



Graceful Discharge Development Test Procedure

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To investigate the effects of voltage degradation on the operation and functionality of a vehicle's electrical system and subsystems while the vehicle is in dynamic real time conditions.

1.2 Applicability. This test procedure applies to all global vehicles.

1.3 Remarks. This test is intended to be a standard test for all new vehicle programs.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

3 Resources

3.1 Facilities. The initial vehicle preparation portion of the procedure should be performed in a test garage or equivalent facility. The dynamic portion of the procedure should be performed on a GM approved closed test track with a safe pull off area or equivalent. Alternatively, a vehicle dynamometer may be used when a closed test track is unavailable.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 High electrical contented vehicle.

3.2.2 Two 30% $\pm$ 5% State of Charge (SOC) batteries.

3.2.3 One 90% $\pm$ 5% SOC battery.

3.2.4 General Motors Local Area Network (GMLAN) vehicle communications data monitoring device.

3.2.5 Tools to disconnect/reconnect vehicle's battery.

3.2.6 Battery jumper cables.

3.2.7 Digital volt meter to monitor vehicle system voltage.

3.3 Test Vehicle/Test Piece. The test vehicle should be highly electrically contented and include the latest production intent electrical subsystems and components. The tester should also have access to the production intent mechanization/layout of the wiring, components, and their connections.

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3.4 Test Time.

Calendar time:	2 to 3 days
Test hours:	5 to 10 hours
Coordination hours:	10 to 15 hours

3.5 Test Required Information.

 Not applicable.

3.6 Personnel/Skills. This test requires two people in the test vehicle, one to drive and the second, a Test Engineer, to document the results and perform other activities as required. The people performing the test should be familiar with basic vehicle system functionality. The Test Engineer performing the test should be familiar with Diagnostic Trouble Codes (DTC) and State of Health (SOH) messages, and how to read them via a data monitoring device.

4 Procedure

4.1 Preparation.

 The requesting Engineer must:

- Verify that the latest approved hardware and software is available for all modules for a given test start date, even if there is only one module of concentration for testing. Record module specific information on Data Sheet A1.
- Identify if any GMLAN controlled functions exist that should be monitored during the test.
- Arrange for communication. Be sure to have a cellular phone or two-way communication device available while performing this test.
- Arrange for emergency assistance. If the vehicle becomes disabled while performing the test on the test track, road assistance may be needed.
- Secure a large sign that states "WARNING – Vehicle Stall Test" and secure it to the rear of the vehicle.
- Set up a device to read and track battery voltage.
- Check vehicle for proper functional operation of the electrical subsystems.

4.2 Conditions.

4.2.1 Environmental Conditions. Test at $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ ($77\text{ }^{\circ}\text{F} \pm 18\text{ }^{\circ}\text{F}$), $50\% \pm 30\%$ relative humidity, and dry road conditions (for the road tests).

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Setup Instructions.

4.3.1.1 While vehicle is still in the garage, clear all DTCs from the vehicle using a communications device.

4.3.1.2 Perform a "pretest check" of the following items and record the results on Data Sheets A4 thru A7:

4.3.1.2.1 State of Health Check. Ensure all devices that should be on the communications bus are there and are sending out their state of health message. Record results on Data Sheet A4.

4.3.1.2.2 DTC Check. Ensure that all DTCs have been cleared and that none are returning. If they are returning, either remedy the problem or note the DTC on Data Sheet A5 to show that it was present prior to start of test.

4.3.1.2.3 Odometer. Ensure that the odometer is reading and storing correctly. Record odometer information on Data Sheet A6.

4.3.1.2.4 General Customer Functional Check. Ensure that all electrical subsystems are functioning as desired. Record results on Data Sheet A7.

4.3.1.3 Prior to testing, place the $90\% \pm 5\%$ SOC battery in the vehicle's trunk. If possible, place the battery in a plastic RV/marine storage case for protection. Secure the battery so it will not move around in the vehicle's trunk. These measures will minimize vibrations to the battery.

4.3.1.4 Replace the current vehicle's battery with one of the two pre-conditioned $30\% \pm 5\%$ SOC batteries. Label and save the original battery to reinstall later. Put the second pre-conditioned $30\% \pm 5\%$ SOC battery in the vehicle's trunk or rear, or leave it in the garage for later use on the second test iteration.

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4.3.1.5 Place a set of jumper cables in the vehicle.

4.3.1.6 Disable the alternator output to the battery. Tape up the terminal with non-conductive tape and safely secure it away from moving engine parts. The objective is to safely disable the alternator from charging the battery, so the vehicle is powered only with the charge currently stored in the battery. This will result in the voltage degradation required for the test.

4.3.1.7 Start the vehicle and go to the test track.

4.3.2 "Loads On" Test Instructions.

4.3.2.1 Once on the test track, pull over to the side and stop.

4.3.2.2 Keep the engine running. Turn ON all loads possible in the vehicle, including windshield wipers on low, radio, headlights, interior reading lights, hazard lights, and all information displays, e.g., heads-up displays, driver information centers, etc. Turn the Heating Ventilation Air Conditioning (HVAC) blower on high to hear it blowing and to monitor for degradation. HVAC can be on any temperature or directed anywhere, as long as its operation can be monitored. Use Data Sheet A8 to verify that each load becomes active as expected. Note any exceptions in the Comments area of Data Sheet A8.

4.3.2.3 Perform a "start of test check" of the following items, and record the results on Data Sheets A4 thru A7:

4.3.2.3.1 State of Health Check. Ensure all devices that should be on the communications bus are there and are sending out their State of Health message. Record results on Data Sheet A4.

4.3.2.3.2 DTC Check. Ensure that all DTCs have been cleared and that none are returning. If they are returning, either remedy the problem or note the DTC on Data Sheet A5 to show that it was present prior to start of test.

4.3.2.3.3 Odometer. Ensure that the odometer is reading and storing correctly. Record odometer information on Data Sheet A6.

4.3.2.3.4 General Customer Functional Check. Ensure that all electrical subsystems are functioning as desired. Record results on Data Sheet A7.

4.3.2.4 Return to the test track. Engage the cruise control to go 48 km/h (30 mph). Disengage cruise at any time if safety conditions require it.

4.3.2.5 Continue to ride around the test track and note when, what, and how the vehicle functionally degrades. Notice when and what telltales or any other driver warnings or indications become active. Use the GMLAN serial data monitor device to read and note any DTCs as necessary. Record this information on Data Sheet A9.

Warning: Be prepared for loss of power steering and power brakes.

4.3.2.6 Pull over to the side of the road and stop when the vehicle ceases operation.

4.3.2.7 Using the jumper cables, connect the $90\% \pm 5\%$ SOC battery in parallel to the current vehicle battery.

4.3.2.8 Perform a "posttest check" of the following items and record the results on Data Sheets A4 thru A7:

4.3.2.8.1 State of Health Check. Ensure all devices that should be on the communications bus are there and are sending out their State of Health message. Record results on Data Sheet A4.

4.3.2.8.2 DTC Check. Ensure that all DTCs have been cleared and that none are returning. If they are returning, either remedy the problem or note the DTC on Data Sheet A5 to show that it was present prior to start of test.

4.3.2.8.3 Odometer. Ensure that the odometer is reading and storing correctly. Record odometer information on Data Sheet A6.

4.3.2.8.4 General Customer Functional Check. Ensure that all electrical subsystems are functioning as desired. Record results on Data Sheet A7.

4.3.2.9 Turn the vehicle off and replace the vehicle battery with the second $30\% \pm 5\%$ SOC battery.

4.3.3 "Loads Off" Test Instructions.

4.3.3.1 Once on the test track, pull over to the side and stop.

4.3.3.2 Keep the engine running. Turn OFF all the loads possible in the vehicle. Turn off windshield wipers, radio, headlights, interior reading lights, hazard lights, and all information displays, e.g., heads-up displays, driver information centers, etc. On Data Sheet A10, verify that each listed vehicle load is not active. Note any exceptions or if any of the loads were not turned off, e.g., Daytime Running Lamps (DRL), HVAC blower in low if necessary, etc., in the Comments area of Data Sheet A10.

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4.3.3.3 Perform a "start of test check" of the following items, and record the results on Data Sheets A4 thru A7:

4.3.3.3.1 State of Health Check. Ensure all devices that should be on the communications bus are there and are sending out their State of Health message. Record results on Data Sheet A4.

4.3.3.3.2 DTC Check. Ensure that all DTCs have been cleared and that none are returning. If they are returning, either remedy the problem or note the DTC on Data Sheet A5 to show that it was present prior to start of test.

4.3.3.3.3 Odometer. Ensure that the odometer is reading and storing correctly. Record odometer information on Data Sheet A6.

4.3.3.3.4 General Customer Functional Check. Ensure that all electrical subsystems are functioning as desired. Record results on Data Sheet A7.

4.3.3.4 Return to the test track. Engage the cruise control to go 48 km/h (30 mph). Disengage cruise at any time if safety conditions require it.

4.3.3.5 Continue to ride around the test track and note when, what, and how the vehicle functionally degrades. Notice when and what telltales or any other driver warnings or indications become active. Use the GMLAN serial data monitor device to read and note any DTCs as necessary. Record this information on Data Sheet A9.

Warning: Be prepared for loss of power steering and power brakes.

4.3.3.6 Pull over to the side of the road and stop when the vehicle ceases operation.

4.3.3.7 Using the jumper cables, connect the $90\% \pm 5\%$ SOC battery in parallel to the current vehicle battery.

4.3.3.8 Perform a "posttest check" of the following items and record the results on Data Sheets A4 thru A7:

4.3.3.8.1 State of Health Check. Ensure all devices that should be on the communications bus are there and are sending out their State of Health message. Record results on Data Sheet A4.

4.3.3.8.2 DTC Check. Ensure that all DTCs have been cleared and that none are returning. If they are returning, either remedy the problem or note the DTC on Data Sheet A5 to show that it was present prior to start of test.

4.3.3.8.3 Odometer. Ensure that the odometer is reading and storing correctly. Record odometer information on Data Sheet A6.

4.3.3.8.4 General Customer Functional Check. Ensure that all electrical subsystems are functioning as desired. Record results on Data Sheet A7.

4.3.4 Post Test Instructions.

4.3.4.1 Reinstall the original battery in the vehicle.

4.3.4.2 Reconnect the alternator output to the battery.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Upon subjecting the vehicle to the Graceful Discharge Procedure, the tester should ensure that no undesired events occur as the vehicle's voltage degrades.

5.3 Test Documentation. Data Sheet A1 (Module Information) and A2 (Instrumentation Calibration Record) can be filled out prior to test. As test progresses, complete Data Sheets A3 thru A10.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Note: Extreme care should be used when performing this test procedure. Due to the nature of the procedure, electrically assisted systems will cease to operate and the vehicle will eventually stall.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

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DRL	Daytime Running Lamps
DTC	Diagnostic Trouble Code
GMLAN	General Motors Local Area Network
HVAC	Heating Ventilation Air Conditioning
ID	Identification
N/A	Not Applicable
SOC	State of Charge
SOH	State of Health
VLT	Vehicle Link Tester

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW16140

9 Release and Revisions

This standard was originated in October 2008. It was first approved by Electrical Vehicle Integration and Development of Electrical Development and Validation in January 2009. It was first published in January 2009.

Issue	Publication Date	Description (Organization)
1	JAN 2009	Initial publication.
2	MAY 2014	Revised to current template. (Electrical Performance Validation)

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Appendix A:

Data Sheet A1: Module Information

Vehicle Number: _____

Domestic/Export: _____

Device/Source ID	Hardware Level/Date	Software Level/Date	Calibration Level/Date

Note: ID = Identification**GM Confidential**

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