Pinion Stem 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 a front/rear drive pinion.

1.2 Applicability. This specification is applicable for front and rear pinions.

1.3 Remarks. This specification subjects the pinion stem to high stresses induced due to high torque input at the flange and allows for the calculation of pinion 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 Technical 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.

Test facility with equipment capable of applying and monitoring a high torque load on drive pinions.

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 Axle dynamometer or other suitable loading device capable of delivering the required pinion torque and absorbing the required output torque at the required speeds. The test equipment shall be capable of accurately applying the loading conditions described in this document. The equipment must be able to apply these inputs at vehicle-specific levels (forces, etc.) and frequencies specified separately by the SSTS or the test requestor. All measurement equipment must be capable of accurately making the measurements specified.

3.2.2 Fixtures, reaction members and adapters to mount the pinion stem.

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3.2.3 Vibration monitoring device to provide automatic shutdown if failure occurs.

3.2.4 Counter to record pinion gear cycles.

3.3 Test Vehicle/Test Piece. Unless other direction is provided by the requesting engineer, a minimum of six (6) samples are to be tested at each torque load.

3.4 Test Time. (Based on 250 000 cycles for each of two (2) loading cycles: T_1 and T_2.)

Calendar time:	54 days
Test hours:	210 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. Inspect each sample prior to testing with magnetic penetrant equipment or equivalent.

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.

4.2 Conditions. Pinion spline end is to be fitted to a mating flange/yoke and connected to the drive end of rotary actuator or other equipment capable of required torsional loading. Pinion head should be squared off to allow it to be rigidly fixed to the machine. The overall height and width of the squared pinion head must be larger than the adjacent pinion diameter. The modification of the pinion for fixturing must not impact the strength of the test part.

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. Pinions are to be tested at two (2) torsional loads:

- T_1 = Torque Requested (typically 120% of full axle torque capacity, unless otherwise determined by the requesting engineer)
- $T_2 = 0.8 \times T_1$

Test parts are to be cycled to failure at a rate of 40 cycles/minute.

4.3.1 Unless otherwise specified, the GM SVE is to approve test setup.

4.3.2 Take photograph or digital image of test configuration.

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

4.3.4 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.

4.3.5 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.

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