



Objective Measurement of Dynamic Wheel Bearing Drag

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 the test is to quantify the dynamic drag torque of wheel bearing hub units.

1.2 Applicability. This standard may be used on all passenger vehicle and truck applications.

1.3 Remarks. This test standard assesses the loaded and unloaded bearing drag during various rotational speeds and bearing conditions. This test procedure shall be used for development and/or validation purposes.

The applicable Wheel Bearing Statement of Requirements (SOR) or Component Technical Specification (CTS) provides program specific information and acceptance criteria for bearings tested according to this procedure. In the event there is disagreement between this procedure and the SOR or CTS, the SOR or CTS has precedence.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15760

2.3 Additional References.

- Component Technical Specification (CTS)
- Wheel Bearing Statement of Requirements (SOR)

3 Resources

3.1 Facilities. Facility with Test Improvement Process (TIP) approved test machine shall be used.

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.

3.1.2.1 Test facilities must be certified per the GM Test Improvement Process (TIP).

3.2 Equipment.

3.2.1 Bearing Drag Test Machine.

3.2.1.1 The bearing drag test stand shall be capable of measuring loaded and unloaded bearing drag.

3.2.1.2 The test machine shall have a method of accurately resolving the bearing drag from the test data. Drag torque from the test stand fixture that is measured by the torque transducer or load cell cannot be quantified during a separate test and cannot be estimated for the purpose of adjusting the measured value.

3.2.1.3 The test machine shall have an adjustable test fixture that provides for various loads and offsets.

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3.2.2 Data Acquisition System. Measurements shall be recorded using a digital acquisition system recording at 10 Hz or greater, unless otherwise specified.

3.2.3 Speed Sensor.

3.2.4 Bearing Race Thermocouple.

3.2.5 Torque Transducer or Load Cell.

3.3 Test Vehicle/Test Piece. A statistically valid sample size shall be tested to attain confidence in the results. A minimum of seven (7) driven and seven (7) non-driven bearings should be tested.

3.3.1 Test parts used for Design Validation (DV) are to be from production tooling and processes to the extent possible. Production Validation (PV) requires parts to be from production tooling and processes unless an exception is approved in writing by the General Motors contact specified in the SOR document.

3.3.2 Selection of parts undergoing PV shall be made according to GMW15760 Multi-Vari Sample Selection Procedure for Product Validation.

3.3.3 The part selection concepts in GMW15760 should also be applied, if possible, during the assembly of components for DV.

3.3.4 The GM design engineer and validation engineer will determine quantity of parts to test with and without Constant Velocity (CV) joint (half-shaft). Data without CV joint should be reported separately.

3.4 Test Time.

Calendar time: 1 day/bearing

Test hours: 15 hours/bearing

Coordination hours: 2 hours

3.5 Test Required Information. The test bearings shall initially be in a new, unused condition.

3.6 Personnel/Skills. One (1) technician trained in the operation of the bearing drag test stand and to perform the duties described in Section 4 is required for this test.

4 Procedure

4.1 Preparation.

4.1.1 Install a thermocouple on the fixed outer portion of the bearing.

4.1.2 The radial load applied to the bearing hub shall have a magnitude of one-half ($\frac{1}{2}$) the Gross Axle Weight Rating (GAWR) of the vehicle. The radial load must have the same direction and offset condition as the vehicle.

4.2 Conditions.

4.2.1 Environmental Conditions. Test should be run at an ambient temperature of normal room temperature, $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$.

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. Figures 1, 2, and 3 provide a visual description of the test procedure. The procedure consists of four (4) distinct sections. These sections shall all be run both clockwise and counterclockwise on the same sample. The sequence shown (in the Figures) is an example; if the supplier wishes to run the sections in a different order, it is acceptable as long as proper cool down time is included.

4.3.1 Steady State Drag (Loaded, Clockwise) (Figure 1). Apply the radial load to the test bearing. Adjust the speed to 50 rpm, 400 rpm, 800 rpm, and 950 rpm. Record the torque for 5 minutes at each speed, with the bearing turning in the clockwise direction. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value of the last minute should be used for the table value.

With the speed still at 950 rpm, operate at this speed for 1 h (break-in period). Record the drag torque at 0.5 Hz during the 1 h period. The alternative torque recording method can be set to record at 10 Hz for 5 s, every 30 s, with the last 2 minute's average used as the table value for every 15 minute increment in the break-in period.

Startup torque shall be measured during the last minute of the 950 rpm speed.

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After the 1 h break-in period, with the radial load still applied, the speed shall be adjusted to 800 rpm, 400 rpm, and 50 rpm. Record the drag torque for 5 minutes at each of the different speeds. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value of the last minute should be used for the table value.

After the steady state drag measurements, the bearing should be allowed to cool down for approximately 30 minutes or until the bearing reaches room temperature. A fan may be used to assist with cooling.

4.3.2 Unloaded Drag (Clockwise) (Figure 1). Remove the radial load from the test bearing. Adjust the speed from 50 rpm, 400 rpm, 800 rpm, and 950 rpm. Record the drag torque for 5 minutes at each of the different speeds, with the bearing turning in the clockwise direction. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value of the last minute should be used for the table value.

After the unloaded drag measurements, the bearing should be allowed to cool down for approximately 30 minutes or until the bearing reaches room temperature. A fan may be used to assist with cooling.

4.3.3 Steady State Drag (Loaded, Counterclockwise) (Figure 1). Apply the radial load to the test bearing. Adjust the speed to 50 rpm, 400 rpm, 800 rpm, and 950 rpm. Record the torque for 5 minutes at each speed, with the bearing turning in the counterclockwise direction. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value of the last minute should be used for the table value.

Startup torque shall be measured during the last minute of the 950 rpm speed.

With the speed still at 950 rpm, operate at this speed for 1 h (break-in period). Record the drag torque at 0.5 Hz during the 1 h period. The alternative torque recording method can be set to record at 10 Hz for 5 s, every 30 s, with the last 2 minute's average used as the table value for every 15 minute increment in the break-in period.

After the 1 h break-in period, with the radial load still applied, the speed shall be adjusted to 800 rpm, 400 rpm, and 50 rpm. Record the drag torque for 5 minutes at each of the different speeds. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value of the last minute should be used for the table value.

After the steady state drag measurements, the bearing should be allowed to cool down for approximately 30 minutes or until the bearing reaches room temperature. A fan may be used to assist with cooling.

4.3.4 Unloaded Drag (Counterclockwise) (Figure 1). Remove the radial load from the test bearing. Adjust the speed from 50 rpm, 400 rpm, 800 rpm, and 950 rpm. Record the drag torque for 5 minutes at each of the different speeds, with the bearing turning in the counterclockwise direction. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value of the last minute should be used for the table value.

After the unloaded drag measurements, the bearing should be allowed to cool down for approximately 30 minutes or until the bearing reaches room temperature. A fan may be used to assist with cooling.

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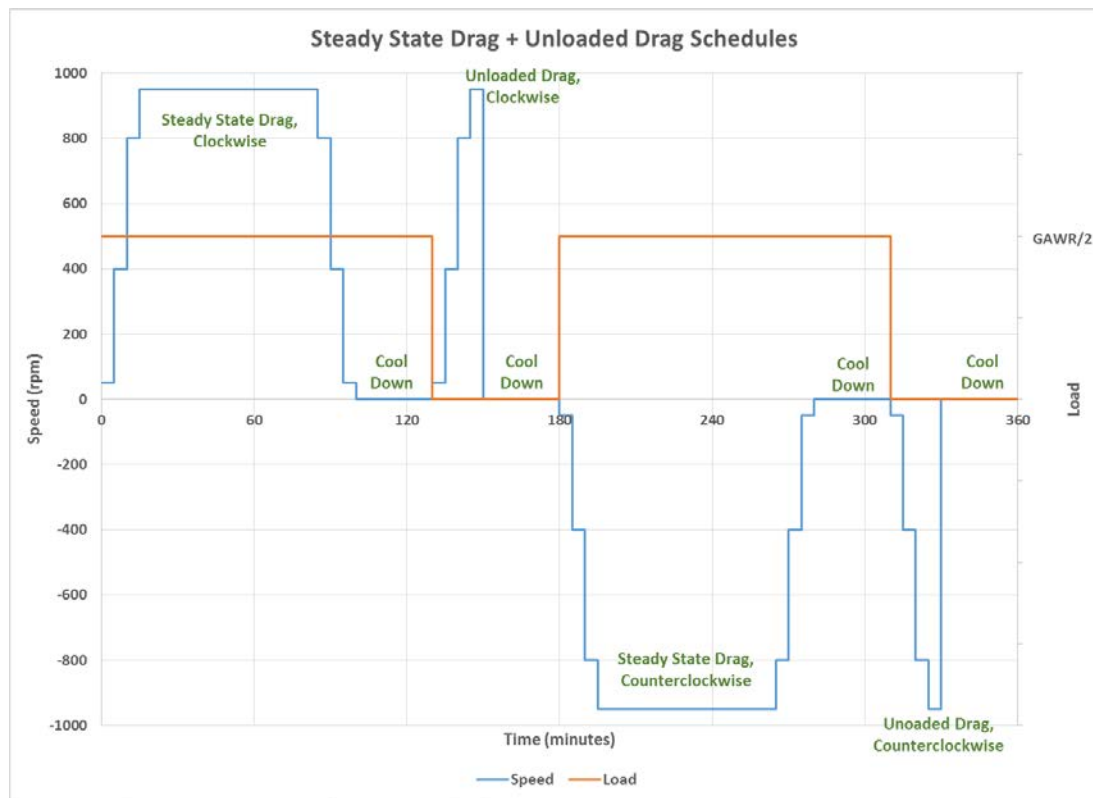


Figure 1: Bearing Drag Test Procedure – Steady State Drag and Unloaded Drag Schedules

4.3.5 Spin Loss (Clockwise) (Figure 2). Apply the radial load to the test bearing. Adjust the speed to 650 rpm and operate at this speed for 45 minutes (warm-up period), with the bearing turning in the clockwise direction. Record the drag torque at 0.5 Hz during the 45 minute period. The alternative torque recording method can be set to record at 10 Hz for 5 s, every 30 s, with the average value of the last minute used as the table value for every 5 minute increment in the warm-up period.

After the 45 minute warm-up period, with the radial load still applied, the speed shall be adjusted from 950 rpm to 150 rpm, in 50 rpm increments. Record the drag torque for 1 minute at each of the different speeds. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value should be used for the table value. Repeat this measurement collection from 950 rpm to 150 rpm twice, for a total of three (3) runs with no cooling in between.

After the spin loss measurements, the bearing should be allowed to cool down for approximately 30 minutes or until the bearing reaches room temperature. A fan may be used to assist with cooling.

4.3.6 Spin Loss (Counterclockwise) (Figure 2). Apply the radial load to the test bearing. Adjust the speed to 650 rpm and operate at this speed for 45 minutes (warm-up period), with the bearing turning in the counterclockwise direction. Record the drag torque at 0.5 Hz during the 45 minute period. The alternative torque recording method can be set to record at 10 Hz for 5 s, every 30 s, with the average value of the last minute used as the table value for every 5 minute increment in the warm-up period.

After the 45 minute warm-up period, with the radial load still applied, the speed shall be adjusted from 950 rpm to 150 rpm, in 50 rpm increments. Record the drag torque for 1 minute at each of the different speeds. The torque can be recorded at 10 Hz for 5 s, every 30 s, and the average value should be used for the table value. Repeat this measurement collection from 950 rpm to 150 rpm twice, for a total of three (3) runs with no cooling in between.

After the spin loss measurements, the bearing should be allowed to cool down for approximately 30 minutes or until the bearing reaches room temperature. A fan may be used to assist with cooling.

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