



Corner Assembly Rotary Bending Fatigue Test with Wheel

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

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

1.3 Remarks. Hub fatigue life is dependent on the wheel with which it is mated. It is important that hubs be tested with all released wheels to obtain a true evaluation. If this is impractical, it is recommended that the wheel with the highest lateral bending stiffness be used, as past studies have shown this usually produces the highest stress in the hub. For purposes of this standard, a lateral acceleration of 0.7G is considered representative of the maximum capability of a standard passenger vehicle when tested by the constant-radius method for maximum lateral acceleration.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Component Technical Specification (CTS), Platform Specific
- Magnaflux Company, Glenview, Illinois, www.magnaflux.com

3 Resources

3.1 Facilities. GM Proving Ground Brake Systems Laboratory or equivalent test facility 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.

3.2 Equipment.

3.2.1 One rotary fatigue machine.

3.2.2 Front or rear wheel hub rotary fatigue fixture.

3.2.3 Six clamping studs of 16 mm in diameter or larger.

3.2.4 One cutoff switch.

3.2.5 One steering knuckle designed for use with the hub being tested.

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

3.2.7 Samples of all wheel assemblies released for use with the hub being tested.

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3.2.8 A strain gauged wheel hub, if method of 4.3.8.2 is used.

3.2.9 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. See example instrumentation calibration sheet in Figure A3 (Appendix A).

3.3 Test Vehicle/Test Piece.

3.3.1 Unless otherwise specified, a minimum of seven (7) samples of each wheel hub are to be tested. Data for each sample are to be documented in the test record.

3.3.1.1 Four (4) samples are to be at minimum specified casting hardness, minimum wheel mounting face thickness, and with minimum bearing cup press fit.

3.3.1.2 Three (3) samples are to be as above except with maximum specified bearing cup press fit.

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

3.4 Test Time.

Calendar time: 10 days

Test hours: 100 hours

Coordination hours: 32 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. One technician or engineer trained to perform the instructions in Section 4 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 to the steering knuckle. Refer to Figure A1 (Appendix A) throughout assembly of test equipment.

4.3.2 Install the wheel hub on the steering knuckle with the specified lubricated bearings, nut, and washer.

4.3.3 Adjust the wheel bearings to nominal end play.

4.3.4 Mount the wheel on the hub. Tighten the wheel nuts to minimum torque.

4.3.5 Mount the wheel, hub, and knuckle assembly to the plate of the rotary fatigue machine using the clamping ring and studs.

4.3.6 Adjust the assembly at the studs to allow no more than 0.13 mm maximum runout of the loading shaft at the point of load application.

4.3.7 Place the load fixture with its bearing and air cylinder in its proper location and angle (as determined in 4.3.8.1) and bolt it down securely.

4.3.8 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.

4.3.8.1 If an A versus B comparison study is to be conducted, or if the vehicle hub strain levels are unknown, determine the test load using the following formulas. Refer to Figure A2 (Appendix A).

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AVA Documents
Document Sharing Hub

Vertical Load = Static Load + Lateral Load Transfer

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

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

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

Test Load Angle = θ

$$= \tan^{-1} \frac{\text{Vertical Load}}{\text{Lateral Load}}$$

Moment Arm Length = $RR / \tan \theta$

Where:

W_f = Front distribution of the GM gross vehicle weight (Newtons)

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

T_f = Front track width (millimeters)

RR = Tire rolling radius (millimeters)

G = Gravitational constant

a = Vehicle lateral acceleration

Note: Unless otherwise specified in platform specific Component Technical Specification (CTS), use $a/G = 0.7$.

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

4.3.8.2 If vehicle-derived values of strain are to be used, perform 4.3.8.2.1 thru 4.3.8.2.3.

4.3.8.2.1 Install a strain gauged wheel hub in a suitable vehicle and determine the peak hub strain levels while conducting high lateral force turns, often referred to as G turns.

4.3.8.2.2 With the strain gauged hub mounted in the test fixture, determine and record moment arm length, test load angle, and test load required to achieve strain levels not less than 75% of those determined in 4.3.8.2.1.

4.3.8.2.3 Conduct all tests for a particular hub application using the parameter values derived in 4.3.8.2.2.

4.3.9 Adjust the cutoff switch to cut off at 1.6 mm switch travel.

4.3.10 Start the machine and run to 400 000 wheel rotations or to hub failure. The rotational speed should be 350 rpm or as specified in the technical specifications.

Note: Shutdowns due to broken fasteners do not constitute a failure. If the machine shuts down due to broken fastener(s), all fasteners are replaced and the test is resumed. Each fastener may be re-torqued once during the test.

4.3.11 Failure is defined as one of the following conditions.

- 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. (The initiation of a crack is not considered a failure of the hub.)
- The loss of press fit between a bearing race and hub bore.
- An increase of 1 mm in deflection at the switch located below the loading point.

5 Data

5.1 Calculations. See 4.3.8 and Figure A2 (Appendix A) for calculation necessary for test setup. No calculations are required to report test results.

5.2 Interpretation of Results.

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