GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW15835

Rear Wiper System

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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 defines the testing methodology and requirements for validating rear wiper systems to GM requirements.

1.2 Applicability. This document is applicable for all car, Multipurpose Passenger Vehicle (MPV), and truck models produced by GM with rear wiper systems. Rear wiper systems components include wiper motor/transmission, wiper arm, wiper blade, wiper arm beauty cap/covers, water seals, park ramp and any attaching hardware. This procedure does not cover front windshield wiper components. It also does not cover washing system components unless washer nozzle/hoses are attached to one (1) of the rear wiping system components.

1.3 Remarks. This document is the GM Worldwide rear wiper testing standard. Its purpose is to establish a common test methodology for rear wiper systems to ensure that a high quality world class system is consistently developed and produced. This is a living document and any suggestions or revisions will be reviewed and/or updated annually by the Wiper and Wash Systems Global Subsystem Leadership Team (GSSLT).

This procedure does not fulfill any GMW3172 requirements specified in the Subsystem Technical Specifications (SSTS). A separate “motor only test plan” shall be developed with GM Validation to meet GMW3172 requirements.

2 References

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

2.1 External Standards/Specifications.

IEC 60068-2-27 SAE J903

2.2 GM Standards/Specifications.

GM4483M GMW3172

2.3 Additional References.

- 5-Phase Document.
- GM Security Guidelines.
- Subsystem Technical Specifications (SSTS).

3 Resources

3.1 Facilities. No special facilities required.

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 Thermal Chamber large enough to minimally contain one (1) test buck and capable of -40 °C to 95 °C with controlled humidity.

3.2.1.1 Body test buck consisting of sheet metal, structure, glass, and/or park ramp.

3.2.1.2 Fabricated test buck consisting of steel mounting fixture and glass.

3.2.1.3 Electrical power supply device that reflects vehicle electrical interface (mating connector, wire gage, control box, etc.)

3.2.1.4 Water spray equipment/nozzles according to SAE J903 (820 cm^3/minute, minimum).

3.2.1.5 Tip force, attack angle gage, dynamic torque gun.

3.2.1.6 Water used shall comply with GM4483M water quality specification**.**

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3.3 Test Vehicle/Test Piece.

3.3.1 Unless otherwise specified, three (3) samples of components, or systems, shall be tested.

3.3.2 All components/systems used in testing shall be within drawing specifications and have supporting data prior to start of test.

3.3.3 Glass used for test bucks must be within drawing tolerances and no cracks or known deformities are allowed. Supplier to provide source warrants or surface data from glass supplier for each test piece.

3.4 Test Time. Time is dependent on test being performed.

3.5 Test Required Information.

3.5.1 GM Validation is to be notified of test failures within a 24 h period of occurrence.

3.5.1.1 Supplier to develop a 5-Phase document for all test failures.

3.5.2 Product Security. Security protocol for the test vehicle must be followed per GM Security Guidelines.

3.6 Personnel/Skills. A person with previous wiper test experience who has conducted similar tests for GM**.**

4 Procedure

4.1 Preparation.

4.1.1 Properly clean glass before every new test with GM approved windshield cleaner or equivalent to ensure water sheeting action is present.

4.1.2 Properly clean blade element before every new test by wiping the element with a cloth soaked in windshield washer solution.

4.1.3 Prior to test startup, operate wiper system on wet glass for 20 minutes ± 5 minutes to achieve operating temperature. Unless otherwise specified for specific test.

4.1.4 Arm to pivot shaft nut torque must be established according to 4.3.1 before system testing can be started.

4.1.5 Attack angle and arm load need to be within design specifications at park position on test buck before start of any system level test.

4.1.6 Nominal fastener torques unless otherwise specified.

4.1.7 Before attaching the wiper arms to the wiper motor, the motor must be activated once.

4.1.8 Distance between park position and window frame. Activate the wiper system for one (1) cycle on wet glass during idling. Measure the distance between the tip of the wiper blade and the lower window frame.

4.1.9 Activate the wiper system for one (1) cycle on wet glass during idling.

4.1.10 Arm load and attack angle. Use a force gage at the wiper arm tip to determine the force in park and reversal point. Before measuring, move the wiper arms into and out of service up position, three (3) on wet glass. Measure the attack angle in park and reversal point.

4.2 Conditions.

4.2.1 Environmental Conditions. The following conditions apply to all tests unless otherwise specified:

- Ambient temperature: +23 °C ± 3 °C.
- Voltage: Nominal Voltage (V_{NOM}) ± 0.3 V at motor terminals.
- Humidity is to be between 50% and 75% for all tests unless otherwise specified.
- Minimum Temperature ($\mathbf{T_{min}}$) is -40 °C unless otherwise specified.
- Maximum Temperature ($\mathbf{T_{max}}$) is +85 °C unless otherwise specified.

4.2.1.1 Emerging Market Environmental Conditions. Emerging Markets are to use the following unless stated otherwise in the program specific SSTS.

- $\mathbf{T_{min}}$ = -20 °C for India.
- $\mathbf{T_{min}}$ = -40 °C for Russia.
- $\mathbf{T_{min}}$ = -15 °C for South America Only.

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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. Unless otherwise specified, use a dynamic gun at 100 rpm to dynamically torque the nut for all tests.

4.2.2.1 Part Orientation. Parts are to be tested in vehicle orientation unless otherwise specified.

4.2.2.2 Water Hardness. Verify that the hardness of the water does not exceed 12 grains per gallon. The water hardness certification may be obtained from the local water supplier. Otherwise, contractor shall obtain an equivalent certification or conduct such test within 60 days of beginning of compliance test run. A suitable water softener shall be used if required.

4.3 Instructions. Refer to Appendix A, Figure A1, to understand the test sequencing for all test samples included in this procedure.

4.3.1 Arm Strip Torque.

Note: This test shall be completed before all other tests in this procedure.

4.3.1.1 Purpose. This test is to ensure that a wiper arm joint will not come loose during normal and restricted wipe operation.

4.3.1.2 There are two (2) procedures listed; one (1) for developing the arm nut torque and the other for confirming it.

4.3.1.3 Test Equipment. See 3.2.

- Clamping device.
- Electric dynamic torque tool equipment.
- Torque wrench.
- Arm head torque fixture.

4.3.1.4 Test Preparation. Not applicable.

4.3.1.5 Test Procedure for Nut Torque Development.

Note: If supplier has known nut torque value, skip this step and verify using nut torque confirmation test.

4.3.1.6 Test Samples. Minimum 14 painted or plastic arm heads, pivot shafts, and fastening nuts.

4.3.1.6.1 Determine maximum torque at pivot shaft with 16 V, low and high speed, maximum highest torque motor expected to be produced and arm restricted.

4.3.1.6.2 Set torque-apply equipment to a constant 50 rpm and attach wiper arm heads onto pivot shafts. At least six (6) samples of each are to be tested at torque values listed in 4.3.1.6.3.

4.3.1.6.3 Type M8 threaded shaft: 4 Nm, 6 Nm, 8 Nm, 10 Nm, 12 Nm, 14 Nm, and 16 Nm.

4.3.1.6.4 Place pivot shaft assemblies in environmental chamber and set temperature to +90 °C ± 3 °C. Maintain temperature for 16 h and then reduce temperature 23 °C ± 3 °C for 14 h.

4.3.1.6.5 At room temperature, block-arm head so it can withstand torque values up to 100 Nm. If a clamp is used to block/support the arm head, ensure minimum clamp load is used and that there is a minimum distance of 35 mm from applied clamp load to the pivot shaft to avoid inducing hoop stress into the joint.

4.3.1.6.6 Using pivot shaft torque fixture with a torque transducer apply torque in a clockwise rotation (nut tightening direction) at a speed of 100 rpm until arm head disengages from pivot shaft causing a strip condition. Record maximum strip torque versus nut torque on all samples and chart data according to Appendix B, Figure B1.

4.3.1.6.7 Appendix B, Figure B1, shows a graphical approach in determining the minimum nut torque value required. Follow the instructions in 4.3.1.6.8 through 4.3.6.8.5 to understand how to create and use this chart.

4.3.1.6.8 Plot strip-out torque versus nut torque data on an x-y scatter plot; nut torque on the X axis and strip-out torque on the Y axis.

4.3.1.6.8.1 On scatter plot, add horizontal lines at the maximum pivot shaft torque value and 125% of that value determined in 4.3.1.6.1.

4.3.1.6.8.2 Draw a best-fit line through the data from low to high nut torque.

4.3.1.6.8.3 Draw two (2) lines parallel with the best-fit line that intersects with the highest and lowest data points to get a measure of the unexplained variation.

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4.3.1.6.8.4 Find the intersection between the lower parallel line and the 125% pivot shaft output torque. Read down to the X axis to find the minimum nut torque value using a whole number. In the example in Appendix B, Figure B1, the minimum value is 7.3 Nm, so minimum nut torque is 8 Nm.

4.3.1.6.8.5 Calculate nominal nut torque value by increasing minimum value by 10%. Next, calculate maximum torque value by increasing nominal by 10%. All values must be whole numbers. For example:

- Minimum is 8 Nm.
- Nominal is 9 Nm.
- Maximum is 10 Nm.

4.3.1.7 Test Procedure for Nut Torque Confirmation.

4.3.1.7.1 Test Samples. Three (3) painted arm heads per cavity and corresponding number of pivot shafts and fastening nuts.

4.3.1.7.2 Determine maximum output torque at pivot shaft with 16 V, low speed, and arm restricted.

4.3.1.7.3 Set torque-apply equipment to a constant 50 rpm and attach wiper arm heads onto pivot shafts. At least three (3) samples from each cavity (minimum six (6) samples) are to be tested at torque values: -2 Nm below Minimum. Nominal, Maximum; +2 Nm above Maximum. Example: Confirm Torque 10 Nm ± 2 Nm would test 6 Nm, 8 Nm, 10 Nm, 12 Nm, and 14 Nm.

4.3.1.7.4 Place pivot shaft assemblies in environmental chamber and set temperature to +90 °C ± 3 °C. Maintain temperature for 16 h and then reduce temperature to +23 °C ± 3 °C for 14 h.

4.3.1.7.5 At room temperature, clamp pivot shaft in clamping device so it can withstand torque values up to 100 Nm.

4.3.1.7.6 Using arm head torque fixture and torque wrench, apply torque in a clockwise rotation (nut tightening direction), at a speed of 100 rpm until arm head disengages from pivot shaft, causing a strip condition. Record maximum torque value on all samples and chart data according to Appendix B, Figure B1.

4.3.1.7.7 Test Requirement. Requirement for nut torque confirmation is that all sampled parts must have strip-out values >125% of maximum pivot shaft output torque but <60 Nm needed to create internal motor damage. Wiper arm must strip before internal motor damage occurs.

4.3.2 Arm Head Burst Strength. Static.

4.3.2.1 Purpose. This test is to verify that the arm head design and pivot shaft are strong enough to survive over torque conditions of fastening nut.

4.3.2.2 Test Equipment.

- Clamping device.
- Electric dynamic torque tool equipment.

4.3.2.3 Test Samples.

4.3.2.3.1 Three (3) painted metal arm heads or three (3) plastic arm heads from each cavity and corresponding number of pivot shafts and fastening nuts.

4.3.2.4 Test Preparation. Not applicable.

4.3.2.5 Test Condition. Refer to specific tests within this procedure.

4.3.2.6 Test Procedure. Assemble wiper arm head to pivot shaft with fastening arm nut using electric dynamic tooling. Torque the arm nut to 1.5 times maximum specified static torque determined in 4.3.1.6 using static torque tool until failure occurs. Record the failure mode and the torque at which it occurred. If no failure mode is observed during torque, remove arm nut and inspect parts for cracks, elongation, or other failure modes. If no failure mode is observed at inspection, reassemble and torque to ultimate failure and record torque value and ultimate failure mode. Use magnification to determine if cracks appear under the nut.

4.3.2.7 Test Requirement. For metal arm head designs, the head and/or pivot shaft shall withstand a torque at least 1.5 times the maximum specified arm nut installation torque.

4.3.2.7.1 For plastic arm head designs, with metal inserts, the head and/or pivot shaft shall withstand a torque at least 2.0 times the maximum specified arm nut installation torque for service replacement.

4.3.3 Arm Head Burst Strength - Dynamic.

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4.3.3.1 Purpose. This test is to verify that the arm head design and pivot shaft are strong enough to survive over torque conditions of fastening nut.

4.3.3.2 Test Equipment.

4.3.3.2.1 Clamping device.

4.3.3.2.2 Electric dynamic torque tool equipment.

4.3.3.3 Test Samples.

4.3.3.3.1 Three (3) painted arm heads from each cavity and corresponding number of pivot shafts and fastening nuts.

4.3.3.4 Test Preparation. Not applicable.

4.3.3.5 Test Condition. See 4.2.

4.3.3.6 Test Procedure. Assemble wiper arm head to pivot shaft with fastening arm nut using dynamic torque tool. Torque the arm nut at a constant 100 rpm to 1.5 times maximum specified dynamic torque determined in 4.3.1.6.2. If no failure mode is observed during torque, remove arm nut and inspect parts for cracks, elongation, or other failure modes. Use magnification to determine if cracks appear under the nut. If no failure mode is observed at inspection, reassemble and torque to ultimate failure and record torque value and ultimate failure mode. Use magnification to determine if cracks appear under the nut.

4.3.3.7 Test Requirement. Arm head and/or pivot shaft shall withstand a torque at least 1.5 times the maximum specified arm nut installation torque.

4.3.4 Wipe Speed.

4.3.4.1 Purpose. This test is used to confirm the wiper system design meets GM's operating speed requirements. See Appendix E, Data Sheet E1.

4.3.4.2 Test Equipment. See 3.2.

4.3.4.3 Test Samples. One (1) System.

4.3.4.4 Test Preparation. See 4.3.

4.3.4.5 Test Condition. Refer to specific tests within this procedure.

4.3.4.6 Test Procedure. At +23 °C ± 3 °C, operate wiper system for one minute on wet glass and record wipe cycles during the following conditions:

- $\mathbf{V_{NOM}}$ ± 0.3 V at motor terminals, low speed.
- 9.0 V, Low speed.
- 16 V, Low speed.

4.3.4.7 Test Requirement. Must meet wipe speed at $\mathbf{V_{NOM}}$ ± 0.3 V at motor terminals according to SSTS.

4.3.4.7.1 No interference or contact with surrounding components is allowed anytime during tests.

4.3.4.8 Repeat 4.3.4.3 through 4.3.4.7 using the following for 4.3.4.6 temperature.

- -30 °C ± 3 °C for 4.3.4.6, and the wiper blades in their park position.

4.3.4.9 Test Requirement. The initial wipe cycle must operate at the nominal specified range immediately.

4.3.5 Wiper Arm Beauty Cap Retention.

4.3.5.1 Purpose. This test is done to ensure a beauty cap will maintain retention when exposed to external forces such as a car wash.

4.3.5.2 Test Equipment. See 3.2.

- Force gage with hook attachment.

4.3.5.3 Test Samples. Three (3) new caps and four (4) aged caps from each cavity and corresponding number of wiper arms, pivot shafts and fastening nuts.

4.3.5.4 Test Preparation. Create aged cap samples by exposing them in environmental chamber at 80 °C ± 3 °C for 4 h on a flat surface to relieve molding stresses.

4.3.5.5 Test Condition. See 4.2.

4.3.5.6 Test Procedure. At ambient, install wiper arm onto pivot shaft using maximum and minimum nut torque specification.

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4.3.5.6.1 Install all new cap samples and two (2) aged cap samples on wiper arm. Set force gage to record peak force and pull each cap from edge locations specified in Figure 1 by pulling upward along shaft vector measuring peak removal force.

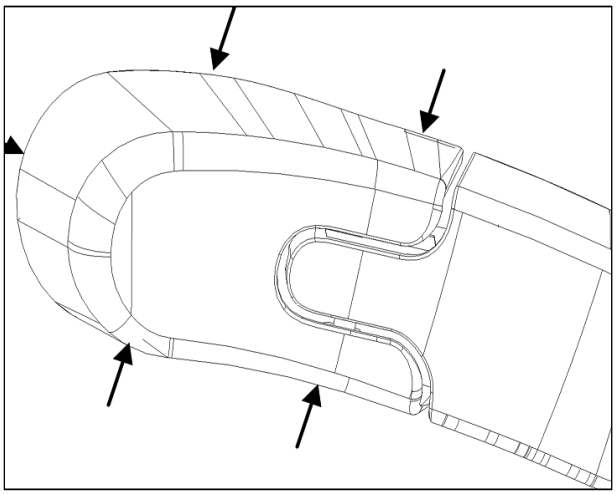

Figure 1: Beauty Cap Pull Locations

4.3.5.6.2 Install and remove all cap samples five (5) additional times for serviceability requirement.

4.3.5.6.3 Repeat 4.3.5.6.1 through 4.3.5.7 for remaining two (2) aged cap samples and three (3) new cap samples after a 4 h cold soak at -30 °C ± 3 °C.

4.3.5.7 Test Requirement. The following requirements are to be met.

- There shall be no damage to the attachment scheme.
- Force to remove wiper beauty cap, either new or aged, after first installation must be >30 N each time.
- When removed for serviceability, force to remove cap, either new or aged, must be >30 N each time. Record the first and last removal.
- When installed for serviceability, the force**,** either new or aged**,** must be within ergonomic requirements – this can be found in the ergonomic guidelines. Record the first and last installation

4.3.5.8 Repeat 4.3.5.6.1 through 4.3.5.7 for remaining two (2) aged cap samples and three (3) new cap samples after a 4 h cold soak at -30 °C ± 3 °C.

4.3.6 Motor Stall/Thermal Trip.

4.3.6.1 Purpose. This test is to verify that the wiper motor will not be damaged if the wiper system is activated with an obstruction and not able to move for an extended period of time.

4.3.6.2 Test Equipment. See 3.2.

- Electric motor dynamometer.
- Output shaft holding fixture.

4.3.6.3 Test Samples. One (1) motor.

4.3.6.4 Test Preparation. See 4.1.

4.3.6.5 Test Condition.

- -30 °C ± 3 °C.
- -5 °C ± 3 °C.
- 80 °C ± 3 °C.

4.3.6.6 Test Procedure. Prior to test, subjectively evaluate the motor/module noise (including but not limited to whine, growl, clicks, clunks, etc.) per Appendix D, Table D1, GM Subjective Rating Scale for Component Noise, under the following conditions: $\mathbf{V_{NOM}}$ ± 0.3 V at motor terminals, wet glass.

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4.3.6.6.1 Mount motor to a dynamometer and run at V_{NOM} ± 0.3 V at motor terminals with a 2.0 Nm constant load for 30 minutes. After warm up period, obtain motor performance via a speed torque curve from free speed to stall.

4.3.6.6.2 Place motor in holding fixture with output shaft restricted.

4.3.6.6.3 Soak motor at -30 °C ± 3 °C for 2 h at -30 °C, energize restricted motor for 2 h.

4.3.6.6.4 Soak motor at -5 °C ± 3 °C for 2 h at -5 °C, energize restricted motor for 2 h.

4.3.6.6.5 Soak motor at 80 °C ± 3 °C for 2 h at 80 °C, energize restricted motor for 2 h.

4.3.6.6.6 Remove motor from chamber and allow cool down for 4 h. After cool down period, repeat the performance test via the speed-torque curve.

4.3.6.6.7 Repeat motor noise evaluation.

4.3.6.7 Test Requirement. Wiper motor speed, current, and torque must not degrade more than 10% from initial performance.

4.3.6.7.1 Thermal protection device shall function accordingly.

4.3.6.7.2 Initial motor noise subjective rating must be >8 and after test >6.

4.3.7 Wipe Pattern Verification.

4.3.7.1 Purpose. This test is used to verify wiper system meets design intended wipe coverage.

4.3.7.2 Test Equipment. See 3.2.

- Full size 1:1 ratio drawing of applicable wipe pattern.
- Dry erase marker.

4.3.7.3 Test Samples. One (1) System.

4.3.7.4 Test Preparation. See 4.1.

4.3.7.5 Test Condition. See 4.2.

4.3.7.6 Test Procedure. On wet glass, operate wiper system at 13.5 V on and trace outline of actual wipe pattern on inside glass surface.

4.3.7.6.1 Tape full size drawing on outside of glass, aligning to glass blackout, and compare drawing outline to actual wipe pattern.

4.3.7.6.2 On wet glass, operate wiper system at $\mathbf{V_{NOM}}$ ± 0.3 V at motor terminals and measure distances A through E in Figure 2. Measure from the blade element wiping lip to edge of glass and calculate wiping angles.

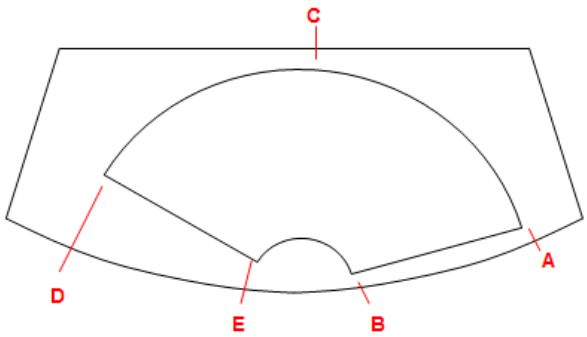

Figure 2: Wipe Pattern Clearance Checks

4.3.7.7 Test Requirement. Wipe coverage must meet design intent wipe pattern.

4.3.7.7.1 Dimension **"C"** to be ± 3.0 mm from nominal.

4.3.7.7.2 Wipe angles must be within design specification.

4.3.8 Initial Wipe Quality Check.

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4.3.8.1 Purpose. This test is to verify the clearing capability of the wiper system with a new blade. See Appendix E, Data Sheet E1.

4.3.8.2 Test Equipment. See 3.2.

4.3.8.2.1 Inside of glass to be tinted black.

4.3.8.3 Test Samples. See 3.3.1.

4.3.8.4 Test Preparation. See 4.1.

4.3.8.5 Test Condition. See 4.2.

4.3.8.6 Test Procedure. On wet glass, operate wiper system at V_{NOM} ± 0.3 V at motor terminals for 5 minutes. Clean windshield with GM approved windshield cleaner, or equivalent, to ensure water sheeting action.

4.3.8.6.1 With wiper parked, spray water onto glass for 5 s to 10 s. Stop sprayer and cycle wiper to out wipe position. Evaluate wipe quality within 3 s according to GM Wipe Quality Rating Scale in Appendix C, Table C1.

4.3.8.6.2 With wiper at out wipe, spray water onto glass for 5 s to10 s. Stop sprayer and cycle wiper to park position. Evaluate wipe quality within 3 s according to GM Wipe Quality Rating Scale in Appendix C, Table C1.

4.3.8.7 Test Requirement. Wiper shall provide smooth wiping operation with wipe quality rating of 10 per GM Wipe Quality Rating Scale in Appendix C, Table C1.

4.3.9 Durability/Reliability.

4.3.9.1 Purpose. This test is to verify a wiper system will meet specified performance requirements during a vehicle's lifetime with reliability and confidence level of R95C50 at one (1) life (as shown in Table 1). One (1) life is defined in program SSTS.

4.3.9.2 Test Equipment. See 3.2.

- Cycle counter/encoder.
- Oscilloscope.

4.3.9.3 Test Samples. See 3.3.1.

4.3.9.3.1 Replace blade elements every 500 K cycles. If elements are not serviceable, replace assembly.

4.3.9.3.2 Replace blade assembly/structure every 1.5 Million cycles.

4.3.9.3.3 Verify wipe pattern after one (1) life.

4.3.9.4 Test Preparation. See 4.1.

4.3.9.4.1 If GM validation engineer is not available to view test, provide video record showing test setup and initial system operation.

4.3.9.4.2 Reliability requirement can be met through either Success or Failure testing. Review with GM Validation Engineer and get agreement on which method will be used before start of test.

4.3.9.4.2.1 Success Test. Table 1 provides direction for required test duration with three (3) samples. Repeat durability test profile, replacing blades and/or structure as specified, until life cycles have been run without failure. See 4.3.9.7.1 for definition of failure.

Note: A Beta slope of 1.5 shall be used as a default and for new suppliers or new designs. The value can be increased based on the following.

- Experienced Supplier.
- Similar designed systems with historical data (carryover motor, carryover linkage, etc.)
- Approval by the Subsystem Validation Engineer (SVE) and Design Engineer (DE) for the program.

Supplier shall notify SVE and DE of the Beta slope used and whether Success or Failure test method will be used prior to start of any testing.

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Table 1: Reliability 95% with 50% Confidence

R95C50 Chart Using Beta = 1.5	
Sample Size	Number of Life Cycles
3	2.73
6	1.72
R95C50 Chart Using Beta = 2.0	
Sample Size	Number of Life Cycles
3	2.12
6	1.50
R95C50 Chart Using Beta = 3.0	
Sample Size	Number of Life Cycles
3	1.65
6	1.31

4.3.9.4.2.2 Failure Test. Recommended for Design Validation (DV) Testing. A Minimum of six (6) samples shall be used. Repeat durability test profile, replacing blades and/or structure as specified, until a failure defined in (4.3.9.7) Test Requirements is detected. Analyze the resulting failure data using a Weibull probability plot to estimate the reliability. The estimate must be R95C50 or better at one (1) life. Deviations to this must have approval by the SVE and DE for the program.

4.3.9.5 Test Condition. Refer to specific tests within this procedure.

4.3.9.6 Test Procedure. Prior to test, subjectively evaluate the motor/module noise (including but not limited to whine, growl, clicks, clunks, etc.) per Appendix D, Table D1, GM Subjective Rating Scale for Component Noise, under the following conditions: $\mathbf{V_{NOM}}$ ± 0.3 V at motor terminals wet glass.

4.3.9.6.1 Conduct durability/reliability test using rear wiper durability test profile in Figure 3. Verification of system operation and data monitoring equipment must be done at least twice a day.

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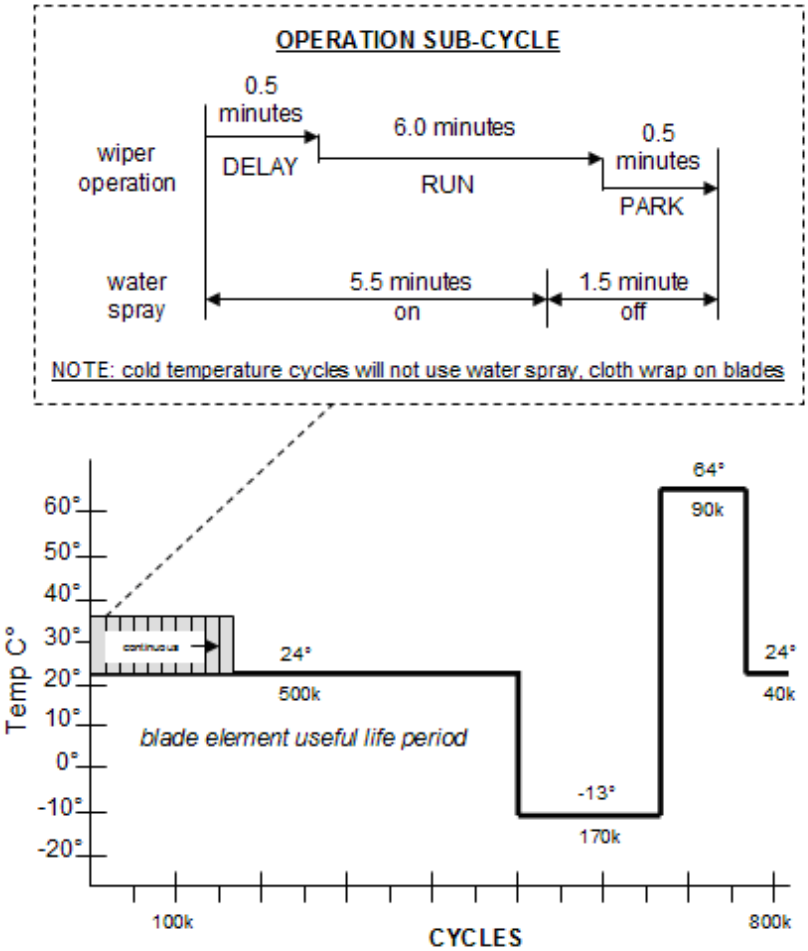

Figure 3: Rear Wiper Durability Profile

4.3.9.6.2 During durability/reliability test, collect the following data as specified.

4.3.9.6.2.1 Record the following data every 100 000 cycles.

- Cycles per Minute (CPM) during **Run** while under load and wet glass.
- Measure wipe pattern, see 4.3.7. Chart the data on a graph.
- Armload.
- Attack Angle.
- In ambient condition only, evaluate and record wipe quality of blade element being replaced and record wipe quality of new blade being installed. (Appendix E, Data Sheet E1).
- After each removal of the blade element, confirm that the blade still meets “Useful Life” criteria per SSTS.

4.3.9.6.3 At the end of one (1) life cycle durability, operate system in ambient condition with water spray and verify no failures occurred according to test requirements.

- Measure wipe pattern, see 4.3.7. Chart the data on a graph.

4.3.9.6.4 Test Requirement. The following requirements apply.

- The expansion and growth due to wear of the wiper system after 10 years (1 life) shall not cause the rear glass wiper components to hit any other vehicle components, other than the rubber blade element touching the rear glass.

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