
Vehicle Electrification System Standards

XII. Regenerative (Regen) Braking Systems

XII.b Regenerative (Regen) Braking Systems

OEM Acronyms:

can be found in the XIIa Regen Braking Acronyms and Definitions document

Description:

Regenerative braking uses an electric vehicle's motor as a generator to convert much of the vehicle kinetic energy (i.e., energy in motion) lost when decelerating back into energy stored in the vehicle battery. The generation of electrical power results in negative torque on the vehicle axle causing its speed to slow (braking effect). The rate of vehicle speed reduction is determined by a significant number of factors in the powertrain and battery pack system. The next time the car accelerates, it uses much of the energy previously stored from regenerative braking instead of utilizing energy that was stored from battery charging. Regen braking system not only used for safely slowing the vehicle but, also increase the battery pack state of charge that, results in increased range (BEV/PHEV) or fuel economy (HEV).

Outcome (Goal):

Students shall be able to articulate how the mechanical, hydraulic, electrical, and electronic systems operate to permit and control the Regen Braking System, and how to test, analyze, and service the Regen Braking System when provided with test equipment.



Objective:

Students shall be able to:

1. Identify all components related to the Regen Braking System
 2. Articulate how the electric and hydraulic Regen Braking System operates during specific blending braking event (i.e., electric and hydraulic) and an ABS braking event.
 3. Utilize electronic, electric, and mechanical tool and equipment to test, analyze, and diagnose the functionality of the Regen Braking System.
 4. Describe verbally and in written communications how vehicle power inverter module is used in regenerative braking mode to control the level of electrical current that is used for negative torque.
 5. Describe verbally and in written communications how the operation of the drive motor during the regenerative braking mode.
 6. Describe verbally and in written communications the operation of the base (hydraulic) braking system during the regenerative braking mode.
 7. Describe verbally and in written communications the operation of the regenerative braking mode during the activation of the ABS braking system.
 8. Describe verbally and in written communications the operation and control strategy of the battery pack controller and how battery pack SOC% is controlled, during a regenerative braking event.
 9. Using a worksheet provided by the instructor Students will perform base brake system service on a specified vehicle.
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Tasks:

Students will be able to:

1. Connect a Scan Tool or Specialized Test Equipment to the vehicle DLC and complete a vehicle road test, using specified road-testing criteria, to



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- document/record braking pressures to the front and rear brakes during an aggressive and moderate/blended (electric + hydraulic) Regen Braking event.
2. Connect a Scan Tool to the vehicle DLC and an Oscilloscope (with current clamps and other necessary jumper cables) to the vehicle power inverter and road test a vehicle, to document/record Regen Braking current created by the drive motor (Oscilloscope) and how much current is delivered to the battery pack to increase the SOC% (Scan Tool PIDs).
 3. Capture Propulsion and Regen braking waveforms on a vehicle by using an Oscilloscope and current clamps and articulate the difference in the waveforms by using the current regulation section of the waveforms.
 4. Identify the location of the base and regen braking systems components by using OEM service information and handouts from the instructor.
 5. Demonstrate how to eliminate the Regen braking function on a vehicle so only the base braking system can be tested.
 6. Articulate the operation of the Regen braking system based on a given vehicle speed, braking pressure, and battery pack SOC%, and battery pack temperature.
 7. Using electronic diagrams, the Students will articulate how the Power Inverter Module will modulate electric machine Regen Braking torque, based on IGBT and Flyback diode operation, during a specified braking event.
 8. Perform the replacement of specified brake hardware on the front brakes of a vehicle, including bleeding the brake system, by using mechanical, hydraulic, and Scan Tool equipment as specified by the OEM service information.
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Required Special Tools and/or Equipment to Complete Task:

Scan tool, Oscilloscope, AC current clamps, Power Inverter Jumper Cables (if needed), DVOM, Specialized brake service equipment, OEM service information,



Associated Professional Standards, Technical Papers or, Journals to support the development of the NEVTEX Regenerative Braking Curriculum and Training:

SAE Technical Papers and Journals

- 2020-01-1612
- 2010-01-1681
- 929139
- 2021-01-1264
- 2017-01-1595
- 2020-01-0217
- 2020-01-0846
- 2015-01-9131
- 2017-01-1578
- 2018-01-0816
- 2012-01-0234
- 2016-36-0348
- 2019-01-5089

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