Specification of Competency Standards
for the Automotive
Unit of Competency

Functional Area - Vehicle Servicing

Title	Master the complicated techniques of power systems on hybrid electric vehicles
Code	111758L4
Range	This unit of competency is applicable to technicians working at vehicle service and inspection departments. Practitioners should be able to master the operating principles of various types of hybrid electric vehicle systems to enhance the efficiency and accuracy of inspection and complicated fault diagnosis.
Level	4
Credit	3 *(For Reference Only)*

Competency	**Performance Requirements**
	
	1. Knowledge (Power system of hybrid electric vehicles)
	• Master the use of special service tools, personal protection and first-aid equipment for relevant tasks.
	• The principles of electrical and electrochemical engineering:
	  ◦ Master basic theories of electricity and electrochemistry
	  ◦ Good understanding of the working principles of electric motors, generators and alternators, their output characteristics, and relevant electric power supply control methods
	  ◦ Understand the performance, structure, operating principles, characteristics, safety precautions, recycling measures and applicative limitations of different kinds of secondary batteries, including but not limited to lead-acid batteries, nickel-based batteries and lithium-ion batteries
	• Electric energy management:
	  ◦ Good understanding of the methods of battery charging and energy control, traction power and regeneration regulation, and associated thermal control management, the structure and operating principles of all related components
	• Power systems of various types of hybrid electric vehicles:
	  ◦ Master the definition, operating characteristics, structure and operating mode control of various types of hybrid systems, such as plug-in hybrid, power hybrid and mild hybrid, the operating relationship among engine, alternator and traction motor under different modes of operation
	  ◦ Good understanding of the structure and operating principles of power-splitting devices of the power hybrid systems
	  ◦ Master the operating and control principles of combustion engines as well as their sub-systems and components, such as fuel metering, emission control, etc.
	  ◦ Master the control principles of electric power supply and regeneration as well as the structure, functions and operating principles of their related circuits and components
	  ◦ Good understanding of the electric power supply, including external power charging, and control methods of traction motors and generators

	2. Performance (Inspection, fault diagnosis and analysis of hybrid electric vehicle system performance)
	• Conduct inspection, fault diagnosis and analysis procedures according to fault symptoms (including recurrent or intermittent defects) of power and transmission systems, their auxiliary systems and related components, such as:
	  ◦ Engine defects, such as stalling, insufficient power, weak acceleration, rough engine running or excessive fuel consumption, etc.
	  ◦ Declining charging and discharging efficiency of the traction battery, including the efficiency of electricity regeneration and the onboard charging unit for external power input
	  ◦ Unstable control of engine power cut-in and cut-out patterns
	  ◦ Abnormal operating temperature, such as traction motor, traction battery, power electronics, engine, etc.
	  ◦ Declining acceleration power and speed of vehicle
	  ◦ Occurrence of abnormal engine and traction motor operating noise or vibration
	• Review the causes of defects and the associated diagnostic methods; submit written report to seniors covering preventive measures, instructions on inspection and maintenance, as well as suggestions for improvement.

Assessment Criteria	The integrated outcome requirements of this unit of competency are that the practitioner being assessed shall prove that he/she is: • Capable of mastering the structure, functions, control and operating principles of hybrid electric vehicle systems (including traction battery and engine), their auxiliary systems and related components to enhance the efficiency and accuracy of inspection and complicated fault diagnosis; • Capable of mastering the characteristics of hybrid electric vehicle systems as well as the factors affecting vehicle power output and charging performance, such as efficiency of electrical energy management and thermal management, traction motor and engine controls, etc., to solve the complicated technical problems effectively and accurately, including high fuel consumption, battery performance decay, lack of vehicle power output, and noisy operation; and • Capable of compiling report covering preventive measures and compiling instructions on inspection and maintenance, as well as providing suggestions for improvement, etc., according to specific defects found in respective power systems.
Remark	The credit for this competency unit assumes that the practitioner already possesses extensive knowledge of hybrid electric vehicles and is familiar with the use of special service tools/equipment and the application of diagnostic principles. When working on the high-voltage electrical systems, the practitioner concerned should be a recognised competent person in electrified vehicles, such as a registered vehicle mechanic who has completed an electric vehicle – low voltage training course, or equivalent, and the servicing process should be under the high-voltage system power-down condition, which is confirmed by the checking result of special service tools / authorised competent person. If the live high-voltage system is involved during the operation, the practitioner concerned should be a recognized competent person in electrified vehicles, such as a registered vehicle mechanic who has completed an electric vehicle – high voltage training course, or equivalent. The major ordinance involved in this unit of competency is as follows: • Road Traffic (Construction and Maintenance of Vehicles) Ordinance • Occupational Safety and Health Ordinance (This UoC replaced 108741L4)