THE OFFICIAL ASE STUDY GUIDE

Includes L3 Certification Test Reference

*TEST INFORMATION*

*FOR THE*

# *LIGHT DUTY HYBRID/ELECTRIC VEHICLE SPECIALIST (L3) TEST*

- OVERVIEW
- TEST SPECIFICATIONS
- TASK LIST
- CERTIFICATION TEST REFERENCE
- SAMPLE QUESTIONS
- INDUSTRY TRAINING

National Institute for
AUTOMOTIVE
SERVICE
EXCELLENCE

# ASE Light Duty Hybrid/Electric Vehicle Specialist (L3) Test

## Contents

# Introduction

Use this *Official ASE Study Guide* to prepare for the ASE Light Duty Hybrid/Electric Vehicle Specialist (L3) Test. This document contains general information, the Test Specification, the Task List, sample questions, and test preparation resources for this ASE test. In addition, **this guide includes the 5-page *Certification Test Reference* which will be available as a pop-up during your test**. Familiarizing yourself with the *Test Reference* contents beforehand is a key to success.

The Test Specification in this study guide lists the main content covered by the test and the number of test questions devoted to each topic.

The Task List is developed by working professionals and technical experts, and it spells out the technical knowledge and skills required for success on this test. The Task List provides a valuable checklist of what you should know. Every question on the test represents one or more of these tasks, although some tasks may not appear on the version of the test that you see. To improve chances of success, use the Task List to identify weak areas and to select learning resources.

The sample questions show the several types of multiple-choice question formats used on an actual ASE test. Some questions have special instructions; those same instructions will appear with similar questions on the ASE tests. If you are a native Spanish speaker, be aware that all ASE tests have a pop-up English-to-Spanish glossary.

ASE certification requires successful completion of the test and documentation of relevant work experience (3 years for this test). Appropriate vocational training may count toward part of the work experience requirement. Visit www.workexp.ase.com/FormInstr.aspx for more details.

To register for the L3 Test, you must have previously passed the Automobile Electrical/Electronic Systems (A6) and Engine Performance (A8) tests. **For more information about ASE tests in general and the ASE Certification process, download *ASE Certification: Need to Know* at www.ase.com/ase-study-guides.**

## How Long are the Tests?

| Light Duty Hybrid/Electric Vehicle Specialist Test | | | |
|---|---|---|---|
| **Test** | **Name** | **Number of questions** | **Testing time** |
| L3 | Light Duty Hybrid/Electric Vehicle Specialist | 55 total/45scored* | 2.5 hrs/150 mins |
| L3R | Light Duty Hybrid/Electric Vehicle Specialist Recertification | 45 | 2.25 hrs/135 mins |

* To gather the performance statistics required for use in the scored section of future tests, each CERTIFICATION test contains 10 questions that are not counted for score. Since you don't know which questions those are, you need to answer every question. The L3 and L3R tests both have the same number of scored questions.

# Test Specifications
# Light Duty Hybrid/Electric Vehicle Specialist (L3) Test

| | Content Area | Questions in Test | Percentage of Test |
|---|---|---|---|
| **A.** | High-Voltage (HV) Battery System | 11 | 25% |
| **B.** | Internal Combustion Engine | 6 | 13% |
| **C.** | Drive Systems | 9 | 20% |
| **D.** | Power Electronics | 13 | 29% |
| **E.** | Supporting Systems | 6 | 13% |
| | **Total** | 45* | 100% |

*Note: The L3 CERTIFICATION test will contain 10 unscored questions (55 total questions) included to gather statistics needed for future possible inclusion as scored items. Your answers to these questions will not affect your score, but since you do not know which ones they are, you should answer all questions in the test.

The L3 CERTIFICATION and RECERTIFICATION tests both cover the same content areas and have the same number of scored questions.

# Task List
# Light Duty Hybrid/Electric Vehicle Specialist (L3) Test

## A. High-Voltage (HV) Battery System (11 questions)

1. Perform high-voltage (HV) system de-energize/disable procedure; energize/enable high-voltage system.
2. Identify, inspect, and use proper personal protective equipment (PPE).
3. Identify, validate, and use proper electrical testing equipment and leads.
4. Retrieve and diagnose DTCs; determine needed repairs.
5. Diagnose problems caused by damaged or failed harnesses, connectors, terminals, and fuses.
6. Diagnose high-voltage (HV) battery pack malfunctions.
7. Remove and install high-voltage battery pack.
8. Test, diagnose, and repair high-voltage leaks/loss of isolation.
9. Test, diagnose, and repair high-voltage battery pack thermal management (heating and cooling) systems.
10. Test, diagnose, repair, and/or replace high-voltage battery pack internal components.

## B. Internal Combustion Engine (6 questions)

1. Retrieve and diagnose DTCs; determine needed repairs.
2. Determine if the internal combustion engine (ICE) is in CRANK mode or RUN mode.
3. Differentiate between driveability problems caused by the internal combustion engine and/or hybrid drive system.
4. Perform internal combustion engine cranking compression test; interpret results.
5. Operate internal combustion engine during service/emissions testing.
6. Diagnose internal combustion engine no-crank condition.
7. Diagnose internal combustion engine cranks/no-start condition.
8. Interpret engine manifold pressure (vacuum) readings.
9. Identify engine start/stop strategy; diagnose malfunctions.
10. Service engine cooling system.
11. Diagnose evaporative emission (EVAP) system faults specific to hybrid vehicles; determine needed repairs.
12. Identify special service and maintenance considerations for internal combustion engine (ICE).

## C. Drive Systems (9 questions)

1. Perform high-voltage (HV) system de-energize/disable procedure; energize/enable high-voltage system.
2. Identify, inspect, and use proper personal protective equipment (PPE).
3. Identify, validate, and use proper electrical testing equipment and leads.
4. Retrieve and diagnose DTCs; determine needed repairs.
5. Diagnose problems caused by damaged or failed harnesses, connectors, terminals, and fuses.
6. Test, diagnose, and repair high-voltage leaks/loss of isolation.
7. Diagnose motor-rotor position sensor (Resolver or Encoder type).
8. Diagnose malfunctions in the drive/traction motor-generator assembly (such as an inoperative condition, noise, shudder, overheating, etc.).
9. Diagnose improper electrically actuated parking pawl operation; determine needed repair.
10. Identify transmission fluid and coolant fluid requirements; verify fluid levels.

## D. Power Electronics (13 questions)

1. Perform high-voltage (HV) system de-energize/disable procedure; energize/enable high-voltage system.
2. Identify, inspect, and use proper personal protective equipment (PPE).
3. Identify, validate, and use proper electrical testing equipment and leads.
4. Retrieve and diagnose DTCs; determine needed repairs.
5. Diagnose problems caused by damaged or failed harnesses, connectors, terminals, and fuses.
6. Identify procedures necessary to establish the proper vehicle operational power mode during service (OFF, ACCESSORY, POWER ON, READY TO DRIVE).

# L3 Task List (continued)

7. Diagnose the cause of a high-voltage system warning displayed on the instrument panel and/or a driveability complaint.
8. Diagnose AC/DC inverter faults; perform needed repair.
9. Remove and install AC/DC inverter.
10. Diagnose power electronics thermal management (heating and cooling) system; determine needed repair.
11. Locate and test the voltage level of capacitors.
12. Diagnose faults in safety interlock circuit(s); perform needed repair.
13. Diagnose DC/DC converter system; perform needed repair.
14. Remove and install DC/DC converter.
15. Inspect high-voltage cable condition; test for loss of isolation.
16. Perform testing of low-voltage battery.
17. Diagnose high-voltage contactor faults; perform needed repair.
18. Diagnose high-voltage on-board AC charging faults; perform needed repair.
19. Diagnose high-voltage DC charging faults; perform needed repair.
20. Diagnose failures in data communication bus network; determine needed repair.

### E. Supporting Systems (6 questions)

1. Perform high-voltage (HV) system de-energize/disable procedure; energize/enable high-voltage system.
2. Identify, inspect, and use proper personal protective equipment (PPE).
3. Identify, validate, and use proper electrical testing equipment and leads.
4. Retrieve and diagnose DTCs; determine needed repairs.
5. Diagnose problems caused by damaged or failed harnesses, connectors, terminals, and fuses.
6. Observe and interpret driver indicators, power flow display, and energy monitor; determine necessary action.
7. Diagnose passenger compartment thermal management (heating and cooling) systems; determine needed repairs.
8. Test and diagnose high-voltage air conditioning compressor operation; determine needed repairs.
9. Remove and install high-voltage air conditioning compressor; identify and select proper system oil.
10. Differentiate between brake hydraulic system and regenerative braking faults; determine needed repairs and procedures.
11. Inspect fluid level(s) of liquid cooling systems; determine needed action.
12. Perform maintenance and service of liquid cooling system(s).
13. Test and diagnose high-voltage battery charging problems when using electric vehicle supply equipment (EVSE).
14. Diagnose faults in high-voltage DC/AC inverter system for 120/240 VAC power outlet(s).
15. Diagnose faults in high-voltage DC/AC inverter system for 120/240 VAC for vehicle-to-grid (V2G) power conversion.
16. Diagnose and repair electric/electronic steering systems. □

# Certification Test Reference
# ASE Light Duty Hybrid/Electric Vehicle Specialist (L3) Test

The block diagrams of the ASE system types, included on pages 2-3 of this Certification Test Reference, represent the powertrain configurations used by the electrified vehicles included in the ASE Light Duty Hybrid/Electric Vehicle Specialist test. These ASE system types are not intended to represent any specific make or model.

- Although additional details may be provided in individual test questions, the following information should beconsidered common to each of these systems.
- All ASE system types are high voltage. Any system greater than 60 VDC or 30 VAC should be considered high voltage.
- Each system type is equipped with a low-voltage battery.
- In all system types, the motor/generators (MGs) are high-voltage e-machines which use three-phase AC power.
- Each system type is equipped with a high-voltage (HV) battery pack. Neither battery chemistry nor total battery pack voltage is defined in this general description document.
- Each system type uses a DC/AC bi-directional inverter to transfer power between the motor/generator (MG) and the high-voltage (HV) battery (traction battery).
- Each system type uses a DC/DC converter which steps down high voltage to the vehicle's low-voltage system and replaces the traditional generator (alternator).

When evaluating the scenarios covered in the ASE test questions, the following should be considered.

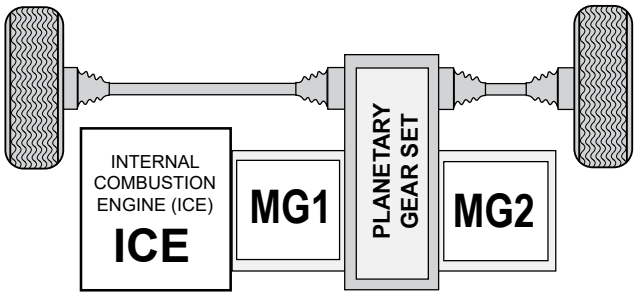
- Failures affecting the vehicle's electric drive system may result in the display of a system warning on the instrument panel.
- The terms Encoder and Resolver (position/speed/direction sensors) may be used interchangeably.

Because of the variation in terminology used by different manufacturers when referring to the vehicle system's readiness state, ASE test questions will use the following to indicate the operational power modes.

| | |
|---|---|
| OFF | All systems OFF. The engine (if equipped) and electric drive system are powered OFF. |
| ACCESSORY | Same as ACC on a conventional vehicle. |
| POWER ON | Equivalent to Key ON/Engine OFF (KOEO). In this mode, the engine (if equipped) will not run, nor will the vehicle move under electric power. |

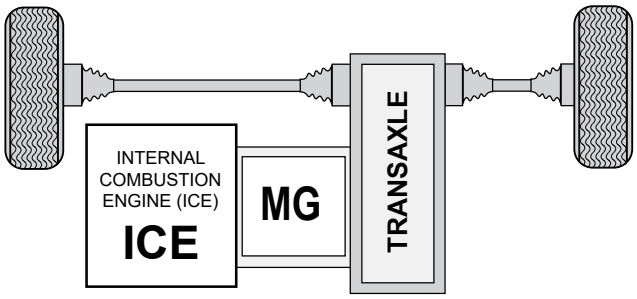
The **Type-1** hybrid-drive system uses a power split system.

- Power from the internal combustion engine (ICE) and MG1 and/or MG2 can propel the vehicle.
- MG1 is used to control the effective gear ratio between the ICE and the drive wheels.
- MG1 is used as the starter motor for the ICE, and conversely, it can be driven by the ICE to act as a generator.
- MG2 serves as a generator during regenerative braking and also provides REVERSE.




The **Type-2** hybrid-drive is a type of parallel system design.

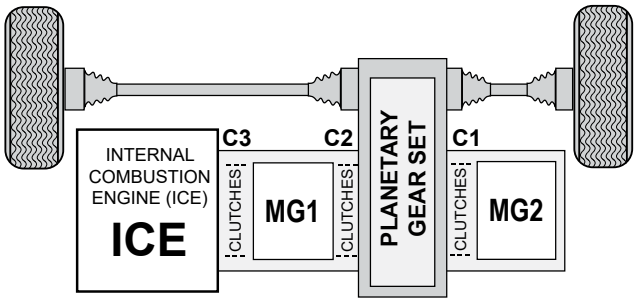
- Uses a single MG coupled with crankshaft of the internal combustion engine (ICE) and the transmission.
- ICE and MG are used together to maximize vehicle propulsion.
- During regenerative braking, the MG acts as a generator.
- A 12 V starter motor is used for initial ICE start. The MG serves as a starter motor for START/STOP operation.




- Power flow to the drive wheels can be provided by a split-pulley/steel belt continuously variable transmission, a conventional automatic transmission, or a standard transmission.

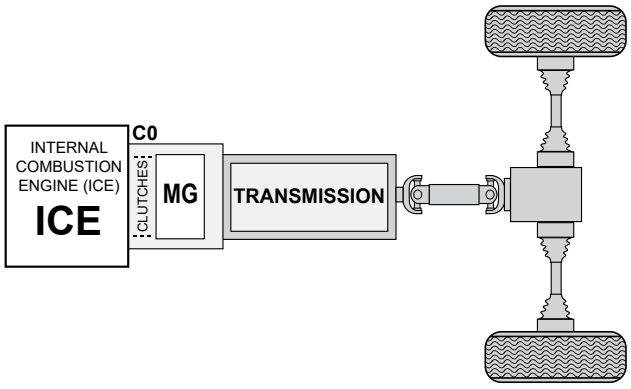
The **Type-3** hybrid-drive system is an extended range electric vehicle which can operate in:

- Battery mode with one motor – MG2 provides vehicle propulsion and electrical regeneration while braking.
- Battery mode with two motors – In certain situations, MG1 assists MG2 by combining power flow through a planetary gear set to reduce the speed of MG2.
- Series mode – The ICE drives MG1 to generate sufficient current to power MG2 and maintain the HV battery pack.
- Parallel mode – The ICE, MG1, and MG2 propel the vehicle.



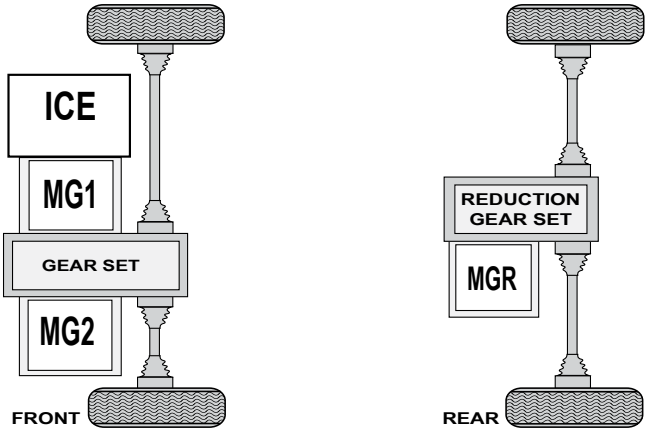
The **Type-4** hybrid-drive is a type of parallel system design.

- Uses single motor/generator (MG) integrated between the ICE and the transmission. A decoupling clutch (C0), positioned between the MG and the crankshaft, allows for electriconly MG propulsion when the ICE is OFF.
- The ICE and MG may be used together to provide maximum power to the drive wheels.
- During regenerative braking, the MG acts as a generator.
- A 12 V starter motor is used for initial ICE start.
- The MG serves as a starter motor for START/STOP operation.
- Power flow is completed using a conventional automatic transmission or a dual-clutch automatic transmission (DCT).



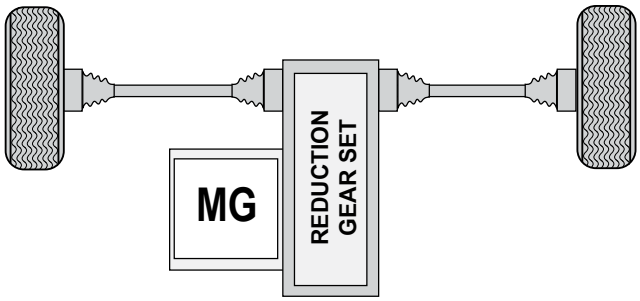

The Type-5 hybrid-drive system uses a power split system like the Type-1. A secondary electric propulsion system is added to provide all-wheel drive.

- Power from the internal combustion engine (ICE) and MG1 and/or MG2 can propel the vehicle.
- MG1 is used to control the effective gear ratio between the ICE and the drive wheels.
- MG1 is used as the starter motor for the ICE, and conversely, it can be driven by the ICE to act as a generator.
- MG2 serves as a generator during regenerative braking and also provides REVERSE.
- MGR can provide propulsion and regenerative braking.




The Type-6 is a battery electric drive system.

- Uses one or more MG located within the axle drive assembly. There may be multiple axle drive assemblies for all-wheel drive operation.
- The MG functions as an electric motor to provide the torque required to propel the vehicle.
- During regenerative braking, the MG(s) acts as a generator.
- A reduction gear set is used to multiply torque to the drive wheels.



# Glossary of Terms
# Light Duty Hybrid/Electric Vehicle Specialist Test

The reference materials and questions for this test use electronic and emission terms and acronyms that are consistent with the industry-wide SAE standards J1715, J1772, J1930, and J2012. Some of these terms are listed below.

**12-volt Battery** - See Low-Voltage Battery

**16-volt Battery** - See Low-Voltage Battery

**AC Level 1 (120 volts AC) Charging** - See EVSE

**AC Level 2 (208/240 volts AC) Charging** - See EVSE

**Auto Stop (Start/Stop)** - In the READY TO DRIVE (KOER) operational power mode, the internal combustion engine is automatically turned off when power demand is zero or negative, such as during vehicle stop, and then restarted automatically.

**Battery Cell** - An assembly of a positive electrode, a negative electrode, and other necessary electrochemical and structural components. A cell is a self-contained energy conversion device whose function is to deliver electrical energy to an external circuit via an internal chemical process.

**Battery Electric Vehicle (BEV)** - A vehicle without an ICE, which has one or more MGs that propel the vehicle using HV battery power. The HV battery is recharged using utility electrical power provided through the EVSE or regenerative braking.

**Battery Module** - A grouping of interconnected cells in a single mechanical and electrical unit.

**Battery Pack/Traction Battery** - Interconnected battery modules that have been configured for a specific energy storage application.

**Battery System** - Completely functional energy storage system consisting of the pack(s) and necessary ancillary subsystems for physical support, thermal management, and electronic control.

**Bidirectional Charging** - Vehicle-to-load (V2L) / vehicle-to-grid (V2G) / vehicle-to-house (V2H): A form of managed charging in which either charging or discharging is adjusted to meet the prioritized needs of the EV owner and the power utility grid.

**Chiller** - see Heat Exchanger

**DC Fast Charging/DC Level 2 (50-1000 VDC)** - See EVSE

**DC/AC Inverter** - Changes DC voltage to AC voltage. Some units may contain a rectifier to change AC voltage to DC voltage.

**DC/DC Converter** - A power converter that produces an output voltage greater than (boost) or less than (buck) the input voltage.

**E-machine** - See MG

**Electric Drive System Warning** - A display on the instrument panel that is activated when failures affectingthe vehicle's electric drive system are detected. For example: "Master Warning Light," "Service Hybrid System," "IMA Warning Light," etc.

**Electrified Vehicle** - Any electrified propulsion vehicle, such as an automobile/light truck, for which part or all propulsion is powered by an electric motor that draws primarily from a rechargeable high-voltage (HV) battery.

**Energy Information Display** - An animated graphic displayed on the driver information center indicating details about the high-voltage system which could include generation, usage, efficiency, and flow of energy,as well as battery state of charge, driving range estimate, etc.

**EVSE** - Stands for Electric Vehicle Supply Equipment and consists of the external components intended to deliver energy to an electric vehicle primarily to charge the high-voltage battery. EVSE equipment is classified as AC Level 1 (120 volts AC), AC Level 2 (208/240 volts AC), and DC Fast Charging/DC Level 2 (50-1000 VDC).

**Heat Exchanger** - A component or device used to transfer heat from one fluid or gas to another.

**High Voltage** - Any vehicle electrical system which contains one or more circuits operating at voltages greater than 60 VDC or 30 VAC.

**High-Voltage System** - The components and wiring that contain or are connected to high voltage.

**ICE** - Internal Combustion Engine

**IGBT** - Insulated Gate Bipolar Transistor

**Low Voltage** - Any vehicle electrical system which contains one or more circuits operating at voltages equal to or less than 60 VDC or 30 VAC.

**Low-Voltage Battery** - A device consisting of one or more cells, in which chemical energy is converted into electrical energy for the low-voltage system. On electrified vehicles, typical low-voltage battery configurations include 12-Volt and 16-Volt.

**Low-Voltage System** - The components and wiring that contain or are connected to low voltage.

**Manual Service Disconnect (MSD)** - A connector/plug which, when removed, isolates the high-voltage battery from the high-voltage components and harness.

**MG** - Motor/Generator, also known as an e-machine, is an electromechanical device that can operate in two modes without changing rotational direction. As a motor, it converts electrical energy into mechanical energy. As a generator, it converts mechanical energy into electrical energy.

**Parallel Hybrid** - The ICE and the MG(s) can simultaneously or independently contribute to driving the vehicle.

**Power Split (Series-Parallel) Hybrid** -The power-split hybrid uses two MGs and combines the function of a series and a parallel hybrid. The ICE and MG1 can operate as the generator while MG2 propels the vehicle (series mode). MG1 can be used to control the effective gear ratio between the ICE and the drive wheels. MG2, along with the ICE, can simultaneously propel the vehicle (parallel mode).

**Series Hybrid** - The ICE and the vehicle final drive have no direct mechanical connection. The ICE drives a MG to generate electrical power and recharge the HV battery. High-voltage (HV) battery power is used by oneor more MGs to propel the vehicle. Some hybrid vehicles have multi-mode transmissions that can operate in a series mode in which the ICE and a MG are decoupled from the driveline and are generating electrical power.

**Thermal Management** - Methods to control the transfer of heat to maintain a desired temperature (i.e., heating and cooling).

# Sample Questions
# Light Duty Hybrid/Electric Vehicle Specialist (L3) Test

**NOTE:** The ASE Light Duty Hybrid/Electric Certification Test Reference on pages 7-11 in this study guide will be available to you as a pop-up document on the computer screen during the L3 test, but you should review it before that time. It may help to review those pages before you attempt the following questions.

1. An electrified vehicle equipped with push button start will enter the POWER ON mode, but will not enter the READY TO DRIVE mode. A "High Voltage Loss-of-Isolation" DTC is stored. The cause could be:

   (A) the manual service disconnect (MSD) is removed.
   (B) a failed brake pedal position sensor
   (C) a pinched high-voltage cable.
   (D) the low-voltage battery is discharged.

**Question #1 Explanation:**

**Answer (A) is wrong.** If the manual service disconnect (MSD) is removed, the vehicle will enter the POWER ON mode but will not enter the READY TO DRIVE mode. However, with the MSD removed, a "High Voltage System Inter-lock Circuit" DTC would be stored.

**Answer (B) is wrong.** If the brake pedal position sensor fails, the vehicle will enter the POWER ON mode but will not enter the READY TO DRIVE mode. However, a "Brake Pedal Position Sensor Circuit" DTC would be stored.

**Answer (C) is correct.** With a damaged high-voltage cable, the vehicle will enter the POWER ON mode but will not enter the READY TO DRIVE mode. This condition would set the "High Voltage Loss-of-Isolation" DTC because of the damage to the insulation of the high-voltage cable.

**Answer (D) is wrong.** A discharged low-voltage battery will prevent the vehicle from entering any operational power mode, since the powertrain ECU would not be able to power up.

2. An electrified vehicle has a "Drive Motor Inverter Over Temperature" DTC. The coolant is at the "full" level in the powertrain coolant reservoir tank.

   Technician A says that a failed powertrain coolant pump could be the cause.

   Technician B says that insufficient coolant in the high-voltage battery cooling system could be the cause.

   Who is right?

   (A) A only
   (B) B only
   (C) Both A and B
   (D) Neither A nor B

# L3 Sample Questions (continued)

3. A Type-1 hybrid vehicle will enter READY TO DRIVE (KOER) mode but will not crank the internal combustion engine (ICE). When in NEUTRAL gear range, and the vehicle is pushed, the engine crankshaft rotates. Which of these could be the cause?

   (A) A seized MG2
   (B) Stripped splines on the input shaft
   (C) A depleted high-voltage battery
   (D) A seized planetary gear set

4. An electrified vehicle sets a "Drive Motor Inverter Cooling System Performance" DTC.

   Technician A says that a shorted motor generator stator winding could be the cause.

   Technician B says that a low coolant level in the powertrain cooling system could be the cause.

   Who is right?

   (A) A only
   (B) B only
   (C) Both A and B
   (D) Neither A nor B

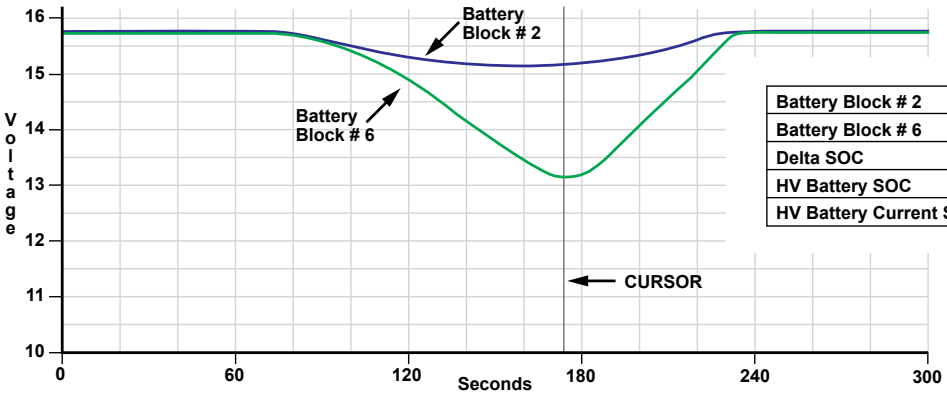
5. The electric drive system warning is illuminated, and a "Module Deterioration" DTC is stored. The cause could be a failed high-voltage:

   (A) battery section.
   (B) battery contactor.
   (C) battery current sensor.
   (D) manual service disconnect fuse.

6. A battery electric vehicle (BEV) has a brake noise concern during braking when the high-voltage battery is charged to 100%. There are no stored DTCs. Which of these could be the cause?

   (A) An open MG stator winding
   (B) A failed brake booster/simulator
   (C) A failed drive motor inverter
   (D) A rusted brake rotor surface

# L3 Sample Questions (continued)




| | |
|---|---|
| Battery Block # 2 | 15.26 V |
| Battery Block # 6 | 13.23 V |
| Delta SOC | 31.8 % |
| HV Battery SOC | 58.2 % |
| HV Battery Current Sensor | 11.57 A |

7. A vehicle has an illuminated high-voltage (HV) system warning and a stored DTC indicating HV battery deterioration. During diagnosis, the scan tool data and graph are observed. Which of these could be the cause of the DTC?

   (A) A low HV battery state of charge (SOC)
   (B) A failure in battery block # 2
   (C) Low current to the battery
   (D) A failure in battery block # 6

8. A Type-6 electric vehicle will enter READY TO DRIVE mode but has no propulsion, and there is metallic grinding noise from the drive unit. Which of these could be the cause?

   (A) A loss of isolation in the high-voltage battery
   (B) A failed motor position sensor
   (C) A failed reduction gear set
   (D) A seized MG rotor

**ANSWERS:** 1)C 2)A 3)D 4)B 5)A 6)D 7)D 8)C

# Industry Training
# Light Duty Hybrid/Electric Vehicle Specialist (L3)Test

The training sources listed in this guide are designed to help you sharpen your technical skills in advanced emission and driveability diagnostics. Since the L3 test reflects these skills - the more you learn, the better your chances are of passing this test.

Please contact the listed organizations for availability, schedules, and prices. In addition, many new sources of training in this area are being developed. You may wish to check with auto manufacturers, community colleges, tool and equipment suppliers, and technical training organizations for the latest training information. Training resources can also be found on ASE's home page at www.ase.com, the International Automotive Technicians Network (iATN) at www.iatn.net, or the Diagnostic Network at www.diag.net.

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**ACDelco** offers training in a variety of delivery methods to ensure the maximum learning benefit for the service professional. In addition to traditional instructor-led technical training courses and seminars, a wide-selection of online courses are also available. For more information about all training offerings, visit www.acdelco.com/training-programs or call ACDelco at (800) 825-5886.

**Automotive Technician Training Services** offers seminars, webinars, and self-study training courses all designed to help technicians stay in touch with the latest diagnostic and repair procedures. Instructor-led/hands-on training is also offered for hybrid vehicle diagnosis. Technician-trainers deliver the instructor-led seminars and webinars. Self-study materials deliver information that will both teach, and enhance diagnostic skills. ATTS Training Center, 10 Lupi Plaza, Mahopac, NY 10541 Call:(845) 628-1062. Internet: www.attstraining.com

**Automotive Career Development Center (ACDC)** offers training classes, seminars, webinars, DVDs and manuals covering all aspects of hybrid and electric vehicle diagnosis and repair. Instructor-led training classes are a comprehensive mix of classroom education followed up by hands-on application in the shop working on hybrid/electric vehicles. All material covers the most popular hybrid/electric vehicles found in production today. For more information, call 800-939-7909. Internet: www.fixhybrid.com.

**AVI OnDemand** offers several different video training programs covering hybrid vehicle diagnosis and repair. These include HVAC systems, case studies, and safety for first responders. For more information, call: (800) 718-7246. Internet: www.aviondemand.com

**CARQUEST** The Training and Certification System (TACS) provides a full scope of training solutions. This includes the ability to setup a career path for instructor-led training, online training, ASE Test Prep Study Guides, Technical Assessments, and more. Visit the website at www.ctionline.com for more information.

**Cengage Learning** provides training textbooks and online, interactive courseware covering many areas of automotive repair, including hybrid/electric vehicles. The online interactive computer program is called Technician Test Preparation (TTP). TTP is designed to help prepare technicians for the ASE tests. For a free catalog, write: Cengage Learning, 5 Maxwell Drive, Clifton Park, NY 12065, or call (800) 347-7707. Internet: www.cengage.com/training/

**Delphi Product and Service Solutions** offers technical training materials and classes with real world applications to today's vehicles. All content has been developed by drawing on experience from working with many different vehicle manufacturers. Training products include textbook and CD-ROM formats, including hybrid/electric vehicles. Instructor led training classes covering a wide range of topics are also available. An overview of all training products and services is available on the website. Phone: (877) 550-TECH Internet: www.delphiautoparts.com/resource-center/5

**Motor Age Training** for ASE Certification is a self-study training guide that is updated regularly and contains both technical information and sample questions. For ordering information, write: Motor Age Training, P.O. Box 6310, Duluth, MN 55806. Phone: (800) 240-1968; Internet: www.motoragetraining.com

**NAPA Autotech** is an ASE Accredited Training Provider offering a broad spectrum of automobile and light/medium duty vehicle training options. These include ASE test preparation classes, assessments, e-learning and instructor-led training. NAPA Autotech provides quality real world / problem solving technical training solutions for today's technicians that include leading technologies and the latest repair techniques. Regularly scheduled classes are offered nationwide as well as custom training solutions. For more information about training offerings, visit www.napaautotech.com/learn or call (800) 292-6428.

**Standard Motor Products, Inc.** offers professional technician seminars that focus on real-world problems and solutions, not just theory. Engage in actual diagnosis using case studies in the shop to apply what you've learned. An ASE-Certified professional instructor conducts the four-hour seminars during the evening, with a heavy emphasis on diagnostics and troubleshooting. Each seminar includes a workbook for your reference after the class. SMP also offers live, as well as a number of archived, one-hour long webinars. These can be viewed anywhere an internet connection is available, including at home. Internet: www.pts.smpcorp.com

**VEEJER Enterprises** offers training in automotive electrical diagnosis and repair and vehicle electronics troubleshooting. Training programs are designed to teach step-by-step methods used for performing electrical repairs, as well as the skills necessary for troubleshooting electrical and electronic problems in both low voltage and high voltage (HV) systems. Training programs cover the use of a DMM, current clamp, digital logic probe, scope meter, and dual-trace lab scope when testing and diagnosing electrical and electronic circuits. Training is offered through home-study programs, as well as hands-on instructor led electrical/electronics trouble-shooting training workshops. For more information, contact: Veejer Enterprises, 3701 Lariat Lane, Garland, TX 75042-5419, or call (972) 276-9642. Internet: www.veejer.com.