



Wiper Blade Wind Lift Performance 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. The purpose of this procedure is to define and standardize the test methodology for validating windshield wiper blade wind lift performance on specific vehicle designs.

1.1.1 Wind lift occurs during dynamic vehicle speeds when the oncoming air stream contacts a wiper arm/blade and causes them to lose pressure on the windshield. Initial lift (blade does not wipe in one direction of wipe-cycle) and terminal lift (blade does not wipe in either direction of wipe-cycle) are to be evaluated.

1.2 Applicability. This document is applicable for all car, Multipurpose Passenger Vehicle (MPV), and truck models produced by GM.

1.3 Remarks. This procedure shall be used to ensure that wiper system meets the intended wind lift performance requirements in wiper Subsystem Technical Specification (SSTS). This is a living document and any suggestions or revisions will be reviewed and/or updated annually by the Windshield Wiper Global Subsystem Leadership Team (GSSLT). Supplier to use current approved five (5)-phase to be provided by GM Product Engineering.

2 References

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

2.1 External Standards/Specifications.

R (EU) No. 1008/2010

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Five (5)-Phase Document
- GM Security Guidelines
- Part Number 9965864 Glass Cleaner
- Program SSTS
- Subsystem Technical Specification (SSTS)
- Vehicle Technical Specification

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 Wind tunnel facility with climatic capability and resources for achieving 210 km/h (130 mph) wind speed.

Note: If wind tunnel facility is not available in testing region, test track where vehicle can be driven up to 201 km/h (125 mph) is an alternative (see 4.4).

3.2 Equipment.

3.2.1 Full size layout of design wipe pattern.

3.2.2 Dry erase marker.

3.2.3 GM approved Glass Cleaner (Part Number 9965864 Glass Cleaner) or equivalent (i.e., Bon Ami) to assure water sheeting action.

3.2.4 External water spray bar (rain bar) with nozzles capable of delivering a uniform spray pattern across the windshield surface. See Figure E1 in Appendix E.

3.2.5 Water spray bar shall consist of 7 nozzles equally spaced (~300 mm) across the width of the vehicle with the flow rate set to 9 L/minute $\pm$ 3 L/minute.

3.2.6 Variable pressure wiper arms or a set of arms set to the minimum, nominal and maximum design pressure.

3.2.7 Tip force and Attack Angle Gages.

3.2.8 Anemometer (for track testing only).

3.3 Test Vehicle/Test Piece.

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

3.3.2 For conventional and flat blade wiper blade designs, a minimum of three (3) samples per side are required to be validated. The spline curvature shall be set to maximum, minimum, and nominal. Pressure distribution plots are to be provided with all flat blade samples. Minimum pressure distribution blades must be identified and tested before start of test.

Note: If minimum, maximum, and nominal blade curvatures cannot be obtained, a minimum of 10 samples per side are required.

3.4 Test Time.

Calendar time:	1 d
Test time:	8 h
Coordination time:	4 h

3.5 Test Required Information.

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

3.5.2 Product related information, such as Model year, blade supplier, design level, part number, wiper arm tip force, attack angle, etc. See Appendix A and Appendix C for Left Hand Drive (LHD), and Appendix B and Appendix D for Right Hand Drive (RHD).

3.6 **Personnel/Skills.** GM Validation and GM Design Engineer must be present during test. Supplier Engineer is also recommended but not required.

4 Procedure

4.1 Preparation.

4.1.1 After vehicle is placed in wind tunnel chamber, remove any front end camouflage that is not adhesively bonded to vehicle.

Note: Be sure to obtain proper approval for removal of camouflage.

4.1.2 Place full size design pattern layout over windshield aligning blackout lines. From inside of vehicle, trace wipe pattern and wipe zones with dry erase marker.

4.1.3 Properly clean outside windshield surface with GM approved cleaner.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Unless otherwise specified:

- Ambient temperature: $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$
- Battery Voltage: $V_{\text{NOM}} - \pm 0.3\text{ V}$ specified in the SSTS (defaults 13.5 V). Voltage reading shall be at motor terminals.

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. (See GM Validation and GM Design Engineers).

4.3 Instructions.

4.3.1 Wind Tunnel – Preferred Method. Remove existing wiper arms from vehicle and replace with adjustable tip force arms. Verify arm tip force and attack angles are set to minimum design intent specifications. If needed, make adjustments.

4.3.2 Install first set of wiper blade test samples.

4.3.3 Set water spray bar, with nozzles, height to be level with leading edge of vehicle hood surface and place approximately 1 m in front of vehicle. See Figure E1 in Appendix E for picture.

4.3.4 Place occupant in the driver seat of vehicle and set tunnel speed for 112 km/h (70 mph) with water spray on. Water should lightly mist windshield so the wipe pattern is visible for a few seconds after the wipers are cycled. Depending on the vehicle geometry, it may be necessary to adjust the water spray volume to achieve necessary misting. Excess water will limit wipe pattern visibility and make it difficult to identify missed wipe areas during evaluation.

Note: Spray volume may need tuning at higher speeds. Make adjustments as necessary.

4.3.5 With evaluators in the vehicle, set tunnel speed to 128 km/h (80 mph) with water spray on. Set wipers on low speed and look for missed wipe areas throughout the wiping pattern. These will typically appear as localized blurred area > 10 mm diameter as shown in Figure 1.

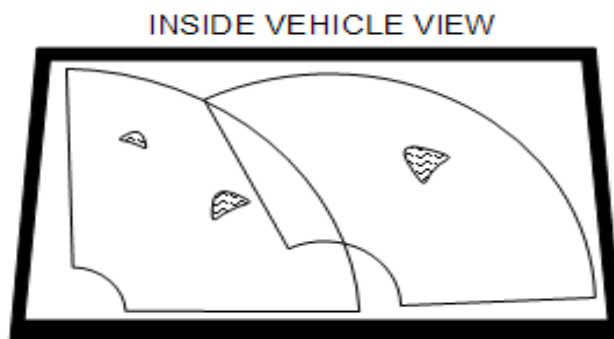


Figure 1: Unwiped Areas

Note: Light blade chatter is not considered a defect or failure during evaluation.

4.3.6 Increase tunnel speeds in 8 km/h (5 mph) increments until initial wind lift is determined on each wiper blade. Document speed on data recording sheet.

4.3.7 Continue increasing tunnel speeds by 8 km/h (5 mph) increments until terminal wind lift is demonstrated on each blade. If blade does not experience wind lift up to 209 km/h (130 mph), the test results shall be recorded and testing stopped. Check SSTS or Vehicle Technical Specifications (VTS) for program specific V_{MAX} .

4.3.8 Repeat 4.3.5 and 4.3.6 using additional test samples.

4.3.9 Increase arm tip force to nominal tolerance tip force called out on drawing. Verify attack angle is set at nominal.

4.3.10 Repeat 4.3.5 and 4.3.7 with nominal tip force arms on all test samples as necessary.

4.3.11 Increase arm tip force to maximum tolerance tip force called out on drawing. Verify attack angle is set at nominal.

4.3.12 Repeat 4.3.5 and 4.3.7 with maximum tip force arms on all test samples as necessary.

4.3.13 When testing is complete, remove dry erase wipe pattern, reinstall original wiper arms/blades, and put vehicle camouflage back on vehicle.

4.4 Instructions for Test Track. Only if wind tunnel is not available, for development testing only.

4.4.1 Remove existing wiper arms from vehicle and replace with adjustable tip force arms. Verify arm tip force and attack angles are set to minimum design intent specifications. If needed, make adjustments.

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4.4.2 Install first set of wiper blade test samples. Make sure the fluid reservoir is full with the appropriate test fluid.

Note: An external fluid source can be used instead of using the washer system for two reasons;

- a. The fluid capacity is very limited.
- b. The fluid is relatively concentrated and can make it difficult to detect wind lift.

4.4.3 Place occupant in the driver seat of vehicle and drive to the test track. Start the test when a speed of 112 km/h (70 mph) with washer on has been reached. Washer fluid should lightly mist windshield so the wipe pattern is visible for a few seconds after the wipers are cycled. Excess water will limit wipe pattern visibility and make it difficult to identify missed wipe areas during evaluation.

Note: Spray volume may need tuning at higher speeds. Make adjustments as necessary.

Note: Talk with the track safety coordinator to ensure all safety guidelines are followed.

4.4.4 With driver and evaluators in the vehicle, increase speed to 128 km/h (80 mph) with washers on. Evaluator is to monitor windspeed with anemometer. Set wipers on low speed and look for missed wipe areas throughout the wiping pattern. These will typically appear as localized blurred area > 10 mm diameter as shown in Figure 1.

Note: Light blade chatter is not considered a defect or failure during evaluation.

4.4.5 Increase speeds in 8 km/h (5 mph) increments until initial wind lift is determined on each wiper blade. Document speed on data recording sheet.

4.4.6 Continue increasing speeds by 8 km/h (5 mph) increments until terminal wind lift is demonstrated on each blade. If blade does not experience wind lift up to 209 km/h (130 mph), the test results shall be recorded and testing stopped. Check SSTS or VTS for program specific V_{MAX} .

4.4.7 Repeat 4.3.4 and 4.3.5 using additional test samples.

4.4.8 Reduce arm tip force to minimal tolerance tip force called out on drawing. Verify attack angle is set at nominal.

4.4.9 Repeat 4.3.4 and 4.3.6 with nominal tip force arms on all test samples as necessary.

4.4.10 Reduce arm tip force to maximum tolerance tip force called out on drawing. Verify attack angle is set at nominal.

4.4.11 Repeat 4.3.4 and 4.3.6 with maximum tip force arms on all test samples as necessary.

4.4.12 When testing is complete, remove dry erase wipe pattern, reinstall original wiper arms/blades, and put vehicle camouflage back on vehicle.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Vehicle speed requirements for wind lift are listed in R (EU) No. 1008/2010 and the Program SSTS document and shall be met with both nominal and minimal tip force wiper arms.

5.3 Test Documentation. Wind lift areas are to be recorded on Data Sheet A1 and Data Sheet C1 in Appendix A and Appendix C for Left Hand Drive (LHD) vehicles or Data Sheet B1 and Data Sheet D1 in Appendix B and Appendix D for Right Hand Drive (RHD) vehicles.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

In general, a risk assessment needs to be performed for every driving instruction prior to executing this standard. (**Note:** National law needs to be considered while performing a risk assessment.) The required rating of risk by exposure probability and possible violation will be done in a separate document. Every identified risk must be named inside the risk assessment for the relevant driving instruction in order to announce that risk to employees. Within the risk assessment, the vehicle equipment and different vehicle build stages have to be considered. After performing a risk assessment, non-acceptable risk needs to be mitigated by appropriate countermeasures. Here technical measures are preferred because these are independent from attendant circumstances. In case