



Damper Temperature Fade and Lag 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 performance characteristics of a suspension damper at high and low temperatures.

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. Temperature fade and lag can adversely affect damper performance. This procedure tests for both of these conditions. The temperature fade test will determine whether or not the damper exhibits noticeable signs of loss of damping when tested over a range of temperatures.

The lag test portion of this test procedure consists solely of Step 4.3.11 in 4.3. This step may be run independent of the total procedure if the purpose of the testing is to quantify lag only.

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 Brand) 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 general 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.

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3.2.2 Temperature measurement system. The system shall be a contact type sensor providing continuous reporting of the temperature. Electronic recording of the temperatures and test control throughout the test is desirable, but optional.

3.2.3 Cooling chamber capable of temperature of -40 °C.

3.2.4 Attachment fixtures specific to damper being tested.

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 17 h. (This includes 1 h of actual testing time and 16 h of damper cold soak at low temperature.)

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

Calendar time: 1 d to 2 d

Test hours: 1 h

Coordination hours: 0.5 h

3.5 Test Required Information.

3.5.1 Damper test stroke amplitude and test speeds for basic performance test.

3.5.2 Test Sequence to Run (complete or lag only).

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

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 Apply thermocouple or similar surface mounted temperature measurement device to the dampers to be tested in the location specified in Table 1.

Table 1: Lag Test Conditions

Damper Type	Twintube	Monotube
Test stroke (mm)	Same as basic performance test as defined by requestor; if unknown, default is ± 40 mm	
Speed	3.33 Hz (200 cpm) or 5 Hz (300 cpm) for stroke $< \pm 37.5$ mm	
Limiting Temperature (°C)	100	
Measurement Location	Outer surface at the level of the bottom (base) valve	Center of outer tube

cpm = Cycles Per Minute

4.1.2 Disconnect air bladders, dust tubes or other devices attached to the reservoir tube. If air bladders cannot be disconnected then inflate to minimum pressure to avoid interference as described in GMW14243.

4.1.3 See GMW14243, Damper Basic Performance Test, for additional general preparation guidelines.

4.2 Conditions.

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

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.

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Table 1 outlines the conditions for the Lag Test.

4.3 Instructions. The following instructions shall be performed for each test specimen:

4.3.1 Run standard performance test at requested speeds at room temperature, $T_1 = (23 \pm 2.5) ^\circ\text{C}$.

4.3.2 Store damper in neutral position at $-35 ^\circ\text{C}$ to $-40 ^\circ\text{C}$ for a minimum of 16 h.

4.3.3 Run standard performance test at requested speeds at $T_2 = (-30 \pm 3) ^\circ\text{C}$.

4.3.4 Heat damper to $(-5 \pm 3) ^\circ\text{C}$ by stroking at a rate of 1.25 Hz (75 cpm) at the requested test displacement.

4.3.5 Run standard performance test at requested speeds at $T_3 = (0 \pm 2.5) ^\circ\text{C}$.

4.3.6 Heat damper to $T_4 = (23 \pm 2.5) ^\circ\text{C}$ by stroking at a rate of 1.25 Hz (75 cpm) at the requested test displacement.

4.3.7 Run standard performance test at requested speeds at $T_4 = (23 \pm 2.5) ^\circ\text{C}$.

4.3.8 Heat damper to $(75 \pm 2.5) ^\circ\text{C}$ by stroking at a rate of 3.33 Hz (200 cpm) at the requested test displacement.

4.3.9 Heat damper to $(80 \pm 2.5) ^\circ\text{C}$ by stroking at a rate of 1.67 Hz (100 cpm) at the requested test displacement.

4.3.10 Run standard performance test at requested speeds $T_5 = (80 \pm 2.5) ^\circ\text{C}$.

4.3.11 Heat damper to $T_6 = (100 \pm 2.5) ^\circ\text{C}$ by stroking at a rate of 3.33 Hz (200 cpm) at the requested test displacement. When damper has reached temperature, record force and displacement data.

Note: For self-load-leveling dampers such as the ZF Sachs Nivomat, this step should be run at 5 Hz (300 cpm), with test displacement and damper rod position as determined by the part drawing.

5 Data

5.1 Calculations. Force vs. displacement and force-velocity curves will be recorded for each test.

Lag: The percent lag is calculated as the percent of stroke that it takes for the damper to reach the fully developed force-displacement curve as shown in Figure A2.

Fade: Using the results for the test at room temperature as a baseline, the force-velocity tolerance bands can be calculated from the equations shown in Table A1. These values can be modified as required by the vehicle program team. See Figure A1 for an example of fade test results at one (1) temperature.

5.2 Interpretation of Results. The amount of fade or lag shall be compared to the specified requirements or the default values shown in Table A1 and Table A2 respectively.

Curves for the other temperatures must not deviate by more than the limiting values.

5.3 Test Documentation. General damper description as required per local test site. At a minimum, required information includes part number, damper type (monotube/twintube), stroke length, 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.

6.1 Special care must be taken when handling the dampers directly out of the cold chamber or at the end of the test sequence. Insulated Heat/Cold resistant gloves are recommended.

6.2 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. Refer to GMW14243, Damper Basic Performance Test for general definitions.

Fade (Temperature): A reduction in damping force at a given velocity with respect to temperature. See Figure A1.

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