Rotary Fatigue Test for Front and Rear Wheel Bearings (Component Only)

1 Scope

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 standard is to determine the rotary fatigue life characteristics of various wheel bearing hubs.

1.2 Foreword. Hub fatigue life is partially dependent on the wheel with which it is mated. This test is to be conducted with a hub adaptor that has the same interface profile as the wheel design that is defined by analysis to be the worst case. If no wheel interfaces are known at time of testing, a dual ring adaptor should be used. For purposes of this standard, a lateral acceleration of 0.8G is considered representative of the maximum capability of a standard passenger vehicle when tested by the Constant Radius Method for maximum lateral acceleration.

1.3 Applicability. This standard applies to passenger vehicles and light trucks.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14249

3 Resources

3.1 Facilities. GM Milford Proving Ground Brake Systems Laboratory or equivalent test facility shall be used.

3.2 Equipment.

3.2.1 One rotary fatigue machine**.**

3.2.2 Front or rear wheel hub rotary fatigue fixture capable of monitoring and recording bearing vibration.

3.2.3 Adaptor plate with wheel interface profile.

3.2.4 One linear travel cutoff switch.

3.2.5 One load adaptor plate to position load relative to vehicle architectural requirements.

3.2.6 Wheel bearings as required, designed for use with the hub being tested.

3.2.7 All instrumentation is to be calibrated as required. Document instrumentation details and date of calibration in the test record, unless the information is otherwise preserved in the testing laboratory records.

3.3 Test Vehicle/Test Piece.

3.3.1 Unless otherwise specified, a minimum of 6 samples of each wheel bearings are to be tested. Data for each sample are to be documented in the test record.

3.3.1.1 Three samples are to be at minimum specified pre-load. For Generation 1 bearings, three samples should be set at minimum press fit and minimum drive shaft torque.

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3.3.1.2 Three samples are to be at maximum specified pre-load. For Generation 1 bearings three samples should be set at maximum press fit and maximum drive shaft torque.

3.3.2 All hubs are to be Magnaflux inspected before and after test.

3.4 Test Time.

Calendar time:	12 days per 6 samples
Test hours:	33 hours per sample
Coordination hours:	15 hours per 6 samples

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. One technician or engineer trained to perform the instructions in Section 4 Procedure is required.

4 Procedure

4.1 Preparation. Not applicable.

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 Mount the loading arm assembly to the bearing. Refer to Figure A1 throughout assembly of test equipment or refer to Figure A2 as alternate test setup method using a full corner assembly build.

4.3.2 Install the bearings and wheel spindle to the steering knuckle for a Generation 1 wheel bearing with the specified lubricated bearings, nut, and washer or stub Constant Velocity Joint drive shaft. For Generation 2 bearings, a stub shaft should be used. For Generation 3 bearings, testing should be completed with and without the stub shaft as defined in the bearing Component Technical Specification (CTS) and Statement of Requirements.

4.3.3 Torque the drive shaft to the minimum torque level for 3 bearings samples and at the maximum torque level for 3 bearings samples.

4.3.4 Mount the bearing hub assembly to the wheel adaptor plate. On 3 bearings samples tighten the wheel nuts to minimum torque, and on 3 bearings samples tighten the wheel nuts to the maximum torque.

Note: If there is need to evaluate the bearings for structural damage other than wheel studs, the wheel studs can be pressed out and replaced with high strength bolts.

4.3.5 Mount the wheel bearing and adaptor assembly to the rotary fatigue machine and load adaptor to adjust the lateral and vertical load points to the specified Static Loaded Radius (SLR) and tire offsets as defined by the vehicle architecture.

4.3.6 Adjust the wheel adaptor plate to the rotary fatigue machine at the studs or wheel bolts to allow no more than 0.020 mm maximum run out of the loading application point.

4.3.7 An alternative method for loading can be used, similar to the corner assembly test GMW14249. Place the load fixture with its bearing and air cylinder in its proper location and angle (as determined below) and bolt it down securely.

4.3.7.1 Set the air pressure to apply a test load derived by the methods of 4.3.8.1 or 4.3.8.2; the correct air pressure is the test load divided by the cross-sectional area of the air cylinder. Pressure is in Pascals if the load is in Newtons and the area is in square meters. Option: Use load cell to measure test load directly.

4.3.8 Determine the test load using the following formulae. Refer to Figure A3.

4.3.8.1 For Preferred Setup Loading:

Vertical Load =Static Load + Lateral Load Transfer

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$$= \left(\frac{1}{2} + \frac{CG}{T_f} * \frac{a}{G} \right) W_f$$

Lateral Load $= \frac{a}{G} *$ Vertical Load

Where:

W_f = Front distribution of the GM Gross Vehicle Weight Rating (N)

= Gross Axle Weight Rating (GAWR) (N)

CG = Height of the vehicle center of mass (mm)

T_f = Front track width (mm)

RR = Tire rolling radius (mm)

G = Gravitational constant

a = Vehicle lateral acceleration

4.3.8.2 For the alternative setup loading:

Test Load = $\{(\text{Vertical Load})^2 + (\text{Lateral Load})^2\}^{1/2}$

Test Load Angle = θ

$$= \tan^{-1} \frac{VerticalLoad}{LateralLoad}$$

Moment Arm Length = RR/tan θ

Note: Unless otherwise specified, use a/G = 0.8 for all wheel bearings or hub assemblies.

Note: For International System of Units (SI), the test load must be converted from kilograms (mass) to Newtons (force) for air cylinder setting.

4.3.9 Once the load is applied adjust the lateral travel limit to 1 mm for the preferred loading condition or to 1.6 mm switch travel for the alternative loading method.

4.3.10 Start the machine and run to 450 000 wheel rotations or to hub failure. The rotational speed should be 500 rpm or as specified in the technical specifications.

Note: Shutdowns due to broken fasteners do not constitute a failure if the test is to be run for raceway or hub fatigue only, as specified by the bearings CTS. If the machine shuts down due to broken fastener(s) initially, all fasteners are replaced and the test is resumed until suspension point or shutdown resulting from one of the other failure modes.

4.3.11 The shutdown and failure criteria is defined as one of the following conditions.

a. The inability of the hub to support the test loading resulting from a complete separation of a portion of the hub due to a fracture or a crack in the wheel mounting face wall or barrel extending completely through a section.

b. An increase in vibration of 2 times the initial vibration as defined below.

c. An increase of 1 mm deflection in the lateral direction or 1.69 mm at the micro-switch located below the loading point for the alternative method.

d. The loss of press fit between a bearing race and hub bore.

e. An increase in endplay or bearing rock above 15 microns at end-of-test, if test goes to suspension. Bearing rock to be measured by applying ± 100 N at the SLR and measuring the flange movement at the bearing spindle outer ring flange position.

4.3.12 Test Monitoring Procedures. The following conditions are to be monitored while conducting this test.

4.3.12.1 Vibration. The rotating wheel bearing is to be monitored for vibration. An accelerometer attached to the bearing housing or on the rigid fixture that applies the radial load, oriented in the same direction as the radial (vertical) loading, is to be used as the transducer for measuring vibration.

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