



Axle Assembly Torsional Impact Abuse 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 evaluate the torsional impact abuse capability of axle systems and their associated subcomponents when subjected to an impact load condition.

1.2 Applicability. Test is applicable for front and rear axles used in light trucks and passenger vehicles.

1.3 Remarks. 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.

None

2.3 Additional References.

- CG4655
- Component Technical Specification (CTS)
- GM1829 Analysis/Development/Validation/Plan & Report (ADVP&R)
- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS) (for Axle/Rear Drive Module (RDM))
- 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 Requires 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 energy absorption devices capable of absorbing the output of the input source and regulating the output speed (± 5 rpm). See Appendix A, Figure A1 and Figure A2.

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) at the ramp up rate specified in the Subsystem Technical Specification (SSTS) (typically on the order of $> 50\,000\text{ N}\cdot\text{m/s}$).

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3.2 Equipment.

3.2.1 Fixtures, reaction members and adapters to mount the axle/RDM.

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

3.2.3 Output adapters (two (2) required) (provide for connection to dynamometer and sealing of output shafts; i.e., dummy joints).

3.2.4 Temperature monitoring in sump with resolution within 1 °C (2 °F).

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

Remarks: Preferred method of detecting imminent parts problem is to use a delta analyzer for early warning.

3.3 Test Vehicle/Test Piece.

3.3.1 Test sample size to be determined by requesting engineer (or performance engineer or validation engineer).

Record on CG4655 Data Sheet for Axle Torsional Impact Abuse Test External Supplement to GMW17705.

Note: Typically, a quantity of three (3) or more axles should be evaluated.

Note: This test does not require brake assemblies.

3.3.2 For rear axle applications, the test axle/RDM should be of the lowest numerical axle/RDM ratio available for that model in order to test the worst case condition for impact load.

3.3.3 For front axle applications, the test axle/RDM should be all of the available ratios available for that model.

Note: Confirm axle ratio requirement with requesting engineer and/or Design Responsible Engineer (DRE).

3.3.4 All samples must be **magnetic** particle (or dye penetrant in the case of aluminum) inspected prior to conducting the test. If any cracks or indications are found, notify the DRE.

3.3.5 Sample Preparation. Test samples must be built per the processes in 3.3.5.1 through 3.3.5.6. Inspections are to be performed and recorded during the build process. Record all results on table titled Pre-Test Inspection Results in CG4655.

Note: Confirm need for inspection requirements with requesting engineer and/or DRE.

3.3.5.1 Inspect and thoroughly clean all axle/RDM components with a suitable solvent to insure no chips or foreign materials are present in the assembly.

3.3.5.2 Lubricate with the test lubricant and assemble the following components in the differential case:

- Side gears and thrust washers.
- Pinions and thrust washers.
- Cross shaft and pin.

3.3.5.3 Install differential side bearings and differential case assembly into axle/RDM.

3.3.5.4 Adjust side bearing preload (drag torque) to mean specification. Record results on table titled Pre-Test Inspection Results in CG4655.

3.3.5.5 Adjust ring gear backlash to mean specification. Record results on table titled Pre-Test Inspection Results in CG4655.

3.3.5.6 Adjust drive gear set contact pattern to nominal pattern at production test load or equivalent pattern at no load and record results on Table titled Pre-Test Inspection Results. Take photographs of contact patterns for each unit or record on table titled Contact Pattern in CG4655.

3.3.6 The test axle/RDM must be equipped with a means of monitoring and recording oil sump temperature.

3.3.6.1 Install a thermocouple in the lower sump drain plug. See Appendix A, Figure A3 Sump Temperature via Drain Plug.

3.4 Test Time. Per one (1) sample.

Calendar time: 2 days

Test hours: 3 hours to 5 hours

Coordination hours: 4 hours

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3.5 Test Required Information. Possible sources are:

- Statement of Requirements (SOR).
- Subsystem Technical Specification (SSTS).
- GM1829 Analysis/Development/Validation Plan and Report (ADVP&R)
- Validation Cross Reference Index (VCRI)

3.5.1 Type of axle being tested (i.e., front or rear). Record on CG4655.

3.5.2 Gear ratio(s) of axle(s) being tested. Record on CG4655.

3.5.3 Axle/RDM allowable oil temperature range. Record on CG4655.

3.5.4 Pinion inclination angle of axle being tested. Record on CG4655.

3.5.5 Obtain appropriate values for axle abuse/impact torque requirements (or Axle Torque Capacity (ATC)) from SSTS. Acquire concurrence for impact requirements from Program Team DRE. Requirements are listed in 3.5.5.1 through 3.5.5.7.

Note: If ATC is not available from SSTS, select ATC from table titled Axle Torque Capacity Table in CG4655.

3.5.5.1 Peak Pinion Forward Impact Load.

3.5.5.2 Peak Pinion Reverse Impact Load.

3.5.5.3 Ramp Rate.

3.5.5.4 Total Forward Cycles Required.

3.5.5.5 Total Reverse Cycles Required.

3.5.5.6 Forward Cycle Block Count. Typical block counts are 15, 30, or 45 repeats before proceeding to the Reverse Cycle counts.

3.5.5.7 Reverse Cycle Block Count. Typical block counts are 15, 30, or 45 repeats before proceeding to the Forward Cycle counts.

3.5.6 Apply impact loads in cycle blocks counts of Forward gear, then Reverse gear. See test requestor for cycle block counts.

3.5.7 Repeat cycle block counts until the full cycle count requirement has been accomplished. Reference Table 1 for test requirement values. Record Table 1 information on CG4655 Data Sheet.

Table 1: Test Requirement Values ^{Note 1}

Requirement Number	Requirement Description	SSTS Requirement	Operator	Test Requirement Value
3.5.5.1	Peak Pinion Forward Impact Load	_____ % ATC ^{Note 2}	=	_____ N·m
3.5.5.2	Peak Pinion Reverse Impact Load	_____ % ATC ^{Note 2}	=	_____ N·m
3.5.5.3	Ramp Rate	SSTS	≥	_____ N·m/s
3.5.5.4	Total Forward Cycles required	SSTS	=	_____ Cycles
3.5.5.5	Total Reverse Cycles required	SSTS	=	_____ Cycles
3.5.5.6	Forward Cycle Block count		=	_____ Counts
3.5.5.7	Reverse Cycle Block count		=	_____ Counts

Note 1: For testing purposes, the forward direction for a rear axle is equivalent to the reverse direction for a front axle, just as the reverse direction for a rear axle is analogous to the forward direction for a front axle.

Note 2: Typical Impact Load values can be 200% of ATC (two (2) times the ATC value) or 150% of ATC (one and a half (1.5) times the ATC value).

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