



Wheel Attachment Loosening Test (WALT)

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.

1.1.1 Test A. The purpose of this test is to check the secure fitting of the wheel mounting.

1.1.2 Test B. The purpose of this test is to evaluate a vehicle's wheel attachment's tendency to loosen from initial assembly to the first service event. This test is not intended to validate the long term, life of vehicle performance of the wheel attachment.

1.2 Applicability.

1.2.1 Test A. Complete vehicle range.

1.2.2 Test B. This procedure applies to the initial tightening event of the wheel attachment fasteners, wheels, and brake rotors or brake drums.

1.3 Remarks.

1.3.1 Test A. Not applicable.

1.3.2 Test B. This procedure provides minimum performance requirements for wheel attachments of vehicles intended for normal highway use on passenger vehicles, light trucks, and multipurpose vehicles.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW16590

2.3 Additional References.

Global Wheel Validation Guidelines Version 7

3 Resources

3.1 Facilities.

3.1.1 Test A. Test center with handling track (Appendix A, Figure A1).

3.1.2 Test B. This test is run on a flat dry surface that is clear of debris.

3.2 Equipment.

3.2.1 Test A.

3.2.1.1 Sensor to measure wheel bolt temperatures.

3.2.1.2 Towing force measuring device (dynamometer).

3.2.2 Test B.

3.2.2.1 Torque wrench of sufficient capacity to measure torque on the individual fasteners.

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3.3 Test Vehicle/Test Piece.

3.3.1 Test A. The vehicle shall generally correspond to the release status. Dimensions and weight distribution shall be adjusted so that they comply with the current release status.

3.3.2 Test B. The test vehicle must have the same basic chassis and powertrain (engine size, drive (Front Wheel Drive (FWD), Rear Wheel Drive (RWD), All Wheel Drive (AWD), or Four Wheel Drive (4X4))) as the vehicle that will be built in the assembly plant.

3.4 Test Time.

3.4.1 Test A. Not applicable.

3.4.2 Test B.

Calendar time: 5 days

Test hours: 6 hours

Coordination hours: 20 hours

3.5 Test Required Information.

3.5.1 Test A. Not applicable.

3.5.2 Test B.

3.5.2.1 Gross vehicle axle mass ratings.

3.5.2.2 Minimum dynamic assembly plant wheel attachment torque specification.

3.6 Personnel/Skills. Personnel must comply with local driver regulations and certifications. Relevant technical expertise and training is required.

4 Procedure

4.1 Preparation.

4.1.1 Test A.

4.1.1.1 Before starting the test, new brake rotors or drums from one manufacturer and new brake friction materials from one batch shall be installed and the brakes should be burnished (approximately 200 km driving).

4.1.1.2 Check axial clearance of drum brake linings before their installation in the respective drum; make sure it does not exceed 0.8 mm.

4.1.1.3 Readjust brakes after burnish if they are not self-adjusting.

4.1.1.4 The vehicle shall be loaded with the maximum load under consideration of the corresponding specifications.

4.1.1.5 New wheels including wheel bolts shall be mounted on the front axle.

4.1.1.6 The wheel bolts at the rims shall be applied with a color marking.

4.1.1.7 The tightening torques of all wheel bolts shall be measured.

4.1.1.8 Calculation of the necessary tractive force, F_{Zug} .

This corresponds to the downhill dragging force of the vehicle to be tested on an average gradient of 9%.

$$F_{Zug} = 0.09 \times G_{zul} \text{ in N}$$

The tractive force shall be measured by means of a dynamometer fitted with a wire strain gage.

Example:

Astra 17TD with a Gross Vehicle Weight Rating (GVWR) of 1710 kg

$$F_{Zug} = 0.09 \times 1710 \text{ kg} \times 9.81 \text{ m/sec}^2 = 1510 \text{ N}$$

4.1.2 Test B.

4.1.2.1 Wheel Attachment Loosening Test (WALT) parts must have their attachment interface surfaces measured and qualified for flatness prior to mounting on vehicle for testing. These parts include the wheel, brake rotor, and wheel bearing flange or axle flange. The location of the measurement points on the cast or forged light alloy wheel mounting surface are shown in the WALT Dim Sheet of the Global Wheel Validation Guidelines

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Version 7 or later. Validation test parts must also be measured after test to document flatness changes. Typical flat light alloy wheel mount Geometric Dimensioning & Tolerancing (GD&T) specification:

“ 50 µm MUST NOT BE CONVEX”

4.1.2.1.1 Flat Mount Cast or Forged Light Alloy Wheels. Measure and document that the GD&T value for the flatness is less than or equal to the lower quartile of the wheel flatness specification ($\leq 13 \mu\text{m}$ for wheel flatness specification of “ 50 µm MUST NOT BE CONVEX”).

4.1.2.1.2 Dual Ring Mount Cast or Forged Light Alloy Wheels. Measure and document that the step height between the inner and outer rings meets the wheel drawing specifications.

4.1.2.1.3 Step Mount Cast or Forged Light Alloy Wheels. Measure and document that the step height between the inner and outer section meets the wheel drawing specifications.

4.1.2.1.4 Steel Wheels. Measure and document that the step height or flatness between the inner and outer mounting areas meet the wheel drawing specifications.

4.1.2.1.5 Brake Rotor Hat. Measure and document that the rotor hat flatness of both inner and outer surfaces meet the brake rotor drawing specifications. Nominal GD&T **concave** brake rotor flatness value is acceptable for test (typically $25 \mu\text{m} \pm 10 \mu\text{m}$).

4.1.2.1.6 Bearing or Axle Flange. Confirm and document that the GD&T value for the flange flatness is less than or equal to the lower quartile of the flange flatness specification ($\leq 13 \mu\text{m}$ for flange flatness specification of “ 50 µm MUST NOT BE CONVEX”).

4.1.2.2 Ballast vehicle to front and rear Gross Axle Mass Rating (GAMR) or as specified by the test requestor.

Note: That ballasting may need to be done after the installation of new parts on the vehicle as noted in 4.1.2.8.

4.1.2.3 Inflate tires to the intended placard pressure or as specified by the test requestor.

4.1.2.4 Install an accelerometer for the detection of brake fade during braking phases.

4.1.2.5 Install a counter on the dash board for counting the test cycles, especially in the Antilock Brake System (ABS)-B schedule.

4.1.2.6 Install a fire extinguisher in the vehicle.

4.1.2.7 Place a **Sudden Stops** sign on the back of the vehicle.

4.1.2.8 Install new brake pads, brake rotors and/or drums, wheels and wheel nuts on all four corners.

Note: That this section describes the procedure and order of part installation and ballasting based on hoist capability and test timing.

4.1.2.8.1 Replace wheel bearing assemblies (with supplier installed wheel bolts) if possible, or install new wheel bolts. Refer to vehicle service manuals for wheel bolt replacement technique.

4.1.2.8.1.1 Note on Stud Reuse: Wheel bolts should be replaced after a maximum of six (6) test cycles, or if heavily worn or damaged, because studs may be tightened only to a maximum of six (6) times without invalidating the test. This means that if it is known that the studs assembled in the hub have been tightened five (5) times or less, the test wheels may be fastened using these studs. If the reuse history of the studs is not known, new studs must be used. This is a general rule for wheel tests where the outcome could be influenced by fastener performance. The reason that fasteners used for a wheel test should not be tightened any more than six (6) times is that the fastener torque-tension relationship can be significantly affected by thread wear on studs that have been tightened more than six (6) times. Note that M14 studs that have been over tightened through the use of an impact wrench will not have significantly higher thread wear than those tightened to specifications using a torque wrench. They will also not have significantly higher stretch. For these reasons, these studs should be treated in the same way as M14 studs that have not been over tightened. However, M12 studs can be stretched when over tightened through the use of an impact wrench. The way to check for this is to put a nut on the stud by hand. If the stud has been stretched, the nut will not easily spin on the stud. A stretched stud should not be used for a wheel test.

4.1.2.8.1.2 Special Instructions for Dual Wheel Systems: Since the contact area of the wheel hub is flat (no step or pads), and the brake rotor or drum is not sandwiched between the wheel and the hub, there is no embedment. New hubs do not need to be used. Since the two-part nuts have coatings that have less friction than regular wheel fasteners, studs can be reused as many times as necessary prior to a wheel test, as long as nuts easily spin on the studs.

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4.1.2.8.2 Tighten the wheel fasteners to the minimum assembly plant dynamic torque specification as follows. Ballasting and test parts installation order, proper procedure for tightening the fasteners, and the timing of the start of the test should be as specified.

4.1.2.8.2.1 The ideal sequence is to ballast the vehicle, then remove and replace parts with brand new test parts as required, and then start the test immediately. In this case, secure the wheels by first tightening the fasteners to 30 N·m, while the vehicle is on the hoist and the assembly is suspended, in a standard star pattern to align the wheel. Then, take the vehicle off of the hoist and tighten each fastener to the full torque specification in a smooth continuous motion. Repeat this star pattern tightening process until all of the fasteners are stable at the test torque.

4.1.2.8.2.2 However, if the vehicle hoist is not capable of lifting the ballasted vehicle, the test parts must be installed prior to ballasting. Secure the wheels as described, then ballast. The test should be started immediately after the ballasting is complete.

4.1.2.8.2.3 If it is known that there will be a significant delay between preparation of the test vehicle and the actual test (such as overnight), the procedures should be used to tighten the fasteners: If the hoist is capable of lifting the vehicle, follow the ideal sequence as described, but leave the fasteners at 30 N·m instead of tightening completely. Later, tighten them to the specification as described and start the test immediately. If the hoist is not capable of lifting the vehicle, follow that sequence as described. Immediately before the test, check the torque on the fasteners and adjust as necessary. Note that it is important to avoid significantly loosening the fasteners for any reason between preparing for the test and running it, because loosening and retightening the fasteners will cause wear at the nut bosses, changing the fastener torque-tension relationship. If a wheel is completely removed, the embedment of the wheel on the rotor may also change.

4.1.2.9 Paint index marks on all wheel nuts relative to the wheel.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Test A. Dry road surface (μ is approximately 0.9).

4.2.1.2 Test B. Roads must be dry and clear of debris that might reduce tire traction.

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 Test A.

4.3.1.1 Towing Test (Simulated Alpine Descent Test).

4.3.1.1.1 Before performing the towing test, the complete measuring system shall be calibrated and a functional control shall be performed.

4.3.1.1.2 Perform the towing test as follows: The vehicle shall be towed on an even track with a speed of $v = 22.2$ km/h. The transmission is in neutral. The tractive force shall be produced by means of the service brake and continually monitored by a special indicating instrument:

$$F_{\text{Zug}} = 0.09 \times G_{\text{zul}} \text{ in N}$$

Where:

- The calculated tractive force, F_{Zug} , is the towing force, and
- G_{zul} is the GVWR.

The tractive force is maintained by varying the brake line pressure.

The brake shall be operated continually. It is released every 5 minutes for approximately 3 s, in order to ensure volume compensation for the brake fluid as it becomes warm. The towing distance is 14.8 km which results in a towing time of approximately 40 minutes.

Immediately after towing, the vehicle shall be stopped for 15 minutes.

4.3.1.1.3 The wheel bolt temperature shall be measured after the post-heating time expires.

4.3.1.2 Driving Test (Sporty Driving on the Handling Track).

4.3.1.2.1 Drive ten (10) laps on the handling track using a very sporty driving style.

4.3.1.2.2 After the last lap the additional tightening torques of all wheel bolts shall be measured.

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