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INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J198 | REV. JUN91

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Superseding J198 MAR81

(R) WINDSHIELD WIPER SYSTEMS—TRUCKS, BUSES, AND MULTIPURPOSE VEHICLES

1. ***Scope***—This SAE Recommended Practice establishes for 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. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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

SAE J687—Nomenclature—Truck, Bus, Trailer

SAE J941—Motor Vehicle Driver's Eye Range

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

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)

2.2 Definitions

2.2.1 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.

2.2.2 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.

2.2.3 WIPER BLADE ELEMENT—The resilient member of the wiper blade that contacts the windshield glazing surface.

2.2.4 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.

2.2.5 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.

2.2.6 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.

2.2.7 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.

2.2.8 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.

2.2.9 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.

2.2.10 MULTIPIECE WINDSHIELD—A windshield consisting of two or more windshield glazing surface areas.

2.2.11 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.

2.2.12 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.

2.2.13 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.

2.2.14 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.

2.2.15 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.

2.2.16 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.

2.2.17 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 3.1.1
b. Wipe Frequency: See 3.1.2
c. Durability: See 3.1.3

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

NOTES—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.

d. Wiped Quality: See 3.2.3

3. Requirements

3.1 Windshield Wiper System Requirements

3.1.1 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 plane 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 4.1, see Table 2 for percentages to be wiped.

3.1.2 FREQUENCY

a. The windshield wiper system shall be designed to provide two or more frequencies.
b. The highest frequencies 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 4.2.

3.1.3 DURABILITY—Wiping system, except for the blade, and the control valve/switch must remain functional using test procedures and conditions established in 4.2 per the following durations:

a. Light- and medium-duty vehicles.
   Trucks, buses, and multipurpose vehicles with GVW to 11 800 kg (26 000 lb)
   1.5 million cycles
b. Heavy-duty trucks/buses—vehicles with GVW of 11 801 kg (26 001 lb) or greater
   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.

3.1.4 SYSTEM STRENGTH—The system shall be capable of withstanding the loads induced by stall, using test conditions and test procedures established in 4.3, with all mechanical components remaining functional and without permanent distortion.

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

Pneumatic system operation must resume upon removal of the restriction.

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.

3.1.5 TEMPERATURE OPERATIONAL CAPABILITY—The windshield wiper system shall be capable of functioning between 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 4.4.

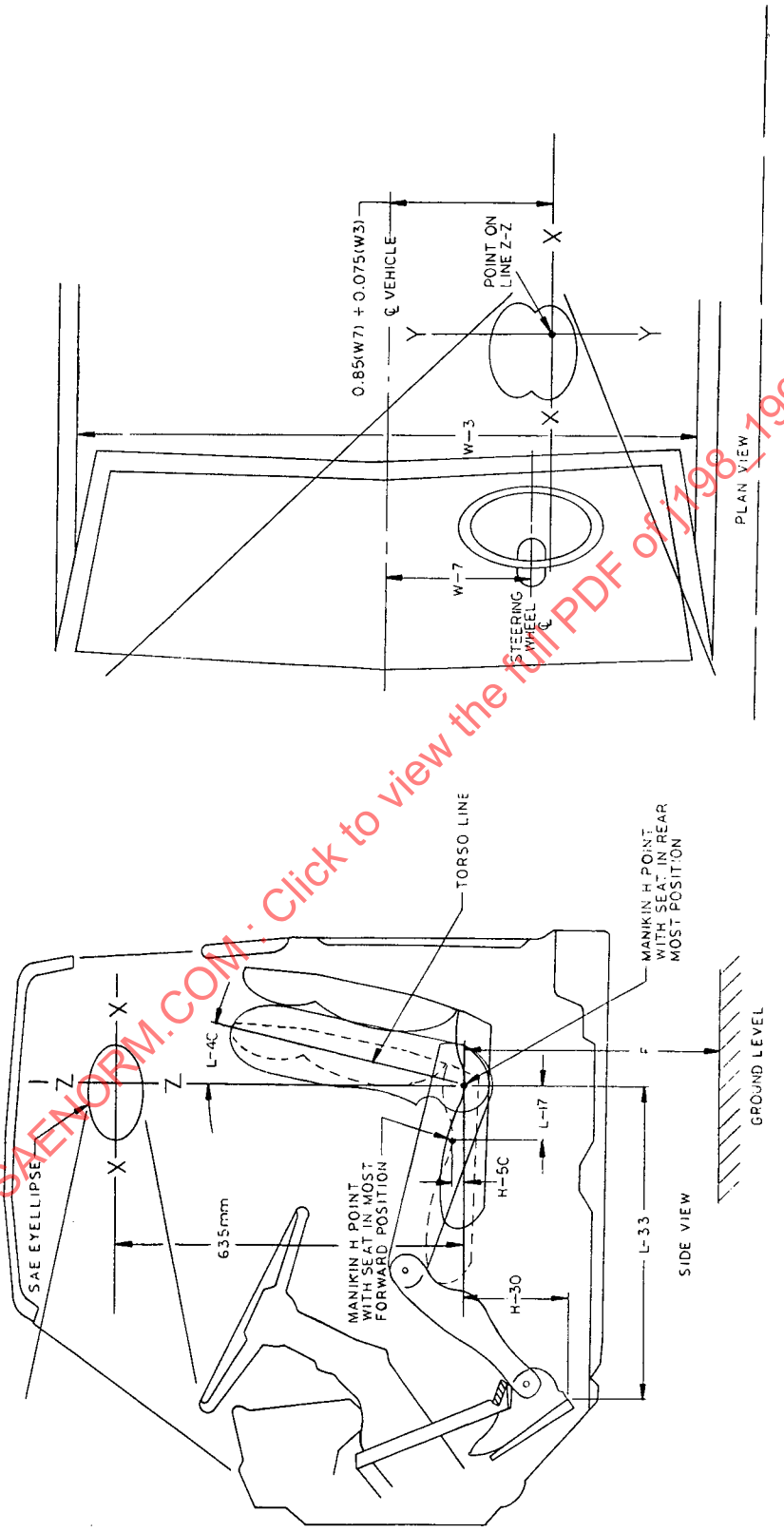

FIGURE 1—EYELLIPSE TEMPLATE LOCATION (FOR DEFINITION OF DIMENSIONS—SEE J941)

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

3.1.6 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 main visibility area

3.1.7 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.

3.1.8 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 3.2.3 with both the vehicle parked and at maximum allowable vehicle speeds.

3.2 Windshield Wiper Blade Requirements

3.2.1 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 4.2. 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.

3.2.2 AGING—The wiper blade element of the wiper blade assembly shall withstand the ozone test established in 4.5, with an ASTM rating of "0," as defined in ASTM D 1171.

3.2.3 WIPE QUALITY—Using test procedures and equipment described in 4.2, 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 3.2.1, 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.

3.2.4 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. Test Methods

4.1 Area to be Wiped Test Procedure

4.1.1 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

4.1.2 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 experimentally or an allowance of 3 degrees each direction of wipe may be utilized.

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 4.1.2 (b), and transfer the pattern together with areas A, B, and C into this unwrapped view.

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

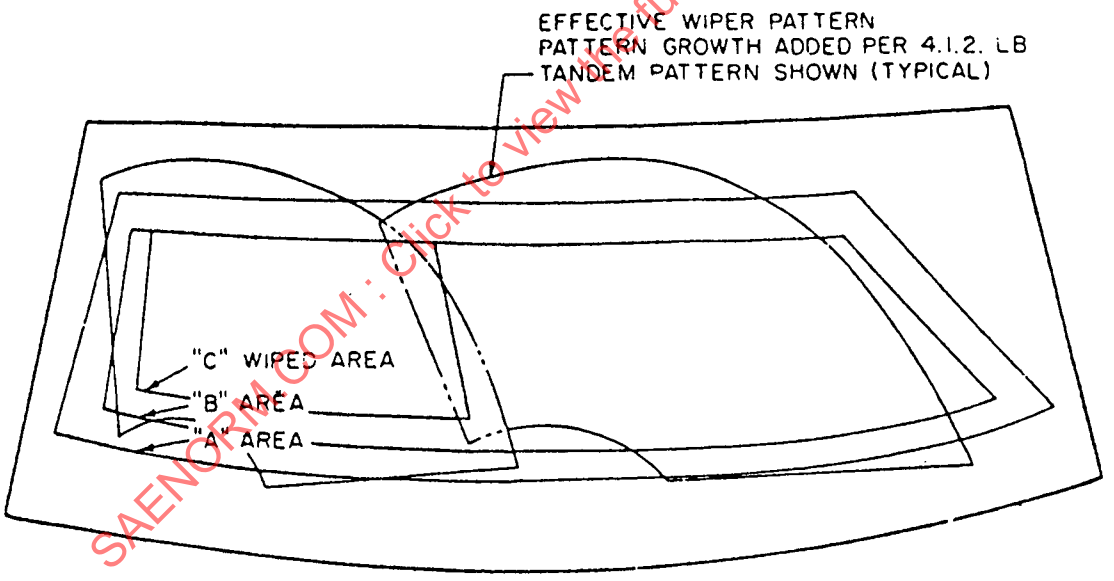

FIGURE 2—WIPED AREA EVALUATION, DRAFTING TEST PROCEDURE—UNWRAPPED VIEW SHOWING WIPED PATTERN AND AREAS A, B, AND C

4.1.3 EVALUATION TECHNIQUES—Both methods are acceptable.

4.1.3.1 *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 4.1.2. Calculate the percentages of the A, B, and C areas wiped. Compare the calculated values to those of Table 2.

NOTES—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 3.1.3.

4.1.3.2 *Test Buck Evaluation*

a. Operate test buck with water on, wiper system on high speed, and mark outline of wipe pattern.
b. Transfer full-size unwrapped view with wipe pattern and areas A, B, and C as determined in 4.1.2 (e) to transparent heavy gage plastic sheet.
c. Transfer wipe pattern from test buck to plastic sheet and recalculate the percentages of areas A, B, and C that are wiped and compare the values with those of Table 2.

4.2 Wiper System Durability and Frequency Test

4.2.1 TEST EQUIPMENT

a. Test equipment—as required
b. Power source—see 4.1.1 (d)
c. Counter—a device for determining the number of cycles
d. Spray equipment—see 4.1.1 (e)
e. Water softener—a device, where required, to supply water meeting requirements of 4.2.2 (d)
f. Cleanser—nonabrasive type that leaves no coating or residue on the glass
g. Temperature measuring device—thermometer or equivalent
h. Gauges—appropriate for measuring/monitoring pressure, flow, etc., of the wiper motor(s)

4.2.2 TEST CONDITIONS

a. Ambient temperature of 10 to 38 °C (50 to 100 °F)
b. Water temperature of 5 to 27 °C (40 to 80 °F)
c. Water nozzles—to be located so as to provide an approximately equally distributed water flow on windshield glazing surface at rate of no less than 820 mL/min (50 in^3/min)
d. Water hardness—not to exceed 205 ppm
e. Power input level at drive (frequency test only)—the minimum power available at the drive motor, as specified by the vehicle manufacturer, under normal vehicle operating conditions

4.2.3 DURABILITY TEST PROCEDURE—The windshield wiper system shall be operated to requirements per 3.1.3 with approximately 80% operation at low speed and 20% operation at high speed, according to the sequences in Table 3, or with the first half of the total test cycles at high speed and the remainder at low speed according to the sequence in Table 4.

TABLE 3—OPERATION SEQUENCES

Speed/Sequence	Minutes
High Speed—wet windshield	1
Low Speed—wet windshield	5
Low Speed—dry (drying) windshield	0.5
Park—dry windshield	0.5

For the wet operation, water is to be supplied to the windshield in accordance with provisions of 4.2.2 (c). The windshield is to be cleaned when necessary. If rubber deposits appear within 15 min after cleaning, the wiper blade element or wiper blade must be replaced.

4.2.4 FREQUENCY TEST PROCEDURE—Clean the windshield. Water is to be applied continuously to the windshield throughout the test, as indicated in 4.2.2 (c). Apply power to the drive motor as specified in 4.2.2 (e). With appropriate control settings, determine system operating frequencies.

TABLE 4—LOW SPEED OPERATION SEQUENCE

Low Speed Sequence	Minutes
Wet windshield	5.5
Dry (drying) windshield	0.5
Park—dry windshield	1 max

4.2.5 WIPE QUALITY—To evaluate for wipe quality, both initially and after durability test, the windshield is to be cleaned (see 4.2.3) and the lip of the wiping element can be cleaned to remove residue of abrasion, etc. If desired, various methods such as providing a dark background for the windshield, use of a powdered dispersion in the test fluid to aid the visual display of streaks, etc., may be employed.

The wiper system shall be activated for a single cycle while the windshield has a fine dispersion of water evenly distributed across the effective wipe pattern. Observation of streaks, unwiped area, lines, etc., is to be made. Test may be repeated for evaluation of reproducibility of the wipe quality. Specialized laboratory equipment may be utilized to evaluate wipe quality by agreement of vehicle manufacturer and system supplier.

4.3 Wiper System Stall Test

4.3.1 TEST EQUIPMENT

a. Test buck—see 4.1.1 (c)
b. Power source—see 4.1.1 (d)

4.3.2 TEST PROCEDURE—At an ambient temperature between 10 °C and 38 °C (50 °F and 100 °F), and with the specified power source, the wiper system shall meet the requirements specified in 3.1.4 when the wiper arms, in any position in the wipe cycle, are restrained from movement for 15 min.

4.4 Wiper System Temperature Operation Capability

4.4.1 TEST EQUIPMENT

a. Test buck—see 4.1.1 (c)
b. Power source—see 4.1.1 (d)
c. Test chamber—a room or chamber large enough to contain the complete test buck and capable of maintaining a temperature of 55 °C ± 3 °C (130 °F ± 5 °F) and/or −30 °C ± 3 °C (−20 °F ± 5 °F)

4.4.2 HOT TEST PROCEDURE—The test buck and spray equipment are to be soaked in the test chamber at a temperature of 55 °C ± 3 °C (130 °F ± 5 °F) for 4 h. Following this soak period, and in the same temperature environment, the wiper system and spray equipment are to be turned on and operated for a period of one-half h at maximum wiper speed control setting with water applied continuously as indicated in 4.2.2 (c).

4.4.3 COLD TEST PROCEDURE—The test buck is to be cold soaked in the test chamber at a temperature of −30 °C ± 3 °C (−20 °F ± 5 °F) for 4 h. Following this soak period, and in the same temperature environment, the wiper system is to be turned on and the wipers operated for one-half h at maximum wiper system speed control setting.

4.5 Ozone Testing

4.5.1 EQUIPMENT—Commercial ozone test cabinet.

4.5.2 PREPARATION OF WIPER BLADE ELEMENT—A 150 mm (6 in) specimen of the wiper blade element of the wiper blade assembly is to be installed in a suitable clamping fixture similar to that described in procedure A of ASTM D 518. Specimens are to be stretched to an extension of 15%, measured

between gage marks that are 250 mm (10 in) apart. The mounted specimens are then to be exposed for 48 h in an ozone-free atmosphere.

4.5.3 PROCEDURE—Test specimens are to be placed in the ozone test chamber for a period of 72 h. The test chamber is to be operated at a temperature of 38 °C ± 3 °C (100 °F ± 5 °F) and at a concentration of 0.5 ppm, by volume.

4.5.4 RATING—That area of the specimen between the two benchmarks shall meet the requirements established in 3.2.2.

5. Notes

5.1 Marginal Indicia—The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

PREPARED BY THE SAE TRUCK AND BUS DEFROSTING, DEFOGGING, AND WINDSHIELD WIPER SUBCOMMITTEE OF THE SAE TRUCK AND BUS CAB OCCUPANT AND ENVIRONMENT COMMITTEE