



Propeller Shaft to Underbody Clearance 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. The purpose of this test is to determine propeller (prop) shaft to underbody clearance under dynamic conditions.

1.2 Applicability. This test applies to vehicle(s) utilizing a single and/or multiple longitudinal prop shaft assembly. Examples would be full size pickup truck including All Wheel Drive (AWD), and Four Wheel Drive (4WD), crossover, or sedan models with rear wheel or AWD systems.

Note: This procedure details rear longitudinal prop shaft underbody clearance. The procedure would be similar for front longitudinal prop shaft (AWD/4WD systems) underbody clearance.

1.3 Remarks. This test may be accomplished by one of two means: Either by traditional use of modeling clay in areas of interest to determine dynamic clearance or by use of high speed video imaging to measure the dynamic clearance plus understand the relative movement of various components occupying and/or adjacent to the operation envelope of the prop shaft system.

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.

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

Design layout of the test vehicle prop shaft tunnel areas. (ID)

3 Resources

3.1 Facilities. Road system, loop or segment determined by Design/Validation/Development Engineers to input sufficient lateral and vertical inputs so as to impart maximum deflection of components in close proximity to the prop shaft. Most suitable and generic would be a loop of a general durability test road system which incorporates the previously noted qualities.

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 List of critical clearance points, measurements, and requirements to obtain them, are to be supplied by test requester.

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3.2.2 Body clay (traditional evaluation).

3.2.3 Spray silicone (traditional evaluation).

3.2.4 Scale.

3.2.5 Calipers.

3.2.6 Ballast (as required).

3.2.7 Inclinator.

3.2.8 Axle trim pins (furnished by requester).

3.2.9 Tire pressure gage.

3.2.10 High speed video imaging camera(s) (optional evaluation).

3.2.11 Video recording equipment as required (optional evaluation).

3.2.12 Imaging analysis software (optional evaluation).

3.3 Test Vehicle/Test Piece. Test vehicle with selected underbody and the drivetrain and pinion bumper at a specific requested height. Rear suspension, bushings, and rear springs to be supplied by requester.

3.4 Test Time.

Calendar time: 4 days

Test hours: 16 hours

Coordination hours: 16 hours

3.5 Test Required Information. See the data sheets in Appendix A.

3.6 Personnel/Skills. Driveline technician. Some metal fabrication skills may be required, see 4.1.5. Video measurement must be conducted by qualified technician/engineer to ensure accuracy of measurements.

4 Procedure

4.1 Preparation.

4.1.1 Place vehicle on platform hoist or suitable substitute.

4.1.2 Measure and record on Data Sheet A1, Page 1, in Appendix A the following at curb weight with vehicle in neutral and parking brake off.

4.1.2.1 Front and rear joint angles.

4.1.2.2 Front and rear trim heights.

4.1.2.3 Design (D) height.

4.1.2.4 Pinion bumper to contact surface clearance.

4.1.3 Inspect for correct rear suspension components. Record rear suspension bushing rates, if known.

4.1.4 For Vertical Movement. Add test load 11.3 kg (25 lb) on floor and 56.7 kg (125 lb) in seat per passenger and weight in trunk/cargo area, if applicable, to get correct D height. Insert pin of correct measurements. Measure and record on Data Sheet A1, Page 1, in Appendix A the measurements found in 4.1.4.1 and 4.1.4.2.

4.1.4.1 Front and rear joint angles.

4.1.4.2 Dimension from top of prop shaft to underbody at three or more places (front, middle and rear). Select what appears to be the closest part of the underbody to the prop shaft. Measure distance back from centerline front flex joint (Universal (U) joint or Constant Velocity (CV) joint) to these three places.

4.1.4.3 Remove test load.

4.1.5 For Shaft Side Movement. For mule or non-production level vehicle bodies, have a template made from a design layout at front, middle, and rear to verify test vehicle tunnel. If relationship tunnel to prop shaft is out of specification, relocate tunnel or fabricate spacers to represent the tunnel. Production intent underbodies may not require this operation.

4.1.6 Stick body clay on underbody at these probable points of minimum clearance at the top and sides. Apply oil or silicone to the shaft to prevent clay from sticking to it (traditional evaluation).

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Note: For high speed video measurement, fabricate fixturing necessary to enable clear view(s) of probable point(s) of minimum clearance.

4.1.7 Apply body clay to top of axle tube under frame. Apply body clay next to pinion bumper. This will determine the amount of axle ride travel for accompanying prop shaft travel (traditional evaluation).

4.1.8 Load vehicle to desired test weight, set tire pressure for this weight. Test to be run at driver only, design passenger loading, and at Gross Vehicle Mass Rating (GVMR) load. Measure and record the following for each test weight:

4.1.8.1 D height.

4.1.8.2 Clearance between pinion nose bumper and contact surface.

4.1.8.3 Clearance between prop shaft and underbody at previously determined positions.

4.2 Conditions.

4.2.1 Environmental Conditions. Vehicle must be soaked at room temperature prior to test. Road surfaces must be dry for optional high speed video measurement.

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 Load Vehicle to Driver Only Load.

4.3.2 Vertical Movement.

4.3.2.1 For normal ride clearance between prop shaft and underbody, operate vehicle on the following roads at posted speeds:

4.3.2.1.1 A road segment which exhibits a roughly patched and potholed road surface.

4.3.2.1.2 A road segment with ride swells and significant lateral load inputs such as could be found on a ride and handling course.

4.3.2.1.3 Massoit bump type road segment with severe undulating bumps and dips to impart significant suspension compression and rebound.

Note: From past experience, the recommended maximum entrance speed for the initial pass over the Massoit bump type road segment is 32 km/h (20 mph).

4.3.2.2 For minimum prop shaft to underbody clearance with maximum axle wind up and ride motion, the following test must be run.

Wide Open Throttle (WOT) standing start traveling over severe undulating bumps and dips. Throttle **must** be held wide open until vehicle has normalized after bump. Speed at severe bump road section is recommended to be 32 km/h (20 mph). Increase speed over bump in 8 km/h (5 mph) increments until prop shaft contacts underbody or 56 km/h (35 mph), whichever occurs first.

Note: Designated generic test road section must emulate the previously noted road for sufficient vertical input as follows: The section of road must have multiple severe sinusoidal undulations to introduce maximum suspension jounce and rebound. These inputs are required to articulate the driveline sufficiently to promote possible contact with components in or near the prop shaft operating envelope.

4.3.3 Shaft Side Movement. Drive vehicle over road system with ride swells and significant lateral load inputs such as could be found on a ride and handling course. On ride and handling course, drive through pot holes and make severe lane changes over a long straight sections with ample room to safely execute such maneuvers.

4.3.4 Measurements. Place vehicle on platform hoist or suitable substitute. (There must be no bind on axle or suspension to prevent it from assuming its normal position). Adjust weight to layout design as in 4.1.4. Measure and record on Data Sheet A1, Page 2, in Appendix A the following:

4.3.4.1 Front and rear joint angles.

4.3.4.2 Dimensions from top of shaft to underbody at locations established in 4.1.4.2.

4.3.4.3 Thickness of clay at various locations along tunnel.

4.3.4.4 Thickness of clay on pinion pad.

4.3.4.5 Thickness of clay on axle tube.

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