



Gear Tooth Pattern Measurement (Unloaded)

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 specify the procedure of measuring the gear tooth contact pattern for ring and pinion gear sets in an unloaded condition.

1.2 Applicability. This procedure is applicable to components mounted in a bench level test fixture. This specification applies to passenger cars and light trucks.

1.3 Remarks. The ring and pinion tooth contact pattern are used to double check ring and pinion gear alignment and provide direction on making adjustments.

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.

- CG5115 Data Table
- CG583 Development/Validation Test and Vehicle Review Form (ID)
- Component Technical Specification (CTS)
- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS) (for front or rear axle, Transfer Case, PTU, RDM, FDU)
- Validation Cross Reference Index (VCRI)

(ID) = This website/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.

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 holding fixture to accurately and securely position the Device Under Test (DUT). The fixture must position the assembly horizontally.

3.2.2 Suitable device to add drag to the output shafts during the contact measurement process.

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December 2017

Page 1 of 7

3.2.3 Gear marking compound (e.g., red lead, white grease, hydrated ferric oxide (yellow oxide or iron), or other suitable gear marking compound).

3.2.4 Application brush.

3.2.5 Drive socket with spline that matches pinion shaft spline.

3.3 Test Vehicle/Test Piece.

3.3.1 The test piece shall consist of a complete assembly as would be installed on a production vehicle.

Note: Differential cover needs to be removed for measurement process.

3.4 Test Time.

Calendar time: 0.5 days

Test time: 2 hours

Coordination time: 2 hours

3.5 Test Required Information.

- CG583 Development/Validation Test and Vehicle Review Form.
- Component Technical Specification (CTS).
- Statement of Requirements (SOR).
- Subsystem Technical Specification (SSTS) (for front or rear axle, Transfer Case, Power Transfer Unit (PTU) Rear Drive Module (RDM), Front Drive Unit (FDU)).
- Validation Cross Reference Index (VCRI).

3.5.1 Obtain 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 set up prior to the start of test.

3.5.2 DUT that complies with backlash specifications.

3.6 Personnel/Skills. Test Technician should be proficient in operation of the facilities listed in 3.1, proper selection and operation of the equipment listed in 3.2, and familiar with gear tooth profiles and how they interact during rotational contact conditions. See Appendix C, Figure C1 and CG5115.

4 Procedure

4.1 Preparation.

4.1.1 Remove differential case cover if installed.

4.1.2 Mark the differential case using a paint stick with the numbers one (1) through four (4) in equally spaced quadrants.

4.1.3 Apply a thin even coat of gear marking compound on four (4) to five (5) gear teeth (heel to toe; root to top of tooth; drive and coast side) in each of the four (4) segments around the ring gear. See Appendix A, Figure A1 and CG5115 Data Sheet.

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 Contact Pattern Measurement.

4.3.1.1 Install assembly in holding fixture.

4.3.1.2 Lock both output shafts from rotation.

4.3.1.3 While applying hand force drag on the output shafts, rotate the input (pinion) shaft in the Drive direction by a sufficient amount of rotations.

Note: Full hunting rotation requires the pinion to rotate revolutions that are equal to the ring gear tooth count so that the complete contact pattern impression is formed around the ring gear.

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December 2017

Page 2 of 7

Note: In order to achieve full hunting rotation, it is required to:

- rotate the ring gear according to the number of teeth on the pinion (i.e., assuming a 12 tooth pinion, rotate any ring gear 12 times); or.
- rotate the pinion according to the number of teeth on the ring gear (i.e., assuming a 41 tooth ring gear, rotate any pinion 41 times).

4.3.2 Observe the mesh pattern in the compound on the ring gear teeth. Verify legible contact pattern results have been obtained. See Appendix B, Figure B1 and CG5115 Data Sheet.

4.3.3 Document gear pattern with photos of each quadrant, on the drive side.

4.3.4 Rotate the input (pinion shaft) in the Coast direction, as done in the Drive direction above.

4.3.5 Document gear pattern with photos of each quadrant, on the coast side.

4.3.6 Reinstall differential case cover.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results.

5.2.1 Notify requesting engineer of results.

5.2.2 Determine if pattern is acceptable or if adjustments (shimming) is required by consulting the Requesting Engineer.

Note: See CG5115 for potential solutions if Gear Mesh Patterns are not suitable.

5.3 Test Documentation.

5.3.1 Test Piece Description. Part name and number, development status, date of manufacture, drawing number, drawing revision, drawing date and photograph.

5.3.2 Test Description. Description of test bench with photograph, brief description of testing machine, description of used test set up, calibration of testing equipment, certificate of test facility.

5.3.3 Documentation of Individual Results. Reporting should consist of pictures and graphs of the transient events, the test conditions and all recorded data.

5.3.3.1 Record the following:

- Observation notes. Evaluation of results (Okay (OK), Not OK (NOK)).
- Photos of contact pattern results. See Appendix B, Figure B1 for photo criteria.
- Record photos in CG5115 Data Log.
- Comparison of results with the specifications in the SSTS/CTS/part drawing.
- Photographs of the resulting contact pattern shall be included.

5.3.3.2 A report specifying all relevant results along with how the results were generated, including complete identification of test item, test material, test component, conditions, report observations, and any deviations used to run test should be written.

5.3.4 Acceptance Criteria.

5.3.4.1 Refer to Requesting Engineer evaluation and approval.

5.3.4.2 See SSTS/CTS/part drawing requirements.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

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December 2017

Page 3 of 7