

## IMIEV3

# Service and repair non-live electric and hybrid vehicle systems



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### Overview

This unit covers the competence and knowledge technicians need to carry out servicing and general repairs on non-live high energy electrical systems and components on electric and hybrid vehicles safely. The unit also ensures that the technician is aware of the effect that high energy electrical component technology has on other vehicle systems.

**Note:** *This unit only covers the competence and knowledge required to work on **non-live** high energy electrical components and associated systems. It does not enable a candidate to dismantle 'live' components, for example battery packs.*

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### Performance criteria

- You must be able to:*
- P1 wear suitable personal protective equipment and use appropriate vehicle coverings throughout all **work activities**
  - P2 ensure the **electric/hybrid vehicle** is safe to work on
  - P3 support your work activities by reviewing:
    - P3.1 vehicle technical data
    - P3.2 removal and replacement procedures
    - P3.3 legal requirements
  - P4 prepare, test and use all the test and diagnostic **equipment** required following manufacturers' instructions
  - P5 carry out all removal and replacement activities following:
    - P5.1 manufacturers' instructions
    - P5.2 recognised researched repair methods
    - P5.3 health and safety requirements
  - P6 work in a way which minimises the risk of:
    - P6.1 damage to other vehicle systems, components and units
    - P6.2 damage to your working environment and injury to yourself and others
  - P7 ensure replaced **high energy electrical components** meet the manufacturers' recommendations or conform to operating specification
  - P8 record and report any additional faults you notice during the course of your work
  - P9 use suitable **testing methods** to evaluate the performance of the reassembled **high energy electrical** system accurately
  - P10 ensure the reassembled system performs to the vehicle operating specification and legal requirements before return to the customer
  - P11 ensure your records are accurate, complete and passed to the relevant person(s) promptly in the format required

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### Knowledge and understanding

*You need to know and understand:*

### Safety Precautions

- K1 the health and safety legislation and workplace procedures relevant to working with **electric/hybrid vehicles** including appropriate personal protective equipment and its use
- K2 the legislation relevant to the activities described in the Scoping Statement for this NOS
- K3 your workplace procedures for the:
  - 3.1 referral/reporting of problems when working with **electric/hybrid vehicles**
  - K3.2 how to make others aware of the work carried out **on electric/hybrid vehicles**
- K4 the differences between an **electric/hybrid vehicle** and non-electric vehicles
- K5 the charging systems associated with **electric/hybrid vehicles** and how to charge **electric/hybrid vehicles** safely
- K6 the precautions necessary when using plug-in charging equipment.
- K7 how to carry out a risk assessment on damaged and broken down **electric/hybrid vehicles**
- K8 how to make **electric/hybrid vehicles** safe in order to carry out work activities, including isolating **high energy electrical** systems, where required, within your level of training
- K9 how to safely ensure that **high energy electrical** system is not live
- K10 how to reduce the risk of hazards when working on and around **electric/hybrid vehicles**
- K11 the hazards associated with **electric/hybrid vehicle** batteries when exposed to extreme temperatures, impact and other adverse conditions
- K12 the specific vehicle manufacturer restrictions regarding non-start and recovery, for example jump starting (hybrid only) and towing/lifting
- K13 the implications of electrical conductivity through the human body and the potential medical conditions that can occur regardless of voltage or current type present in an **electric/hybrid vehicle**

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K14 the disposal of waste materials including recycling obligations, as well as COSHH regulations with regards to hazardous battery chemicals and compounds

K15 how to reduce the risk of hazards when working on and around **electric/hybrid vehicles**

K16 how to work safely avoiding damage to other vehicle systems, components and units and contact with leakage and hazardous substances

### Use of technical information

*You need to know and understand:*

K17 how to find, interpret and use sources of information applicable to component repair and replacement within **high energy electrical** systems

K18 the importance of using the correct sources of technical information

### Electrical/hybrid vehicle component construction

*You need to know and understand:*

K19 how **high energy electrical** components function and are constructed, including battery modules, electric motors and associated electrical components

### Electrical/hybrid vehicle systems and component removal and replacement

*You need to know and understand:*

K20 how to identify the components that make up the **high energy electrical** system

K21 how to identify the typical location of **high energy electrical** cabling and associated components including using wiring labelling and colour.

K22 the different types of energy storage systems and voltages associated with **electric/hybrid vehicles**.

K23 the manufacturer's specification for the type and quality of components to be used.

K24 how to store, dispose of, recycle and return any removed **high energy electrical** components in line with legislation and organisational procedures.

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### Electrical and electronic principles

*You need to know and understand:*

K25 vehicle earthing principles and earthing methods as appropriate to **electric/hybrid vehicles**

K26 basic electrical and electronic principles, including ohms law, voltage, power, current (ac/dc), resistance, magnetism, electromagnetism and electromagnetic induction

K27 specific high energy circuit protection

K28 electrical and electronic principles associated with ancillary systems, including types of sensors and actuators, their application and operation

K29 the interaction between electrical, electronic and mechanical components within **electric/hybrid vehicle** systems

K30 how electric vehicle systems interlink and interact, including multiplexing

### Use of electrical testing equipment and electrical testing techniques

*You need to know and understand:*

K31 how to use the electrical testing equipment required

K32 how to prepare, test and use all the repair and replacement equipment required

K33 how to conduct tests on non-live **high energy electrical** systems following electrical safety and workplace procedures

K34 how to determine the serviceability of a component in a **high energy electrical** system

K35 how to interpret the results of your tests and make recommendations based on these results

K36 the importance of basing your recommendations on test results

K37 how to perform safety and operational checks on the tools and equipment required to remove and replace electrical components

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### Vehicle electrical equipment faults and their correction

*You need to know and understand:*

K38 how to identify faults and damage in **electric/hybrid vehicle high energy electrical** systems

K39 the common underlying causes of faults and damage in **high energy electrical** components

K40 how to test and evaluate the performance of replacement components and the reassembled system against operating specifications and legal requirements

K41 the importance of ensuring electrical components are functioning correctly before release to the customer

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### Additional Information

#### Scope/range

- 1 **Electric/hybrid vehicle** – any vehicle that is powered wholly or in part by an electrical drive train. This includes electric hybrid plug-in vehicles.
- 2 **High energy electrical/high voltage** – typical voltages used for a range of Electric and Hybrid Vehicles 100-650V **ECE R100** (relating to vehicle regulations) paragraph 2.14 clearly defines high voltage: “High Voltage” means the classification of an electric component or circuit, if its working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (rms).’
- 3 **Additional equipment includes:**
  - 3.1 hand tools
  - 3.2 code readers
  - 3.3 specialist tools, for example manufacturer specific software
  - 3.4 safe and appropriate electrical testing equipment
  - 3.5 relevant safety equipment
- 4 **Testing methods include:**
  - 4.1 visual
  - 4.2 aural
  - 4.3 functional
  - 4.4 measurement
- 5 **Components include:**
  - 5.1 batteries/stack, pod, module
  - 5.2 motors

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- 5.3 cabling
- 5.4 relays/control units
- 5.5 charger and charging points
- 5.6 isolators
- 5.7 inverters
- 5.8 battery management interface
- 5.9 ignition/key-on control switch
- 5.10 driver display panel
- 5.11 multi-battery server unit
- 5.12 drive trains
- 5.13 power sources
- 5.14 ancillary systems and components

### **6. Work activities**

- 6.1 servicing non-live high energy electrical systems and components
- 6.2 general repair of non-live high energy electrical systems and components

### **7. Diagnostic testing as defined by:**

- 7.1 verifying the fault
- 7.2 collecting further information
- 7.3 evaluating the evidence
- 7.4 carrying out further tests in a logical sequence
- 7.5 rectifying the problem
- 7.6 checking all systems



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<b>Suite</b>	Electric and Hybrid Vehicles; Maintenance & Repair - Light Vehicle; Maintenance & Repair – Motorcycle; Maintenance and Repair - Heavy Vehicle; Maintenance and Repair - Heavy Vehicle Trailer; Maintenance and Repair - Lift Truck; Auto Electrical & Mobile Electrical Installation; Accident Repair - Mechanical, Electrical and Trim

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### Key words

Electric vehicle; hybrid vehicle; high energy electrical; status of vehicle; hazards; work activities