SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

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Superseding J198 JUL2003

Windshield Wiper Systems - Trucks, Buses, and Multipurpose Vehicles

RATIONALE

The requirements in the previous version of this standard established wiper durability based on the GVW of the vehicle with a cut-off at 11 800 kg (26 000 lb) GVW. The intention was to prescribe a greater durability requirement for over-the-road (OTR) trucks that have long life expectancy. This, however, meant that some low-mileage vocations such as recreational vehicles, fire apparatus, school buses, etc. would be held to the higher durability standard simply because of their GVW. Other vocations below 11 800 kg (26 000 lb) GVW would not require the higher durability even though their mileage life expectancy may be high. The standard has therefore been revised to recommend wiper durability based on the life expectancy of the vocation (in miles) rather than the GVW.

1. SCOPE

This SAE Recommended Practice establishes for left-hand steer on-road trucks, buses, and multipurpose passenger vehicles with GVW of 4500 kg (10 000 lb) or greater:

a. Minimum performance requirements for windshield wiping systems.

b. Uniform test procedures that include those tests that can be conducted on uniform test equipment by commercially available laboratory facilities.

c. Uniform terminology of windshield wiper system characteristics and phenomena consistent with those found in guides for the use of engineering layout studies to evaluate system performance.

d. Guides for the design and location of components of the systems for function, servicing of the system, etc.

The test procedures and minimum performance requirements, outlined in this document, are based on currently available engineering data.

It is the intent that all portions of the document will be periodically reviewed and revised as additional data regarding windshield wiping system performance are developed.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J680 Location and Operation of Instruments and Controls in Motor Truck Cabs

SAE J687 Nomenclature - Truck, Bus, Trailer

SAE J941 Motor Vehicle Drivers' Eye Locations

SAE J2349 Electric Windshield Wiper Switch - Trucks, Buses, and Multipurpose Vehicles

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D 518 Test Method for Rubber Deterioration - Surface Cracking

ASTM D 1171 Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

2.1.3 ISO Publication

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 9259 Passenger cars - Windscreen wiper systems - Wiper arm to blade connections

3. DEFINITIONS

3.1 WIPER SYSTEM

The wiper system consists of all the apparatus for clearing the exterior of the windshield glazing surface, together with the necessary devices and controls to start and stop the operations.

3.2 WIPER BLADE

A device for clearing the effective wipe pattern, capable of receiving a load from an arm, comprising a suitable superstructure supporting and controlling a wiper blade element.

3.3 WIPER BLADE ELEMENT

The resilient member of the wiper blade that contacts the windshield glazing surface.

3.4 WIPER ARM

A device to both interconnect the wiper blade and the output shaft of the wiper motor or linkage assembly.

The wiper arm has the dual function of:

a. Maintaining the wiper blade into its desired position throughout the wipe pattern.

b. Exerting a load onto the wiper blade, sufficient for its function.

3.5 LINKAGE ASSEMBLY

The multicomponent member that connects to the wiper motor (where applicable) to transmit its action into accurate motion for driving the wiper arm.

3.6 WIPER CONTROL VALVE/SWITCH

The manually actuated mechanism that allows passage of pneumatic or electric signal to the wiper motor for activating the wiper system into its various operating or nonoperating modes.

3.7 WIPED AREA

The specific area on the glazing surface which shall be covered by the effective wiper pattern; the area developed as being compatible with viewing requirements necessary to operate the types of vehicles listed in Table 1.

3.8 EYELLIPSE

A statistical representation of the driver's eye location in a motor vehicle, as defined in SAE J941. For the purpose of this document, the head turn consideration in SAE J941 will not be used.

3.9 EFFECTIVE WIPE PATTERN

That portion of the wet windshield glazing surface which is cleared when the wiper blade travels through a cycle with system on highest frequency.

3.10 MULTIPIECE WINDSHIELD

A windshield consisting of two or more windshield glazing surface areas.

3.11 CYCLE

A cycle shall consist of wiper blade movement during system operation from one extreme of the wipe pattern to the other extreme and return.

3.12 DAYLIGHT OPENING (DLO)

The term “daylight opening” (DLO) refers to the maximum opening of any glass aperture which is unobstructed by moldings, masking, or framing.

3.13 LIGHT-DUTY VEHICLE

A light-duty vehicle is a personnel and/or cargo carrying vehicle with basic GVW of 4500 kg (10 000 lb) or less (class 1 and 2) and with the basic design intended for both on- and off-highway use.

3.14 MEDIUM-DUTY VEHICLE

A medium-duty vehicle is a personnel and/or cargo carrying vehicle with basic GVW of 4500 kg (10 000 lb) to 11 800 kg (26 000 lb) (class 3 to 6) and with the basic design intended for both on-and off-highway use.

TABLE 1 - WIPED AREA VIEWING REQUIREMENTS

Classification	F Dimension mm	F Dimension in	Area	Angle Up, deg	Angle Down, deg	Angle Left, deg	Angle Right, deg
Truck, CBE and CAE[1]	0–1020	0–40	A	10	5	18	56
			B	5	3	14	53
			C	5	1	10	15
	1020–1270	40–50	A	8	7	18	56
			B	3	5	14	53
			C	3	3	10	15
	1270–Up	50–Up	A	6	9	18	56
			B	1	7	14	53
			C	1	5	10	15
Buses, CBE — School and Commercial[2]	1270–1520	50–60	A	7.5	22	22	62
			B	3	22	22	62
			C	1	16	22	15
Buses, Forward Control, School and Commercial	1270–1520	50–60	A	7	14	18	65
			B	2	11	18	65
			C	1	11	18	25
Forward Control or Multipurpose	All	All	A	9	7	18	56
			B	4	4	14	53
			C	2	2	10	15
Light-Duty Utility Vehicle[1]	All	All	A	7	5	16	49
			B	4	3	13	49
			C	4	2	8	13
Van, Multistop[1]	Open	Open	A	7	12	18	58
			B	2	11	15	56
			C	1	6	10	15
Trucks, COE	1020–Up	40–Up	A	6	9	18	56
			B	1	7	14	53
			C	1	5	10	15

See SAE J687 for nomenclature. Angles are minimum.

1. Specifications also cover passenger carrying derivatives.
2. Geometric center of eyellipse located 457 mm (18 in) from centerline of vehicle.

3.15 HEAVY-DUTY VEHICLE

A heavy-duty vehicle is a personnel and/or cargo carrying vehicle with basic GVW of 11 801 kg (26 001 lb) or greater (class 7 and 8) and with the basic design intended for both on- and off-highway use.

3.16 PASSENGER CARRYING DERIVATIVE

A passenger carrying derivative is a vehicle where the basic design, other than driver windshield relationship, has been modified for the purpose of carrying occupants.

3.17 FUNCTION

Ability of the wiper system to clear the specified area of the windshield when the system is operated in accordance with the vehicle manufacturer's instructions.

The FUNCTION requirements are defined as follows:

a. Wiped Area: See 4.1.1

b. Wipe Frequency: See 4.1.2

c. Durability: See 4.1.3

d. Wiped Quality: See 4.2.3

3.18 INTERMITTENT

Wiping action consisting of an individual complete sweep (start to start) with an interval between stop and subsequent activation.

3.19 WIPER MOTOR

That mechanism, operated by an external power media/source (electric, pneumatic or hydraulic), that provides a controlled power to the other components of the system (either by direct drive to the Wiper Arm(s) or to the linkage), and is activated by the Wiper Switch/Value.

3.20 CAB-ALONGSIDE-ENGINE (CAE)

A vehicle in which the driver's compartment and controls are located alongside the engine compartment.

3.21 CAB-BEHIND-ENGINE (CBE)

A vehicle in which the driver's compartment and controls are located at the rear of a hood enclosed powerplant or are located partially over the rear of the powerplant or located partially beside the rear of the powerplant.

3.22 CAB-OVER-ENGINE (COE)

A vehicle in which all, or a substantial part of, its engine is located under the cab.

3.23 MULTIPURPOSE PASSENGER VEHICLE

Motor vehicle with motive power, except a low-speed vehicle or a trailer designed to carry 10 persons or less which is constructed either on a truck chassis or with special features for occasional off-road operation.

4. REQUIREMENTS

4.1 Windshield Wiper System Requirements

4.1.1 Required Wiped Area

The minimum windshield wiped area is described by three specific areas on the exterior windshield glazing surface. The three areas are developed with the vehicle loaded to the manufacturer's base design load and are identified in Table 1 as areas A, B, and C. Each area has been established using the angles of Table 1 applied as shown in Figure 1. In the side view, the upper and lower boundary of the area is established by the intersection of two planes, which are seen as lines in the side view tangent to the upper and lower edges of the eyellipse, with the windshield glazing surface. The planes are fixed by the angles above and below the XX line. In the plan view the left and right boundary of the area is established by the intersection of two vertical planes tangent to the left and right edges of the eyellipse with the windshield glazing surface. The planes are fixed by angles to the left and right of the XX line. The areas used in determining the percentage of wiped area are those areas on the exterior glazing surface which are not within 25 mm (1 in) of the edge of the daylight opening (pillars, division bar, header, etc.). The percentage is the ratio of wiped area within the defined area to the defined area. Using test procedures established in 6.1, Table 2 for percentages to be wiped.

4.1.2 Frequency

a. The windshield wiper system shall be designed to provide two or more frequencies.

b. The highest frequency shall be a minimum of 45 cycles/min.

c. The highest and one lower frequencies shall differ by at least 15 cycles/min.

d. Such lower frequency shall be at least 20 cycles/min.

e. Frequencies must be obtainable under normal vehicle operating conditions regardless of engine speed and/or engine load, following test procedures and test conditions described in 6.2.

    1. If the wiper system is capable of INTERMITTENT OPERATION, operation must be as follows:

    2. Upon activation of INTERMITTENT, the wiper will initiate one sweep and then begin counting for the interval.

    3. Upon cancellation of INTERMITTENT, the wiper will complete the sweep and proceed into the PARK position or to Continuous speed mode.

    4. Selecting a Continuous speed mode immediately negates the INTERMITTENT mode.

Activation of a programmed WASH feature overrides the INTERMITTENT mode but returns the Wiper system to the previous mode upon completion of the programmed WASH.

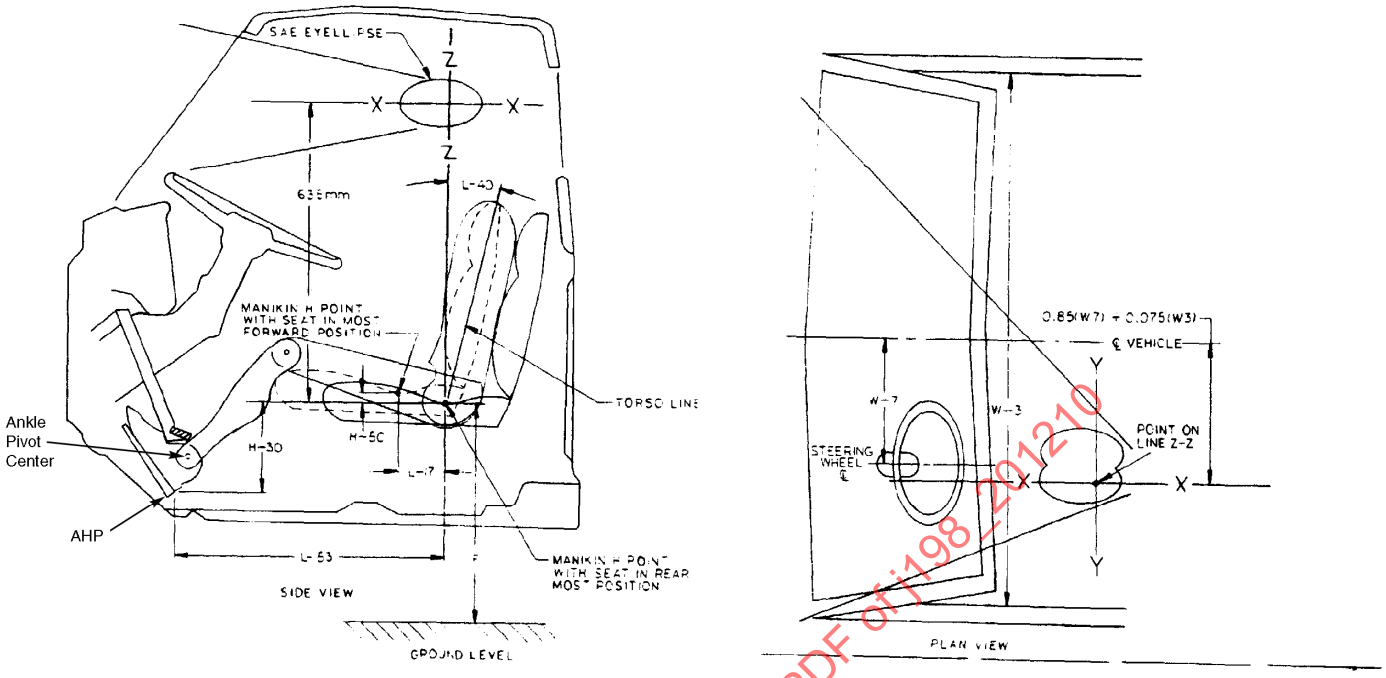


FIGURE 1 - EYELLIPSE TEMPLATE LOCATION (FOR DEFINITION OF DIMENSIONS - SEE SAE J941)

TABLE 2 - MINIMUM PERCENT OF WINDSHIELD TO BE WIPED

Windshield Type	Area A	Area B	Area C
One Piece	80	94	99
Multipiece	65	70	84

4.1.3 Durability

Wiping system, except for the blade, and the control valve/switch must remain functional using test procedures and conditions established in 6.2 per the following durations:

a. Trucks, buses and multipurpose vehicles with life expectancy at or below 300 000 miles: 1.5 million cycles

b. Trucks, buses and multipurpose vehicles with life expectancy in excess of 300 000 miles: 3.0 million cycles

The control valve/switch, when using the same test procedure and conditions will, during the test, be activated/deactivated the following minimum cycles:

5000 cycles for a 1.5 million cycle wiper system
10 000 cycles for a 3 million cycle wiper system

NOTE: Any component failure, except the wiper blade during this test, denotes system failure. Throughout this test and at the completion of such:

1. Wipe angles as measured on the high speed setting with wet glass must allow compliance with vision area specification and should not exceed the DLO (unless specifically designed to do so).

2. All components must remain without permanent set or distortion which would impair function of the wiper system or result in damage to the windshield surface or to metal/nonmetallic exterior surface.

3. Support members onto which the wiper motor and bracket, the linkage and pivot assemblies are mounted must remain without permanent set, distortion, crazing, fatigue cracking, etc., that affect either performance of the wiper system or cause failure of such.

4.1.4 System Strength

The system shall be capable of withstanding the loads induced by stall, using test conditions and test procedures established in 6.3, with all mechanical components remaining functional and without permanent distortion.

Upon removal of the obstruction induced to cause a stall, system operation should be as follows:

a. For electrical systems, operation must resume within the specified parameters of the manufacturer.

b. For Pneumatic system, operation must resume.

c. Support members onto which the wiper motor and bracket, the linkage and pivot assemblies are mounted must remain without permanent set, distortion, crazing, etc., that would affect either performance of the wiper system or cause failure of such.

4.1.5 Temperature Operational Capability

The windshield wiper system shall be capable of functioning between the temperatures of 55 °C ± 3 °C (130 °F ± 5 °F) and –30 °C ± 3 °C (–20 °F ± 5 °F), using test procedures and test conditions established in 6.4.

4.1.6 Accessibility

The control for the wiper system should be positioned so that it is readily accessible to the driver. Controls are to be:

a. On either the dash panel or console per SAE J680,

b. Or attached to the steering column,

c. Or mounted above the operator in the header section,

d. Or, if due to special needs of the specific vehicle/function, located in an area that does not restrict, operator's normal bodily movement or require diverting attention from primary visibility area.

4.1.7 Component Accessibility

The wiper system components, such as the wiper motor assembly, pivot assemblies, and/or transmission assemblies, shall be accessible for servicing/replacement preferably within maximum of 1 h each.

4.1.8 Wiper Arm Loading

The wiper arm must be capable of applying sufficient load to the wiper blade so as to allow it to function consistent with 4.2.3 with both the vehicle parked and at maximum allowable vehicle speeds.

4.1.9 Intermittent Operation

If the system has capability to be operated intermittently it may be that of a fixed intermittent or variable intermittent. The intermittent operation may be at any speed as designated by the manufacturer.

4.2 Windshield Wiper Blade Requirements

4.2.1 Durability

The wiper blade, except for the wiping element of the wiper blade, must remain functional after operating 1.5 million cycles using test procedures and conditions established in 6.2. Function is evidenced by the frame or structure of the wiper blade remaining without deformation or wear that affects the function or allows it to come into contact with the windshield surface or surrounding moldings. The wiper blade element shall wipe effectively for 500 000 cycles of the three million cycle system test. Element shall remain intact, without tearing or otherwise disengaging from its frame.

4.2.2 Aging

The wiper blade element of the wiper blade assembly shall withstand the ozone test established in 6.5, with an ASTM rating of "0," as defined in ASTM D 1171.

4.2.3 Wipe Quality

Using test procedures and equipment described in 6.2, the wiper blade shall clear its entire wipe pattern within one wiping cycle with only minor streaking or unwiped lines remaining. A rapidly disappearing haze is acceptable. Unwiped areas, aside from minor streaking, are not to occur in the critical primary vision area of the windshield.

After the durability test described in 4.2.1, the wiper blade element may lose its effectiveness by allowing more numerous streaks, wider unwiped lines, or longer lingering haze, but must be capable of functioning.

4.2.4 Chemical Resistance

A section of the wiper blade element when placed in a 50% solution of either methyl or isopropyl alcohol for a period of 24 h, shall not exceed more than 2% weight change.

4.3 Wiper Arm to Wiper Blade Connection

Specify the main dimensions and general recommendations for windshield wiper arm to wiper blade connections. The following connections are defined:

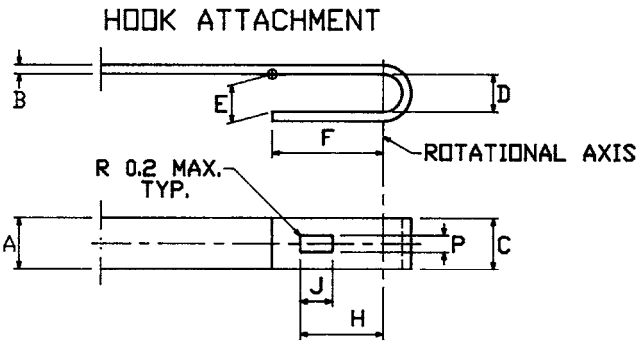
a. Hook connection

b. Saddle with nut and bolt connection

c. Pin on arm connection

4.3.1 Hook Connection

See Figure 2.



DIMENSIONS IN MILLIMETERS

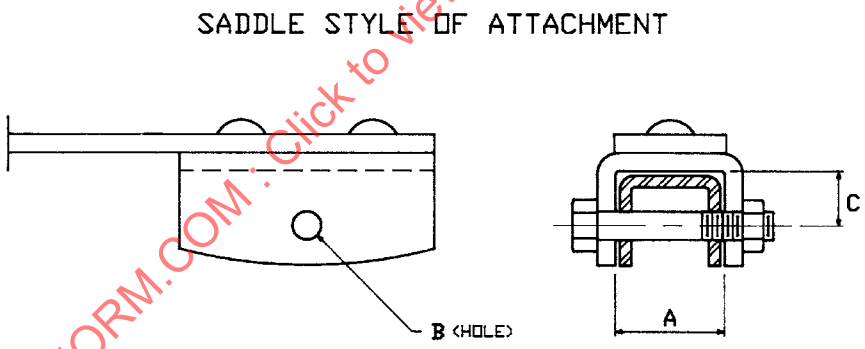
NOMINAL ARM SIZE (A X B)	C +0 -0.15	D +0.25 -0	E +0.8 -0	F +0.5 -0	H +0.4 -0	J MIN.	P MIN.
7 X 2.2	6.8	5.7	5.7	18	14	4.8	2.1
9 X 2.5	8.8	6.7	6.7	18	14	5.7	2.9
9 X 3.3	8.64	6.85	6.85	18	17.35	5.8	3.1
9 X 4	8.8	10.7	10.7	21	17	5.7	3.5

NOTE: ALL DIMENSIONSD ARE BEFORE PAINTING/PLATING.

FIGURE 2 - HOOK ATTACHMENT

4.3.2 Saddle with Nut and Bolt Connection

See Figure 3.



DIMENSIONS IN MILLIMETERS

A	B (DIAMETER)	C
5.6	3.3	8.7
6.4	3.6	
12.5	5.6	9.5
13.6	5.0	9.5
16.2	6.0	
25.2	8.0	

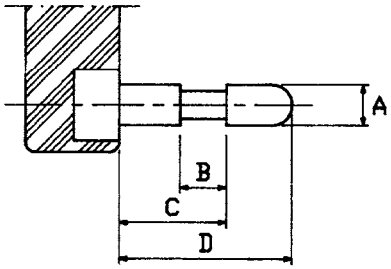
NOTE: ALL DIMENSIONS ARE BEFORE PAINTING/PLATING.

FIGURE 3 - SADDLE WITH NUT AND BOLT CONNECTION OR SADDLE STYLE OF ATTACHMENT

4.3.3 Pin on Arm Connection

See Figure 4.

PIN ON ARM ATTACHMENT



DIMENSIONS IN MILLIMETERS

A ±0.03	B ±0.10	C +0.08 −.0.13	D ±0.05
4.8	6.55	10.5	17.2
6.35	6.60	15.6	25.4

PIN MAY BE MOLDED INTO A WIPER ARM TIP
OR EXIST AS A SEPARATE COMPONENT.

NOTE: ALL DIMENSIONS ARE BEFORE PAINTING/PLATING.

FIGURE 4 - PIN ON ARM ATTACHMENT

4.3.4 General Recommendations for Wiper Arm to Blade Connections

4.3.4.1 Lateral Angular Movement

The lateral movement between the blade assembly and the arm assembled shall not exceed 2 degrees when 0.1 Nm (0.75 ft/lb) is applied to blade end (see Figure 5). The angular deflection shall be measured between the arm and the main lever of the wiper blade to which the clip is assembled.

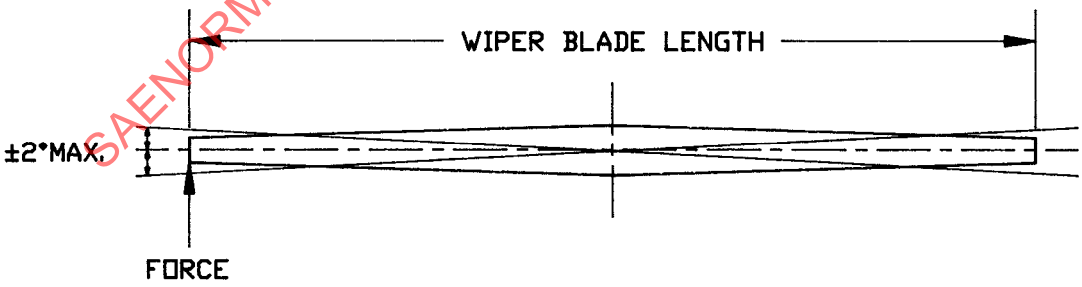


FIGURE 5 - LATERAL ANGULAR MOVEMENT - WIPER BLADE TO WIPER ARM

4.3.4.2 Rotational Movement

The torque which is necessary to move the wiper blade once installed, about its pivot axis on the SADDLE AND PIN STYLE wiper arm, shall not exceed 1.0 Nm (0.75 ft/lb). In addition, the position of the pivot axis on the blade shall be such as to ensure that the blade is free to move relative to the arm when operated on the vehicle.

4.3.4.3 This document is consistent with ISO J9259-1991.

5. WINDSHIELD WIPER SWITCH

5.1 Must conform to SAE J2349.

6. TEST METHODS

6.1 Area to be Wiped Test Procedure

6.1.1 Test Equipment

a. Drafting equipment sufficient for full size windshield and wiper system layout

b. Transparent heavy gage plastic sheet—prepared clear acetate or equivalent

c. Test Buck—A test buck shall consist of a structure capable of maintaining throughout a test the proper relationship of the glazing surface and the windshield wiping system components as established by the vehicle manufacturer.

d. Power source must be capable of supplying power to the drive motor as required per vehicle manufacturer's specifications

e. Spray Equipment—Spray nozzles to apply water to glazing surface

6.1.2 Drafting

a. Work to exterior surface of windshield glazing.

b. The design wipe pattern shall be shown plus the growth due to wet windshield and high-speed wiper operation. This growth may be determined either experimentally or by using an allowance of 3 degrees each direction of wipe.

c. All calculations to be made in the unwrapped view.

d. In vehicle position plan view and side view, layout windshield surface, DLO (daylight opening), 95th percentile eyellipse per Appendix of SAE J941, and the areas A, B, and C, generated on the exterior of the windshield glazing using the angles from Table 1.

e. Develop an unwrapped view of the windshield glazing surface and DLO. Design the wipe pattern, apply growth as described in 6.1.2 (b), and transfer the pattern together with areas A, B, and C that are wiped with design pattern plus growth, in the unwrapped view.

f. Calculate the percentages of areas A, B, and C that are wiped with design pattern plus growth, in the unwrapped view, Figure 6 and compare the values with those of Table 2.

6.1.3 Evaluation Techniques

Both methods are acceptable.

6.1.3.1 3-Dimensional CAD Evaluation

Construct a full-scale 3-dimensional model of the windshield, wiper arms, wiper blades, sweep patterns, and the A, B, and C areas, as described in 6.1.2. Calculate the percentages of the A, B, and C areas wiped. Compare the calculated values to those of Table 2.

NOTE: The 3-dimensional models of the arms and blades must retain the same functional characteristics as the parts.

The 3-dimensional sweep pattern must lie on the windshield model, and must represent the actual sweep pattern, as measured according to 4.1.3.