

Submitted for recognition as an American National Standard

**Accessory Drive Tensioner Test Standards
(Mechanical Rotary Type)**

1. **Scope**—To document test procedures and set-ups that address known failure modes for mechanical rotary tensioners and establish minimum acceptance criteria. This SAE Standard does not encompass the pulley or pulley bearing. The sample sizes should be determined by agreement between the original equipment manufacturer (OEM) and the supplier.

The failure modes to be addressed are:

a. Durability

Corrosion	Contamination
Structural	Wear
Temperature	Alignment

b. Functional

Clamp Load	Damping
Drop (Safety)	Lift Lugs
Load	Noise
Ozone	Snap

2. **References**

- 2.1 **Applicable Publications**—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J2198—Glossary—Automatic Belt Tensioner (Measuring techniques for the acceptance criteria can be found in this paper.)

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117-95—Method of Salt Spray (Fog) Testing

ASTM D 1149-91—Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber (Flat Specimens)

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3. **General**—Table 1 is based on a 100 mm arm length and is a general guideline for setting test parameters. It is for reference only since there are many factors that affect amplitude and frequency and should be specified by the OEM depending on the application. Peak-to-Peak refers to complete arm travel as measured at the pulley center. The frequency in the table refers to the drive excitation.

TABLE 1—GENERAL GUIDELINES

Damping	Engine Application
4 cylinder engine Application	
Frequency 25 Hz	
5%	8 mm peak-to-peak
10%	6 mm peak-to-peak
20%	4 mm peak-to-peak
40%	2 mm peak-to-peak
6 cylinder engine Application	
Frequency 30 Hz	
5%	6 mm peak-to-peak
10%	5 mm peak-to-peak
20%	2.5 mm peak-to-peak
40%	1.5 mm peak-to-peak
8 cylinder engine Application	
Frequency 40 Hz	
5%	4 mm peak-to-peak
10%	1.5 mm peak-to-peak
20%	1 mm peak-to-peak
40%	0.5 mm peak-to-peak

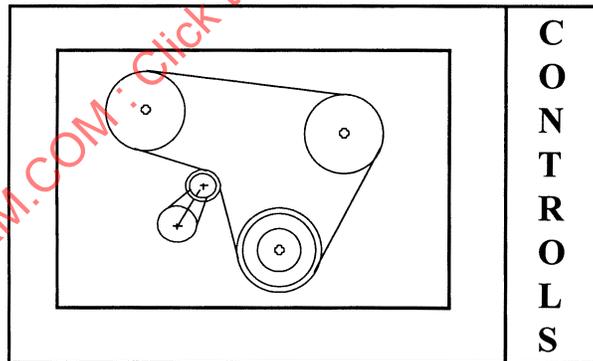


FIGURE 1—BELT DRIVEN TEST CHAMBER

Figure 1 is an example of a belt driven test chamber. One of the pulleys must be eccentric to obtain the desired peak-to-peak arm travel of the tensioner. The production intent belt material should be used if possible. This test chamber is used for the cold test and the contamination test. It is more likely that the belt driven test chamber will seize the tensioner than the cable driven test chamber.

Figure 2 is an example of a cable driven test chamber. The center pulley is eccentric to obtain peak-to-peak arm travel. The specified cable diameter is 6 mm. This chamber is used for the corrosion test and the hot box test. This configuration is used to test durability by accelerating wear. This test stand must be capable of running at elevated temperatures.

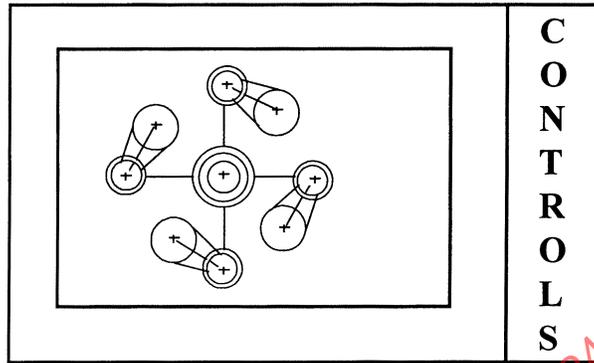


FIGURE 2—CABLE DRIVEN TEST CHAMBER

4. Contamination Test

4.1 Purpose—To evaluate tensioner lock up and durability by exposing the tensioner to a contaminated environment and to determine the effects on the damping rate over the range of the test. The components to be evaluated are the bushing, damping elements, the spring, and any parts subject to contamination. It is also possible to gain some preliminary knowledge of the sealing of the bearing if the production intent pulley, bearing, and dust shield are used.

4.2 Equipment—The test stand is an environmental chamber capable of operating at $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The tensioners are to be installed in vehicle nominal position (to obtain correct hub load and gravity bias direction). The tensioners are to be actuated by a belt drive attached to an eccentric pulley, as shown in Figure 1. The belt should be production intent material. A squeeze bottle with a 1.8 mm nozzle should be used to apply the solution to the tensioner.

4.2.1 CONTAMINATION SOLUTION:

- | | | |
|----|---------|--------------------------------|
| a. | 3.8 L | Water |
| b. | 0.14 kg | SAE Course Test dust |
| c. | 0.14 kg | #400 grit aluminum Oxide Grain |
| d. | 0.05 kg | #150 grit aluminum Oxide Grain |
| e. | 0.14 kg | Table salt |
| f. | 0.005 L | Red food coloring |

4.3 Procedure—Actuate the tensioners based on the application (see Table 1) in the test chamber at $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 24 h with no contamination to run in the belt and tensioner. Reset the amplitude to the original displacement with the tensioner hot. Begin the test by actuating the tensioners in the test chamber at $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. Mix the previous ingredients into a solution and spray the tensioner in the 12, 3, 6, and 9 O'clock positions parallel to the mounting face and directly at the center of the front. Apply the solution for 2 s in each position completely wetting the tensioner 3 times a day. This test is to be run for 400 h with data collected at 0 h, 1 h, 200 h, and 400 h.

4.4 Acceptance Criteria—The components must remain functional at the end of test.

- a. The noise level cannot degrade throughout the duration of the test.
- b. Parallelism should not change more than 0.5 degree.
- c. The offset change should be no more than 0.80 mm.
- d. The change in spring load should not be more than $\pm 15\%$.
- e. The damping must remain within the minimum and maximum design envelope established by application design parameters.

NOTE—Functional measurements of alignment and offset should be made at in vehicle geometry nominal position. If the damping changes and falls outside of the design specifications, the OEM may choose to continue the test at a higher amplitude to induce bushing failure which would be a secondary failure.

5. Corrosion Test

5.1 Purpose—To evaluate tensioner functional performance and durability by exposing the tensioner to a corrosive environment and determine the effects on the damping rate over the range of the test. The components to be evaluated are the bushing, damping elements, the spring and any parts subject to wear and/or corrosion.

5.2 Equipment—The test stand is an environmental chamber capable of introducing and maintaining a salt fog as per ASTM B117-95 standard. The tensioners are actuated by cables attached to an eccentric pulley as shown in Figure 2.

5.3 Procedure—Actuate the tensioners based on the application (see Table 1) in the test chamber at room temperature. Follow ASTM B 117-95. Run for 72 h, then turn off the salt spray and the tensioner actuation. Open the chamber and let it sit for 24 h. Close the chamber and start the salt spray and the tensioner actuation. Visually inspect the tensioner movement. Run for 96 h, then turn off the salt spray and the tensioner actuation. Open the chamber and let it sit for 24 h. Close the chamber and start the salt spray and the tensioner actuation. Visually inspect the tensioner movement. Run for 72 h, then turn off the salt spray and the tensioner actuation. Open the chamber and let the tensioners dry for 24 h before checking for function. The test time with the salt spray and tensioner actuation is 240 h. The total test time is 312 h.

Every 24 h visually inspect and check for audible noise of the components. Audit the function of the components at 0 h and end of test. Do not open the test chamber more than once a day.

5.4 Acceptance Criteria—The components must remain functional at the end of test.

- a. The noise level cannot degrade throughout the duration of the test.
- b. Parallelism should not change more than 0.5 degree.
- c. The offset change should be no more than 0.80 mm.
- d. The change in spring load should not be more than $\pm 15\%$.
- e. The damping must remain within the minimum and maximum design envelope established by application design parameters.

NOTE—Functional measurements of alignment and offset should be made at in vehicle geometry nominal position. If the damping changes and falls outside of the design specifications, the OEM may choose to continue the test at a higher amplitude to induce bushing failure which would be a secondary failure.

6. Hot/Cold Cycling Test

6.1 Purpose—To evaluate tensioner functional performance and durability by inducing wear on the components and to determine the effects of heat on the damping rate over the range of the test. The components to be evaluated are the bushing, damping elements, the spring, and any plastic parts.

6.2 Equipment

6.2.1 EQUIPMENT HOT CYCLE—The test stand for the hot cycle is an environmental chamber capable of maintaining a minimum of $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The tensioners are actuated by cables attached to an eccentric pulley as shown in Figure 2.

6.2.2 EQUIPMENT COLD CYCLE—The test stand for the cold cycle must be capable of maintaining $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The tensioners are actuated by a belt as shown in Figure 1 with the tensioner installed in vehicle position including belt wrap angle. The belt should be production intent material.

6.3 Procedure—Actuate the tensioners based on the application in the test chamber at $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 1 h. Soak in cold box at $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a minimum of 1 h. Cycle for 5 min with an acceleration rate of 100 rpm in the first 2 seconds, 750 rpm within 7 s, and the correct amplitude and frequency within 10 s. Return to hot box and run tensioners at $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 100 h. Soak in cold box at $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a minimum of 1 h. Cycle for 5 min with an acceleration rate of 100 rpm in the first 2 s, 750 rpm within 7 s, and the correct amplitude and frequency within 10 s. Return to hot box and run tensioners at $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 100 h. Soak in cold box at $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a minimum of 1 h. Cycle for 5 min with an acceleration rate of 100 rpm in the first 2 s, 750 rpm within 7 s, and the correct amplitude and frequency within 10 s. Total test time 201 h and 15 min.

Every 24 h inspect visually and check for audible noise of the components. Audit the function of the components at 0 h, 1 h, and end of test.

6.4 Acceptance Criteria—The components must remain functional at the end of test.

- a. The noise level cannot degrade throughout the duration of the test.
- b. Parallelism should not change more than 0.5 degree.
- c. The offset change should be no more than 0.80 mm.
- d. The change in spring load should not be more than $\pm 15\%$.
- e. The damping must remain within the minimum and maximum design envelope established by application design parameters.

NOTE—Functional measurements of alignment and offset should be made at in vehicle geometry nominal position. If the damping changes and falls outside of the design specifications, the OEM may choose to continue the test at a higher amplitude to induce bushing failure which would be a secondary failure.

7. Cold Box Test—Eliminated as a stand alone test. This test is to be run if the Hot/Cold Cycling Test was not passed. This will help identify if the failure was due to cold temperature.

7.1 Purpose—To evaluate tensioner functional performance and durability by inducing wear on the components. Determine the effects of cold on the damping rate over the range of the test. The components to be evaluated are the bushing, damping elements, the spring, and any plastic parts.

7.2 Equipment—The test stand must be capable of maintaining $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The tensioners are actuated by a belt with the tensioner installed in vehicle position including belt wrap angle. The test chamber is shown in Figure 1.

7.3 Procedure—Actuate the tensioners based on the application in the test chamber at $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 1 h. Soak in cold box at $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a minimum of 1 h. Cycle for 5 min with an acceleration rate of 100 rpm in the first 2 s, 750 rpm within 7 s, and the correct amplitude and frequency within 10 s. Repeat the cold soak and 5 min cycle 3 times.

After each run inspect visually and check for audible noise of the components. Audit the function of the components at 0 h, 1 h, and end of test.

7.4 Acceptance Criteria—The components must remain functional at the end of test.

- a. The noise level cannot degrade throughout the duration of the test.
- b. Parallelism should not change more than 0.5 degree.
- c. The offset change should be no more than 0.80 mm.
- d. The change in spring load should not be more than $\pm 15\%$.
- e. The damping must remain within the minimum and maximum design envelope established by application design parameters.

NOTE—Functional measurements of alignment and offset should be made at in vehicle geometry nominal position. If the damping changes and falls outside of the design specifications, the OEM may choose to continue the test at a higher amplitude to induce bushing failure which would be a secondary failure.

8. Hot Box Test—Eliminated as a stand alone test. This test is to be run if the Hot/Cold Cycling Test was not passed. This will help identify if the failure was due to elevated temperature.

8.1 Purpose—To evaluate tensioner functional performance and durability by inducing wear on the components. Determine the effects of heat on the damping rate over the range of the test. The components to be evaluated are the bushing, damping elements, the spring, and any plastic parts.

8.2 Equipment—The test stand is an environmental chamber capable of maintaining a minimum of $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The tensioners are actuated by cables attached to an eccentric pulley. The test chamber is shown in Figure 1.

8.3 Procedure—Actuate the tensioners based on the application and Table 1 in a test chamber shown in Figure 1 at $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a minimum of 200 h. Every 24 h inspect visually and check for no audible noise of the components. Audit the function of the components at 0 h, 1 h, and 200 h.

8.4 Acceptance Criteria—The components must remain functional at the end of test.

- a. The noise level cannot degrade throughout the duration of the test.
- b. Parallelism should not change more than 0.5 degree.
- c. The offset change should be no more than 0.80 mm.
- d. The change in spring load should not be more than $\pm 15\%$.
- e. The damping must remain within the minimum and maximum design envelope established by application design parameters.

NOTE—Functional measurements of alignment and offset should be made at in vehicle geometry nominal position. If the damping changes and falls outside of the design specifications, the OEM may choose to continue the test at a higher amplitude to induce bushing failure which would be a secondary failure.

9. Lift Lug Test

9.1 Purpose—To test the affect of installing a belt on the tensioner arm for offset and parallelism. To determine the strength of the lifting feature of the tensioner.

9.2 Equipment—The fixture must be able to withstand the force necessary to break the lifting feature of the tensioner. Use a torque wrench capable of measuring and recording peak torque. OEM is to specify the torque wrench arm length.

9.3 Procedure—Install the tensioner assembly in the test fixture. Torque the tensioner mounting fasteners to the minimum torque specification. Lift the tensioner arm with the torque wrench as if the belt is being installed. Determine and record the amount of torque necessary to lift the arm to the belt install position (Load Stop). Using the torque wrench, lift the arm to the torque measured previously and continue to apply torque until the residual (break away) torque of the pulley bolt is reached. If the lifting feature is not a bolt, continue to apply torque until 2 times the measured torque as stated previously. Repeat the test 6 times per test part.

NOTE—The torque wrench should be oriented such that the wrench is along the axis of the tensioner to obtain the maximum force that can be applied (see Figure 3).

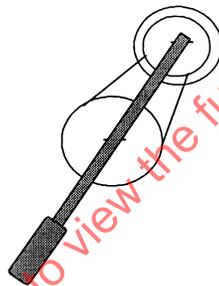


FIGURE 3—TORQUE WRENCH ORIENTATION

9.4 Acceptance Criteria—No failures allowed.

10. Ozone Test

10.1 Purpose—To test all exposed rubber for cracking resistance when subjected to a test chamber containing ozone.

10.2 Test Equipment—See ASTM D 1149-91

10.3 Procedure—See ASTM D 1149-91. Test duration is 70 h with an ozone concentration of 100 pphm.

10.4 Acceptance Criteria—No visible cracks to the unaided eye.

11. Safety Drop Test

11.1 Purpose—This test addresses safety issues by ensuring that the tensioner assembly remains intact after sustaining a drop from a specified height, simulating a possible assembly handling occurrence.