NOS Title: IMIEV5 Diagnose, test and repair electric and hybrid vehicle high voltage batteries

Overview - This standard is about working on live or potentially live battery systems and the related high voltage components in Electric and Hybrid Vehicles.

Warning: It has been recommended by industry experts that only those with appropriate training and experience on working with high voltage components of Electric and Hybrid Vehicles should carry out the functions below.

Performance Criteria

You must be able to:

1. observe safety information prior to commencing work on the high voltage vehicle
2. carry out a dynamic risk assessment of the vehicle and the work to be carried out
3. select and wear correct and appropriate personal protective clothing and equipment as advised by the manufacturer
4. carry out thorough inspection of the external and visible parts of the high voltage battery for signs of damage
5. check for external damage to high voltage connections or cables
6. follow your organisation’s and manufacturer’s instructions if damage to the high voltage components has been found
7. use diagnostic and test equipment in line with manufacturer’s guidelines to ensure the integrity of the high voltage battery and the high voltage system prior to commencing any repairs
8. interpret the results obtained from the diagnostic test equipment
9. ensure all work carried out takes place immediately following inspection where possible. Re-inspection is recommended following timescales recommended by manufacturers.
10. isolate the high voltage system as per manufacturer’s guidance
11. select appropriate tools/lifting equipment in line with manufacturer’s guidelines and specification
12. carry out a visual inspection of the lifting/supporting tools and equipment prior to use
13. remove the high voltage battery following manufacturers’ guidelines and place in a suitable, isolated area with restricted access
14. remove the battery housing or inspection covers to carry out a visual inspection avoiding contact with any components. When possible, never leave the battery unattended.
15. ensure the high voltage battery is made safe and access to the storage area restricted if the battery is to be left unattended
16. reduce the battery voltage to a safe working limit in line with manufacturers guidelines where possible
17. select and wear appropriate Personal Protective Equipment (PPE) when the battery voltage cannot be reduced to a safe working limit
18. inspect all new components for damage prior to installation using visual inspection methods
19. carry out all removal and replacement activities following:
19.1 manufacturer’s instructions
19.2 recognised researched repair methods
19.3 health and safety requirements
20. carry out a thorough inspection where possible, along with a suitably experienced colleague, to ensure the integrity of the repair prior to reestablishing the normal operating battery system voltage
21. re-establish the normal operating battery voltage in line with manufacturers guidelines
22. reassemble the battery housing/inspection covers
23. recommission the battery in line with manufacturers guidelines using specialist, high voltage test equipment
24. reinstall the battery following manufacturers recommended guidelines with particular attention to any potential equalisation connections
25. reinstate the vehicle following manufacturers guidelines
26. carry out diagnostic test prior the handover of the vehicle
27. ensure records of work are accurate complete and passed to the relevant person in the format required

Knowledge and Understanding

You need to know and understand:

Health and safety procedures

1. the procedure for authorisation to allow an individual to work on high voltage systems
2. how to carry out a dynamic risk assessment of the vehicle and the work to be carried out
3. the current health and safety legislation and specific vehicle manufacturers repair and safety procedures relevant to working with electric and hybrid vehicles
4. how and where to access relevant information on the specific electric and hybrid vehicle systems
5. the terminology used within Electric and Hybrid vehicle systems
6. how to inform and make others aware of the potential hazards prior to and when work is being carried out on high voltage systems
7. how to work in a way that minimises the risk of:
   5.1 injury to yourself and others
   5.2 damage to your working environment
   5.3 damage to other vehicle systems, components and units
8. the hazards associated with electric/hybrid high energy vehicle systems, batteries when exposed to extreme temperatures, impact and other adverse conditions
9. how to identify high voltage components and/or parts that are connected to the high voltage system within the battery

Diagnosing and repairing damaged batteries and components

10. how to identify any damage to the battery and the high voltage connections and cables
11. how to use diagnostic and test equipment and interpret the results to ensure the integrity of the high voltage system
12. series circuits and connection of multiple battery cells and the effect on voltage levels
13. how to safely isolate the vehicle following manufacturer's guidelines
14. how to select and visually inspect the appropriate tools and lifting equipment for battery removal
15. the procedure for the safe removal and storage of the high voltage battery
16. the importance of storing the high voltage battery in a safe, restricted area if left unattended
17. how to reduce the battery voltage to a safe working limit in line with manufacturers guidelines
18. the correct recognised repair methods for batteries and how to carry them out observing health and safety requirements
19. how to ensure the integrity of the repair prior to restablishing the normal operating battery system voltage
20. how to use specialist, high voltage equipment to recommission the battery
21. how to reinstate the vehicle following manufacturer’s guidelines
22. basic first aid and safety training including the correct procedures that must be followed in the event of electric shock
23. how to safely dispose of or recycle battery components inline with legislation and organisation procedures
24. how to accurately report the work that has been carried out on the vehicle to relevant persons

Scope of the standard

Battery damage includes:
- over heating
- physical impact damage
- chemical leakage
- smoke
- water damage

High voltage tests and equipment includes:
- pressure testing equipment to ensure the battery is properly sealed (IP Testing)
- isolation/dielectric test to ensure the integrity of the high voltage system
- cell symmetry test

Protective clothing/equipment includes:
- insulated high voltage gloves
- face shield
- fire resistant clothing/apron
- insulated tools

Glossary

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).'

Live: Equipment that is at a voltage by being connected to a source of electricity. This implies that, unless otherwise stated, the live parts are exposed so that they can be touched either directly or indirectly by means of some conducting object and that they are either live
at a dangerous energy level or dangerous potential, ie over 50 V ac or 120 V dc in dry conditions - see BSI publication PD 6519:5

**Electric/hybrid vehicle** – any vehicle that is powered wholly or in part by an electrical drive train

Links to other NOS – IMIEV4 Isolating and reinstate Electric and Hybrid Vehicles