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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J903

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Submitted for recognition as an American National Standard

(R) Passenger Car Windshield Wiper Systems

***Foreword*—**This Document has also changed to comply with the new SAE Technical Standards Board Format. References were added as Section 2, Definitions changed to Section 3. All other section numbers have changed accordingly.

***1. Scope*—**This SAE Recommend Practice establishes for passenger cars, light trucks, and multipurpose vehicles with GVW or 4500 kg (10 000 lb) or less:

a. Minimum performance standards for windshield wiper systems.
b. Test procedures 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 standards, 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 Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

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

SAE J941—Motor Vehicle Drivers' Eye Location

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 518—Test Method for Rubber Deterioration—Surface Coating
ASTM D 1171—Test Method for Rubber Deterioration—Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

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2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 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

3. Definitions

3.1 Windshield Wiper System—The wiper system consists of all the apparatus for cleaning the exterior surface of windshield glazing, together with the necessary devices and controls to start and stop operation.

3.2 Wiper Blade—A device for cleaning the effective wiper pattern, capable of receiving the load exerted by an arm, comprising a suitable superstructure, and 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 interconnect the wiper blade and the output shaft of the wiper motor 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 multi-component member that connects to the wiper arm(s) (where applicable) to transmit its action into accurate motion for driving the wiper arm(s).

3.6 Wiper Control Valve/Switch—The manually actuated mechanism that allows passage of pneumatic or electrical signal to the wiper motor for activating the wiper system into its various operating or non-operating modes.

3.7 Wiped Area—The specific areas on the windshield glazing surface which shall be covered by the effective wiper pattern. These areas were developed as being compatible with viewing requirements necessary to operate a passenger car, light truck, or multipurpose vehicle.

3.8 Eyellipse—A statistical representation of the driver's eye location in a motor vehicle, as defined in 4.1.5 of SAE J941 (latest version) regarding head turn. For the purpose of this document, the head turn consideration in 4.1.5 of SAE J941 will not be used. For individual-type passenger car seats, use A.2.2 of Appendix A of SAE J941.

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. Minimum Wiped Area is defined in 4.1.1.

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

3.11 Tandem Pattern—The pattern produced by the wiper blades moving in the same direction across the windshield glazing surface simultaneously. See Figure 1.

3.12 Opposed Pattern—The pattern produced by the wiper blades moving in opposite directions across the windshield glazing surface simultaneously. See Figure 2.

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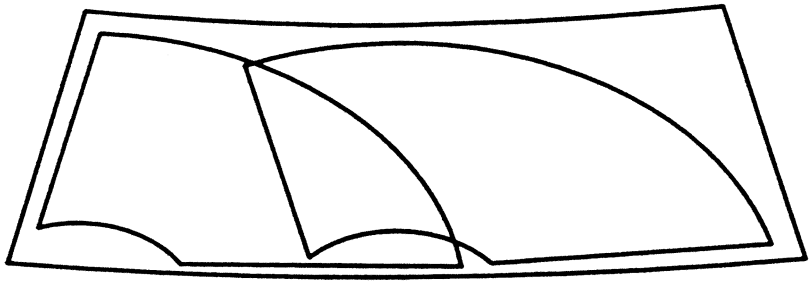

FIGURE 1—TANDEM PATTERN

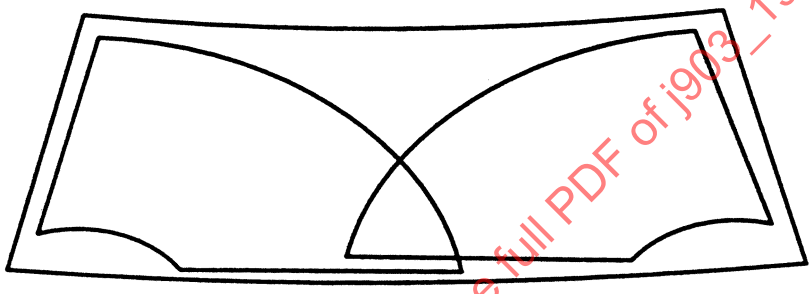

FIGURE 2—OPPOSED PATTERN

3.13 Single Arm Pattern—The pattern produced by a single wiper blade moving across the windshield glazing surface.

a. Single Arm (see Figure 3.)
b. Single Extending Arm (see Figure 4.)

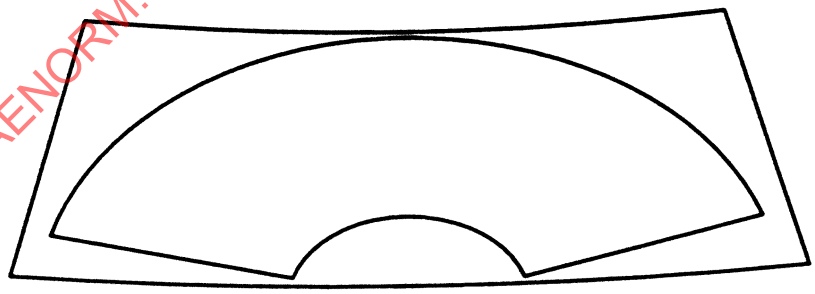

FIGURE 3—SINGLE ARM PATTERN

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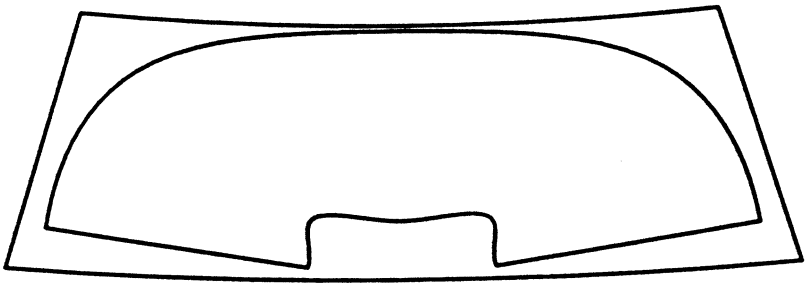

FIGURE 4—SINGLE EXTENDING ARM

3.14 Chatter—Irregular movement of the wiper blade usually accompanied by temporary visible radial lines and/or noise.

3.15 Ballooning—Unwiped areas within the wipe pattern, varying in size and usually round.

3.16 Streaking—Fine arcuate lines of unwiped moisture within the wipe pattern.

3.17 Scalloping—Uneven wipe at the outer periphery of the pattern.

3.18 Lace Curtain—A maze of fine water droplets which are formed after the wiper blade passes over the windshield glazing surface.

3.19 Hazing—An aerated film spread by the blade and resulting in a transient trailing band on the windshield glazing surface.

3.20 Snow Load—The load imposed on the wiper system by the accumulation of packed snow, resulting in a limitation of blade travel.

3.21 Motor Stall Torque—The maximum torque that the motor can maintain for two cycles at specified conditions.

3.22 System Torque—Torque necessary to overcome friction of the wiper blade(s) and the driving mechanism under the specified conditions.

3.23 Damp Dry—The condition of the windshield which produces the highest friction during the transition from a wet to a dry surface.

3.24 Moisture—Atmospheric water precipitation in liquid, semi-liquid, or frozen (snow) state.

3.25 Relative Air Speed—The vector difference of vehicle speed and the component of the wind speed parallel to the direction of travel of the vehicle.

3.26 Daylight Opening (DLO)—The term DLO refers to the maximum unobstructed opening through the windshield aperture, with reveal or garnish moldings adjoining the glazing surface installed normal to glass surface.

3.27 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.

3.28 Multi-Piece Windshield—A windshield consisting of two or more windshield glazing surface areas.

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3.29 Oversweeping—The travel of the wiper blade beyond the limits of the wipe pattern established under high speed wet operation, associated with wiper blade making contact with moldings, masking, or framing.

3.30 Flip Over—A characteristic of the wiper blade wherein the lip of the blade flexes (flips over) to its opposite position when the direction of the blade travel reverses.

3.31 Rubber Deposit—A deterioration of the wiping element characterized by particles of rubber adhering to the glazing surface sufficient to form a visual or non-visual area of high friction material. If permitted to remain, operation of the wiper blade across such areas causes further deterioration.

3.32 Cycles per Minute—Speed of the wiper system measured by the number of complete operations from one extremity of the wipe pattern to the opposite extremity and return within 1 min.

3.33 Windlift—Any wind force lifting arm and blade from windshield, typically at high vehicle speeds and characterized by unwiped areas in the wipe pattern.

3.34 Attack Angle—The angular relationship in which the tip of the wiper arm, at the attachment for the wiper blade, is presented to the glazing surface at any point throughout the wipe pattern. The sign of the attack angle is determined by looking from the tip of the wiper blade to the heel. From this perspective, a counter-clockwise rotation from the windshield surface normal to the blade centerline is positive and a clockwise rotation is negative. (See Figure 5.)

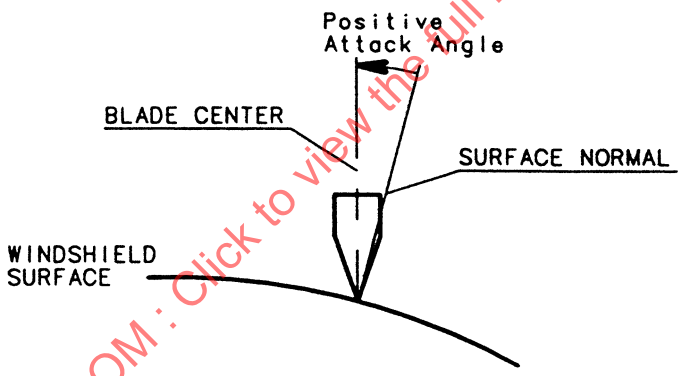

FIGURE 5—View from Blad Tip to Heel

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3.35 Tip Load—Amount of “arm load” as applied to blade against glazing surface; the force transmitted by the arm to the blade.

3.36 Arc or Arcuate Wiper Arm—A wiper arm that maintains a fixed attitude between the arm and blade throughout the wipe pattern.

3.37 Articulate—A windshield wiper system having a specially designed wiper arm with dual extensions restrained to separate base points. The dual arm allows the blade to swivel near the outer extremity of the wipe pattern, thereby enlarging the overall wipe pattern.

3.38 Pantograph—A windshield wiper system having a specially designed wiper arm with dual extensions restrained to separate base points that allows the attached wiper blade to remain essentially parallel throughout the wipe pattern, to that of the blade when in its mid-stroke position.

3.39 Heel—The end of the blade closest to the output shaft.

3.40 Tip—The end of the blade furthest from the output shaft.

4. General Performance

4.1 Windshield Wiper System

4.1.1 VISION AREAS—The vision areas are 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 6. In the side views, the upper and lower boundary of the area is established by the intersection of two planes, which are seen as lines tangent to the upper and lower edges of the eyellipse, with the windshield glazing surface. The planes are fixed by 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 the wiped area within the defined area to the defined area. Using test procedures established in 5.1, see Table 1 for percentages to be wiped.

TABLE 1—AREA TO BE WIPED

Area	Minimum Percent Wiped	Angles, degrees Left	Angles, degrees Right	Angles, degrees Up	Angles, degrees Down
A	80	18	56	10	5
B	94	14	53	5	3
C	99	10	15	5	1

4.1.2 FREQUENCY

4.1.2.1 The windshield wiper system shall be designed to provide two frequencies:

a. One of not less than 45 cycles/min
b. One of not less than 10 and not more than 55 cycles/min
c. The difference between the highest and at least one of the lower frequencies shall be at least 15 cycles/min

4.1.2.2 The frequencies prescribed in 4.1.2.1 must be obtainable under normal vehicle operating conditions regardless of engine speed and engine load, following test procedures and test conditions established in 5.2.

4.1.3 DURABILITY—Wiping system shall remain functional after operating 1 500 000 cycles, using test procedures and test conditions established in 5.2.

4.1.4 STRENGTH—The system shall be capable of withstanding the loads induced by stall, using test procedures and test conditions established in 5.3, with all mechanical components remaining functional.

4.1.5 TEMPERATURE OPERATIONAL CAPABILITY—The windshield wiper system shall be capable of operating between temperatures of –30 to 55 °C ± 3 °C (–20 to 130 °F ± 5 °F) using test conditions and test procedures established in 5.4.

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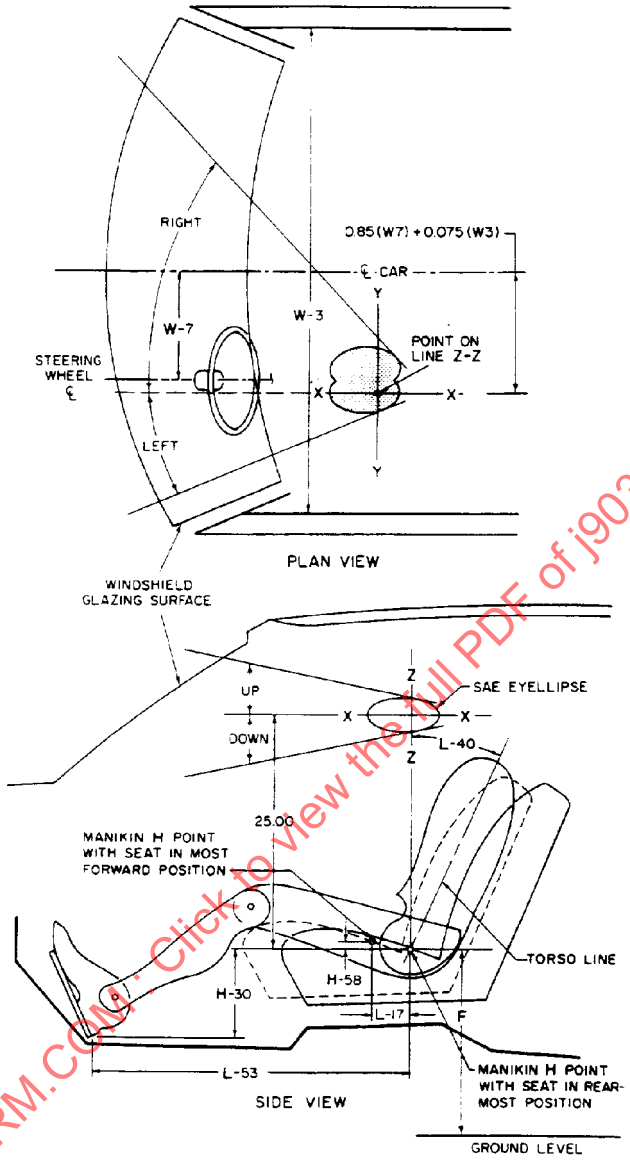

FIGURE 6—WINDSHIELD WIPER SYSTEM

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4.1.6 WINDLIFT—The windshield wiper blade element shall continue to contact at least 98% of Area C as defined by 4.1.1, in each wiper travel direction, to meet the minimum requirements (equipped with new OEM blades) when subjected to relative air speeds equal to 80% of the vehicle's maximum speed, but not exceeding 160 km/h (100 mph) while operating at maximum frequency, using test conditions and procedures established in 5.5.

4.1.7 ACCESSIBILITY—The control of the wiper system should be positioned so that it is readily accessible to the driver. Controls are to be located in an area that does not restrict operator's normal bodily movement or require diverting attention from any main visibility area.

4.2 Windshield Wiper Blade

4.2.1 AGING—The wiper blade element of the wiper blade assembly shall withstand the ozone test established in 5.5, with an ASTM rating of 2, as defined in ASTM D 1171.

4.2.2 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 at 23 °C ± 2 °C (73 °F ± 4 °F), shall not exceed more than 2% weight change. Test method is stated in 5.7.

5. Test Methods

5.1 Area to be Wiped Test Procedure

5.1.1 TEST EQUIPMENT

5.1.1.1 Analytical

5.1.1.1.1 Computer-based analytical tool capable of surface modeling full-scale windshield and wiper system layout.

5.1.1.2 Empirical

5.1.1.2.1 Transparent Heavy Gage Plastic Sheet—Prepared clear acetate or equivalent.

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

5.1.1.2.3 Power Source—The power source shall supply to the wiper motor the nominal power expected by the vehicle manufacturer under the conditions specified in any of the test procedure paragraphs.

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

5.1.2 TEST PROCEDURE

5.1.2.1 Vision Zones Development

5.1.2.1.1 All work and calculations shall be performed based on the exterior of the windshield glazing surface.

5.1.2.1.2 The design wipe pattern shall be shown plus the growth due to wet windshield and high-speed system operation (effective wipe pattern). This growth may be determined experimentally, or a predicted allowance for each direction of wipe may be utilized.

5.1.2.1.3 Using 3-D vehicle coordinates, lay out the windshield surface, DLO (daylight opening) curve(s), 95th percentile eyellipse per SAE J941, and develop the areas A, B, and C (shown in Figure 7) on the exterior of the windshield glazing surface using the procedure described in 4.1.1 and the angles from Table 1.

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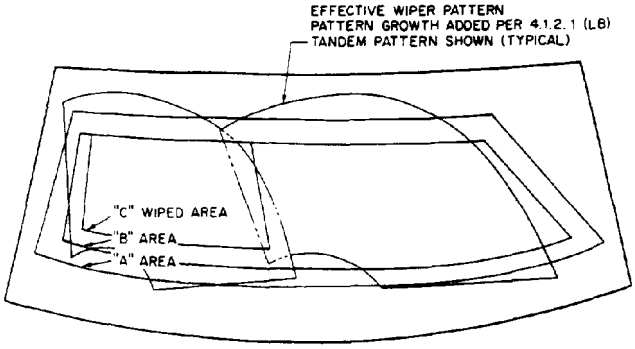

FIGURE 7—UNWRAPPED REAR VIEW OF WINDSHIELD

5.1.2.2 Test Buck Evaluation

a. Operate test buck with water on and wiper system on high speed, and mark outline of wipe pattern.
b. Create full-size unwrapped view of wipe pattern and areas A, B, and C as developed in 5.1.2.1.
c. Transfer full-size unwrapped view with wipe pattern and areas A, B, and C as determined in 5.1.2.2b to transparent heavy gage plastic sheet.
d. Transfer wipe pattern from the test buck to the plastic sheet and recalculate the percentages of areas A, B, and C that are wiped and compare the values with those in Table 1.

5.2 Wiper System Durability and Frequency Test

5.2.1 TEST EQUIPMENT—AS REQUIRED

a. Test buck—See 5.1.1.2.2.
b. Power source—See 5.1.1.2.3.
c. Counters—A device for determining the number of cycles.
d. Spray equipment—See 5.1.1.2.4.
e. Water softener—A device, where required, to supply water meeting requirements of 5.2.2d.
f. Cleanser—Of a nonabrasive type.
g. Temperature measuring device—Thermometer or equivalent.
h. Voltmeter.
i. Vacuum gage.
j. Hydraulic pressure gage.

5.2.2 TEST CONDITIONS

a. Ambient temperature of 10 to 38 °C (50 to 100 °F).
b. Water temperature of 7 to 24 °C (45 to 75 °F).
c. Water nozzles—To be located so as to provide as approximately equally distributed water flow on windshield glazing surface at a rate of no less than 820 cm^3/min (50 in^3/min).
d. Water hardness—Not to exceed 0.2 kg/m^3 (12 grains/gal).
e. Power input level at drive motor (frequency test only)—The minimum power available at the drive motor, as specified by the vehicle manufacturer, under normal vehicle operating conditions.
f. Durability controller to simulate controller in vehicle application for current and voltage.

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5.2.3 FREQUENCY TEST PROCEDURE—Clean the windshield. Water is to be applied continuously to the windshield throughout the test, as indicated in 5.2.2c. Apply power to the drive motor as specified in 5.2.2e. With appropriate control settings, determine system operating frequencies.

5.2.4 DURABILITY TEST PROCEDURE—The windshield wiper system shall be operated for 1 500 000 cycles, 300 000 cycles at the high-frequency setting and 1 200 000 cycles at low-frequency setting. In both the high-frequency and low-frequency test cycles, the operational sequence shall be as follows:

Wet operation—water on 5.5 min.
Dry operation—water off 0.5 min.
Park position—0.1 min minimum to 1 min maximum

For wet operation, water is to be supplied to the windshield in accordance with the provisions of 5.2.2c. The windshield is to be cleaned when necessary. Any component failure during this test denotes system failure.

5.3 Wiper System Stall Test

5.3.1 TEST EQUIPMENT

a. Test buck—See 5.1.1c.
b. Power source—See 5.1.1.2.2.

5.3.2 TEST PROCEDURE—Under any normal mode of operation, the wiper system shall meet the requirements specified in 4.1.4 when the wiper arms and blades are restrained from movement for 15 s at any position on the windshield. Arm restraint may be applied anywhere along the arm and to each arm separately or both arms together. Blade to be restrained along the entire length of the rubber blade element. The wiper system shall be tested at each of the following two temperatures: –30 and 55 °C ± 3 °C (–20 and 130 °F ± 5 °F). The wiper system shall also meet this requirement at the temperature (between listed limits) which corresponds to the highest output torque at the pivot.

5.4 Wiper System Temperature Operation Capability

5.4.1 TEST EQUIPMENT

a. General—Test buck, power source, timing device, and other pertinent equipment described in 5.2.1 shall be used in this test.
b. Test chamber—A room or chamber large enough to contain the complete test buck and capable of maintaining a temperature of –30 to 55 °C ± 3 °C (–20 to 130 °F ± 5 °F).

5.4.2 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 0.5 h at maximum wiper speed control setting with water applied continuously, as indicated in 5.2.2c.

5.4.3 COLD TEST PROCEDURE—The test buck is to be soaked in the test chamber at a temperature of –30 ± 3 °C (–20 ± 5 °F) for 4 h. Following this soak period and in the same temperature environment, the wiper system is to be turned on and operated for a period of 0.5 h at maximum wiper system speed control setting.

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