



Trailer Hitch Component Durability Test up to 3500 kg Trailer Weight Rating

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 evaluate and validate the durability strength of the Trailer Hitch System (THS) as a component test. The THS is mounted on a rigid support system. For trailer hitch tests on vehicles, see GMW15934. The supplier shall work with the GM Design Responsible Engineer (DRE) to comprehend this requirement.

1.2 Applicability. This test procedure is applicable to all Body Frame Integral (BFI) passenger vehicles up to a permitted trailer weight rating of 3500 kg. The test target depends on what is stated in the specific Vehicle Technical Specification (VTS) and/or the specific Subsystem Technical Specification (SSTS).

1.3 Remarks. This durability test procedure is intended to provide representative service loads which are acting on the THS and on the vehicle. The selected inputs are representative of 240 000 km (150 000 mi) of operation for a 95th percentile severity customer. The representative service loads on the road are acting in all directions simultaneously.

2 References

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

2.1 External Standards/Specifications.

UN R 55.01 CARLOS TC

2.2 GM Standards/Specifications.

GMW14048 (ID) GMW15245 GMW15269 GMW15934 (ID)

(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.

- Subsystem Technical Specifications (SSTS)
- Global Vehicle Technical Specifications (VTS)

3 Resources

3.1 Facilities.

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 A hydraulic power system.

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3.2.2 A multi-axial test rig capable of applying forces in three (3) directions simultaneously in the center of the coupling ball:

- F_x (longitudinal)
- F_y (lateral)
- F_z (vertical)

3.2.3 The main parts in the test rig consist of hydraulic actuators and a control system.

3.2.4 Adequate physical equipment for fixation of the THS. An example of a test rig is shown in Appendix A, Figure A1.

3.3 Test Vehicle/Test Piece. The THS shall be supplied by the requestor.

3.4 Test Time.

Calendar time: 8 days
Test hours: 92 hours
Coordination hours: 10 hours

3.5 Test Required Information. The requesting engineer is responsible for providing specifications appropriate to the particular THS being tested.

3.6 Personnel/Skills. Prior experience in setting up and running similar tests and experience in the use of the referenced test equipment.

Note: Prior experience in setting up and running similar tests and experience in the use of the referenced test equipment will minimize the potential for accidents and injuries.

4 Procedure

4.1 Preparation.

4.1.1 Component Preparation.

4.1.1.1 Check that all parts needed are included for the mounting.

4.1.1.2 Check that the actual trailer hitch is mounted according to the mounting instructions and with correct torque.

4.1.1.3 Paint critical areas with an appropriate color (e.g., white) to make it easier to find cracks.

4.1.2 Test Stand Setup.

4.1.2.1 The THS must be installed in the support system so that the coordinate systems (XYZ) for the THS, test rig and vehicle all correspond. The trailer hitch coupling ball center must be the origin of the coordinates.

4.1.2.2 Unintended moments at a distance from the coupling point must be avoided.

4.1.2.3 The defined coordinate system with directions is shown in Appendix A, Figure A2.

4.1.2.4 Fixation of the THS. Stiff support of the test specimen is required.

4.1.2.4.1 All attachment points on the THS shall be used and the screws shall be tightened with torques specified in the mounting instruction.

4.1.2.4.2 It is difficult to state how stiff a support system must be. An aiming target can be that the compliance of the fitting points to the THS has to be about 0.5 mm to 1.0 mm (for the maximum forces F_x , F_y , F_z).

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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 Static Longitudinal Loading. This shall be performed before the variable loading tests.

4.3.1.1 Maximum force $F_x = -2.5$ D-value. See 7.1 for D-value definition.

4.3.1.2 Rise and decreasing time shall be 0.5 s each.

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4.3.1.3 Dwell time at maximum force shall be 2 s.

4.3.1.4 Verification requirements according to UN R 55.01.

4.3.2 Variable Loading Test.

4.3.2.1 Base Signals – Loading Modules – Files and Test Duration.

4.3.2.1.1 The loading modules are load time histories of the variable force components with service like correlations/phase relations:

- F_x (longitudinal, channel 1)
- F_y (lateral, channel 2)
- F_z (vertical, channel 3)

4.3.2.1.2 The sample rate is constant, $\Delta t = 0.0025$ s.

4.3.2.1.3 The three (3) master load files required to run this test are posted in the Load Database. Using Basic Search, select Vehicle Component: "Trailer Hitch"; or enter "trailer", "hitch", "coupling" and/or "towbar" in the text search field. GM DRE is to supply required load information to supplier.

4.3.2.1.4 For the total test, apply the module repetition sequence/frequencies shown in Table 1.

Table 1: $10 \times (5 \times (10 \times M1 + M2) + M3)$

Module	Data-file	Module duration	Repetition frequency	Total test duration
1	CTC_M1.*	630 s	500	92 h
2	CTC_M2.*	271 s	50	
3	CTC_M3.*	51 s	10	

4.3.2.2 Test on the THS. This test serves as a verification test for the THS strength.

4.3.2.2.1 The scaling factor for the three (3) force components of the CAR Loading Standard, Trailer Coupling (CARLOS TC) control signals (CD-ROM) is 1.15 D. GMNA uses a scaling factor of 1.0 D and test is run until a minimum of 2.2 D lives.

4.3.2.2.2 The 15% increase of amplitudes compared to the car body verification (point A) corresponds to a factor of 2.0 in terms of calculated life time (slope of the SN-curve $k = 5$) and 2.3 ($k=6$) respectively.

4.3.2.2.3 The maximum values amount to:

- Longitudinal force $F_x = +1.47$ D, -1.97 D
- Lateral force $F_y = +0.47$ D, -0.44 D
- Vertical force $F_z = +0.66$ D, -0.67 D

4.3.2.3 Support Load (Static Vertical Load).

4.3.2.3.1 The variable load modules M1, M2 and M3 do not include the static vertical support load (see Table 1).

4.3.2.3.2 The permissible support load has to be added to the vertical loads F_z (channel 3, support load sign is negative).

4.3.2.4 Additional Requirements.

GMW15269 "Structural Durability Pseudo-Fatigue Analysis".

GMW15245 "Real Time Test Development Correlation Criteria".

4.3.2.4.1 The maximum force amplitudes of F_x , F_y , and F_z must be reached for all modules.

4.3.2.4.1.1 This is to be evaluated by the comparison of the Root Mean Square (RMS)-value of the error signal (target signal minus actual signal in time domain).

4.3.2.4.1.2 The deviation in ratio (RMS error divided by RMS target) has to be less than 5%.

4.3.2.4.1.3 The fictive damage sum for the total test must be reached.

4.3.2.4.1.4 This is to be evaluated, for example, by:

- Online damage accumulation during the whole test.

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