



Park Subsystem Abuse

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 determine durability of automatic transmission park mechanism and actuating system. The test may be targeted for a specific vehicle application or may be structured to encompass several applications in worst case loading to the test.

1.2 Applicability. Passenger cars and trucks of 6577 kg (14 500 lb) Gross Vehicle Weight Rating (GVWR) or less with automatic transmissions that do not have Electronic Transmission Range Select (ETRS).

1.3 Remarks. The test is compliant with external distribution process per CG4941. This test subjects a vehicle's automatic transmission parking pawl to the following dynamic durability conditions:

- a. Vehicle retention on grades in Park.
- b. Park engagements with test vehicle in motion.
- c. Vehicle-to-vehicle impact, with test vehicle in Park.

1.3.1 This test procedure is categorized as: Road, Global Propulsion Systems – Park Product Development Team (PDT), Transmission.

2 References

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

2.1 External Standards/Specifications.

SAE J972

2.2 GM Standards/Specifications.

GMW15474 (ID)

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

2.3 Additional References.

(ID) = This document is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

- CG4540 (ID)
- CG4941
- Global Document Management (GDM) System, (<https://documents.gm.com/gdm3/component/main>)

3 Resources

3.1 Facilities. Road test surface with 0% (level grade), 11.6% grade, 23% grade to 27% grade, and 30% grade, and a laboratory with magnetic particle inspection test capabilities.

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.

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3.2 Equipment.

3.2.1 Ballast, force gage, torque wrench, and road speed indicating device. Record calibration information on Data Sheet A1, Appendix A.

3.2.2 Impacting Vehicle. An impact vehicle with a plate welded to the frame may be used with a total mass of 1900 kg (4190 lb) minimum and so documented on Data Sheet A3, Appendix A. Alternatively, a moving barrier as depicted in Figure 1, and having the characteristics in 3.2.2.1 thru 3.2.2.3 may be used:

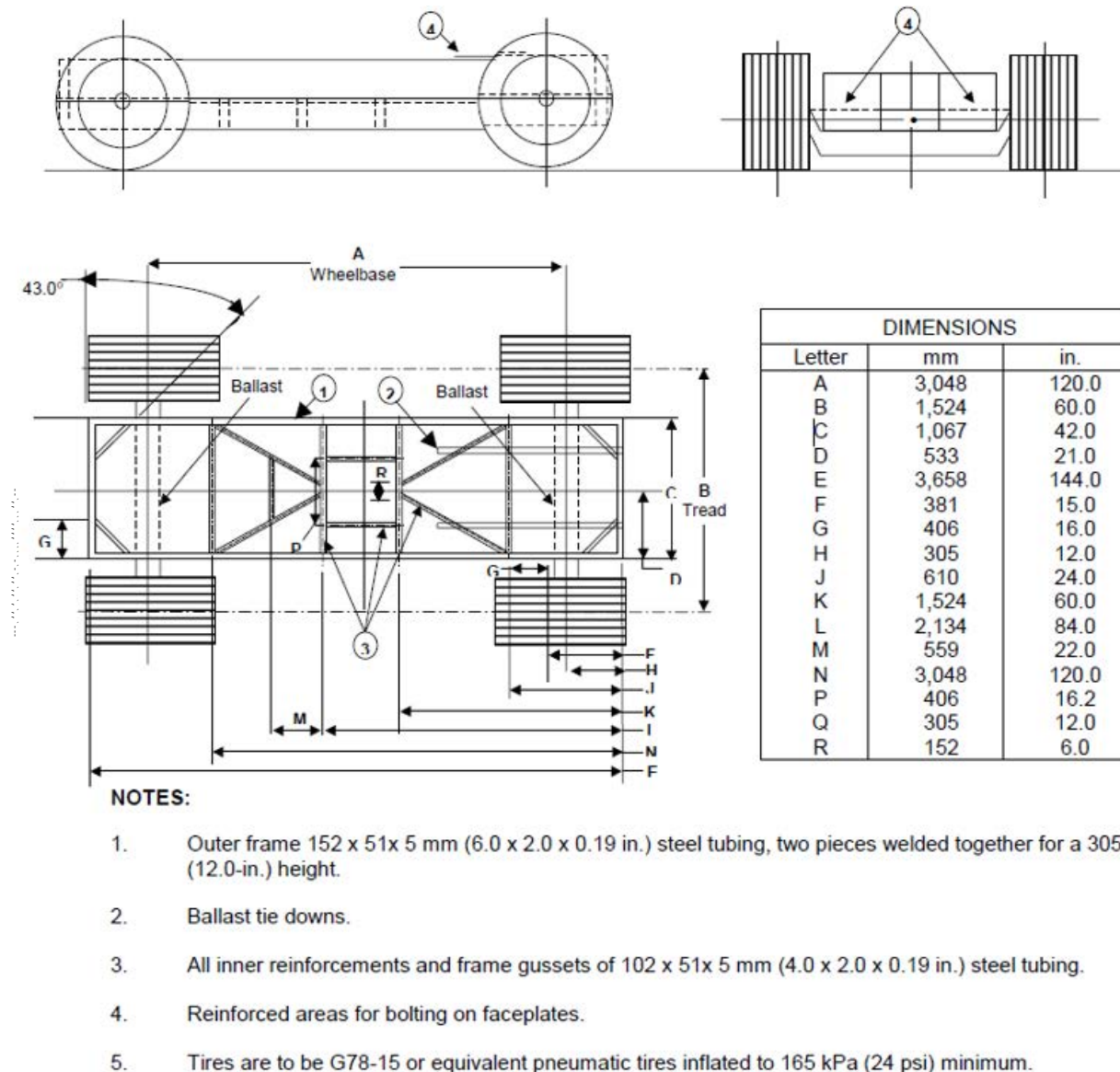


Figure 1: Impacting Vehicle

3.2.2.1 The weight of the moving barrier, including the impact surface, supporting structure and carriage is to be between 1814 kg (4000 lb) and 1851 kg (4080 lb).

3.2.2.2 The impact surface of the barrier is to be a vertical rigid, flat rectangle 1981 mm wide x 1524 mm high (78 in wide x 60 in high), perpendicular to its direction of movement with its lower edge horizontal and 127 mm (5 in) above the ground surface.

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3.2.2.3 During the entire impact sequence, the barrier shall undergo no significant amount of dynamic or static deformation and shall absorb no significant portion of the energy resulting from the impact, except for energy that results in translation rebound movement of the barrier.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Vehicle. Vehicle must be selected to enable the highest dynamic loading based on axle ratio, tire size, and Gross Vehicle Weight (GVW) as determined from applications analysis. This could be the greatest Gross Vehicle Mass Rating (GVMR) ballasted to Gross Axle Mass Rating (GAMR) of its driving axle(s), and with the highest transmission output shaft dynamic over run torque for the desired engine/transmission combination. The highest dynamic overrun torque will be produced by a test vehicle, which incorporates these aspects of the vehicle line model type represented:

- a. Highest traction tires.
- b. Least resilient powertrain and suspension mountings.
- c. Lowest overall speed ratio between the engine and the drive wheels (N/V) (largest rolling radius tires, lowest numerical ratio final drive).
- d. Four-wheel drive vehicles to be run with transfer case in four (4) HIGH.

3.3.2 Test Materials/Components. Transmission with parking mechanism and actuating system to be tested.

3.3.3 Development Testing (Optional). If the test is conducted as a development activity or for "envelope" testing, additional test mass can be added to simulate conditions for the worst case future application. Vehicle, modifications, and test mass are to be included in the test report. Perform all of 4.3, but performing the test in the sequence of the sections is not required. Any deviation in the procedure shall be documented in the test request.

3.4 Test Time.

Calendar time: 2 days to 3 days

Test time: 14 h to 16 h

Coordination time: 8 h to 10 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Technical ability as needed to run instrumentation, complete test setup, and execute test.

4 Procedure

4.1 Preparation.

4.1.1 Design Release Engineer (DRE)/Technical Specialist to perform dynamic load calculation to determine the required tire size/GVW for worst loading for all related applications. Record the vehicle/transmission information for the vehicle application or envelope testing with required tire wheel size, Static Loaded Radius (SLR), at the top of Data Sheet A1, Appendix A. Determine the needed ballast conditions by filling out Data Sheet A1, Appendix A. Record the vehicle/transmission information indicated at the top of Data Sheet A3, Appendix A.

4.1.2 This section is optional; perform only when requested.

Perform visual and magnetic particle inspection pretest on parking gear, pawl, and related components and record on Data Sheet A1, Appendix A.

4.1.3 This section is optional; perform only when requested.

Record distances of parking pawl's engagement into parking gear and its clearance from root diameter. Measure and record any designated bolt torques or other dimensions, when applicable.

4.1.4 Check and if necessary, adjust the manual shift linkage.

4.1.5 Assure that Four Wheel Drive (4WD) locking hubs are in **lock** position if the vehicle is so equipped.

4.1.6 Weigh the curb weight of vehicle and post the scale reading on Data Sheet A2, Appendix A, and begin testing at curb weight plus driver. Set tire pressure to specification and record.

4.1.7 Provide a list of the part number of the vehicle shifter lever, cable/linkage, and external park lever. Required to perform calculation for manual shaft torque or optionally a manual shaft torque measurement. If modified from production intent, the shifter type and lever arm distance must be provided to the DRE.

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4.2 Conditions.

4.2.1 Environmental Conditions. Adequate tire and road surface friction to prevent wheel skid. Tests are to be conducted on dry road surfaces.

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.

4.2.2.1 If the test facility does not have the 27% grade, adjustments to the ballasted vehicle mass must be made to result in equivalent loading. See Appendix A, Data Sheet A1. Person performing vehicle test shall complete Data Sheet A2, Appendix A, including posted scale printout of weights for all test conditions and serialization of any instruments used.

4.3 Instructions. A summary of the test in a tabular presentation is in Appendix A, Table A1.

4.3.1 Moving Engagement at Test Weight Number 1 (Curb Weight) on Level Road.

4.3.1.1 Move test vehicle to a dry, level road, drive the vehicle forward at 8 km/h (5 mph) and shift into Park. Allow the pawl to ratchet until engagement occurs during coast down. Record maximum speed at which pawl engages for five (5) times and calculate the average on Data Sheet A3, Appendix A.

4.3.1.2 Drive the test vehicle rearward at 8 km/h (5 mph) and shift into park; allow the pawl to ratchet until engagement occurs during coast down. Record maximum speed at which pawl engages on Data Sheet A3, Appendix A.

4.3.2 Park Disengagement Check on 30% Grade.

4.3.2.1 Place the test vehicle facing downhill on the 30% grade and hold with service brakes.

4.3.2.2 Manually shift into park. Release the service brakes, and allow the park pawl to engage if initially tip-to-tip with parking gear tooth.

4.3.2.3 Measure force (Newtons) to disengage the selector lever from park, at midpoint of shift knob, tangentially to knob travel arc, after disengaging park detent provision. Check five (5) times. Record average on Data Sheet A3, Appendix A.

4.3.2.4 Repeat 4.3.2.1 thru 4.3.2.3 with the test vehicle facing uphill, record.

4.3.3 Park Engagement at Test Weight Number 1 (TW1) (Curb Weight) on 11.6% Grade.

4.3.3.1 Place the test vehicle, at TW1 (curb weight plus driver), facing downhill on the 11.6% grade, with transmission in neutral and engine running. Hold with service brakes.

4.3.3.2 Perform park mechanism engagement with the vehicle facing downhill ten (10) times at just below the engagement speed or the maximum speed at which parking pawl engagement does occur. Any cycles where ratcheting occurs without engagement should be repeated. Vehicle should stop rocking after pawl engagement before starting next parking cycle.

4.3.3.3 Move the vehicle to facing uphill and repeat for ten (10) more cycles at the speed determined in 4.3.3.2.

4.3.3.4 Alternately repeat Park engagement on 11.6% grade (by repeating 4.3.3.2 and 4.3.3.3) for a total of 300 engagements facing downhill and 300 engagements facing uphill.

4.3.4 Park Disengagement on the 30% Grade at TW1 and Test Weight Number 2 (TW2) (After the 600 Engagements).

4.3.4.1 Measure disengagement force on 30% grade after the 600 engagements (repeating 4.3.2) at TW1.

4.3.4.2 Add ballast to obtain TW2 by adding 68 kg (150 lb) in the right front floor well and 50% of the maximum cargo mass in the cargo area, in addition to driver, then measure disengagement force on 30% grade with TW2 (repeating as before, 4.3.2.1 through 4.3.2.4). Record weight in matrix on Data Sheet A3, Appendix A.

4.3.5 Park Engagement with TW2 (Ballast) on the 11.6% Grade.

4.3.5.1 Perform park engagement with ballast TW2 in vehicle for a total of 150 engagements with the test vehicle facing uphill and 150 engagements with the test vehicle facing downhill (repeating 4.3.3 with ballast in vehicle). Reference 4.3.3.4.

4.3.6 Park Disengagement on 30% Grade at TW2 and Test Weight Number 3 (TW3) (After the 300 Engagements).

4.3.6.1 Measure disengagement force (again by repeating 4.3.2) at TW2.

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4.3.6.2 Add additional ballast to vehicle to obtain GVMR and drive axle to GAMR. Record weights in matrix on Data Sheet A3, Appendix A. Measure disengagement force (repeat 4.3.2) at TW3.

4.3.7 Park Engagement at TW3 (GVMR) on 11.6% Grade.

4.3.7.1 Perform park engagement with ballast TW3 in vehicle for a total of 50 engagements with the test vehicle facing uphill and 50 engagements with the test vehicle facing downhill, repeating 4.3.3.

4.3.8 Park Disengagement on 30% Grade at TW3.

4.3.8.1 Measure disengagement force after the 100 engagements (by repeating 4.3.2).

4.3.9 Park Engagement at TW3 (GVMR) on 27% Grade Downhill.

4.3.9.1 Place the test vehicle facing downhill on the 27% grade (or alternatively with adjusted ballast for the grade used to simulate 27% grade loading) and hold with service brakes. Manually shift into park. Moderately release the service brakes, and allow the park pawl to engage. Vehicle should stop rocking after pawl engagement before starting next parking cycle.

Apply the service brake. Disengage park by shifting into neutral and then release the brake allowing the vehicle to roll 0.3 m to 0.9 m (1 ft to 3 ft). Apply the service brake to stop the vehicle and prepare for repeat of engagement.

4.3.9.2 With the vehicle still facing downhill, repeat 4.3.9.1 for a total of 100 times.

4.3.10 Park Disengagement on 30% Grade at TW3 (GVMR).

4.3.10.1 Measure disengagement force (by repeating 4.3.2).

4.3.11 Park Engagement at TW3 (GVMR) on 27% Grade Uphill.

4.3.11.1 Manually shift into park, moderately release service brakes, allowing park engagement 100 times with the vehicle facing uphill (repeat similar to 4.3.9).

4.3.12 Park Disengagement on 30% Grade at TW3 (GVMR).

4.3.12.1 Measure disengagement force (by repeating 4.3.2).

4.3.13 Moving Engagement at TW3 (GVMR) on Level Road.

4.3.13.1 Move test vehicle to a level road, drive the vehicle forward at 8 km/h (5 mph) and shift into Park. Allow the pawl to ratchet until engagement occurs during coast down. Record maximum speed at which pawl engages for five (5) times and calculate the average on Data Sheet A3, Appendix A.

Drive the test vehicle rearward at 8 km/h (5 mph) and shift into Park. Allow the pawl to ratchet until engagement occurs during coast down. Record maximum speed at which pawl engages for five (5) times and calculate the average on Data Sheet A3, Appendix A.

4.3.13.2 Alternately perform moving engagement in reverse and forward directions 40 times each (repeat 4.3.9.1 and 4.3.9.2).

4.3.13.3 Repeat 4.3.13.1 (a total of 100 engagements are completed).

4.3.14 Park Disengagement on 30% Grade at TW3 (GVMR).

4.3.14.1 Measure disengagement force after 100 moving engagements (by repeating 4.3.2).

4.3.15 In Park at Test Weight Number 3 (GVMR) when Impacted by Moving Vehicle/Barrier.

Note: This portion of the test may be conducted in a different vehicle if there are considerations of damage to the initial test vehicle during impact.

4.3.15.1 Impacting vehicle to be used with plate bumper welded to frame or a moving barrier as described in Figure 1 or SAE J972. Verify and record mass of moving barrier test device.

4.3.15.2 Move the test vehicle to a dry, level, paved surface.

Place the transmission range selector lever in park position while the vehicle is still in motion at very low vehicle speed (< 0.8 km/h (0.5 mph)) and release the service brakes to insure the park pawl is in the engaged position to retain the park function. Do not apply the vehicle parking brake.

4.3.15.3 (Optional to 4.3.15.2) Move the test vehicle to a dry, level, paved surface. Place the transmission range selector in park position and release the service brakes. Do not apply the vehicle parking brake. Attempt to move the vehicle by pushing the vehicle in either direction until unable to do so to ensure the park pawl is in the engaged position to retain the park function.

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