



Gear Tooth Pattern Measurement (Loaded)

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 various loaded conditions.

1.2 Applicability. This procedure is applicable to components mounted in a dynamometer. This specification applies to passenger cars and light trucks.

1.3 Remarks. The ring and pinion tooth contact pattern is 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.

- CG5113 Data Sheet
- 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, Power Transfer Case (PTU), Rear Drive Module (RDM), Front Drive Unit (FDU))
- Validation Cross Reference Index (VCRI)

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.

3.1.3 This test requires a lab/test cell for component testing.

3.1.3.1 The lab must be equipped with a dynamometer (power source) capable of delivering required pinion torque (within 1.0% of target) under varying speed conditions (± 5 rpm).

3.1.3.2 Two (2) energy absorption devices capable of absorbing the output of the input source and regulating the output speed (± 5 rpm) under the varying conditions of this procedure.

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3.1.3.3 Control equipment capable of accelerating and decelerating one (1) axle shaft on a linear function from base speed to test speed (± 5 rpm), while maintaining constant speed conditions on the opposite shaft and constant load on the input.

3.2 Equipment.

3.2.1 Fixtures, reaction members and adapters to mount the Device Under Test (DUT).

3.2.2 Input adapter (provide for connection to dynamometer and sealing of input flange).

3.2.3 Two (2) output adapters (provided for connection to dynamometer and sealing of output shafts (i.e., dummy joints)).

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

3.2.5 Application brush.

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. Possible sources are:

- 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 Obtain appropriate 100% Torsional Axle Capacity (derived from the duty cycle) for the testing requirements from the Technical Specifications. If this value is not readily available from Technical Specifications, obtain the value from a consensus of the DRE and Driveline Computer Aided Engineering (CAE) Group (UA625).

3.5.3 Enter the appropriate 100% "Torsional Axle Capacity" value into the applicable box of the Test Run Table found in CG5113, tab "Test Run sequence". The Test Run table will automatically populate the torque requirements for each step of the test process. See Appendix D, Data Sheet D1 for example of Test Run Table.

3.5.4 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 CG5113.

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.

Note: Gear marking compound will be applied after the DUT is installed in the dynamometer test cell.

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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 Install DUT in dynamometer test cell mounted on a test stand that consists of an electric motor input and two (2) electric motors at the outputs.

4.3.2 Connect torque cells and speed sensors at each input/output interface.

4.3.3 Spin up axle to target speed then apply torque.

4.3.3.1 Run DUT at 10 rpm and apply torque, per Step 1 of Test Run Table See CG5113 Data Sheet, Test Run Table.

4.3.4 When full torque is reached, apply rouge to rotating ring gear to the proper location of the teeth (dependent on coast or drive).

4.3.5 While holding torque on ring gear, stop ring gear at each quadrant and apply gear marking compound to side of teeth being measured.

Note: 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; only on side being measured) in each of the four (4) segments around the ring gear. See Appendix A, Figure A1 and CG5113 Data Sheet.

4.3.6 Once rouge has been applied, begin a 3-minute timer holding the specified torque and speed. Run for 3 minutes at torque specified in Step 1 of Run Table (0.74% of test load capacity). See CG5113 Data Sheet, Test Run Table.

4.3.7 At 3 minutes, adjust speed to zero, but leave torque at test set point. Stop ring gear rotation, while holding torque. Spin ring gear opposite of dyno rotation (to not smear rouge). Reverse rotation of ring gear stopping at each quadrant to expose contact pattern.

4.3.8 Observe the mesh pattern in the compound on the ring gear teeth. Verify legible contact pattern results have been obtained.

4.3.9 Photograph gear pattern at each quadrant that was previously marked. Document gear pattern with photos of each quadrant on both the drive side and the coast side. See Appendix B: Figure B1 and CG5113 Data Sheet.

4.3.10 Repeat process for each step on the speed and torque chart.

4.3.11 Repeat 4.3.4 thru 4.3.9 for each step of Run Table (for total of 17 steps). See CG5113 Data Sheet, Test Run Table.

4.3.12 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 adjustment (shimming) is required by consulting the Requesting Engineer. See CG5113 Gear Meshing Patterns Chart 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.

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