



Parking Brake Cable Test

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. This standard sets forth the global procedure for testing of parking brake cables that are supplied to General Motors.

1.2 Applicability. This is a standard applicable to all parking brake cable constructions and vehicle platforms.

2 References

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

2.1 External Standards/Specifications.

ISO 12103-1

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- ACT Test Panel Technologies, Hillsdale, Michigan, USA (<http://www.acttestpanels.com/home.aspx>)
- Auto Technology Company, Strongsville, Ohio, USA (<https://autotechnology.com>)
- National Exposure Testing, Sylvania, Ohio, USA (www.nationalexposuretesting.com)
- Powder Technology Inc., Arden Hills, Minnesota, USA (<http://www.powdertechinc.com/>)

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 Cold Chamber. A chamber capable of maintaining temperatures of $-40\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The cold chamber should be capable of obtaining the required temperature within 1 h after inserting the material.

3.2.2 Humidity Booth. The cable containment chamber that provides a temperature of $38\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ and relative humidity of 98% to 100%. Plant steam is not allowed as a humidity source. The chamber should be able to attain the required temperature and humidity within 1 h after inserting the material.

3.2.3 Water Intrusion Spray Nozzle. A spray nozzle with high velocity discharge should be used. The spray pattern should be a 30 degree full cone with a flow rate of 15 Liters per minute (L/minute) to 26.5 L/minute at 138 kPa (4 gal/minute to 7 gal/minute at 20 psi).

3.2.4 Salt Solution. The solution used has a pH of 6 to 7 and is made by dissolving rock salt in distilled water to achieve a 5% by weight sodium chloride solution. This solution should be determined and monitored by direct measurement of Chloride concentration or of solution specific gravity whenever possible. Making the 5% solution

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via mass portions is also acceptable. The weight percent of salt is calculated by percent (mass of salt ÷ (mass of salt + mass of water)) multiplied by 100 to obtain a 5% solution. It follows that mass of water multiplied by 0.053 equals the mass to be added.

3.2.5 Salt Applicator. A siphon spray powered by regulated plant compressed air typically is used. A hand operated pump sprayer (window cleaning solution bottle) may also be used.

3.2.6 Corrosion Booth. The temperature and Relative Humidity (RH) tolerances are $38\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ and 98% to 100% relative humidity respectively. Humidity levels are best achieved by direct evaporation or atomization of water with a pH between 5.6 and 7. The use of plant steam as humidity source should be avoided. The corrosion booth should be capable of obtaining the required temperature and humidity within 1 h after inserting test material.

3.2.7 Grit Solution. A composite of 75% Arizona fine sand and 25% fire clay mixed in distilled water. The total volume of water should be twice the volume of the composite. The depth of the sand and clay material should not be < 50 mm deep before adding the water. (Dust Type: Arizona Dust conforming to ISO 12103-1, A2 Fine, procured from Powder Technology Incorporated of Burnsville, Minnesota. Dust may also be purchased from ACT Test Panel Technologies, Auto Technology Company, and National Exposure Testing).

3.3 Test Vehicle/Test Piece. Refer to technical specifications for sample requirements and sample size or as in test request.

3.4 Test Time.

Calendar time: 115 days

Test time: 2400 h

Coordination time: 15 h

3.5 Test Required Information. All cables must begin the test in a condition as would be received by an assembly plant. Each cable must carry on through the procedure in the order specified herein. Upon completion of these tests, the source will submit all results to the responsible GM Designing Engineer. The submitted report must show the complete results of each step. Parts that have completed 4.3.4 should be retained at the cable supplier; available for review, for a period of 3 years from the end of the test.

3.6 Personnel/Skills. Brake technicians or engineers trained to perform the instructions in section 4.

4 Procedure

4.1 Preparation. Not applicable.

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 Deflection and Load Efficiency.

4.3.1.1 Twenty (20) new cable sets that have not been exposed to any loads (other than a normal post-manufacturing tension check) are required to complete 4.3.1. Any accidental test error that requires measurements to be restarted must be done on a new cable (i.e., the cable being measured at the time of the test error must be scrapped).

4.3.1.2 Route the entire cable system to the in-car position, as shown on the latest math file available from the GM responsible engineer (any return springs included in the cable designs are to be removed for this portion of the test). Use production intent connectors, equalizers, clips, and guides.

4.3.1.3 Anchor the output end(s) of the cable system such that no deflection can occur to 4500 N.

4.3.1.4 Apply a 100 N preload to set the cable(s) into test position. This point (100 N) will be the zero deflection point.

4.3.1.5 Apply an input load continuously and uniformly up to 4500 N. When input loads of 1500 N, 3000 N, and 4500 N are reached, hold for one (1) minute, and return to the zero point (100 N). Wait 10 minutes, and record

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the strand input position relative to the zero deflection point from 4.3.1.4 (this number represents the total permanent set).

4.3.1.6 Apply an input load continuously and uniformly up to 4500 N. Record the strand deflection at the input end, and system output loads vs. system input load in a minimum of 50 N increments. The strand deflections measured at this point represent elastic deflection.

4.3.1.7 Plot total permanent deflection vs. primary cable input load at 1500 N, 3000 N, and 4500 N.

4.3.1.8 Plot left and right output load vs. primary cable input load.

4.3.1.9 Plot total elastic deflection vs. primary cable input load.

4.3.2 Continuously Sealed Strand Test.

4.3.2.1 Six (6) cables are required to complete 4.3.2. Samples of recent production strand are acceptable to avoid destroying entire cables.

4.3.2.2 Apply a 4000 N load to a new cable assembly (in any routing).

4.3.2.3 Cut off strand end fittings such that a test piece of 300 mm (maximum) is obtained. No sealing of cut strand ends is allowed.

4.3.2.4 Seal a 50 kPa vacuum pump at one of the ends and deposit the other end of the strand into a beaker full of brightly dyed water. Hold for 30 minutes.

4.3.2.5 Record the amount of water that travels through the test specimen.

4.3.3 General Tests.

4.3.3.1 Six (6) cables are required to complete 4.3.3.

4.3.3.2 Breakaway Force.

4.3.3.2.1 Configure cable as shown in Appendix A, Figure A1 at ambient temperature ($22\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$).

4.3.3.2.2 After a 4 h soak, record the peak load to start the strand moving in the conduit ("breakaway force") within 2 minutes from removal from the temperature chamber.

4.3.3.2.3 Repeat 4.3.3.2.1 thru 4.3.3.2.2 at $100\text{ }^{\circ}\text{C}$, and again at $-40\text{ }^{\circ}\text{C}$.

4.3.3.3 Mechanical Strength.

4.3.3.3.1 Configure cable as shown in Appendix A, Figure A1 at ambient temperature. Use production intent strand connectors.

4.3.3.3.2 Apply 10 cycles from 440 N to 3550 N in tension.

4.3.3.3.3 Load strand assembly slowly to 6300 N in tension, and 6300 N to conduit assembly in compression.

4.3.3.3.4 Maintain the strand at 6300 N in tension and the conduit at 6300 N in compression for 15 minutes.

4.3.3.3.5 Record amount of conduit end fitting and strand end fitting slippage (also note load at which slippage begins to occur, if any).

4.3.3.3.6 Inspect cable, conduit ends, strand end fittings, and point of attachment components for evidence of failure.

4.3.3.3.7 Repeat 4.3.3.3.1 thru 4.3.3.3.6 after soaking the cables 4 h at $-40\text{ }^{\circ}\text{C}$, and again after soaking 4 h at $115\text{ }^{\circ}\text{C}$.

4.3.3.4 Conduit End Fitting Retention.

4.3.3.4.1 Load conduit end fittings to 500 N in tension or to failure.

4.3.3.4.2 Record load at which conduit end fitting separates from the conduit.

4.3.3.5 Conduit Sleeve Slip Resistance.

4.3.3.5.1 Apply an axial load of 100 N maximum to conduit-mounted noise insulator and/or abrasion sleeves, and fixed locator tubes, as shown in Appendix A, Figure A2.

4.3.3.5.2 Record insulator/abrasion sleeve movement of the free end.

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4.3.3.6 Water Intrusion.

4.3.3.6.1 At $22\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$, configure cable assembly as shown in Appendix A, Figure A3 and spray cable for 5 s (see glossary for nozzle and flow information).

4.3.3.6.2 With the input strand held at 5 degrees (minimum) from horizontal, stroke the strand 25 mm to 30 mm for five (5) cycles.

4.3.3.6.3 Keeping strand at 5 degrees, repeat spraying and stroking four (4) additional times.

4.3.3.6.4 Repeat 4.3.3.6.1 thru 4.3.3.6.3, but keep strand at -5 degrees (minimum) from horizontal.

4.3.3.6.5 Place assembly at $-40\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 4 h, with the cables routed as in Appendix A, Figures A5 and A6.

4.3.3.6.6 Record maximum breakaway effort, in both directions, measured in the cold temperature chamber.

4.3.3.6.7 Configure cable assembly as shown in Appendix A, Figure A4 and spray cable for 5 s (see 7.1 for nozzle and flow information).

4.3.3.6.8 Cycle conduit 20 times at the rate of 0.5 Hz to 30 degrees (minimum) from horizontal while continuing to spray.

4.3.3.6.9 Place assembly at $-40\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 4 h, with the cables routed as in Appendix A, Figures A5 and A6.

4.3.3.6.10 Record maximum breakaway effort, in both directions, within 2 minutes from removal from the temperature chamber.

Note: Re-soak cables in the cold chamber for 4 h before performing breakaway measurements in the opposite direction.

4.3.3.6.11 Repeat 4.3.3.6 with the cables starting at $-4\text{ }^{\circ}\text{C}$ and also $115\text{ }^{\circ}\text{C}$ (attained by 4 h soak at each temperature).

4.3.3.7 Lubricant Leakage.

4.3.3.7.1 Position test assembly with both ends pointing down and routed through a 180 degree bend, as shown in Appendix A, Figure A7.

4.3.3.7.2 Soak at $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 4 h.

4.3.3.7.3 Record amount of lubricant collected into the test containers.

4.3.3.8 First Wear Life.

4.3.3.8.1 Route cable/cable assembly as described in 4.3.1.2.

4.3.3.8.2 Load each cable from 100 N up to the maximum service load as specified in the work request with a travel of 25 mm to 50 mm.

4.3.3.8.3 Repeat for a total of 50 000 cycles. Ten percent (10%) of these cycles should be done with the system in a $-40\text{ }^{\circ}\text{C}$ environment, and 10% of the cycles at $85\text{ }^{\circ}\text{C}$.

4.3.3.8.4 Inspect cables for cracks, frays, or other failures.

4.3.3.8.5 Repeat 4.3.1 and 4.3.3.6 using these six (6) cables.

4.3.4 Environmental Life Test.

4.3.4.1 Introduction. Accelerated corrosion is a method of estimating the corrosion performance of vehicle components. This specification describes a laboratory test which will accelerate corrosion. The test provides a combination of conditions (salt, moisture, temperature, humidity and dry air) in a cyclic fashion to accelerate metallic corrosion. Test material should be mounted on a fixture (cart) to facilitate movement into and out of the corrosion booth.

4.3.4.2 Sample Size. Use same six (6) cables from 4.3.3.1 to complete 4.3.4 thru 4.3.6.

4.3.4.3 Procedure Outline.

Note: For cables using wire rope strand construction, the following cable preparation must be done:

- Place cable assembly ends in pressurized chamber as illustrated in Appendix A, Figure A8.
- Remove a 10 mm long section of strand coating from each end of the cable; making sure that the bare material strand is exposed fully. These cut sections should be located midway between each strand end fitting and its nearest conduit end fitting (see Appendix A, Figure A9). This procedure of cutting the strand is done to simulate the cutting that may occur due to assembly plant installation, stone impingement and service.

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