



Test Specification – Rough Road Testing

**Center for Evaluation of Clean Energy Technology
(CECET)**

An Intertek Company

430 S. 2nd Avenue

Phoenix, Arizona 85003-2418

Phone: (480) 525-5885

<http://www.intertek.com/automotive>

<http://www.intertek.com/automotive/field-performance>

<http://www.cecet.com>

©2015 by Center for Evaluation of Clean Energy Technology. All rights reserved.

The contents of this document may not be modified but may be downloaded and used with appropriate credit and reference to Center for Evaluation of Clean Energy Technology.

Revision History Log

Revision No.	Revisions Description	Effective Date	Revised/Reviewed By	Approved By
0	Initial release	11/23/2015	Jeffrey Wishart	Jeremy Diez

Table of Contents

1	Objective	4
2	Test Conduct	5
3	Initial Conditions & Prerequisites	6
4	Test Activity Requirements	8
5	Glossary	9
6	References	11

1 Objective

The objective of this Test Specification to provide methods for evaluating the durability of non-production vehicles participating in the Advanced Vehicle Testing and Evaluation (AVTE) program or in other advanced vehicle testing. The purpose of this Test Specification is to test the ability of non-production vehicles to endure extreme conditions over a short time frame. This test is not intended to determine range or speed capabilities of any vehicle. No inferences concerning a vehicle's speed, range or gradeability characteristics should be drawn from this test. This activity is meant to test the vehicle as a total system. This Test Specification outlines the requirements for experimental conduct. The actual specific steps for the test conduct are listed and described in the associated Center for Evaluation of Clean Energy Technology (CECET) internal Work Instruction document.

2 Test Conduct

Documentation resulting from usage of this Test Specification shall be consistent, easy to understand, easy to read, and readily reproducible. All documentation required to complete testing shall be completed, approved, and ready for issue prior to commencing the testing it addresses. The following will abide by company policy:

- Review and approval of test results
- Storage and retention of records during and following testing activities
- Recording of any deviation from the outlined procedures and the reason for the deviation

3 Initial Conditions & Prerequisites

Prior to conduct of any portion of the testing, the following initial conditions and prerequisites shall be met. Satisfactory completion of these items should be verified.

3.1 Personnel

Personnel conducting testing under this Test Specification, i.e., the Test or Project Engineer(s), shall be familiar with the requirements of this Test Specification, shall be trained in accordance with company policy, and shall be certified by a Mandated Reviewer prior to commencing any testing activities. This requirement includes training in all aspects of the Test Specification, including its automatic shutdowns and safety procedures.

3.2 Environmental Conditions

3.2.1 Road tests shall be performed on a road or test track and the roads shall be dry, clean, and smooth.

3.2.2 Ambient temperature during road testing shall be within the range of 41 °F (5 °C) to 100 °F (38 °C).

3.2.3 Tests shall not be conducted when wind speeds average more than 10 mph (16 km/h) or when peak wind speeds are more than 12.3 mph (20km/h). Test should always be conducted during periods of minimum wind velocity.

3.2.4 Tests shall not be run during foggy conditions.

3.3 Vehicle Conditions

3.3.1 Vehicles should have accumulated a minimum of 4,000 miles (6,450 km) prior to this testing. Actual mileage shall be recorded prior to starting testing.

3.3.2 Vehicles shall be tested in its normal configuration with normal appendages (mirrors, bumpers, hubcaps, etc.)

3.3.2.1 The testing instrumentation shall be installed so it does not hinder vehicle operation or alter the operating characteristics of the vehicle. Mounting shall be accomplished so as to not interfere with a tow vehicle if required (nominally at the rear of the vehicle).

3.3.3 Vehicles shall be tested at delivered curb weight plus 332 ± 10 lb (including driver and test equipment), distributed in a manner similar to the original curb loading of the vehicle.

3.3.4 Vehicle Manufacturer's recommended tires and lubricants shall be used. Tires should have accumulated a minimum of 100 miles (160 km) and shall have at least 75% of the original tread depth remaining. All tire break-ins shall be performed on the test vehicle. Tread depth will be recorded in 1/32 inch increments prior to start of test.

3.3.5 Vehicle tires shall be inflated to the Vehicle Manufacturer's recommended cold inflation pressure as specified on the tire placard, corrected for the difference between ambient temperature and tire temperature. [Tire pressures will be increased 1 psi for each 13 °F; the preparation area is higher than the test area (or 1 kPa for each 1 °C)].

NOTE: Tire sizes and inflation pressures shall be in accordance with the requirements of the placard. At no time shall the tire's cold inflation pressure exceed the maximum pressure imprinted upon the tire's sidewall.

- 3.3.6 ESS temperatures throughout the testing shall be within supplier specifications.
- 3.3.7 Accessories shall not be used during testing.

3.4 Instrumentation

No instrumentation is used during the Rough Road testing. The test is a pass/fail.

4 Test Activity Requirements

This section addresses the activities required to meet the stated purpose and objectives of this Test Specification.

NOTE: This Test Specification was written specifically for implementation at the Nissan Arizona Test Center in Maricopa, Arizona or the Ford Arizona Proving Grounds in Wittmann, Arizona. Hazards and appropriate speeds for negotiation of those hazards are specific to this facility. If neither of these facilities are to be used, the Mandated Reviewer should make every attempt to define a course that is similar in length, speeds, and terrain to the course described in this section

4.1 Collected Test Data

- 4.1.1 Date and time of test phase completion
- 4.1.2 Miles traveled / laps completed
- 4.1.3 Equipment failures, if any
- 4.1.4 Equipment abnormalities, if any
- 4.1.5 Damage to vehicle underside
- 4.1.6 Damage to any vehicle components
- 4.1.7 Driver notes, if any

4.2 Collected Environmental Conditions Data

- 4.2.1 Ambient temperature
- 4.2.2 Wind velocity
- 4.2.3 Wind direction

4.3 Rough Road Course Sequence

The rough course consists of the sequence and speeds shown in Table 1. The sequence shall be repeated for two full circuits.

Table 1. Rough Road course sequence and speeds

Step	Course Section	Speed
1	Concrete Rough	20 mph (40 km/h)
2	Belgian Blocks (cobblestone)	20 mph (40 km/h)
3	Fixed Stone	20 mph (40 km/h)
4	Splash Rough	20 mph (32 km/h)

4.4 Test Pass/Fail Determination

The vehicle will be deemed to PASS the rough road testing if full completion of the course is achieved. Should a vehicle become disabled either electrically or mechanically for any reason during testing, it shall be immediately removed from the test course. This will be considered a FAIL in which the Vehicle Manufacturer has 72 hours to remedy the problem. If the Vehicle Manufacturer is able to repair the vehicle within the 72-hour window, the vehicle can be re-tested. The original failure details will be included with the results of the re-test.

5 Glossary

AVTE: Advanced Vehicle Testing and Evaluation

CECET: Center for Evaluation of Clean Energy Technology (CECET)

Charge-Depleting (CD) Mode: An operating mode in which the energy storage system (ESS) state of charge (SOC) is depleted (not continuously, but the trend is depletion) while the vehicle is driven. May be ESS-Only (i.e., the vehicle operates solely on energy from the ESS) or Blended CD (i.e., the vehicle operates on energy from both the ESS and the consumable fuel energy converter (CFEC)).

Charge-Sustaining (CS) Mode: An operating mode in which the energy storage system (ESS) state of charge (SOC) is maintained within a prescribed range by operation of a consumable fuel energy converter (CFEC).

Consumable Fuel Energy Converter (CFEC): An engine which consumes fuel to produce work (either electrical or mechanical).

Curb Weight: The total weight of the vehicle including batteries, lubricants, and other expendable supplies but excluding the driver, passengers, and other payloads.

Effective Date: After a document has been reviewed and approved, the first date the procedure can be utilized in an official capacity.

Energy Storage System (ESS): A component or system of components that stores energy and for which its supply of energy is rechargeable by an electric motor-generator system, an off-vehicle energy source, or both. Examples of ESSs include batteries, capacitors, and electromechanical flywheels.

ESS-Only Mode: An operator selectable vehicle operating mode in which the CFEC is disabled and the vehicle operates solely on energy from the ESS.

Gradeability: The maximum percent grade which the vehicle can traverse for a specified time at a specified speed. The gradeability limit is the grade upon which the vehicle can just move forward.

Initial Conditions: Conditions that must exist prior to an event occurring.

Initial State of Charge (SOC): ESS SOC at the beginning of a test.

Mandated Reviewer: The individual(s) responsible for the implementation of the AVTE program and of other advanced vehicle testing activities.

Prerequisites: Requirements that shall be met or resolved prior to an event occurring.

SAE: Society of Automotive Engineers

Shall: This word is used to indicate an item which requires adherence without deviation. 'Shall' is used to identify the binding requirements in a statement. A go or no-go criterion.

Should: This word is used to identify an item, which requires adherence if at all possible. 'Should' statements identify preferred conditions.

State of Charge (SOC): The ESS SOC is defined as the present capacity, (ampere-hours or watt-hours or miles), expressed as a percentage of the total available.

Test or Project Engineer: The individual(s) assigned responsibility for the conduct of any given test.

Test Mass (Weight): The mass [weight] of the vehicle as tested, including driver and all instrumentation

Tractive Force: The force available from the driving wheels at the driving wheel/ground interface.

Vehicle Manufacturer: Entity that manufactured the test vehicle.

6 References

SAE J688 (cancelled Feb 1997). "Truck Ability Prediction Procedure,"