



Northeast (NE) Challenge Course Wheel Attachment 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. The purpose of this test is to evaluate a vehicle's wheel attachment's tendency to loosen from initial assembly in race conditions. This test is not intended to validate the long term, life of vehicle performance of the wheel attachment.

1.2 Applicability. This procedure applies to the initial tightening event of the wheel attachment fasteners, wheels, and brake rotors or brake drums. This procedure provides minimum performance requirements for wheel attachments of vehicles intended for use on race tracks and in racing events.

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 (Current Version) (ID)
https://share.gm.com/sites/GSSLT_Tire_Wheel_Trim_Jack_and_Tools/Wheel%20GSSLT%20%20Key%20Criteria/Validation%20-%20Wheel%20and%20Trim/GLOBAL%20WHEEL%20VG8.xlsm
 - Vehicle Service Manuals (as appropriate for vehicle being tested)
- (ID) = This website is limited to internal distribution within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

3 Resources

3.1 Facilities. This test is run on a flat dry surface that is clear of debris, set up as the Milford Proving Ground (MPG) Northeast (NE) Challenge Course or a similarly configured course (reference Appendix A, Figure A1).

3.2 Equipment. Torque wrench of sufficient capacity to measure torque on the wheel fasteners.

3.3 Test Vehicle/Test Piece. Since this test requires a test vehicle, follow the security measures required for all pre-production vehicle properties.

3.3.1 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.

3.3.2 Test parts used will be new/unused and include:

- Tires.
- Wheels.
- Rotors/Drums.
- Brake Pads.

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- Bearing or Axles.

Deviation from this requirement must be agreed to by the requestor and the Bill of Material (BOM) Family Owner (BFO).

3.4 Test Time.

Calendar time: 4 days
Test hours: 12 hours
Coordination hours: 20 hours

3.5 Test Required Information. Refer to Appendix A, Data Sheet A1.

3.6 Personnel/Skills. Personnel must comply with local driver regulations and certifications. Relevant technical expertise and training is required. Driver must be sufficiently skilled to perform NE Challenge Course (or similar).

4 Procedure

4.1 Preparation.

4.1.1 Test parts must have their attachment interface surfaces measured and qualified for flatness ($\square$) and must not be convex prior to mounting on vehicle for testing. These parts include the wheel, brake rotor/drum, and bearing or axle flange. The location of the measurement points on the cast or forged light alloy wheel mounting surface are shown in the Wheel Attachment Loosening Test (WALT) Dimension Sheet of the most recent Global Wheel Validation Guidelines. Validation test parts must also be measured after test and to document flatness changes. Typical flat light alloy wheel mounting surface Geometric Dimensioning & Tolerancing (GD&T) specifications on detail drawings are:

$\square$ 0.05 mm MUST NOT BE CONVEX

Note: Wheel used for this test must have a tighter flatness (see 4.1.1.1 for requirements).

4.1.1.1 Flat Mount Cast or Forged Light Alloy Wheels. Measure and document (via calculated average of outer, middle and inner ring measurements) that the GD&T value for the flatness is less than or equal to the lower quartile of the wheel flatness specification (≤ 0.013 mm for wheel flatness specification of $\square$ 0.05 mm MUST NOT BE CONVEX).

4.1.1.2 Dual Ring Mount Cast or Forged Light Alloy Wheels. Measure and document that the step height between the inner and outer rings and the flatness of the outer ring meet the wheel drawing specifications.

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

4.1.1.4 Steel Wheels. Measure and document that the step height between the inner and outer section and the flatness of the outer section meets the wheel drawing specifications.

4.1.1.5 Brake Rotor/Drum. Measure and document that the attachment area flatness of both inner and outer surfaces meet the detailed drawing specifications. Nominal GD&T concave brake rotor flatness value is acceptable for test (typically $\square$ 0.025 mm $\pm$ 0.010 mm MUST NOT BE CONVEX). For two (2) piece rotors (such as those with ceramic sweep areas bolted to aluminum hat sections), it is permissible to reuse rotors with new hat sections.

4.1.1.6 Bearing or Axle Flange. Measure and document that the value for the flange flatness meet the drawing specifications. Nominal GD&T flatness value is acceptable for test (typically $\square$ 0.05 mm MUST NOT BE CONVEX).

4.1.2 Test Vehicle Preparation.

4.1.2.1 The vehicle is to be tested at a weight inclusive of full fluids plus driver. Weight is to be recorded for each corner.

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

4.1.2.3 Install a fire extinguisher in the vehicle.

4.1.2.4 Install new brake pads, brake rotors and/or drums, wheels and wheel nuts on all four (4) corners.

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

4.1.2.4.1 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.

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. If it is known that the studs assembled in the bearing or axle flange 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 because 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 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.

4.1.2.4.2 Tighten the wheel fasteners to the minimum assembly plant dynamic torque specification.

4.1.2.4.2.1 The ideal sequence is to weigh 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.

4.1.2.4.2.2 If it is known that there will be a significant delay between preparation of the test vehicle and the actual test (such as overnight), follow the ideal sequence as described in 4.1.2.4.2.1, but leave the wheels off the vehicle. When ready to test, assemble wheels to vehicle, tighten them to the specification as described in 4.1.2.4.2.1 and start the test immediately. This is to avoid a situation where the fasteners look secured but actually are not.

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.

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

4.2 Conditions.

4.2.1 Environmental Conditions. 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 Section 1 – Brake Burnish.

4.3.1.1 Follow this schedule to prepare the brakes for track use.

- Twenty-five (25) snubs from 100 km/h to 50 km/h at 0.4G, every 1.0 km.
- Sixteen (16) snubs from 160 km/h to 50 km/h at 0.6G, every 1.0 km
- Cooldown: 100 km/h for 15 km.
- Twenty-five (25) snubs from 100 km/h to 50 km/h at 0.4G, every 1.0 km.

4.3.2 Section 2 – Northeast Challenge Course.

4.3.2.1 Aggressively drive the course 30 times in groups of five (5) laps.

4.3.2.2 Every five (5) laps check paint indexes and note on data sheet OK, if index is not broken, or amount of rotation (in 1/16 increments of rotation) if index is broken. If any index is broken by 1/8 turn (45 degrees) or more, discontinue test and complete posttest inspection.

4.3.2.3 Allow wheels and fasteners to cool down to ambient temperature and measure the torque to tighten for each fastener.

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