



## **Hot Weather Truck Limited Powertrain Durability Test**

### **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 assess the durability and reliability performance of a light duty truck powertrain and driveline system subjected to severe customer usage. Portions of this test also subject a vehicle to a test of its systems and components in an actual severe hot weather environment and permit an evaluation of their operating characteristics.

**1.2 Applicability.** This standard is applicable to light duty trucks. Performing hot weather testing as specified in Table B1 will satisfy hot weather requirements as described in GMW15730. Performing this test satisfies the Extreme Hot countries requirements of GMW15730 Hot Weather Exposure Test. Refer to GMW15730 for countries of hot weather test applicability.

#### **1.3 Remarks.**

**1.3.1** This durability test standard is intended to subject the powertrain and driveline system to rigorous sequence of events so that the interfaces can be evaluated. Some selected inputs are representative of a greater than average severity customer operation. Other inputs represent a much lower severity, but are included to help identify performance/pleasability and durability issues.

The hot weather controlled portion of this test specification is intended to provide controlled hot weather exposure representative of up to 2 years of average customer operation in a severe high ambient temperature environment.

**1.3.2** The foundation of this test is data assembled by Product Usage Measurements and Applications (PUMA) from a series of field load and usage measurements conducted throughout the U.S. and Canada on randomly selected customer owned and operated vehicles.

**1.3.3** This test does not encompass all known customer usage treatments. If more rigorous exposure to unique customer usage treatments is desired, other specialized testing should be considered as part of the vehicle test plan.

- GMW15016 Cold Weather Exposure Test
- GMW17353 Trailer Towing Test for Powertrain/Driveline

**1.3.4** Tables A1, A2, and A3 in Appendix A provide listings of the current Durability Events and the number of event cycles per test. Table A1 is used for full size pickup trucks, cargo vans, and cab chassis trucks. Table A2 is used for midsize pickup trucks, passenger vans, and Body on Frame (BOF) Sport Utility Vehicles (SUV) with trailer ratings  $\geq 3175$  kg (7000 lb), excluding vehicles tested to Table A1. Table A3 is used for midsize pickup trucks, passenger vans, and BOF SUVs with trailer ratings  $< 3175$  kg (7000 lb).

**1.3.5** Results of this test should be regarded as highly probable to also occur with some customers inasmuch as the event contains vehicle treatments based on measured customer vehicle operation. The durability test contains vehicle operational and environmental exposure designed to match data collected on groups of randomly selected customers' vehicles. The intent of the test is to subject the vehicle to the treatment of a greater-than-average severity customer for each measurable environment.

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## 2 References

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

### 2.1 External Standards/Specifications.

None

### 2.2 GM Standards/Specifications.

|              |          |          |          |
|--------------|----------|----------|----------|
| GMW3241      | GMW15445 | GMW15555 | GMW16933 |
| GMW8738 (ID) | GMW15527 | GMW15677 | GMW17168 |
| GMW14264     | GMW15550 | GMW15708 |          |
| GMW15444     | GMW15552 | GMW15730 |          |

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

### 2.3 Additional References.

A number of reports are available relating to customer usage and durability testing.

- North American Ambient Temperature Study (Report PG-53238) (For information only).

#### 2.3.1 Yuma.

|          |          |          |          |
|----------|----------|----------|----------|
| DR.YU.AR | DR.YU.GT | DR.YU.MV | DR.YU.SW |
| DR.YU.CY | DR.YU.GV | DR.YU.RL | DR.YU.TD |
| DR.YU.DL | DR.YU.GW | DR.YU.SD | DR.YU.TF |
| DR.YU.DP | DR.YU.IA | DR.YU.SG | DR.YU.TL |
| DR.YU.ET | DR.YU.IT | DR.YU.SP | DR.YU.VH |
| DR.YU.FR | DR.YU.LI | DR.YU.SR | DR.YU.VW |
| DR.YU.GL | DR.YU.ME | DR.YU.SV | DR.YU.WK |

## 3 Resources

**3.1 Facilities.** GM Desert Proving Ground Yuma (DPGY), USA, is utilized as an operations base. Test events are performed at DPGY and on public roads in the vicinity of Phoenix, Arizona.

**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.** Some method of accurate speed indication should be provided to the driver for the accurate execution of the driving events. Some type of acceleration/deceleration rate indicator should also be provided to the driver.

A towing dynamometer is also required for portions of this test.

**3.3 Test Vehicle/Test Piece.** Test vehicle equipped as specified.

**3.3.1 Test Trailer.** Appendix C: Table C1 lists common trailer types and specifications. Trailer ballast conditions are specified in 4.2.3.

**Note:** All trailers 1360 kg or more used in this test must be equipped with trailer brakes. When operated on a highway, a trailer with a gross mass of 1360 kg or more shall be equipped with brakes that are adequate to control the movement of and to stop and to hold the vehicle. The trailer braking system shall be designed to either be applied by the driver of the towing motor vehicle from its cab or be of a type that operates automatically when the service brakes of the towing motor vehicle are applied. The brakes shall be designed and connected so that in case of an accidental breakaway of the towed vehicle, the brakes shall be automatically applied.

#### 3.4 Test Time.

|                    |                                      |
|--------------------|--------------------------------------|
| Calendar time:     | Not applicable                       |
| Test time:         | 1438 h to 1689 h (vehicle dependent) |
| Coordination time: | Not applicable                       |

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**3.5 Test Required Information.** Not applicable.

**3.6 Personnel/Skills.** The procedures that comprise this test are intended to be performed by personnel specifically trained in the proper execution of the driving instructions. Refer to the appropriate proving ground driving instruction documents and related risk assessments.

Different driver license requirements, knowledge of test content, and mandatory health checks for involved personnel have to be considered.

## 4 Procedure

**4.1 Preparation.** This procedure includes towing; therefore, the test vehicle should be equipped with the appropriate trailer hitch and trailer wiring harness. Maximum vehicle speeds are to be supplied by test responsible personnel for driver reference. If the vehicle is equipped with a manual transmission the shift point speeds should also be determined and provided.

**4.1.1** Measurement of adjustments and settings may be made as deemed necessary to document the condition of the vehicle. These measurements must be made without significantly affecting the adjustment or setting being considered. The intent of these measurements is to document the condition of the vehicle without changing the state of the original assembly.

**4.1.2** Vehicles being operated on this test for any other purposes (e.g., design evaluation) should be prepared in a manner appropriate to that particular test intent.

**4.1.3** This procedure includes towing. Therefore, the test vehicle should be equipped with the appropriate trailer hitch.

**4.2 Conditions.** Portions of the test have specific ambient temperature requirements as shown in Appendix B Controlled Hot Weather Portion of Base Test.

**4.2.1 Environmental Conditions.** Test operation for the hot weather portion of the test is required during at least 4 weeks of the peak hot weather season, which is generally mid-May to September. Due to the length of the test, vehicles should not start this test September to December.

The durability events can be performed in all types of weather typically experienced at the DPGY. However, in situations where severe weather causes certain driving maneuvers to be unsafe, events using those maneuvers should be postponed until road conditions improve.

**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.

**4.2.3 Ballast.** Ballast definitions are explained in GMW15445 Vehicle Ballast.

The ballast calculation worksheet in GMW15445 should be used to determine the placement of ballast at Gross Vehicle Mass (GVM) ballast condition. The test trailer should be ballasted to Gross Combined Mass Rating (GCMR) minus GVM. The hitch tongue mass rating should not be exceeded. When ballasting to GCMR, the tongue mass must be counted as part of the vehicle ballast so as not to exceed GVM or rear Gross Axle Mass Rating (GAMR). Ballast should be applied in an even "water level" fashion and distributed so that the tongue carries 10% to 12% of the mass of the loaded trailer (or the tongue mass rating if < 10%). The ballast is to be secured to prevent shifting of the load.

**Note:** Refer to the Owner's Manual for any additional instructions regarding the towing of trailers.

**4.3 Instructions.** Perform the Specified Events listed in Tables A1 through A3.

### 4.3.1 Test Scheduling Guidelines.

**4.3.1.1 Linear Test Content.** The events listed in the controlled hot weather portion of this test (Table B1) should be extracted from the content of Table A1, Table A2 or Table A3. The remaining test content is divided into 5 approximately equal phases to simulate customer usage in a linear manner of operation. The required ballast distribution for the test is shown in the respective tables. The vehicle should be cycled through the 2 ballast conditions once per test phase.

While the vehicle is in the GVM ballast condition, the vehicle should be tested to the hot weather portion of the test when the ambient temperature exceeds 32.2 °C (90 °F) or 37.8 °C (100 °F). The remaining content can be completed at any temperature.

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For inspection and percent of test purposes, the distance from the hot portion of the test should be added to the other driven content and compared to the total base test distance from Tables A1 through A3.

**4.3.1.2 Vehicle Break-In.** The vehicle should not receive any “break-in” miles unless such are specifically required or recommended in the Owner’s Manual in such terms that more than 90% of the vehicle purchasers or users would be expected to follow the recommendation. The intention of this Durability Test is to subject the vehicle to more severe than average operation and it is believed that the omission of “break-in” miles is more severe than is their inclusion.

If the test requester determines that “break-in” mileage is required, then the “break-in” procedure should be completed prior to execution of this test procedure.

**4.3.1.3 Trailer Towing Content.** For vehicles tested from the DPGY test site, an allowance may be made for vehicle and trailer transport. If the vehicle with test ballasted trailer is driven from DPGY to the Phoenix area test site and back, 3 cycles of the DR.YU.FT Freeway Towing event may be reduced from the overall test. The route taken should be one of the following options:

- East on Interstate 8 from Yuma past Gila Bend and take the Stanfield exit through Maricopa. Take Casa Blanca Rd east, after passing through Maricopa, to Interstate 10 west to US 60 east.
- North on Highway 95 to Interstate 10 east to US 60 east.

#### **4.3.2 Controlled Temperature Exposure Guidelines.**

**4.3.2.1 Controlled Hot Weather Exposure.** Appendix B Hot Weather Portion of Base Test table summarizes the portion of the base test to be performed at high ambient temperatures. The listed event cycles are a subset of the base test.

**4.3.2.2** Eight times during the hottest months that the test is performed, the DR.YU.WK (Weekend Soak) and any accompanying events required by that procedure are to be performed. If the vehicle is on a < 7-day operation schedule, the vehicle should be parked during the off days in the full sun as if it were performing a Weekend Soak.

**4.3.2.3** During the off-shift cool down period the vehicle should be parked in the nearest location that is an open area where airflow around the vehicle is not obstructed.

**4.3.2.4** Many of the event cycles listed in Appendix B are to include an engine idle of specified duration at the end of the cycle. Perform DR.YU.IA (Idle and Accessories) whenever an engine idle is specified. The idle should be performed at the completion of the event in the nearest location that does not interfere with other traffic.

**4.3.2.5** Appendix B specifies that a portion of the event cycles with an ambient temperature requirement are to be performed with a soak. A soak is an Ignition Stop as defined in GMW15444 Durability Definitions and Instructions of the specified duration to be performed at the completion of an event cycle. The soak should be performed at the completion of the event in the nearest location that does not interfere with other traffic.

**4.3.3 Driver Responsibilities.** The driver is to provide the first indication that the vehicle requires attention. During the execution of the test, the driver is to observe vehicle behavior, as would a customer, and inform the responsible individuals through written comment whenever a malfunction occurs, or unusual behavior is experienced. In essence, the driver should play the role of the customer and should initiate checkout for potential repair of the vehicle. The driver should be informed of this responsibility and should be instructed to keep accurate, thorough records on the vehicle. The driver is an important source of vehicle performance information for the test coordinator with whom the driver should actively communicate.

The proper execution of this durability test is highly dependent on close driver adherence to the events and the instructions contained therein. This is because accurate correlation with field experience can only be achieved by means of tailored combinations of vehicle speed, road surface, and driving maneuvers.

**4.3.4 Inspections.** All vehicles operated on this test must complete an inspection prior to continuing onto the other events. At the completion of the events or at the termination of the test due to any other reason, an inspection must also be performed.

**4.3.4.1 Maintenance Scheduling Guidelines.** Test vehicle maintenance/repair will be based on Owner’s Manual recommendations and, as closely as possible, customer maintenance/repair practices.

**4.3.4.2 Replacement Parts.** The general guideline for replacement parts shall be that in those cases where a GM service part is used for 10% or more of the market, that part shall be used during this test. In those cases

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