



Electric and Hybrid Vehicle Maintenance

Course: High-Voltage Safety and Diagnostics



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Introduction:

Electric and hybrid vehicle maintenance, covering high-voltage safety and diagnostics, is a 10-day course for automotive technicians, workshop supervisors, fleet engineering and EV programme staff, ending with an HV-Safe Workshop Procedure and Diagnostic Plan for a case fleet. Workshops accepting battery electric and hybrid vehicles without a de-energising routine, insulation testing or battery health checks expose technicians to shock and arc hazards and replace costly packs by guesswork. Nominees already service conventional vehicles, and each day is taught through inspection walkthroughs of high-voltage components, procedures and bay layouts. CoreConcept Training Center delivers this electric and hybrid vehicle maintenance course.

Course Objectives:

- Explain BEV, HEV and PHEV architectures and trace the high-voltage energy path from traction battery to drive motor
- Inspect traction battery packs, BMS functions and thermal management circuits and interpret state of charge and state of health data
- Apply a safe de-energising procedure with suitable PPE, lockout, absence-of-voltage verification and insulation resistance testing
- Diagnose high-voltage faults using scan tools, insulation monitoring alerts, interlock checks and oscilloscope measurements
- Decide between module repair, pack exchange, second-life use or recycling using measured battery health and post-repair quality checks
- Prepare a workshop bay layout, tooling list, fleet maintenance schedule and KPI set for electric and hybrid vehicles

Target Audience:

- Automotive technicians who service, repair and diagnose light and heavy vehicles moving onto electric and hybrid models
 - Workshop supervisors responsible for bay allocation, job quality and safe working on high-voltage vehicles
 - Fleet engineering staff who set maintenance schedules and approve repairs for electric and hybrid vehicles
 - EV programme staff who prepare workshops, tooling and technician authorisation for vehicle electrification
 - Technical quality staff who check repair work and keep high-voltage safety records in service networks
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Course Outline:

Day 1: EV and Hybrid Powertrain Architectures and High-Voltage Layout

- BEV, HEV and PHEV Architecture Comparison by Energy Flow
- Series, Parallel, Power-Split and Mild Hybrid Drive Layouts
- PHEV Charge-Depleting, Charge-Sustaining and Blended Operating Modes
- High-Voltage Component Map With Orange Cabling and Connectors
- Low-Voltage Auxiliary Battery and CAN Network Interfaces

Day 2: Traction Battery Cells, Packs, BMS and Thermal Management

- Cylindrical, Prismatic and Pouch Cell Formats and Chemistries
- Module and Pack Build With Contactors, Fuses and Service Plug
- Battery Management System Monitoring, Cell Balancing and Contactor Control
- State of Charge and State of Health Estimation Methods
- Liquid and Air Battery Cooling Circuits and Coolant Service

Day 3: Electric Drive Units, Inverters, DC-DC Converters and Onboard Chargers

- Permanent Magnet and Induction Traction Motor Construction and Wear
- Traction Inverter IGBT and Silicon Carbide Switching Stages
- Resolver Motor Position Sensor Signals and Offset Learning
- DC-DC Converter Supply to the Low-Voltage Network
- Onboard Charger AC Conversion and Charge Port Control Signals

Day 4: High-Voltage Safety, PPE and Safe De-Energising Procedure

- Electric Shock and Arc Flash Hazards in Traction Systems
- Insulated Gloves, Face Shields and Category-Rated Test Meter Selection
- Safe De-Energising Sequence With Service Disconnect Removal and Lockout
- Absence-of-Voltage Verification Using the Live-Dead-Live Test Method
- Insulation Resistance Testing With a Megohmmeter on HV Circuits

Day 5: Emergency Response and Week-One Guided Inspection Walkthrough

- Damaged Vehicle Triage, Thermal Runaway Signs and Quarantine Bays
 - First Responder Rescue Sheets and Cut Zone Identification
 - Rescue Hook Use and Casualty Release From Energised Conductors
 - Guided Walkthrough Locating HV Components on a Case Hybrid
 - Guided Walkthrough Applying De-Energising Steps on a Case BEV
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Day 6: Diagnostic Tools and High-Voltage Fault-Finding

- Scan Tool Diagnostic Trouble Codes and Live Data Interpretation
- Insulation Monitoring Device Alerts Read Against IEC 61557-8 Principles
- Insulation Fault Location by Circuit Splitting Under IEC 61557-9
- Contactor, Pre-Charge Circuit and HV Interlock Loop Fault Diagnosis
- Oscilloscope Capture of Motor Phase Current Waveforms

Day 7: Battery State of Health, Repair Versus Replace and Quality Control

- Capacity Test and Internal Resistance Measurement for Health Grading
- Cell Voltage Imbalance Analysis From BMS Freeze-Frame Data
- Module Replacement Versus Pack Exchange Decision Matrix
- Pack Opening Cleanliness Controls, Torque Records and Lid Seal Testing
- Post-Repair Insulation Verification and Quality Sign-Off Record

Day 8: Regenerative Braking, Chassis Service and Workshop Readiness

- Regenerative and Friction Brake Blending Checks and Pad Wear
- Electric Brake Booster Service Modes and Fluid Bleeding Procedure
- Tyre, Suspension and Lifting Point Differences for Heavier Vehicles
- HV Workshop Bay Layout, Signage, Barriers and Insulated Tooling
- Technician Authorisation Levels and HV Work Permit Briefings

Day 9: Battery Logistics, End of Life and Fleet EV Maintenance Planning

- Damaged Battery Packaging and Transport Under Dangerous Goods Rules
- Battery Storage Racking, Fire Separation and Temperature Monitoring
- Second-Life Grading and Recycling Hand-Over Documentation
- Fleet EV Preventive Maintenance Intervals and Task Lists
- Workshop KPIs for First-Time Fix, HV Incidents and Downtime

Day 10: Inspection Walkthrough Building an HV-Safe Workshop Procedure and Diagnostic Plan

- Case Fleet Vehicle Mix and HV Risk Profile Review
 - Workshop De-Energising Procedure Drafted for the Case Fleet
 - Diagnostic Flowcharts for Three Recurring Case Fleet Faults
 - Battery Health Screening and Repair Rules for the Case
 - HV-Safe Workshop Procedure and Diagnostic Plan Completion and Defence
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Skills You Will Gain:

- High-Voltage Isolation Practice
- Insulation Resistance Testing
- Traction Battery Inspection
- Battery Health Grading
- EV Fault Diagnosis
- Regenerative Brake Servicing
- HV Workshop Set-Up
- Fleet EV Maintenance Scheduling

Why Attend This Course:

- Deliver an HV-Safe Workshop Procedure and Diagnostic Plan for a case fleet to the workshop manager and the fleet engineering lead
- Decide whether a degraded pack needs module repair, exchange or a second-life route using measured capacity and resistance
- Avoid electric shock incidents, misdiagnosed isolation faults and unnecessary pack replacements that keep vehicles off the road
- Pass on de-energising checklists, diagnostic flowcharts and bay layout templates to technicians and supervisors

Conclusion:

Back at work, the participant gives the workshop manager and the fleet engineering lead an HV-Safe Workshop Procedure and Diagnostic Plan that sets technician authorisation levels, the de-energising and insulation testing sequence, bay layout and tooling, diagnostic flowcharts for recurring faults and repair versus replace rules for battery packs. Management uses it to decide which electric and hybrid work stays in-house, which tools to buy and which jobs go to specialists. After the first months of use, the unit should review HV incidents, first-time fix rate, battery replacements and vehicle downtime against the plan.

Frequently Asked Questions FAQ:

What should participants know before an electric and hybrid vehicle maintenance course?

Participants should already service conventional vehicles and use a digital multimeter and scan tool. No prior high-voltage work is needed. Bringing service data, fault records or workshop photos from their own vehicles helps them apply the walkthroughs and the capstone to their own workshop.

How does an electric and hybrid vehicle maintenance course differ from a charging infrastructure or fleet management course?

It works on the vehicle itself: high-voltage components, safe isolation, diagnosis, battery service and workshop readiness. Charging infrastructure courses design and connect charge points, and fleet management courses cover vehicle acquisition, running costs and telematics across a whole fleet.

Why does electric and hybrid vehicle maintenance require insulation resistance testing?

The high-voltage system is isolated from the vehicle chassis, so one insulation fault can go unnoticed until a second creates a shock path. Testing insulation resistance after de-energising and after every repair confirms the isolation is intact before the vehicle returns to service.

What do participants take back from the electric and hybrid vehicle maintenance course?

Participants take back an HV-Safe Workshop Procedure and Diagnostic Plan for a case fleet, with a de-energising sequence, insulation test record, diagnostic flowcharts, battery health screening rules, bay layout, tooling list and maintenance KPIs they can adapt to their own workshop.