



Axle Cold Start (Green Axle/Rear Drive Module (RDM)/ Front Drive Unit (FDU))

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. Evaluate temperature characteristics of Axle/Rear Drive Module (RDM)/Front Drive Unit (FDU) lube, pinion bearings, and their environment to assure that their lubrication is suitable for low temperature, high speed operation.

1.2 Applicability. This procedure applies to drive Axles/RDMs/FDUs in passenger cars and trucks.

1.3 Remarks.

1.3.1 This test procedure may be run at various temperatures and lube types for development purposes.

1.3.2 A break-in run on the test unit is not necessary or desired for this test.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

9986290

2.3 Additional References.

- CG4656: Data Sheet for Axle Cold Start (Green Axle/RDM/FDU) Test
- Component Technical Specification (CTS)
- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS) (for Axle or Rear Drive Module or Front Drive Unit)
- Validation Cross Reference Index (VCRI)

3 Resources

3.1 Facilities. A cold room facility capable of -30 °C, or a cold box enclosure on the test bed capable of cooling the test unit to the required starting temperature.

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 dynamometer (power source) with a means of applying the required input speed (rpm) (within 1.0%), or suitable drive mechanism to run Axle/RDM/FDU pinion to 3000 rpm and delivering required pinion torque (within 1.0% of target) under varying speed conditions.

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3.2.2 Two (2) energy absorption devices capable of absorbing the output of the input source and regulating the output speed within 1.0% under the varying conditions of this procedure (reference Appendix A, Figure A1).

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

3.2.4 Vibration monitor, or similar device, connected with drive absorption device controls to provide automatic shutdown in the event of failure of either test parts or equipment.

Note: Preferred method of detecting part problems is to use a delta analyzer for early warning.

3.2.5 Counters and timer to record time at test conditions.

3.2.6 Fixtures, reaction members and adapters to mount the Axle/RDM.

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

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

3.2.9 Cold box surround (Appendix A, Figure A2).

3.2.10 Temperature monitoring in sump with resolution within 1 °C (2 °F) (Appendix B, Figure B1).

3.2.11 Inclinator to measure pinion angle.

3.2.12 Thermocouples and temperature monitoring equipment (temperature vs. time).

3.2.13 Tachometer or counter to measure pinion speed (rpm).

3.3 Test Vehicle/Test Piece.

3.3.1 Axle/RDM/FDU final drive assembly (housing modified for thermocouples).

3.3.2 Additional set of pinion bearings.

3.4 Test Time.

Calendar time: 2 days

Test hours: 8 hours

Coordination hours: 4 hours

Note: Test times are estimated for validation testing only.

Note: Development tests may have a longer or shorter duration depending on the number of tests desired.

3.5 Test Required Information.

3.5.1 Possible sources are:

- Component Technical Specification (CTS).
- Statement of Requirements (SOR).
- Subsystem Technical Specification (SSTS) (for Axle, RDM, or FDU).
- Validation Cross Reference Index (VCRI).

3.5.2 Ascertain the following requirements from the appropriate sources and record on Data Sheet CG4656.

3.5.2.1 Pinion bearing preload (Newton·meters (foot pounds·inches)).

3.5.2.2 Torques for fill and drain plugs (Newton·meters (foot pounds·inches)).

3.5.2.3 Pinion angle as defined in SSTS (degrees).

3.5.2.4 Gear oil amount and type (Example: 0.7 L of 9986290, which is 75W90 synthetic gear oil with a friction modifier).

3.6 Personnel/Skills. Test technician should be proficient in operation of the facilities listed in 3.1, as well as the proper selection and operation of the equipment listed in 3.2. Test technician should also be familiar with the general operation of Axle/RDM/FDUs.

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4 Procedure

4.1 Preparation.

4.1.1 Install thermocouples in the Axle/RDM/FDU housing pinion bearing pockets and Axle/RDM/FDU housing sump.

4.1.1.1 Prepare the housing bearing pockets for thermocouples by drilling into the pockets so that the thermocouple can be routed out of the housing.

4.1.1.2 Stake and cement the thermocouple tip into the bearing pocket, while routing the lead out of the housing.

4.1.1.3 Dress the bearing pocket so that no material from the thermocouple intrudes into the area where the bearing outer race will run.

4.1.1.4 Seal the thermocouple exit hole.

4.1.1.5 Prepare a drain plug with a thermocouple for measuring Axle/RDM/FDU sump temperature.

4.1.2 Set pinion bearing preload torque to maximum print specifications.

4.1.3 Measure total Axle/RDM/FDU assembly torque at start of test. Record on CG4656 Data Log.

4.1.4 Fill Axle/RDM/FDU with specified part number, type, and quantity of lubricant when set at design pinion angle (chassis layout design position). Use amount of lube specified in design specifications.

4.1.5 Collect a pretest fluid sample.

4.2 Conditions.

4.2.1 Environmental Conditions. This test can be run in any ambient temperature as long as the Axle/RDM/FDU is able to soak at the desired cold temperature.

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 Place the final drive assembly in the cold room.

4.3.1.1 Connect Axle/RDM/FDU Assembly (ASM) to dynamometer drives at each input/output interface.

4.3.1.2 Connect pinion bearing thermocouples.

4.3.1.3 Connect thermocouple from the lower sump drain plug.

4.3.1.4 Monitor the pinion bearing temps and the Axle/RDM/FDU sump temperature at 10 Hz sample rate.

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

4.3.3 Run axle cold start test.

4.3.3.1 Soak at the required temperature for 12 h with the pinion angle set at design specifications.

4.3.3.2 At the end of the soak, set the Axle/RDM/FDU to the design pinion angle.

4.3.3.3 Monitor the pinion bearing temps and the Axle/RDM/FDU sump temperature. Record at 10 Hz sample rate.

4.3.3.4 Run the pinion up to 3000 rpm (no load) as quickly as possible. Hold until the bearing temperature stabilizes.

4.3.3.5 Measure the time required to reach bearing stabilization temperature. Record on CG4656 Data Log.

4.3.3.6 Measure the Axle/RDM/FDU sump temperature. Record on CG4656 Data Log.

4.3.3.7 Repeat 4.3.3 to achieve a minimum of two (2) runs.

4.3.4 Repeat 4.3.1 through 4.3.3 for each lube type and each temperature bogey to be tested.

4.3.5 Remove Axle/RDM/FDU from test cell to disassembly area and perform teardown for inspection.

4.3.5.1 Measure bearing preload (posttest). Record on CG4656 Data Sheet.

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