Vehicle Electrification System Standards

V. Phase Drive Motors and Generators

V.c Induction Electric Machines

Description:

3-Phase electric machines are the central component of an electric powertrain system and it provides propulsion and generated electrical power to HEV, PHEV, and BEV architectures. Understanding the construction, operation, failure modes, and diagnostic processes for Induction Machines is foundational in preparing students for a service career in the electrification service space.

Outcome (Goal):

Students will be able to describe and illustrate how Induction Machines operate in all modes of vehicle operation; describe how IM electric machines are constructed; analyze and evaluate the condition of IM electric machine technology by using various diagnostic techniques and tools.

Objective:

Students shall be able to:

1. Identify and Define IM electric machine internal components
2. Describe how IM are constructed
3. Explain the concepts of how IM Positive, Negative, and Zero Slip% is produced
4. Compare and contrast Constant Torque and Constant Power
5. Demonstrate how to analyze and evaluate the condition of IM using a serial data (scan) tool, oscilloscope, milliohmmeter, insulation tester, and specialized analysis testers.

Task:

Students will be able to describe how vehicle IM propulsion, regenerative braking, and coasting modes; identify powertrain architectures and powertrain components; perform testing and analysis using live vehicles or test stands; and define the term power density in the provided pictures or diagrams, using OEM vehicle service, component supplier information, and DOE/NREL/INL/ANL vehicle electrification website information while using proper technical terminology, acronyms, and definitions.

Construction and Manufacturing	
Housing	
Stator Core	
	Laminations
	Lamination Slot Configurations
	Slot Fill
	Random Distributed Windings
	Series and Parallel Winding Configurations
	Number of Poles vs. Torque & Speed
	Stator End Turn Cooling
	Stator Temp Sensor
Rotor	
	Copper
	Aluminum
	Rotor Diameter - as it relates to Torque
	Rotor Length - as it relates to Torque
	Rotor Bar Count
	Rotor Bar Shapes
	Rotor Shorting Rings
	Rotor Shaft Bearings
	Rotor Shaft Currents
	Induction Machine Spin Loss
Electric Machine Operating Regions	
Constant Torque	
Constant Power	

Induction Machine Torque & Speed Control Operation	
	Speed (rpm)
	Base Speed
	How Max rpm is Determined
	Torque (Slip%)
	Positive
	Zero
	Negative
	Software Control Slip Tables
	Slip Table Control Strategy
	Slip% Control vs. Stator Current Control
Induction Machine Failure Modes	
	Stator
	Rotor
	Bearings
Diagnostics & DTCs	
Servicing Induction Electric Machines	

To comment or offer suggestions on this standard, contact Ken Mays:

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