



Rotary Bending Fatigue 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 standard is to determine the rotary fatigue life characteristics of axle wheel hubs.

1.2 Applicability. This test is applicable for axle shafts.

1.3 Remarks. The requirement for every specimen is 1 000 000 cycles prior to fracture. The preferred objective is test until failure. Since the load is constantly applied to Tubular Fixture Assembly (which internally contains the axle shaft assembly), every rotation of shaft constitutes one (1) loading cycle.

2 References

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

2.1 External Standards/Specifications.

MET ASTM E1444

2.2 GM Standards/Specifications.

GMW14249

2.3 Additional References.

- CG5114 Data Sheet
- CG583 (ID)
- Component Technical Specification (CTS)
- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS)
- Validation Cross Reference Index (VCRI)

(ID) = This document is limited to internal use within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

3 Resources

3.1 Facilities. The test facility shall have a bedplate large enough for securing the test rig and capable of withstanding dynamic loading of the rig/specimen. Record instrumentation calibration details and date of calibration on CG5114 Data Sheet.

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. The following equipment pieces are all static (non-rotating) during the testing process:

- Hub Fatigue Structural Test Machine (see Appendix A, Figure A1).
- Tubular Fixture assembly.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 1 of 7

- Fixturing.
- Wheel Flange (Hub).
- Electric Motor.
- Bearing-to-spline adapter housing.

3.3 Test Vehicle/Test Piece.

3.3.1 Axle shaft(s).

3.3.2 Unless other direction is provided by the requesting engineer, a minimum of six (6) samples are to be tested at calculated load parameters.

Note: The test piece (axle shaft with hub flange) is the only rotating part during the testing process.

3.4 Test Time.

Calendar time: 7 days

Test time: 8 hours (per piece)

Coordination time: 8 hours

3.5 Test Required Information.

- CG583 ^{Note 1}.
- Component Technical Specification (CTS).
- Statement of Requirements (SOR).
- Subsystem Technical Specification (SSTS).
- Validation Cross Reference Index (VCRI).
- GMW14249.
- MET ASTM E1444.

Note 1: Obtain a copy of CG583 and begin entering information relative to the test procedure. Emphasize to Program Design Release Engineers (DRE) the importance of confirming parts, installation and test setup prior to the start of test.

3.5.1 Obtain the following vehicle parameters (constants) from SSTS or Technical Specifications:

- Gross Vehicle Weight (GVW).
- Gross Axle Weight Rating (GAWR).
- Wheelbase.
- Center of Gravity (CG) Height.
- Track Width.
- Rolling Radius.
- Wheel Offset: Rotor Flange Thickness.
- Specimen desired rotational speed.

3.5.2 See Calculation Sheet in CG5114. Record on CG5114 Acquire concurrence from Program Team DRE.

3.6 Personnel/Skills. Test Technician should be proficient in operation of the facilities listed in 3.1, as well as in proper selection and operation of the equipment listed in 3.2 and familiar with the general operation of axle assemblies.

4 Procedure

4.1 Preparation.

4.1.1 All samples shall be inspected for geometrical conformance with the appropriate specimen drawing and weld specification, if applicable. Any non-compliant specimens must be set aside and a compliant specimen must be tested in its place.

4.1.2 Inspect each sample prior to testing with magnetic penetrant equipment or equivalent.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 2 of 7

4.1.3 Check that all parts and fixtures needed are included for the mounting. Fixturing should be designed and made to mount the test specimen to the test machine.

4.1.4 Run Calculation Work Sheet to obtain the "Input Values for Test." See Appendix A, Figure A1 for pictorial description of Inputs.

4.1.5 See CG5114 Data Log for Calculation Sheet. Transfer Input Values for Test (see Appendix A, Table A1) onto CG5114 Run Table.

4.1.6 Stencil Ink (optional). Crack highlighting paint (white stencil ink) should be applied to areas of interest on the test piece. Cracks will show up as a black line. Do not use regular spray paint as it can hide cracks or show false signs of cracking.

4.1.7 Test Stand Review. The test set up and methodology must be reviewed with the GM System Validation Engineer (SVE). The GM SVE may request review by the DRE and/or the Bill of Material (BOM) Family Owner (BFO). Photographs and/or Computer Aided Design (CAD) images of the test must be provided.

4.1.7.1 On the CG583 Test Review form, complete the test set up, test method, test material, and when applicable, the test vehicle, data acquisition, vehicle and test buck that are appropriate for this test. See the supplemental checklist.

4.1.7.2 Obtain the required approval signatures as shown on CG583.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified, the typical environmental conditions for this procedure are the temperature, humidity and pressure at the test facility. Unless otherwise noted, these conditions are typically 22 °C to 25 °C, Relative Humidity (RH) of 40% to 60%, and atmospheric pressure equivalent to the local barometric pressure.

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.

4.2.2.1 Unless otherwise specified, the GM System Validation Engineer (SVE) is to approve test setup.

4.2.2.2 Take photograph or digital image of test configuration.

4.2.2.3 New test samples shall be used. For product validation testing off-tool parts are mandatory. For design validation testing prototype parts may be used.

4.2.2.4 The test sample orientation on the test bench shall be the same as within the vehicle. Any deviation needs to be approved by the GM SVE and/or the DRE.

4.2.2.5 Test shall be controlled and monitored by a computer program. Load, displacement and cycles of the specimen shall be monitored through entire test until failure.

4.2.2.6 Failure mode is to be recorded and failure location shall be identified for each test specimen. Pictures shall be taken for typical failure modes and any anomalous failures documented and photographed.

4.3 Instructions.

4.3.1 Mount axle shaft into tubular fixture assembly on the Hub Fatigue Structural Test Machine.

4.3.2 Install tubular fixture assembly to electric motor and hydraulic actuator via c-clip.

4.3.3 Fit bearing-to-spline adapter housing to end of axle shaft and tubular fixture assembly.

4.3.4 Set required RPM for electric motor.

4.3.5 Set load and loading angle for hydraulic actuator. See Appendix A, Table A1 for values.

4.3.6 Secure any necessary safety guards. Set load and displacement scales to zero.

4.3.7 Load Test Control Computer with "Input Values for Test" from CG5114.

4.3.7.1 Test parts are to be cycled to failure at a rate of 1 HZ to 3 Hz depending on part.

Note: Since the load (F_s) is constantly applied to Tubular Fixture Assembly (which internally contains the axle shaft assembly), every rotation of shaft constitutes one (1) loading cycle.

4.3.7.2 Test six (6) parts to failure. Each part must meet 1 000 000 cycles.

4.3.8 Initiate Rotary Bending test cycle on axle shaft (or next sample of axle shaft).

4.3.9 Monitor loads, counts, and application rates. Periodically note progress and add comments to Test Log.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 3 of 7