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Automatic Slack Adjuster Test Procedure

**SAE Recommended Practice
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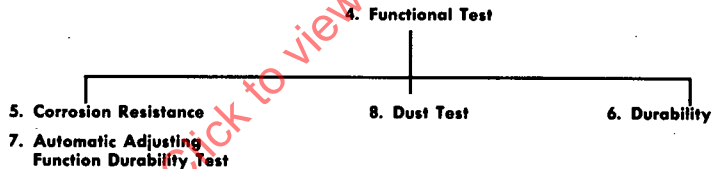
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Ø **AUTOMATIC SLACK ADJUSTER TEST PROCEDURE**

1. **PURPOSE:** This SAE Recommended Practice establishes an accelerated laboratory test procedure for automatic slack adjusters to determine the integrity and durability in various functional modes and environmental conditions.
2. **SCOPE:** This recommended practice is intended for testing of automatic slack adjusters as they are used in service, emergency, or parking brake systems for vehicles that can be licensed for on-road use.
3. Units to be tested per the schedule shown in Fig. 1.



NOTE: No modifications such as cleaning, regreasing, or repairs are to be made from test to test except as outlined in paragraph 6.3.

FIG. 1 - SEQUENCE OF TESTS

4. **FUNCTIONAL TEST:** At ambient temperature of $80 \pm 20^{\circ}\text{F}$ ($27 \pm 11^{\circ}\text{C}$), the following functional tests should be performed.

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- 4.1 Adjusting Torque: Per the manufacturer's recommendations, rotate the adjusting shaft until the worm wheel has made one revolution in the brake applied direction and then in the brake released direction. Record the maximum torque in each direction.
- 4.2 Backlash: Mount a slack adjuster in an appropriate rigid fixture so that no movement is allowed between the fixture and the worm wheel. Measure and record the free movement of the slack adjuster arm at a distance of 6 in (152.4 mm) from the center of the worm wheel by applying a torque of 60 ± 3 in lb (6.78 ± 0.34 Nm) in each direction. Rotate adjusting shaft such that the worm wheel rotates to a new position of 72 ± 3 deg from the previous position and make the backlash check. Repeat this procedure until five measurements have been made covering the worm wheel circumference. Measurements may be taken at any arm length; however, the data shall be factored in terms of 6 in arm lengths.

5. TEST EQUIPMENT:

- 5.1 Environmental Chamber: A salt spray cabinet may be constructed with the following specifications:

- Approximate size 18 in x 18 in x 12 in (457.2 mm x 457.2 mm x 304.8 mm) deep,
- The chamber preferably is constructed of metal and lined with impervious plastic, rubber, or epoxy material,
- All piping which contacts the salt solution should be of inert material such as plastic. A vent pipe to be installed to minimize back pressure,
- An air chamber is to be mounted externally with the push rod extending into the chamber, a suitable boot is to be used to minimize loss of solution,
- The adjuster is to be mounted on a spline shaft which can be rotated to simulate lining wear,
- A salt solution per paragraph 5.2 must be maintained to a depth of 2.00 in (50.8 mm) $\pm$ 0.25 in (6.4 mm) during the test,
- The exhaust air from the air chamber is to be piped into the solution reservoir. The force of the exhaust air, when directed into the solution, must be capable of splashing and totally covering the test adjuster with solution.

- 5.2 Durability test with contamination. An ambient temperature of $80^{\circ}\text{F} \pm 20^{\circ}\text{F}$ must be maintained.

- 5.2.1 Mount slack adjuster in a sealed environmental chamber capable of splashing and totally covering the test adjuster with solution during each application.

- 5.2.2 Mix a contaminated solution in the following proportions:

850 ml	Distilled Water
100 g	Coarse test dust (SAE J726b)
45 g	Sodium Chloride (99.9% Pure Granular or Flake)
5 g	Calcium Chloride (Technical Flake Grade)

5.3 General Test Set-Up:

- 5.3.1 Position the slack adjuster as recommended by the manufacturer.
- 5.3.2 Establish a residual torque of 200 ± 100 in-lb ($22.6 \text{ Nm} \pm 11.3 \text{ Nm}$) on the slack adjuster.
- 5.3.3 With the test torque applied and the unit adjusted to the above requirements, position a shut-off device so that an overstroke of 0.25 in maximum (6.4 mm) at 6 in (152.4 mm) equivalent lever length will discontinue the test.
- 5.3.4 Apply the test torque against a resisting force resulting in a total deflection rate of 15-30 deg min per 1000 in-lb torque (113 Nm).
- 5.3.5 Establish the necessary time cycle controls to obtain the torque application and release requirements per the following table (based on 30 cpm):

Total cycle time of 2 s
Maximum application time .35 s
Minimum dwell time 1.00 s
Release to residual torque for balance of cycle time.

- 5.3.6 To simulate lining wear, the worm wheel shall be rotated in the same direction that the load is applied at a rate of 0.5 deg per 250 cycles of test operation.
- 5.3.7 The slack adjuster test cycle shall be run in the following sequence at 9% of rated torque:
 - 25 000 cycles with contamination
 - Rest for 72 h
 - 25 000 cycles without contamination
 - 25 000 cycles with contamination
 - Rest for 72 h
 - 25 000 cycles without contamination

- 5.3.8 Record whether or not the slack adjuster triggered the shut-off device.

6. DURABILITY: Conduct this test at ambient temperature of $80 \pm 20^\circ\text{F}$ ($27 \pm 11^\circ\text{C}$).

6.1 General Test Setup:

- 6.1.1 Position the slack adjuster on the test fixture.
- 6.1.2 Adjust the unit so that with the rated torque (manufacturer's recommended load x effective lever length) applied, the actuator push rod is perpendicular (90 ± 3 deg) to the effective lever arm of the slack adjuster.

- 6.1.3 Establish a residual torque of $200 + 100$ in lb ($22.6 + 11.3$ Nm) on the slack adjuster. This simulates internal brake frictions and brake return springs (where applicable).
- 6.1.4 With the rated torque applied and the unit adjusted to the above requirements, position a shut off device so that an equivalent overstroke of 0.25 in max (6.4 mm) at 6 in (152.4 mm) lever length will discontinue the test.
- 6.1.5 Apply the test torque per paragraph 6.2.2 against a resisting force resulting in a total deflection rate of 15-30 deg min per 1000 in lb torque (113 Nm).
- 6.1.6 Establish the necessary time cycle controls to obtain the torque application and release requirements per the following table (based on 30 cpm):

Total cycle time 2 s
Maximum application time 0.35 s
Minimum dwell time 1.00 s
Release to residual torque for balance of cycle time

6.2 Gear Set Integrity Test:

- 6.2.1 Provide a reference mark on the adjusting shaft and worm wheel to assure return to original position after torque check per paragraph 6.2.3.
- 6.2.2 The slack adjuster test cycle shall be run in the following sequence:

Number of Cycles	Percent of Rated Torque
155 000	40
35 000	60
8500	80
1500	100

- 6.2.3 Measure and record the adjustment torque per the following schedule:

Number of Cycles

50 000
100 000
155 000
190 000
198 500
200 000

Per the manufacturer recommendations, rotate adjusting shaft five turns in brake applied direction and ten turns in brake released direction. Record max torque in each direction. Return the adjusting shaft to the original position and continue the test.

6.3 Housing Integrity Test:

- 6.3.1 After completion of paragraph 6.2.3, continue cycling at rated torque for 30 000 cycles. Repositioning or replacing of the gear set or its equivalent is permissible at any time during the housing test.
- 6.3.2 Inspect for visible structural fractures through use of dye penetrant and record the findings.

7. AUTOMATIC ADJUSTING FUNCTION DURABILITY TEST: Conduct this test at ambient temperature of $80 \pm 20^{\circ}\text{F}$ ($27 \pm 11^{\circ}\text{C}$).

7.1 General Test Setup:

- 7.1.1 Position the slack adjuster as recommended by the manufacturer.
- 7.1.2 Establish a residual torque of 200 ± 100 in lb (22.6 ± 11.3 Nm) on the slack adjuster.
- 7.1.3 With the rated torque applied and the unit adjusted to the above requirements, position a shut off device so that an overstroke of 0.25 in max (6.4 mm) will discontinue the test. The overstroke is measured from a point on the lever arm 6.0 in (152.4 mm) from the center of the worm wheel.
- 7.1.4 Apply the test torque against a resisting force resulting in a total deflection rate of 15-30 deg min per 1000 in lb torque (113 Nm).
- 7.1.5 Establish the necessary time cycle controls to obtain the torque application and release requirements per the following table (based on 30 cpm):

Total cycle time 2 s
Maximum application time 0.35 s
Minimum dwell time 1.00 s
Release to residual torque for balance of cycle time

7.2 Gear Set and Automatic Adjustment Integrity Test:

- 7.2.1 To simulate lining wear, the worm wheel shall be rotated in the same direction that the load is applied at a rate of 0.5 deg per 250 cycles of test operation.
- 7.2.2 The slack adjuster test cycle shall be run in the following sequence:

Number of Cycles	Percent of Rated Torque
155 000	40
35 000	60
8500	80
1500	100

7.2.3 To simulate reline, where the slack adjuster may be backed off to accommodate the new lining, rotate the worm wheel 50 deg against the direction that the load is applied at 50 000 cycle increments.

7.2.4 Record whether or not the slack adjuster triggered the shut off device.

8. DUST TEST:

8.1 Cubical box inside measurement of 35.43 in (900 mm) on each side.

8.2 Dust: 4.5 kg of fine powdered cement (ASTM C150-56 Specification of portland cement) spread evenly over the bottom of the box.

8.3 General test set up is the same as paragraph 7.1 mounted within the box at least 5.9 in (150 mm) from any wall.

8.4 Cycle at 20% of rated torque for 5000 applications and while cycling, the worm wheel shall be rotated in the same manner as paragraph 7.2.1.

8.5 During cycling, the dust shall be agitated at intervals of 15 min by compressed air or blower(s) by projecting a blast of air downward into the dust for a period of 2 seconds. The dust must be completely and uniformly diffused throughout the entire cube.

8.6 Record whether or not the slack adjuster triggered the shut off device.

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