - mini demo(s) of PCB work and re-work equipment.</b></p>	
Day 2 Session 3 (PM)  1 hour	<b>LO5</b> - Be able to record information detailing the repair in line with company processes.	Learners to complete the following slides/e-learning modules: 67-68  <b>Assessment Criteria:</b> <ol style="list-style-type: none"> <li>1. Understand what information needs to be recorded onto a job card.</li> <li>2. Be able to record technical information on a job card.</li> </ol> <p>*Using an electric vehicle, identify/demonstrate that the charge cable is at fault. Use a live job card to record the details.</p>	Completion of e-learning  Job card record – part 1 (identification / pre-inspection)
Day 2 Session 4 (PM)	<b>LO2</b> - Be able to select and use appropriate information, tools and equipment to carry out the task.	<b>**Practical</b>  Remove, build, and replace a faulty charge cable lead.	<b>Practical assessment / Task document</b>



Session	Learning Outcome No.	Activities and Resources	Assessment
3 hours	<p><b>LO3</b> - Demonstrate the ability to work safely on an electric/hybrid vehicle.</p> <p><b>LO4</b> - Carry out repairs on high energy electrical systems correctly.</p> <p><b>and</b></p> <p><b>LO6</b> - Understand the required safety protocols when working with high voltage systems. Identify high voltage components and assemble these into a high voltage system.</p>	<p><b>Assessment Criteria:</b></p> <p>Practical (summative) assessment – remove, build, and replace a faulty charge cable lead:</p> <ol style="list-style-type: none"> <li>1. Carry out safe isolation, lockout and de-energising.</li> <li>2. Use mandatory PPE, VPE and CPE.</li> <li>3. Be able to perform cable removal, measuring, making and replacing. (Area set up for this?)</li> <li>4. Re-energise the vehicle in a safe manner.</li> <li>5. Be able to confirm the repair.</li> </ol> <p><b><i>Be very clear about workshop safety equipment, exits and assessment timings.</i></b></p> <p>*Learners to be given an electric vehicle wiring diagram/Perform work throughs.</p> <p>**This is a practical activity based on the number of learners in the group: 1-10 should take around 1.5 hours and 10-20 around 2.5 hours (max.).</p> <p><b>*** Ensure all learners are carrying out the tasks and are performing the operations in a safe and controlled manner.</b></p> <p><b><i><u>This is a pass or fail exercise.</u></i></b></p>	Job card record – part 2 (repair)