



Damper Friction 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 standard is to outline a method for determining the level of friction in a damper.

1.2 Applicability. This procedure applies to all passive suspension dampers. It may also be applied to electronically-controlled suspension dampers provided that appropriate control equipment, power source, logic, etc., is supplied or available. However, details specific to electronically controlled damper testing are not within the scope of this procedure.

This procedure applies to Servo-hydraulic or electro-mechanical test stations capable of performing multiple test steps incorporating multiple frequency and/or displacement combinations (hence, multiple velocities).

1.3 Remarks. The friction characteristics of the damper have a significant effect on the ride and handling qualities of the vehicle. It is desirable that damper friction be minimized to reduce ride harshness and improve response to road inputs.

2 References

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

2.1 External Standards/Specifications.

ISO 17025

2.2 GM Standards/Specifications.

GMW14243

3 Resources

3.1 Facilities. Damper tests are normally performed using GM damper test stations. These stations can be either waveform controlled such as servo-hydraulic units (e.g., MTS) or fixed-waveform (sine) such as electro-mechanical units (e.g., Verband der Automobilindustrie (VDA) Association of German Automobile Manufacturers standard test machine). Alternative test facilities and equipment may also be used provided they have the capability to complete the test and processing per this test procedure.

See GMW14243, Damper Basic Performance Test, for machine capability requirements.

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 Basic damper test system as outlined in GMW14243.

3.2.2 Test system must be capable of running at required speeds (minimally < 1.3 mm/s, 0.4 mm/s desired) without any appreciable system noise in the acquired data channels.

3.2.3 Ball joint type non-binding attachment fixtures specific to damper being tested.

3.2.4 Side loading mechanism (e.g., hydraulic actuator or lever with mass plates).

GM Confidential

© Copyright 2015 General Motors Company All Rights Reserved

January 2015

Page 1 of 9

3.3 Test Vehicle/Test Piece. This procedure applies to all types of dampers that are used in vehicle suspension systems.

3.4 Test Time.

3.4.1 Typical test duration, including preparation, execution and teardown is 30 minutes.

3.4.2 If necessary, multiple days may be required to fabricate fixtures to attach dampers to the load frame actuator.

Calendar time: 0.1 to 2 days

Test hours: 0.5 hour

Coordination hours: 0.1 hour

3.5 Test Required Information.

3.5.1 Specification values (optional for non-validation tests).

3.5.2 Target tenon load, if test condition is required.

3.5.3 Design center of damper stroke = Center test stroke = L_M .

3.5.4 Test State (as delivered, broken in).

3.6 Personnel/Skills. Operators shall be qualified and documented as capable to perform this test as required by ISO 17025.

4 Procedure

4.1 Preparation.

4.1.1 Refer to GMW14243, Damper Basic Performance Test, for standard preparation details, as well as safety protocol.

4.1.2 Set up the test station according to friction testing conditions.

4.1.2.1 For Servo-hydraulic stations, this may include valve settings and software configuration.

4.1.2.2 For electro-mechanical stations, this may include amplitude and frequency settings.

4.1.3 Install side load fixtures (hydraulic side loader, mechanical lever and mass plates, etc.) if required.

4.1.4 Install Attachment Fixtures. (Use low friction rod end or spherical bearing as the upper attachment.)

4.1.5 Calibrate/zero instrumentation.

4.1.6. Install damper.

4.2 Conditions.

4.2.1 Environmental Conditions. All tests shall be performed at room temperature (approximately 23 °C (72 °F)).

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.

If the test conditions are not supplied, then the standard conditions shown in Table 1 should be used.

Table 1: Standard Test Conditions

Waveform	Velocity (mm/s)	Speed (cpm)	Amplitude (mm)	Seal Reset Stroke (mm)	Seal Reset Velocity (mm/s)
Ramp ^{Note 1}	1.3	---	2	12	50
Sine	---	1	± 12.5	---	---

Note 1: The ramp wave form can be seen in Appendix B, Figure B2.

GM Confidential

© Copyright 2015 General Motors Company All Rights Reserved

January 2015

Page 2 of 9



Documents
Document Sharing Hub

4.3 Instructions.

4.3.1 Set Damper To Test Position. The damper should be tested at design length (if known), otherwise at mid-stroke.

4.3.2 Run damper through “break-in” cycles per GMW14243 and allow to cool, if damper is new and break-in has been requested.

4.3.3 Subject damper to warm-up strokes as specified in GMW14243.

4.3.4 Subject damper to appropriate input waveform based on the type of test station.

4.3.5 Apply the specified moment at the base of the damper. Unless otherwise noted in the test request, the default standard moments in Table A1 should be applied. When specified, calculate specific moment to establish the desired side load at the rod shoulder of the tenon end per equations in Figure A1 or Figure A2 in Appendix A. Apply masses or pressure to achieve this moment (record applied moment and calculation dimensions used). Alternately you can measure the standard moments and fit a line or interpolate the data to estimate the friction value at the desired moment (see B4 in Appendix B).

4.3.6 Repeat Instructions 4.3.1 through 4.3.5 for each magnitude of side load.

5 Data

5.1 Calculations. See B1 in Appendix B for test station specific calculations.

5.2 Interpretation of Results. Refer to Figures B1 through B4 for information regarding the interpretation of results from a specific test station type.

The sliding friction is designated as F_{friction} in Figure B1, and F_M in Figure B3. The reversal friction from compression to rebound is denoted by F_C and from rebound to compression by F_R . The total reverse friction (F_T) is the sum of those 2 terms: $F_T = F_R + F_C$.

Note: Reversal friction cannot be measured from a ramp wave form test.

5.3 Test Documentation. Friction forces as determined by the test shall be given in the test report. Refer to B4 in Appendix B for sample data output.

General damper description as required per local test site. At a minimum, required information includes part number, damper type (mono-tube/twin-tube), manufacturer, actual test stroke, working fluid and gas charge.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Note: Refer to GMW14243, Damper Basic Performance Test, for safety protocol specific to servo-hydraulic test stations.

7 Notes

7.1 Glossary. See GMW14243, Damper Basic Performance Test, for general definitions of “passive” and “electronically controlled” dampers.

Reversal Friction: Friction force measured at the end of the test stroke when the damper transitions from compression to rebound or from rebound to compression (velocity = 0).

Sliding Friction: Friction force measured at the center of the test stroke as the damper rod is moving through the zero displacement point.

The component of damper force from viscous effects is assumed to be zero in all cases.

7.2 Acronyms, Abbreviations, and Symbols.

cpm Cycles per Minute

VDA Verband der Automobilindustrie

GM Confidential

© Copyright 2015 General Motors Company All Rights Reserved

January 2015

Page 3 of 9



Documents

Document Sharing Hub