SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Windshield Wiper Systems - Trucks, Buses, and Multipurpose Vehicles

RATIONALE

This revision replaces the SAE eyellipse as a means of anchoring the target viewing area construction planes with a similar, but much simpler, method. The new method reduces the complexity of the construction effort while producing results that are well within the test method tolerance. The windshield wiper coverage requirements in the previous version of this standard could not be met for certain configurations of cabs. There were also no accommodations for single occupant cabs or those with the driver centered in the cab. This document corrects these shortcomings to better fit the breadth of current vehicle designs. Definitions were revised for accuracy and consistency.

1. SCOPE

This SAE Recommended Practice establishes testing methods and performance requirements for windshield wiping systems on trucks, buses, and multipurpose passenger vehicles with a GVWR of 4500 kg (10000 pounds) or greater and light duty utility vehicles with a GVWR of less than 4500 kg (10000 pounds).

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.

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 +1 724-776-4970 (outside USA), www.sae.org.

SAE J680 Location and Operation of Air Brake 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

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
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For more information on this standard, visit
https://www.sae.org/standards/content/J198_202006

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 D518 Test Method for Rubber Deterioration - Surface Cracking

ASTM D1171 Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

2.1.3 ISO Publication

Copies of these documents are available online at http://webstore.ansi.org/.

ISO 9259 Passenger Cars - Windscreen Wiper Systems - Wiper Arm to Blade Connections

3. DEFINITIONS

3.1 CAB-ALONGSIDE-ENGINE (CAE)

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

3.2 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.

3.3 CAB-OVER-ENGINE (COE)

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

3.4 CYCLE

Wiper blade movement during system operation from the first extreme position of the wipe pattern to the second extreme and then back to the first extreme.

3.5 DAYLIGHT OPENING (DLO)

The maximum opening of any glass aperture which is unobstructed by moldings, masking, frits, or framing.

3.6 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.

3.7 EYELLIPSE

A statistical representation of the driver's eye location in a motor vehicle, as defined in SAE J941.

3.8 INTERMITTENT

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

3.9 LIGHT-DUTY UTILITY VEHICLE

A personnel and/or cargo carrying vehicle with basic GVWR of 4500 kg (10000 pounds) or less (Class 1 and 2).

3.10 LINKAGE ASSEMBLY

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

3.11 MULTIPIECE WINDSHIELD

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

3.12 MULTIPURPOSE PASSENGER VEHICLE

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

3.13 TARGET WINDSHIELD VIEWING AREA

The area of the windshield through which the driver should be able to see to operate the vehicle.

3.14 VAN

A personnel and/or cargo carrying vehicle with a relatively flat front and a GVWR of greater than 4500 kg (10000 pounds).

3.15 WIPED AREA

The specific area on the glazing surface that is swept by the effective wiper pattern.

3.16 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.

3.17 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.

3.18 WIPER BLADE ELEMENT

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

3.19 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 non-operating modes.

3.20 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/valve.

3.21 WIPER SYSTEM

A group of devices used for clearing the exterior of the windshield glazing surface of water or snow, together with the necessary devices and controls to start and stop the operations.

4. WINDSHIELD WIPER SYSTEM REQUIREMENTS

4.1 Target Windshield Viewing Area

4.1.1 A B C Zones

The target windshield viewing 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 Tables 1A and 1B applied as shown in Figure 1.

4.1.2 Side View

In the side view, the upper and lower boundary of the area is established by the intersection of two planes with the windshield surface. These planes are seen as lines in the side view. These planes are fixed by the angles (from Tables 1A or 1B) above and below the XX line and originating from points based on the seat H-Point as shown in Figure 1.

4.1.3 Plan View

In the plan view the left and right boundary of the area is established by the intersection of two vertical planes with the windshield surface. These planes are fixed by angles (from Tables 1A or 1B) to the left and right of the XX line and originating from points based on the seat H-Point as shown in Figure 1.

4.1.4 Excluded Areas

The target windshield viewing areas exclude those areas on the exterior glazing surface which are within 25 mm (1 inch) of the edge of the daylight opening.

The target windshield viewing area may be reduced in instances where the driver's view through the glass is of some obscuring feature of the vehicle rather than of the vehicle surroundings. This may include the hood, bumper, aerial bucket, concrete chute, molding, masking, frits, framing, or other feature of the vehicle, the view of which would not be important to driving visibility. To accommodate such features, any of the four bounding planes can be distorted into a complex surface that remains straight along the line of sight from the tangent point on the eyellipse, but that conforms to the outermost portion of the obscuring feature. The minimum wiped area thus created should include any line of sight that is useful to a driver whose eyes are within the volume of the projection from the eyellipse.

The target windshield viewing area may be reduced in instances where the curvature of the windshield glass at the edges is so great that it is not practical to get a wiper blade to follow the contour of the glass. To accommodate this situation, the angle of the bounding plane on the side where the curvature takes place may be reduced until the plane touches the outermost edge of the area where the wiper blade is able to sweep and still maintain contact with the glass surface.

4.1.5 Right Hand Drive

Table 1A assumes a left side driving position. For right side driving positions, reflect the angles so that the left values are used for the right and the right angles for the left.

4.2 Wiping Performance Criteria

Each windshield wiping system shall wipe the percentage of the target windshield viewing area specified in Table 2 when tested in accordance with Section 6.

Table 1A - Target windshield viewing area - standard cab

Classification	F Dimension (mm)	F Dimension (inches)	Area	Angle Up (degrees)	Angle Down (degrees)	Angle Left (degrees)	Angle Right (degrees)
Truck Cab Behind Engine (CBE) Cab Alongside Engine (CAE)	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
Truck Cab Over Engine (COE)	1020-Up	40-Up	A	7.5	22	22	62
			B	3	22	22	62
			C	1	16	22	15
Bus, Cab Behind Engine (CBE) School and Commercial	1270-1520	50-60	A	7.5	22	22	62
			B	3	22	22	62
			C	1	16	22	15
Bus, Cab Over Engine (COE) 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	All	All	A	7	5	16	49
			B	4	3	13	49
			C	4	2	8	13
Van	Open	Open	A	7	12	18	58
			B	2	11	15	56
			C	1	6	10	15

Refer to SAE J687 for nomenclature.
Angles are minimum.

Table 1B - Target windshield viewing area - driver centered in cab

Classification	F Dimension (mm)	F Dimension (inches)	Area	Angle Up (degrees)	Angle Down (degrees)	Angle Left (degrees)	Angle Right (degrees)
Cab Behind Engine (CBE) Cab Alongside Engine (CAE)	0-1020	0-40	A	10	5	35	35
			B	5	3	30	30
			C	5	1	15	15
	1020-1270	40-50	A	8	7	35	35
			B	3	5	30	30
			C	3	3	15	15
	1270-Up	50-Up	A	6	9	35	35
			B	1	7	30	30
			C	1	5	15	15
Cab Over Engine (COE)	1020-Up	40-Up	A	6	9	35	35
			B	1	7	30	30
			C	1	5	15	15

Refer to SAE J687 for nomenclature.
Angles are minimum.

Table 2 - Minimum percent of target windshield viewing area to be wiped

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

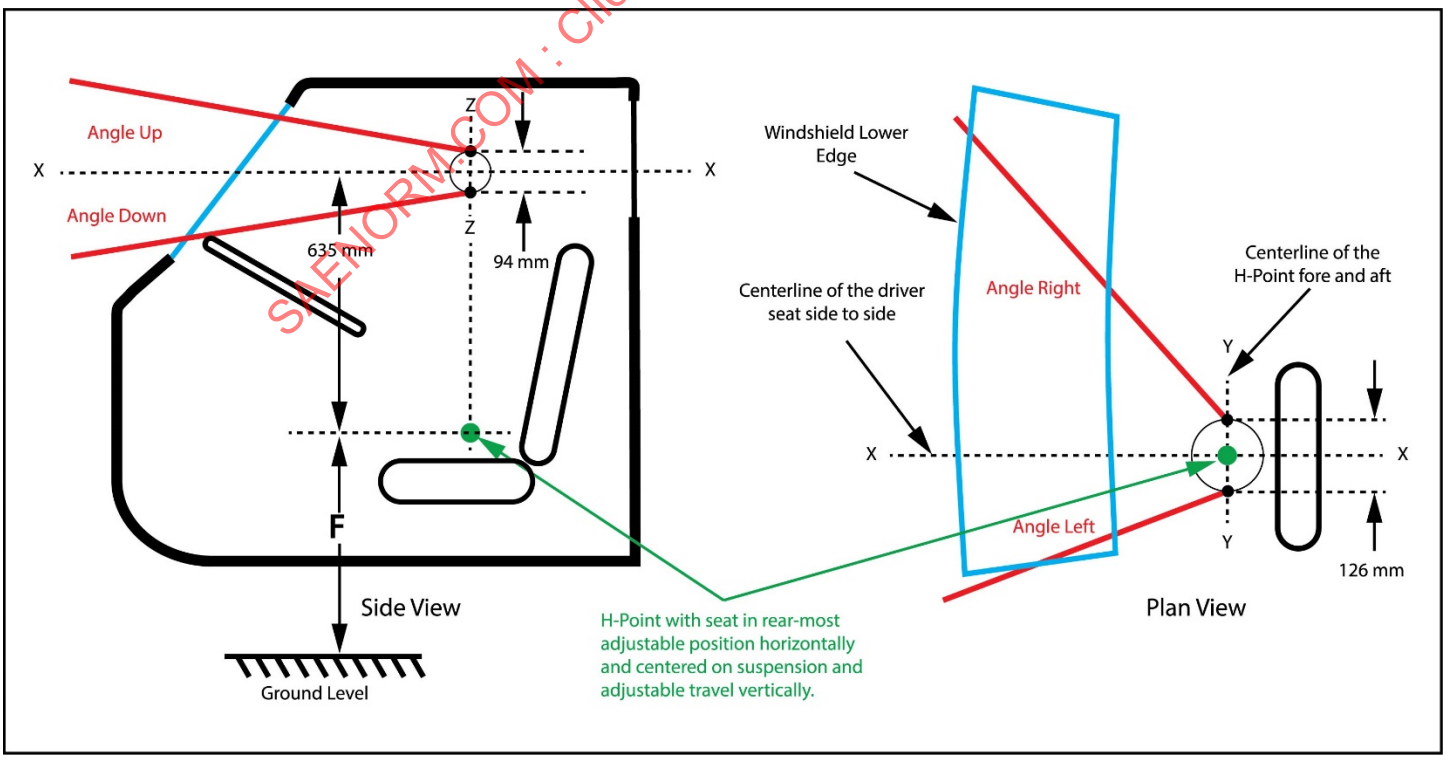


Figure 1 - Target windshield viewing area construction

4.3 Windshield Wiper Oscillation Frequency

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

b. The highest frequency shall be a minimum of 45 cpm.

c. The highest frequency and one of the lower frequencies shall differ by at least 15 cpm.

d. Such lower frequency shall be at least 20 cpm.

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:

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

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

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

4.4 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 300000 miles: 1.5 million cycles.

b. Trucks, buses, and multipurpose vehicles with life expectancy in excess of 300000 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.
10000 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.

4.5 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.

4.6 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.

4.6.1 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, or

b. Attached to the steering column, or

c. Mounted above the operator in the header section, or

d. 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.

4.7 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 hour each.

4.8 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 4.10.3 with both the vehicle parked and at maximum allowable vehicle speeds.

4.9 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.

4.10 Windshield Wiper Blade Requirements

4.10.1 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 500000 cycles of the test. Element shall remain intact, without tearing or otherwise disengaging from its frame.

4.10.2 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 D1171.

4.10.3 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 4.10.1, 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.

4.10.4 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 hours, shall not exceed more than 2% weight change.

4.10.5 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:

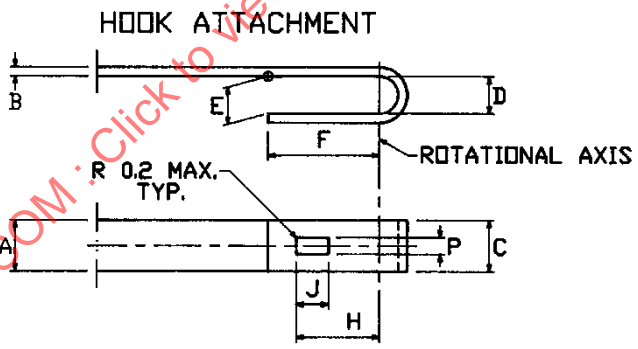
a. Hook connection.

b. Saddle with nut and bolt connection.

c. Pin on arm connection.

4.10.6 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

4.10.7 Saddle with Nut and Bolt Connection

See Figure 3.

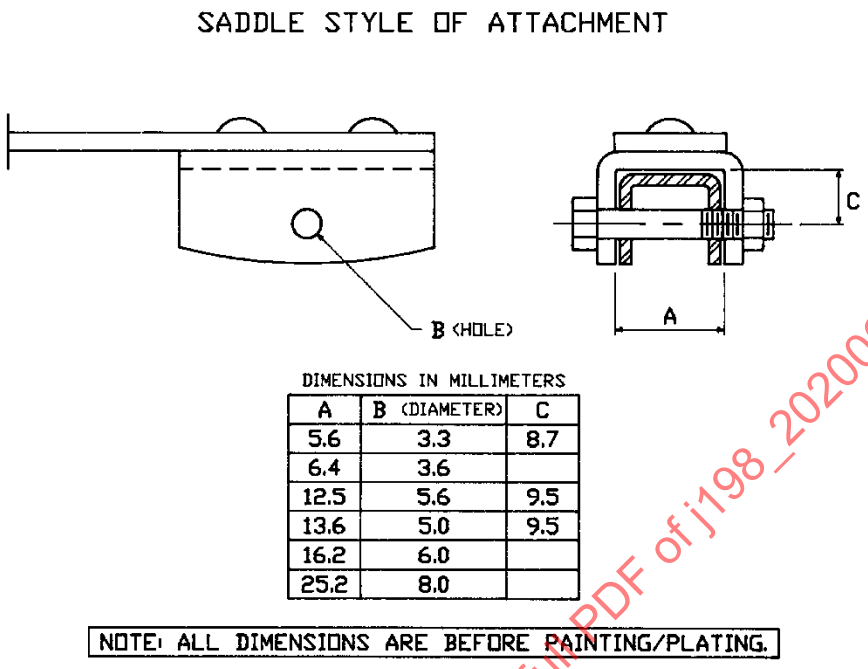


Figure 3 - Saddle with nut and bolt connection or saddle style of attachment

4.10.8 Pin on Arm Connection

See Figure 4.

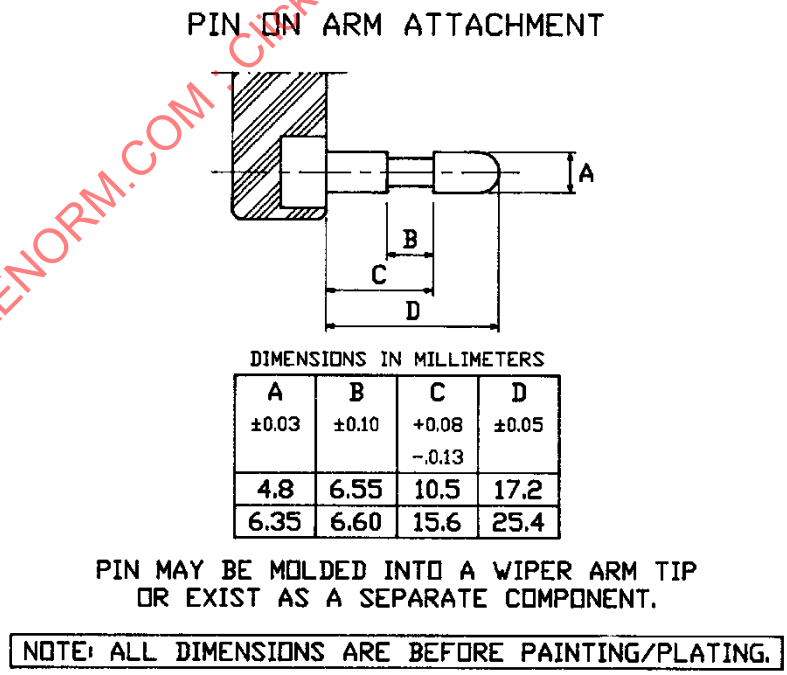


Figure 4 - Pin on arm attachment

4.10.9 General Recommendations for Wiper Arm to Blade Connections

4.10.9.1 Lateral Angular Movement

The lateral movement between the blade assembly and the arm assembled shall not exceed 2 degrees when 0.1 N·m (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.

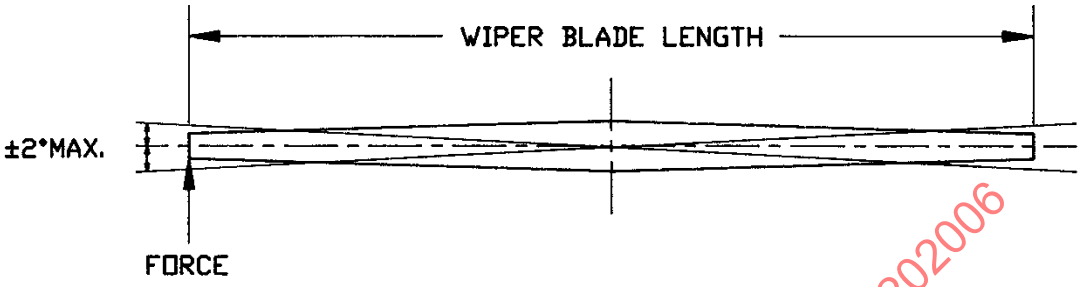


Figure 5 - Lateral angular movement - wiper blade to wiper arm

4.10.9.2 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 N·m (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.

4.10.9.3 This document is consistent with ISO 9259-1991.

5. WINDSHIELD WIPER SWITCH

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 the windshield wiper viewing target using the locations provided in Figure 1. For the purpose of this document, the head turn consideration in SAE J941 will not be used. Layout the intersection of the windshield surface with the up, down, left, and right planes from the values for areas A, B, and C given in the target windshield viewing area Tables 1A or 1B.

e. Develop an unwrapped view of the windshield glazing surface that includes the design wipe pattern (with growth), and the target viewing areas A, B, and C (see example in Figure 6).

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

6.1.3 Evaluation Techniques

Both methods are acceptable.

6.1.3.1 Three-Dimensional CAD Evaluation

Construct a full-scale three-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 three-dimensional models of the arms and blades must retain the same functional characteristics as the parts.

The three-dimensional sweep pattern must lie on the windshield model, and must represent the actual sweep pattern, as measured according to 4.4.

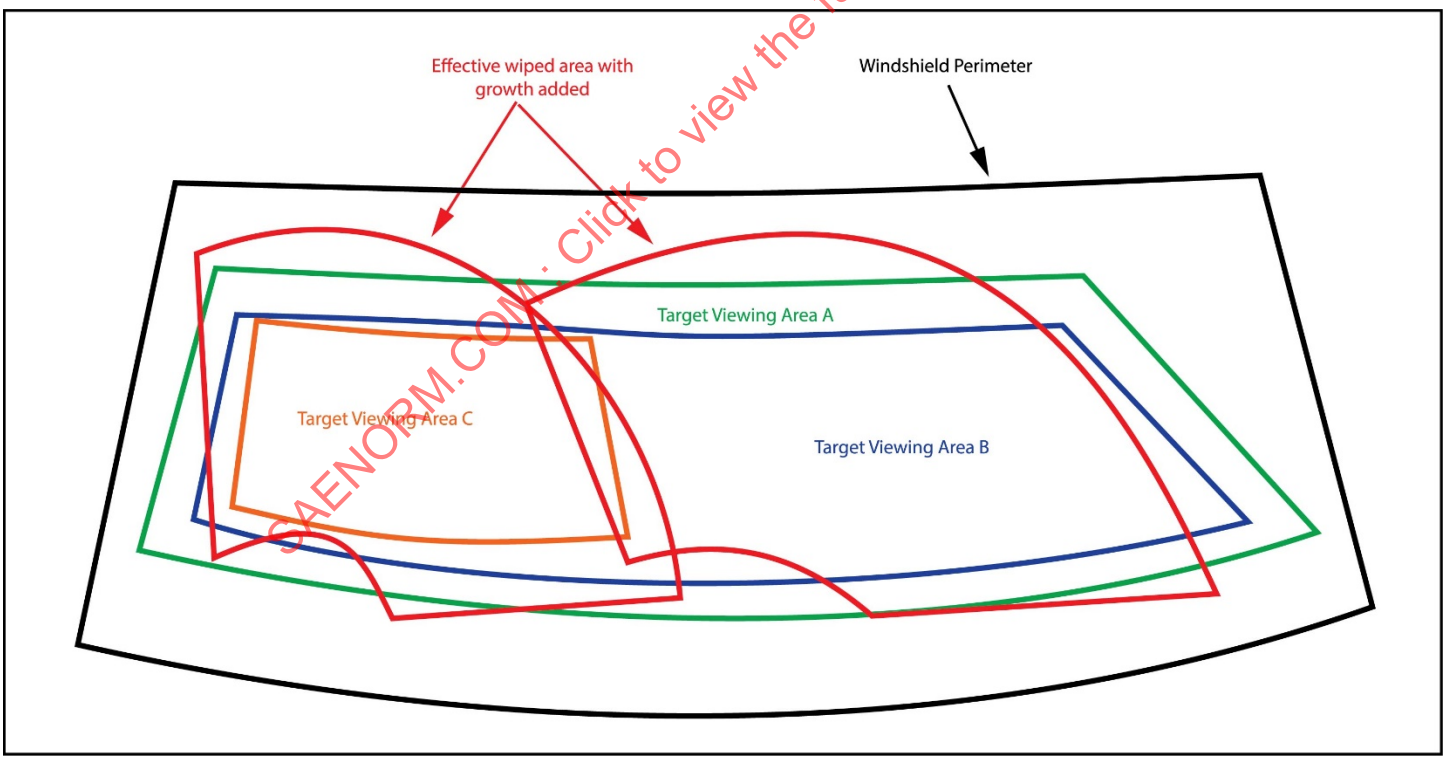


Figure 6 - Wiped area evaluation, drafting test procedure - unwrapped view showing wiped pattern and areas A, B, and C