



Functionality and Durability of Axle Shaft Boots

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. Determination of the durability and functionality of diverse boots for constant-velocity outboard and inboard joints of all vehicle axle shafts at various ambient temperatures, joint angles, and rotational speeds.

1.2 Applicability. Outboard and inboard boots for front and rear axle shafts for the complete vehicle range.

1.3 Remarks. The boots shall be tested on the test bench for suitability under extreme temperature and joint angle conditions.

2 References

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

2.1 External Standards/Specifications.

SAE J2028

2.2 GM Standards/Specifications.

None

2.3 Additional References.

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

3 Resources

3.1 Facilities. Climatic test cabinet (e.g., Weiss, Type 500 AB/60 -120) with a Temperature (T) range of -40 °C to +160 °C and a test area volume of equal or greater than 500 L.

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 Computer-controlled Program Sequence. Temperature and rotational speed measurement in climatic test cabinet with joint angle setting corresponding to program definition.

3.2.2 Mechanical Checking Device and Connecting Parts as Specified by Drawing.

3.3 Test Vehicle/Test Piece. Outboard and inboard boots for front and rear axle shafts for the complete vehicle range. The test piece shall consist of a complete boot assembly with clamps installed on a fabricated test shaft (that duplicates a production halfshaft assembly).

3.3.1 Unless otherwise specified, a minimum of (6) samples of boots are to be tested. Data for each sample are to be documented in the test record.

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Remarks: It is acceptable to use a complete production halfshaft assembly (with boots already installed) as would be installed on a production vehicle.

3.4 Test Time.

Calendar time: 30 days
Test time: 210 hours
(per piece)
Coordination time: 8 hours

Calendar time: 180 days
Test hours: 1260 hours
(6 pieces)
Coordination hours: 8 hours

3.5 Test Required Information.

- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS) (for Halfshaft)
- Validation Cross Reference Index (VCRI)
- Analysis/Development/Validation Plan and Report (ADVP&R) aka (GM1829)
- SAE J2028

3.5.1 Refer to Appendix E – Program specific system operating parameters.

Complete inquiries (answer questions) per Appendix E.

Order of precedence for requirements documents will be as follows:

1. Halfshaft SSTS
2. GM Validation Engineer for halfshaft
3. SAE J2028

Note: Parameters listed in Appendix A through Appendix D are default values from SAE J2028. Exceptions could apply. Refer to the SOR for all exceptions.

3.5.2 Refer to Appendix F – Test parameters required for specific Program (derived from Appendix E).

Use results from Appendix E (Figure E1 and Tables E1 through E3) to determine specific test parameters for testing Constant Velocity (CV) Joint Boots per Appendix F, Tables F1 through F3. Use same order of precedence for requirements as previously stated.

3.6 Personnel/Skills.

This test requires a minimum of one (1) technician or engineer trained in halfshaft measurements. The technician should be proficient in operation of the equipment listed in 3.2, and familiar with the general operation of halfshafts.

4 Procedure

4.1 Preparation.

4.1.1 The boots to be tested shall be installed in production or similar in the joint assembly. Special attention shall be paid to the correct grease level and the specification of the clamps, clamping forces and tensioner.

4.1.2 Apply information determined per 3.5.1, Appendix E, and Appendix F (temperature, rotational speed, and joint angle setting corresponding to program definition) into Computer-controlled Program Sequence in Climatic Test Cabinet.

4.2 Conditions.

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4.2.1 Environmental Conditions. See 4.3. Unless otherwise specified, the typical environmental conditions for this procedure are the temperature, humidity and pressure at the test facility. Unless otherwise noted, these conditions are typically +22 °C to +25 °C, relative humidity of 40% to 60%, and atmospheric pressure equivalent to the local barometric pressure. Hot and cold temperatures will be identified in Appendix E and Appendix F. In the case where the same boot design is used in two (2) locations of the vehicle, the worst-case temperature should be used. This is often identified during CAE thermal modeling and, later, during Climatic Wind Tunnel testing.

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. Conduct the following procedures per the respective Appendices:

4.3.1 Break In for IB and OB Boots. See Appendix A, Table A1.

4.3.2 Radial Expansion for IB and OB Boots. See Appendix B, Figure B1 and Table B1.

4.3.3 OB CV Joint Hot and Cold Boot Testing. See Appendix C, Table C1, Table C2, Figure C1, Figure C2.

4.3.4 IB CV Joint Hot and Cold Boot Testing. See Appendix D, Table D1, Table D2, Figure D1, Figure D2.

5 Data

5.1 Calculations. rpm from vehicle speed and tire outer diameter.

5.2 Interpretation of Results.

Note: Both inboard and outboard boots have the same pass/fail criteria for cold, hot, and radial expansion testing.

5.2.1 Cold Test Pass/Fail Criteria. The boot shall have no through cracks, holes, excessive deformation or distress, grease leakage or discharge.

5.2.2 Hot Test Pass/Fail Criteria. The boot shall have no through cracks, holes, excessive deformation or distress, grease leakage or discharge. During hot tests the light oils from the grease can permeate through the boot material. The presence of this oil film on the outside surface of the boot is acceptable.

5.2.3 Radial Expansion Pass/Fail Criteria. Radial expansion should not exceed 5 mm.

5.3 Test Documentation. The test results shall be presented in a test report with reference to this test procedure. If at any time, the Supplier determines that the requirements cannot be met, the Supplier shall within one (1) business day notify the GM Validation Engineer.

5.3.1 Results Summary and Evaluation.

- Brief evaluation of results (OK, Not OK (NOK)).
- Test specification and, if required, any deviations.
- Comparison of results with the specifications in the SSTS/CTS/part drawing.

5.3.2 Test Piece Description. Part name and number, development status, date of manufacture, drawing number, drawing revision, drawing date and photograph.

5.3.3 Test Description. Description of test bench with photograph, brief description of testing machine, description of used test set-up, calibration of testing equipment, International Organization of Standardization (ISO) certificate of test facility.

5.3.4 Documentation of Individual Results.

Reporting should consist of pictures and graphs of the transient events (going to and from delta speed) and graphs of the components of the steady state events.

The test conditions and all recorded data shall be included in the report.

A report specifying all relevant results along with how the results were generated including complete identification (ID) of test item, test material, test component, conditions, report observations, and any deviations used to run test should be written.

5.3.5 Photographs of the test sample after the test shall be included. Damages of any part shall be described in detail with the help of photographs.

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6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

#	Number
C	Celsius
Comp.	Compression
CTS	Component Technical Specification
CV	Constant Velocity
DRE	Design Release Engineer
DU	Drive Unit
Ext.	Extension
FWD	Front Wheel Drive
GSSLT	Global Subsystem Leadership Team
IB	Inboard
ID	Identification
ISO	International Organization of Standardization
NOK	Not OK
OB	Outboard
SOR	Statement of Requirements
SSTS	Subsystem Technical Specification
SVE	System Validation Engineer
T	Temperature
VCRI	Validation Cross Reference Index

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW17856

9 Release and Revisions

This standard was originated in May 2017. It was first approved by Chassis Driveline Global Subsystem Leadership Team (GSSLT) in December 2017. It was first published in December 2017.

Issue	Publication Date	Description (Organization)
1	DEC 2017	Initial publication.

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Appendix A: Break In

A1 Cold and Hot Break-In Test for Inboard (IB) and Outboard (OB) Boots

Break-In of CV Joint boots are recommended to prevent overheating the joint and affecting the boot performance. Both inboard and outboard boots have the same break in method for cold and hot testing. Rotation of the assembly is required to uniformly distribute the grease. The room temperature soak is required to allow the elastomer compliance to adjust to the sealing surfaces and clamps. "Roller Type" joints do not require break in. Plunge position is not critical for this portion of the test. Rotation and temperature conditions are defined in Table A1.

Table A1: Break-In Conditions for IB and OB Cold and Hot Tests

Test Period		Conditions			Comments
Total	Each Step	Angle (degrees)	Speed (rpm)	Temperature (degrees Celsius)	
0	12 h (72 h for TPE)	0	0	Room Temp (15 – 30)	Soak
12 h	5 minutes	0	1000	Room Temp (15 – 30)	Uniform Grease Distribution
12 h 5 minutes	-	End of Test			

A2 Radial Expansion Break In for IB and OB Boots

No break in required for radial expansion.

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Appendix B

B1 Radial Expansion for IB and OB Boots

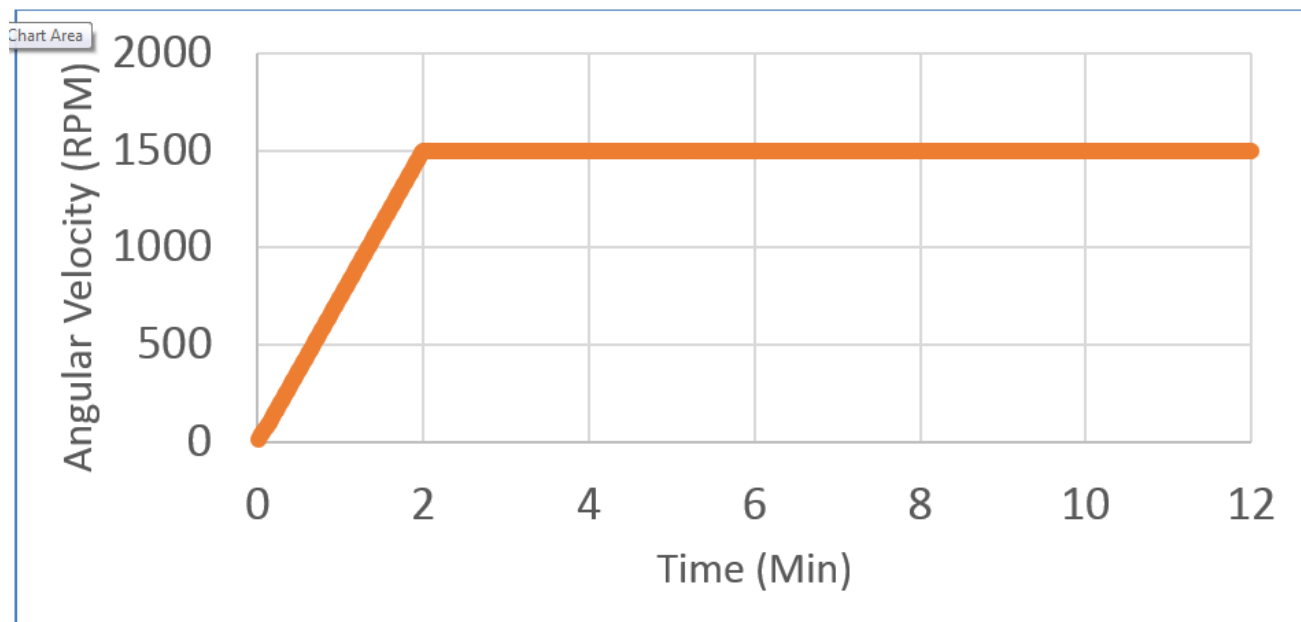
A determination of the static profile of the boot seal is made by mechanical probe, light beam, or photography prior to starting the test. Conditions laid out in Table B1 are for testing outboard and inboard CV joint boots. Refer to Appendix F for the specific test parameters for your program.

Table B1: Radial Expansion Conditions for Outboard and Inboard Boot

Test Period		Conditions			Comments	
Total	Each Step	Angle (degrees)	Speed (rpm)	Temperature (degrees Celsius)		
0	2 minutes	0	1500*	Room Temp	Gradually accelerate to Speed within 2 minutes	1 Cycle
2 minutes	10 minutes	0	1500*	Room Temp		
12 minutes	-	End of Test				

Note: * - Value shown is superseded by value in SSTS/Appendix E and F per 4.3

Figure B1: Radial Expansion Test



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