GM	WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW15956

Brake Pad Sensitivity to Salt and Water Solution

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. Definition of a standardized test method for evaluating brake pad road salt and water solution sensitivity.

1.2 Applicability. This standard is applicable to all vehicles being marketed in climates where road salt may be used to reduce the accumulation of snow or ice on the road systems.

1.3 Remarks. This standard was developed by GM Saab to address the winter driving conditions in Nordic areas where roads are heavily salted. The road salt and water splash from the roads onto the brake pads may result in a delayed braking pedal feel at the beginning of a brake apply. Any perceivable delay in braking effectiveness may result in driver dissatisfaction with the braking system. This standard is designed to evaluate the brake lining material sensitivity to the salt and water splash during brake system development.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14974 GMW15102

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.

3.1.3 Dry, level, vehicle test track suitable for continuous driving at 80 km/h and vehicle brake stops from 55 km/h. The test track must allow a road salt and water solution spray onto the brake corners from vehicle mounted spray equipment, which may result in over-spray or run-off of the solution onto the road surface.

3.1.4 A cold soak chamber positioned as close to the test track as possible and capable of maintaining 0 °C temperature is required.

3.2 Equipment.

3.2.1 A pressure gauge in the primary brake hydraulic circuit shall be used to measure front brake pressure.

3.2.2 An accelerometer mounted on the right sear girder shall be used to measure vehicle deceleration.

3.2.3 Thermocouples mounted in the outboard brake pads on the front corners shall be used to measure brake pad temperatures.

Optional: Thermocouples according to GMW14974.

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3.2.4 A pressure reduction valve shall be installed in the primary brake hydraulic circuit to regulate hydraulic pressure.

3.2.5 A spray system for applying a salt and water solution on the brake pads shall be mounted just behind the front brake calipers.

3.2.5.1 A water man container or similar container should be fitted with two hoses from the container drain outlet to the inlets of two water pumps. The water pumps should be fitted with hoses at the outlets that connect to drilled brake tubes that fit over the brake disks on the left and right sides of the vehicle. See Appendix A, Figure A1 for a photograph of an example of the spray equipment.

3.2.5.2 The drilled brake tubes should be configured for the specific test vehicle brake corner. The tubes should fit over the brake disks and should be have a flange or tab that allows the tubes to be firmly bolted in place. Spray the salt and water solution rectangular in a distance of (10 to 15) mm onto the rotor (incoming direction to pad) with a volumetric flow of (0.4 to 0.7) l/minute.

3.2.6 A data acquisition system capable of recording all data, except temperature, at 100 Hz is required.

3.2.7 All instrumentation shall be calibrated as required. The instrumentation identification numbers and calibration dates shall be documented in the test record or permanently stored in retrievable format by the test facility.

3.3 Test Vehicle/Test Piece.

3.3.1 The test vehicle shall be equipped with the wheels/rims that are the worst case for exposure to the salt and water solution on the brake pads.

3.3.2 Evaluations to compare candidate brake pad materials for a vehicle platform should be performed on the same car model using the same brake system and wheels/rims.

3.4 Test Time.

Calendar time:	2 days to 3 days per test
Test hours:	(12 to 16) h per test
Coordination hours:	(4 to 8) h per test

3.5 Test Required Information. Review the applicable brake subsystem and brake component technical specifications. Adapt the Calculations section of this standard as necessary to obtain the results needed for comparison to the technical specifications.

3.6 Personnel/Skills. A brake engineer or technician trained to perform the standard is required.

4 Procedure

4.1 Preparation.

4.1.1 Install instrumentation.

4.1.2 Install new front brake discs and front pads for each test run. Condition the brake parts by performing a brake burnish as specified in the test request. If a burnish is not specified, perform a 200 stop burnish following the brake burnish instructions in GMW15102.

4.1.3 Install the solution spray system.

4.1.4 Before starting the test runs, disable the rear brake corners.

4.1.5 Load vehicle to Gross Vehicle Weight Rating (GVWR).

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 The ambient air temperature at time of test shall be between +5 °C and +20 °C.

4.2.1.2 The road surface shall be dry at time of test.

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.

4.2.2.1 For each test build, run the Reference Test according to 4.3.1 and the Salt Penetrating Test according to 4.3.2.

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4.2.2.2 Five (5) samples of each pad material shall be tested unless otherwise specified.

4.3 Instructions.

4.3.1 Reference Test.

4.3.1.1 Following the preparation from 4.1, park the vehicle in a cold chamber with temperature maintained between 0 °C and +2 °C for ≈ 8 h. Ice build-up on the front brake discs should be avoided.

4.3.1.2 After the soak, drive the vehicle out of the cold chamber to the test track. Avoid using the service brakes because the initial brake temperature (IBT) for the stops specified in 4.2.1.3 is +3 °C maximum. When appropriate, start and check the recording equipment and instrumentation.

4.3.1.3 Perform and record the data from one brake stop as specified:

4.3.1.3.1 Brake pad IBT ≤ +3 °C.

4.3.1.3.2 Accelerate vehicle to 55 km/h. Shift transmission to Neutral. Let vehicle coast.

4.3.1.3.3 When the vehicle speed has reached 50 km/h, make a complete stop with an apply rate where 50 bar pressure is obtained within 0.5 s from start of brake apply.

4.3.2 Salt Penetrating Test.

4.3.2.1 Total mileage = 120 km.

4.3.2.2 Vehicle speed = 80 km/h.

4.3.2.3 Spray the brake pads with the road salt solution as defined in 7.1, 10 % of the driving distance: 100 m per 1000 m.

4.3.2.4 For any braking during the salt penetrating test miles, the salt solution should spray the brake pad.

4.3.2.5 Immediately after the completed salt penetration, the vehicle shall be placed in the cold chamber according to 4.3.1.1.

4.3.3 Reference Test 2. Repeat 4.3.1.2 through 4.3.1.3.3.

5 Data

5.1 Calculations.

5.1.1 Graphical Presentation. The recorded deceleration data shall be plotted versus time for all test runs. Labeling should indicate the pad material and sample number for each test run. If the requirements are available from the technical specifications, include the requirements in the graph. See Appendix A, Figure A3 for an example graph.

5.1.2 Numerical Presentation. Create a table to summarize the deceleration versus time data. Labeling should indicate the pad material and sample number for each test run. If the requirements are available from the technical specifications, include the requirements in the table. See Appendix A, Table A1 for an example summary table.

5.1.3 Subjective Evaluation. For each test run, evaluate the pedal feel and responsiveness of the brake system using the subjective rating scale in Appendix A, Table A2. The subjective ratings should be presented in a summary table.

5.2 Interpretation of Results.

5.2.1 Where five samples were tested, an average value representing the performance results may be reported. This average value should be calculated by excluding the data from the tests with the best and worst results, and then averaging the results from the remaining three tests.

5.2.2 Results shall be compared to applicable technical specifications.

5.2.3 Results may be used to compare performance among various pad materials when the testing was performed per 3.3.2.

5.3 Test Documentation. All test results shall be published in an Evaluation Report using the GM corporate Evaluation Report template, or equivalent, in the Engineering Document Management (EDM) system or its successor.

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