SAE INTERNATIONAL

**SURFACE VEHICLE STANDARD**

**J2436™** **JUL2016**

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Superseding J2436 JUL1998

# (R) Accessory Drive Tensioner Test Standards

RATIONALE

Revisions to SAE J2436 improves corrosion and contamination test consistency between test sites, standardizes measurement techniques and unit reporting, and confirms accessory drive tensioner failure modes and test factors.

## 1. SCOPE

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

The failure modes to be addressed are:

| | |
|---|---|
| Corrosion | Seizure |
| Load Output | Damping |
| Parallelism | Offset |
| Noise | |
| Structural Failures | |

- Clamp Load
- Lift Lug Failure
- Arm Stop Failure
- Fractures/Cracking/Wear

Test Factors include:

| | |
|---|---|
| Contamination | Temperature |
| Ozone | Arm Displacement and frequency |
| Input Forces | |

NOTE: The Belt Drive Committee recommends that this spec be run using test parts that are close to the upper and lower specifications for load output and damping (tails testing).

## 2. REFERENCES

### 2.1 Applicable Documents

The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

#### 2.1.1 SAE Publication

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2198 Glossary - Automatic Belt Tensioner

#### 2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

ASTM D 1149-XX Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimens) – Refer to latest version.

## 3. GENERAL

### 3.1 Test Chamber Tensioner Actuation Methods

Tensioner actuation can be achieved using cable, chain, belt, or rod. If a specific actuation method is required, it will be noted in the specific test procedure. Below are figures showing examples of actuation options.

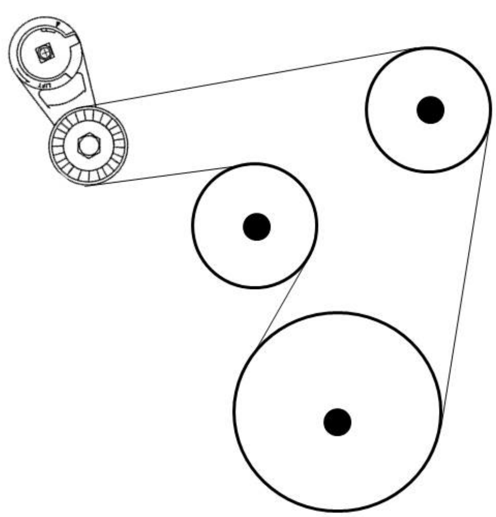

***Figure 1 - Belt driven test chamber***

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.

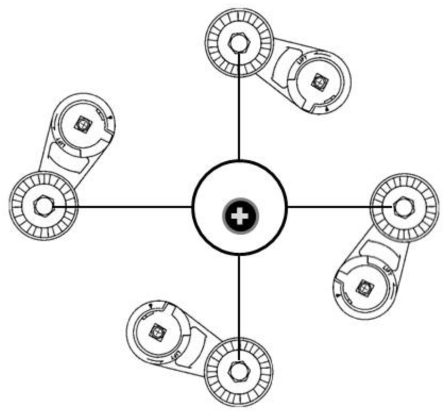

***Figure 2 - Cable driven test chamber***

Figure 2 is an example of a cable driven test chamber. The center pulley is eccentric to obtain peak-to-peak arm travel.

3.2 Inspection and Data Reporting Requirements

Data reporting requirements will be documented in each test procedure. Section 3.2 contains specific information regarding the inspection methodology and data reporting format for typical data reporting requests.

3.2.1 Angularity

Angularity is the tilt of the idler bearing seat relative to the mounting datum of the tensioner. The angularity measurement is to be conducted with the tensioner arm rotated to the nominal arm angle, with the reacting force to rotate the arm located at the proper centerline and hubload angle. Angularity values are to be reported in degrees or mm, and can be specifically separated into pitch and yaw.

3.2.2 Offset

Offset is the distance from the idler bearing seat to the mounting datum of the tensioner. The offset measurement is to be conducted with the tensioner arm rotated to the nominal arm angle, with the reacting force to rotate the arm located at the proper centerline and hubload angle. Offset values are to be reported in mm.

3.2.3 Breakaway Torque

Breakaway torque is the torque required to actuate the tensioner after a soak period that tests for tensioner lockup or seizure. Breakaway torque is measured statically, at approximately 1 Hz. Three (3) full strokes should be taken for the measurement, and data should be reported for all 3 strokes in torque or force vs. displacement hysteresis curves. The breakaway torque measurement should be taken starting from the locked or pinned position, without letting the tensioner arm move toward freearm when unlocked.

3.2.4 Tensioner Break-In

Tensioner break in is the pre-test procedure to stabilize the tensioner damping. Break in is performed by cycling the tensioner for 1 hour at ambient temperature, with an amplitude of 2 degrees pk-pk and a frequency of 20 Hz. Tensioner break in is to be performed prior to all testing and pre-test (0 hour) inspections.

3.2.5 Tensioner (Load) Output

Tensioner output is the force or torque of the tensioner due to the spring. Output is measured dynamically. The tensioner should be tested at 20 ±5 °C, with an amplitude of 2 degrees pk-pk and a frequency of 20Hz. Output should be reported as torque (N-m) at the nominal arm position and a full hysteresis curve of torque or force vs. arm position should be provided. The reported data should include 5 cycles after warmup/break-in has been reached.

#### 3.2.6 Damping

Damping is the force that opposes the displacement of the tensioner arm. Damping is measured dynamically. The tensioner should be tested at 20 ±5 °C, with an amplitude of 2 degrees pk-pk and a frequency of 20Hz. Damping should be reported as energy (N-cm/mm) and a full hysteresis curve of torque or force vs. displacement should be provided. Damping may also be requested in %, force, or torque. The reported data should include 5 cycles after warmup/break-in has been reached.

## 4. CONTAMINATION TEST

### 4.1 Purpose

To evaluate performance and durability by exposing the tensioner to a contaminated environment

### 4.2 Equipment

The test stand is a chamber capable of operating in the range of 15 to 50 °C. The tensioners are to be installed in vehicle nominal position with correct hub load and gravity bias direction. The tensioners are to be actuated by a belt, cable, rod, or chain attached to an eccentric pulley.

### 4.3 Test Parameters

#### 4.3.1 Contamination Solution

Water
Salt (NaCl) 0.3%
Clay (Bell Dark) 5%

The tolerance on the % mass of the contaminants is: ± 10%

NOTE: The contamination concentration must be verified on the output side of the nozzle, not what is in the holding tank. Proper concentration of contamination solution must be maintained throughout the test. A study should be conducted to understand concentration change over time, and monitoring during testing may be necessary to insure proper concentration.

#### 4.3.2 Spray Nozzle(s)

McMaster Carr 3282K54. Hi volume, clog-resistant, full cone, $60^o$, 2.6 GPM @40PSI.

NOTE: The width of the actual spray angle will be approximately $30^o$ under the conditions specified for this procedure

#### 4.3.3 Nozzle Location and Orientation:

One nozzle per tensioner, centered (L-R) on the spring case, aimed upward at 45 degree angle. Distance from tip of the nozzle to the center of the spring case to be 150 mm ± 2 mm.

#### 4.3.4 Deflector Shield

360 degree coverage. Shield radius to be 175 mm ± 10 mm. Depth of shield should be 150 mm minimum from tensioner mounting datum. Tensioner is to be mounted in middle of deflector shield. The purpose of the deflector shield is to simulate the spray redirection that would occur underhood. The deflector shield also serves the purpose of eliminating cross-spray between test samples when multiple samples are run in the same test chamber.

4.3.5 Spray pressure: 8 PSI

4.3.6 Spray time @pressure @nozzle: 10 second

4.3.7 Flow/nozzle/10 sec spray: 550 ml ± 20 ml

4.3.8 Spray frequency: 1 application per hour

4.3.9 Cabinet temperature: 15 to 50 °C

4.3.10 Tensioner arm actuation method: cable, chain, belt, rod, etc.

4.3.11 Tensioner arm amplitude and frequency: 3 degrees pk-pk, 20 Hz

4.3.12 Test duration: 100 hours

4.3.13 Recommended sample size: 6 tensioners

4.4 Procedure

4.4.1 Perform pre-test inspection after tensioner break in for alignment, offset, load output, and damping.

4.4.2 Install tensioner(s) on test stand, in vehicle orientation at proper nominal arm angle and hubload direction.

4.4.3 Begin tensioner actuation. After 30 minutes of testing, apply a 10s spray of contamination solution per 4.3. After the first application, repeat a 10 second spray every hour. Continue testing for 100 h.

4.4.4 At the completion of 100 hours of testing, remove the parts for inspection. It is recommended that 3 parts be removed and inspected within 24 hours. It is recommended that the remaining 3 parts be locked in nominal position, with the reaction force on the arm at the proper centerline, and soaked for 14 days at ambient temperature and humidity conditions. Inspection should include all items in 3.2, with breakaway torque only measured on the tensioners that have completed the 14 day soak.

4.5 Failure Criteria

The components must remain functional at the end of test and must comply to agreed upon limits for the following parameters:

a. The noise level cannot exceed agreed limit throughout the duration of the test.

b. Parallelism.

c. Offset

d. Load Output

e. Damping.

f. Contamination ingress

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 higher amplitude to induce wear surface failure which would be a secondary failure.

## 5. HOT BOX DURABILITY TEST

### 5.1 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.

### 5.2 Equipment

The test stand is an environmental chamber capable of maintaining a minimum of 115 ± 5 °C. The tensioners are actuated by cables or a belt attached to an eccentric pulley. Test chamber examples are shown in section 3. Thermocouples should be installed internal to the tensioner to measure temperature of the plastic components at the wear surface interface.

### 5.3 Test Parameters

5.3.1 Cabinet temperature: 90 to 115 °C. Set final cabinet temperature to keep plastic components within operating temperature limit during chosen operating parameters (frequency and arm amplitude)

5.3.2 Tensioner arm actuation method: cable or belt

5.3.3 Tensioner arm amplitude: Application specific. Typical range is 2 degrees pk-pk to 4 degrees pk-pk

5.3.4 Tensioner arm frequency: typical test range is 20Hz to 30Hz

5.3.5 Test duration: Application and market dependent. Recommend a minimum of 200 hours.

5.3.6 Contamination: A contamination cycle may be added at the discretion of the OEM

5.3.7 Recommended sample size: 6 tensioners

### 5.4 Procedure

Install the tensioners in a test chamber. Set test chamber temperature per 5.3.a. Actuate the tensioners based on the application (see 5.3.c and 5.3.d). Every 24 hours, verify tensioner amplitude is within test specification, inspect visually and check for no audible noise of the components. Resetting tensioner amplitude (if it falls outside of specification during the test), should be agreed with by the OEM prior to the start of the test. Inspect the tensioners at pre-test (after break in), 200 hours, and every 200 hours until the full test duration is complete. Inspection should include all items in 3.2. Perform a final inspection once the final test duration has been achieved.

### 5.5 Failure Criteria

The components must remain functional at the end of test and must comply to agreed upon limits for the following parameters:

a. The noise level cannot exceed the agreed limit throughout the duration of the test.

b. Parallelism.

c. Offset

d. Load Output

e. Damping.

f. Contamination ingress (if applicable)

g. Wear

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. LIFT FEATURE TEST

### 6.1 Purpose

To test the effect on tensioner offset and parallelism due to cycling the tensioner arm to the installation stop with high force. To determine the strength of the lift feature of the tensioner.

### 6.2 Equipment

The fixture must be able to withstand the force necessary to break the lift feature of the tensioner. Use a torque wrench capable of measuring and recording peak torque. OEM is to specify the torque wrench arm length and extension/socket length.

### 6.3 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 stop position. 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).

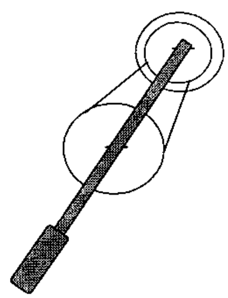

***Figure 3 - Torque wrench orientation***

### 6.4 Failure Criteria

The components must remain functional at the end of test and must comply to agreed upon limits for the following parameters:

a. Parallelism.

b. Offset

c. Load Output

d. Damping.

e. Lift feature damage

NOTE: Functional measurements of alignment and offset should be made at in vehicle geometry nominal position.

## 7. OZONE TEST

### 7.1 Purpose

To test all exposed plastic for cracking resistance when subjected to a test chamber containing ozone.

### 7.2 Test Equipment

See ASTM D 1149-XX (refer to latest level)

### 7.3 Procedure

See ASTM D 1149-XX (refer to latest level)

### 7.4 Failure Criteria

7.4.1 Cracks visible to the unaided eye.

## 8. SAFETY DROP TEST

### 8.1 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.

### 8.2 Test Equipment

a. Concrete Floor

b. Measuring Tape

### 8.3 Procedure

Holding the tensioner by the pulley, drop the tensioner on a concrete floor from a height of 1.5 m (lowest point of tensioner to floor). Drop same tensioner assembly 3 times.

Sample size - An amount to be agreed to by the supplier and OEM.

### 8.4 Failure Criteria

8.4.1 Separation of the arm from the base

## 9. SNAP TEST

### 9.1 Purpose

To ensure that the tensioner assembly remains functional if during the belt installation the tensioner arm is suddenly released from the install stop position to the free arm position.

### 9.2 Equipment

The test fixture must be capable of holding the tensioner. A device must be present to rotate the tensioner to the install stop position and then instantaneously release the arm allowing it to “snap” to the free arm position.

### 9.3 Procedure

Install the tensioner assembly, including the pulley, in the test fixture. Rotate the tensioner to the install stop position and hold to prevent rotation. Release the arm allowing it to “snap” to the free arm position. Each part should be tested 5 times.

9.4 Acceptance Criteria

The components must remain functional at the end of test and must comply to agreed upon limits for the following parameters:

a. Parallelism.

b. Offset

c. Load Output

d. Damping.

e. Arm stop failures

NOTE: Functional measurements of alignment and offset should be made at in vehicle geometry nominal position.

10. CORROSION TEST

10.1 Purpose

To evaluate performance and durability by exposing the tensioner to a corrosive environment

10.2 Equipment

The test stand is a chamber capable of operating in the range of 15 °C to 50 °C. The tensioners are to be installed in vehicle nominal position with correct hub load and gravity bias direction. The tensioners are to be actuated by a belt, cable, or chain attached to an eccentric pulley.

10.3 Test Parameters

a. Corrosion Solution

Water
Salt (NaCl) 0.5% mass

The tolerance on the % mass of the contaminants is: ± 0.1%

NOTE The concentration of the corrosion solution must be verified on the output side of the nozzle, not what is in the holding tank.

b. Spray Nozzle(s): McMaster Carr 3282K54. Hi volume, clog-resistant, full cone, 60°, 2.6 GPM @ 40 PSI.

NOTE: The width of the actual spray angle will be approximately 30° under the conditions specified for this procedure

c. Nozzle Location and Orientation: One nozzle per tensioner, centered (L-R) on the spring case, aimed upward at 45 degree angle. Distance from the tip of the nozzle to the center of the spring case to be 150mm ± 2mm.

d. Deflector Shield: 360 degree coverage. Shield radius to be 175 mm ± 10 mm. Depth of shield should be 150mm minimum from tensioner mounting datum. Tensioner is to be mounted in middle of deflector shield. The purpose of the deflector shield is to simulate the spray redirection that would occur underhood. The deflector shield also serves the purpose of eliminating cross-spray between test samples when multiple samples are run in the same test chamber.

e. Spray pressure: 8 PSI

f. Spray time @pressure @nozzle: 10 seconds

g. Flow/nozzle/10 second spray: 550 ml ± 20 ml

h. Test Cycle: One 24 hour cycle consists of a 10 minute spray application, followed by a 6 hour soak and another 10 minute spray application, followed by a 17 hour 40 minute soak.

i. Cabinet temperature: 15 to 50 °C

j. Tensioner arm actuation method: cable, chain, belt

k. Tensioner arm amplitude and frequency: 2 degrees pk-pk, 20Hz

l. Test duration: 480 hours (20 cycles)

m. Recommended sample size: 6 tensioners

10.4 Procedure

10.4.1 Perform pre-test inspection after tensioner break in of alignment, offset, load output, and damping.

10.4.2 Install tensioner(s) on test stand, in vehicle orientation at proper nominal arm angle and hubload direction.

10.4.3 Begin tensioner actuation. Apply a 10 second spray of contamination solution per 10.3, once per minute for 10 minutes.

10.4.4 Stop tensioner actuation. Keep tensioner stationary at nominal vehicle arm angle, without spray, for 6 hours.

10.4.5 Begin tensioner actuation. Apply a 10 second spray of contamination solution per 10.3, once per minute for 10 minutes.

10.4.6 Stop tensioner actuation. Keep tensioner stationary at nominal vehicle arm angle, without spray, for 17 hours 40 minutes.

10.4.7 Repeat steps 10.4.3 through 10.4.6 for 480 hours.

10.4.8 At the completion of 480 hours of testing, remove parts for inspection. It is recommended that 3 parts be removed and inspected within 24 hours. It is recommended that the remaining 3 parts be locked in nominal position, with the reaction force on the arm at the proper centerline, and soaked for 14 days @ambient temperature and humidity conditions. Inspection should include all items in 3.2, with breakaway torque only measured on the tensioners that have completed the 14 day soak.

10.5 Failure Criteria

The components must remain functional at the end of test and must comply to agreed upon limits for the following parameters:

a. The noise level cannot exceed agreed limit throughout the duration of the test.

b. Parallelism.

c. Offset

d. Load Output

e. Damping.

f. Contamination ingress

g. Corrosion damage

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.

## 11. NOTES

### 11.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

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