



Differential Gear 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. To determine rotary fatigue life of differential gears for front and rear axles.

1.2 Applicability. Passenger cars, Multipurpose Passenger Vehicles (MPV) and light duty trucks having a Gross Vehicle Mass Rating (GVMR) of 4536 kg or less.

1.3 Remarks. This specification describes how temperature, load and rotary speeds are controlled on front and rear axle differential gear sets to obtain their comparative laboratory fatigue life.

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 Test Specification (CTS)
- 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 valid International Organization for Standardization (ISO) certificate which is noted in the test report.

A bedplate large enough for securing the test rig and capable of withstanding dynamic loading of the rig/specimen is required.

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 Power source capable of delivering required pinion torque at required speed.

3.2.2 Two energy absorption devices capable of absorbing the output of the input source and regulating the output speed.

3.2.3 Fixtures, reaction members and adapters to mount test axle at the vehicle mount points.

3.2.4 External recirculating oil pump and cooler with adequate capacity to maintain the axle sump temperature at $82\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($180\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$).

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3.2.5 Instrumentation and related control equipment.

3.2.5.1 Maintain input load within 0.5%.

3.2.5.2 Maintain ring gear speed within 0.5%.

3.2.5.3 Temperature measuring device in sump with resolution 1 °C.

3.2.5.4 Vibration monitoring or similar device connected with drive and absorption device controls to provide automatic shutdown at failure.

3.2.5.5 Counters and timer to record both left and right differential side gear cycles and time at test conditions.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Material. Test sample size to be determined by test engineer. Six (6) differential case assemblies are suggested.

3.4 Test Time.

Calendar time: 10 days

Test hours: 8 hours (each piece)

Coordination hours: 8 hours

3.5 Test Required Information. Possible sources are:

- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS)
- Validation Cross Reference Index (VCRI)

3.6 Personnel/Skills. Test Technician. Should be proficient in proper selection and operation of the equipment listed in 3.2.

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 be tested in its place.

4.1.2 Check that all parts and fixtures needed are included for the mounting.

4.1.3 Paint critical areas with an appropriate color (e.g., white) to make it easier to find cracks.

4.1.4 Test Stand Review. The test setup and methodology must be reviewed with the GM System Validation Engineer (SVE). The GM SVE may request review by the Design Release Engineer (DRE) and/or the Bill of Material Family Owner (BFO). Photographs and/or computer aided design images of the test must be provided.

4.1.5 The following inspections must be performed and recorded for each differential assembly being tested. Reference Table A1, Appendix A.

- a. Ring gear backlash.
- b. Differential backlash.
- c. Drag torque of assembly.
- d. Check ring gear no-load drive and no load coast patterns and photograph.

4.1.6 Install axle/differential assembly on test stand.

4.1.7 Set temperature control system to maintain $80\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($176\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$) sump temperature.

4.1.8 Determine the test load, if no load is given by the requesting engineer use 80% of the axle test capacity.

4.1.9 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 this curve.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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