GM	WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW14684

Force-Deflection Characteristics of Elastomeric Components, Hysteresis Determination

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 hysteresis of elastomeric components. The test according to this test procedure provides information on the viscous-elastic behavior and the dampening capacity of the elastomers used.

1.2 Applicability. All elastomeric components.

1.3 Remarks. Determination of stress ability of the elastomeric components in the installation position in vehicles and in accordance with the installation conditions.

2 References

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

2.1 External Standards/Specifications.

DIN 862	DIN 878	ISO 9513
DIN 876-2	ISO 7500-1	

2.2 GM Standards/Specifications.

GMW14734

3 Resources

3.1 Facilities.

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 Test Equipment.

3.2.1.1 Testing Machine Universal testing machine for stressing of elastomeric components up to 50 kN maximum with constant velocity (v) (maximum deviation ± 10%), The test machine shall fulfill the following requirements:

- The force measuring device of the test machine shall correspond to ISO 7500-1.
- The deflection measuring device shall correspond to ISO 9513.

Accuracy of:

- Force Measurement: ± 1.5% of the relevant value.
- Deflection measurement: ± 0.05 mm.

3.2.1.1.1 Total deformation of universal testing machine frame, testing and clamping devices etc., ≤ 1% of deformation of the elastomeric components subjected to force F_{max} ($+F_v$). In this case, correction of the measurement results by the deformation of the testing machine is not necessary.

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3.2.1.1.2 If the deformation of universal testing machine frame, testing and clamping devices etc., is within the range > 1% to ≤ 10% of deformation of the elastomeric components, then correction of the measurement results shall be performed.

3.2.1.1.3 Measurements with testing equipment, in which deformation > 10% of the deformation of the elastomeric components are not permissible.

Note: The measurement of deformation of the testing equipment shall be performed using a **rigid substitute body** under the same testing and configuration parameters as the component measurement.

However, the velocity v_i shall be selected according to the application. The correction measurement shall cover the entire evaluation area.

The **rigid substitute body** is defined as the outer contour of the elastomeric component pressed into the corresponding component mount, according to the relevant component drawing, with an inserted pin. The pin shall be tightened to the specified torque according to the elastomeric component drawing.

3.2.1.2 Environmental Chamber with Recirculated Air for Use on the Universal Testing Machine.

- Temperature range: -30 °C to +150 °C, continuously adjustable.
- Temperature stability**:** ± 2 °C**.**
- Rate of change in temperature for the empty environmental chamber; ≥ 1.5 °C/minute recommended value.

3.2.1.3 Pre-conditioning Chamber with Recirculated Air.

- Temperature range: -30 °C to +150 °C, continuously adjustable.
- Temperature stability: ± 2 °C.
- Rate of change in temperature for the empty pre-conditioning chamber: ≥ 1.5 °C/minute recommended value.

3.2.1.4 Measuring plate according to DIN 876-2 made of cast iron, 400 mm × 400 mm.

3.2.1.5 Testing and clamping devices for installing and fastening the elastomeric components on the universal testing machine. Roller tables and roller or ball straight-line mechanisms for forces up to 10 kN.

3.2.1.6 Timer with a display range of 168 h and a reading accuracy of 1 minute.

3.2.1.7 Dimensional Measuring Equipment.

3.2.1.7.1 Dimensional change measuring instrument, e.g., dial gauge according to DIN 878 with a display range of 10 mm, a measuring accuracy of ± 0.01 mm and constant measuring force over the measuring path of < 2 N.

3.2.1.7.2 Dimensional measuring instrument, e.g., caliper gauge according to DIN 862.

3.2.1.7.3 Dimensional measuring instrument, e.g., high-accuracy marking gauge with fine adjustment of the slider, vernier 0.1 mm, marking height 500 mm maximum.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Material.

3.3.1.1 Test Sample Form. Test samples are elastomeric components (elastomeric components or elastomeric/metal components), which are used as components in vehicles.

3.3.1.2 Number of Test Samples. At least three (3) test samples shall be tested.

3.4 Test Time. Per Section 4.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Conform to company and/or laboratory requirements. Technician training records must be available upon request.

4 Procedure

Summary of Test Method. Testing of the deformation of elastomeric components for vehicles (elastomeric components or elastomeric/metal components) with constant velocity in the temperature range of -30 °C to +150 °C.

4.1 Preparation.

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4.1.1 Test Sample Preparation. For initial sampling and in cases of arbitration, the test shall be performed no earlier than 7 days, and for continuous quality control no earlier than 72 h, after vulcanization. Before testing, the test samples shall be stored in an unstressed condition for at least 8 h at +23 °C ± 5 °C.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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 Test Procedure.

4.3.1.1 General. The test sample shall be tested according to the data shown in the test specifications and the design drawings of the elastomeric component with regard to installation instructions, stressing devices, etc., as well as in accordance with the relevant test procedure. Between two (2) tests on the same test sample, a period of at least 24 h shall elapse.

Before testing, the weight of the test sample, the testing and clamping devices etc., shall be compensated on the universal testing machine, if this has an influence on the force display or the forces Fj_i and Fj_l.

4.3.1.2 Determination of Height hj0i. The height hj_{0i} shall be measured according to GMW14734 at +23 °C ± 5 °C, if this value is required for the elastomeric component.

4.3.1.3 Conditioning. The test samples shall be pre-conditioned according to the specified test type in 4.3.1.5 and shall be subsequently tested at the specified temperature for this test type per 4.3.1.4 through 4.3.1.4.2.2.5.

4.3.1.4 Test Procedure.

4.3.1.4.1 The test sample shall then be attached to the pre-heated or pre-cooled test device, and the height hj_{ei} shall be determined after 30 minutes ± 1 minute conditioning period.

4.3.1.4.2 The spring characteristic shall then be determined by one (1) of the methods detailed in 4.3.1.4.2.1 or 4.3.1.4.2.2.

4.3.1.4.2.1 The method of determination according to Appendix A, Figure A1.

4.3.1.4.2.1.1 The test piece shall be stressed with a force $Fj_i = Fj_{vi}$ and the height of the elastomeric component hj_{vi} and its initial deflection sj_{vi} shall be determined. Reset the force and displacement measuring equipment to zero.

4.3.1.4.2.1.2 The force $Fj_i = Fj_{vi}$ shall be increased to $Fj_i = Fj_{vi} + Fj_{i\ max}$ at a velocity vj_i.

4.3.1.4.2.1.3 The force $Fj_i = Fj_{vi} + Fj_{i\ max}$ shall be decreased until $Fj_i = Fj_{vi} + Fj_{i\ min}$ at the same velocity.

4.3.1.4.2.1.4 Again, increase the force $Fj_i = Fj_{vi} + Fj_{i\ min}$ to $Fj_i = Fj_{vi} + {}_{i\ max}$ at a velocity vj_i.

4.3.1.4.2.1.5 Repeat the unloading and loading of the force as described in 4.3.1.4.2.1.3 and 4.3.1.4.2.1.4 two (2) more times.

4.3.1.4.2.2 The method of determination shall be performed according to Appendix A, Figure A2. Data shall be graphed and displayed per Appendix A, Figure A2 and Figure A3.

4.3.1.4.2.2.1 Set the force measuring equipment to $Fj_i = 0$ and $Fj_l = 0$. The displacement measuring equipment shall be set to $sj_i = 0$ and $sj_l = 0$ and proceed according to Appendix A, Figure A2 and per 4.3.1.4.2.2.2 through 4.3.1.4.2.2.5.

4.3.1.4.2.2.2 The force $Fj_i = 0$ shall be increased to $Fj_i = Fj_{gi}$ at a velocity vj_i.

4.3.1.4.2.2.3 The test piece shall be stressed from $Fj_i = Fj_{gi}$ to $Fj_l = Fj_{gl}$ at a velocity $|vj_l| = |vj_i|$.

4.3.1.4.2.2.4 The force shall be increased from $Fj_l = Fjg_l$ to $Fj_i = F_{gi}$ at a velocity vj_i.

4.3.1.4.2.2.5 Repeat the unloading and loading of the force as described in 4.3.1.4.2.2.3 and 4.3.1.4.2.2.4 two (2) more times.

4.3.1.5 Conditioning and Test Temperatures. According to agreement, one (1) of the conditions listed in Table 1 for conditioning and test temperatures shall be used for performing the test. The test type is specified on the drawings, and test, and material specifications.

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