



Axle Assembly Torsional 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 test is to determine the torsional fatigue life of an axle assembly.

1.2 Applicability. This procedure is applicable to beam axles, front and rear drive modules, and power transfer units for use in passenger cars and light trucks.

1.3 Remarks. This specification subjects the axle assembly to high stresses induced due to high torque input at the pinion flange and allows for the calculation of the assembly fatigue life.

The axle assembly typically consists of the ring and pinion gears, side gears/shafts, differential gears, differential housing, and axle assembly housing.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14048

2.3 Additional References.

- CG4915 Data Sheet for Axle Assembly Torsional Fatigue Test
- Component Technical Specification (CTS)
- GM1829 Analysis/Development/Validation Plan and Report (ADVP&R)
- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS) (for Axle or Rear Drive Module)
- Validation Cross Reference Index (VCRI)

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 CG4915 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.

3.2.1 A hydraulic power system and test machine (i.e. High Angle Rotary Structural Test Machine) that is compatible with the strength of the components being tested. Since the test will be carried out using load control

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mode, the testing machine must have a servo-hydraulic load-monitoring system mounted in series with specimen. The load and displacement must be monitored continuously until the failure occurs.

3.2.2 A low speed rotatory actuator is required to run this test. The actuator must be capable of operating at speeds less than or equal to 0.3 rpm and generating sufficient torque to fracture an axle. Speed must be controlled to within 0.05 rpm.

3.2.3 Torque meters must be used in line with the rotary actuator to record torque and have sufficient capacity for the torque expected to fracture the test axle. A device such as a tone wheel should be used to record speed and displacement.

3.3 Test Vehicle/Test Piece.

3.3.1 Unless otherwise specified by the DE or the applicable Subsystem Technical Specification (SSTS), the test shall consist of (9) total samples:

- Three (3) samples for calculated 100% loads (Axle Torque Capacity (ATC)) confirmation.
- Three (3) samples for calculated 80% loads testing.
- Three (3) samples for calculated 120% loads testing.

3.3.2 All test material to be dimensionally certified prior to receipt in order to confirm that it is representative of design intent.

3.3.3 All samples must be magnetic particle (or dye penetrant in the case of aluminum) inspected prior to conducting the test. If any cracks or indications are found, notify the Design Responsible Engineer.

3.3.4 Sample Preparation. Test samples must be built per the processes outlined in 3.3.4.1 through 3.3.4.4. Inspections are to be performed and recorded during the build process. Record all results on table titled Pretest Inspection Results in CG4915.

Note: Confirm need for inspection requirements with Requesting Engineer and/or Design Release Engineer (DRE).

3.3.4.1 Adjust side bearing preload (drag torque) to mean specification. Record results on table titled Pretest Inspection Results in CG4915.

3.3.4.2 Adjust ring gear backlash to mean specification. Record results on table titled Pretest Inspection Results in CG4915.

3.3.4.3 Adjust drive gear-set contact pattern to nominal pattern at production test load or equivalent pattern at no load. Take photos of contact patterns for each unit or record on table titled Contact Pattern in CG4915.

3.3.4.4 Conduct leak check or verify leak check was conducted on each axle assembly during the assembly process. Record results on table titled Leak Check in CG4915.

3.3.5 The test axle/Rear Drive Module (RDM) must be equipped with a means of monitoring and recording oil sump temperature.

3.3.5.1 Install a thermocouple to the lower sump drain plug (see Appendix A, Figure A2).

3.4 Test Time.

Calendar time:	21 days
Test time:	170 hours (each piece)
Coordination time:	8 hours

3.5 Test Required Information. Possible sources are:

- Component Technical Specification (CTS).
- GM1829 Analysis/Development/Validation Plan and Report (ADVP&R).
- Statement of Requirements (SOR).
- Subsystem Technical Specification (SSTS).
- Validation Cross Reference Index (VCRI).

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3.5.1 Obtain the following information from the SSTS and/or Project Office:

- Part Name.
- Program Name.
- Part Number.
- Development Status.
- Revision Number.
- VPP/VIA/UPC.
- Axle Type.
- Model Number.
- Drawing Number.
- Model Year.
- Date of Manufacture.
- Model Name.
- Design Level.
- Ratio (Ring/Pinion).
- Shaft Type Pinion Inclination Angle.
- Ring Gear Size.

Note: Record on CG4915 Data Sheet.

3.5.2 Obtain ATC requirements from GM Computer Aided Engineering (CAE) (or Program Lead DRE) per virtual Road Load Acquisition (vRLDA), actual Road Load Data Acquisition (RLDA) or CTS/SSTS. Acquire concurrence from Program Team DRE. If ATC is not readily available from Technical Specifications, the default is to select ATC from the ATC Table in CG4915. Acquire concurrence from Program Team DRE. Record on CG4915 Data Sheet: Calculation Worksheet.

Note: General Motors (and in certain cases, the supplier) will perform RLDA on the appropriate vehicle durability test and/or vehicle abuse test in order to acquire pertinent torsional loads.

3.5.3 Input torques are to be calculated by the test engineer (see CG4915: Calculation Worksheet).

- Input torque = %ATC/Gear Ratio × Gear Efficiency

Note: If the load is measured at the pinion input, use an axle efficiency factor of 95%. This efficiency value is an approximated figure. If an efficiency curve is available from the test axle, select the appropriate value from the curve.

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. Fixturing should be designed and made to mount the test specimen to a bedplate. The axle outputs must be held stationary with fixturing. An input adapter must be fabricated to connect the pinion flange to the input actuator. See Appendix A, Figure A1 for example setup.

Note: Load to be applied through interfaces simulating vehicle attachment. Load points may have to be adjusted if the loads calculated are too great (beyond the capability of the equipment). Acquire concurrence from Program Team DRE and System Validation Engineer (SVE).

Note: Unless approved by the DRE, test samples that complete this test are not to be reused for other testing due to the accrued damage that may be introduced in the parts.

4.1.1 Verify that all ring gear bolts and pan cover bolts have been indexed with hard scribe marks (not paint). All other bolts can be indexed with paint, unless they are exposed to axle lube.

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