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Superseding J902 APR93

Submitted for recognition as an American National Standard

Passenger Car Windshield Defrosting Systems

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format. Definitions have changed to Section 3. All other section numbers have changed accordingly.

1. **Scope**—This SAE Recommended Practice provides a test procedure and performance guideline for evaluating passenger car windshield defrosting systems. It is limited to results of tests that can be conducted on uniform test equipment in commercially available laboratory facilities.

The current engineering practice prescribes that for laboratory evaluation of defroster systems, a known quantity of water shall be sprayed on the windshield to form an ice coating and then melted by the defroster under specific vehicle operating conditions. The procedure provides uniform and repeatable laboratory test results, even though under actual conditions such a coating would be removed by scraping before driving the vehicle. The performance obtained, therefore, does not directly relate to actual driving conditions, but serves as a laboratory performance indicator for comparing test results within or between systems.

This document is intended as a guide toward standard practice but may be subject to frequent change to keep pace with experience and technical advances and this should be kept in mind when considering its use.

2. References

- 2.1 **Applicable Publications**—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, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J826—Devices for Use in Defining and Measuring Vehicle Seating Accommodation
SAE J903c—Passenger Car Windshield Wiper Systems
SAE J941—Motor Vehicle Driver's Eye Location
SAE J1100—Motor Vehicle Dimensions

- 2.2 **Related Publication**—The following publication is provided for information purposes only and is not a required part of this document.

- 2.2.1 ISO PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 3468—Road vehicles—Windscreen defrosting systems for passenger cars—Test methods

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3. Definitions

- 3.1 Defrost**—Melt frost on the inside or outside, or test ice coating on the outside surface of the glass, with the defroster system.
- 3.2 Windshield Defroster System**—Means intended to defrost the windshield.
- 3.3 Defrosted Area**—That area of the windshield composed of dry, cleared surface and melted, or partially melted (wet), test coating, and excluding that area of the windshield covered with dry test coating and which is defined and qualified by the following:
- 3.3.1 The driver's seat in the rearmost position (see Figure 1.)

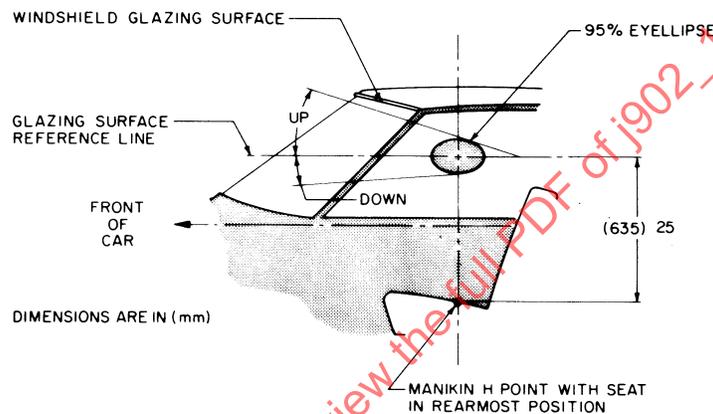


FIGURE 1—SIDE VIEW OF AREA GENERATION

- 3.3.2 The 95th percentile tangential cutoff two-dimensional ellipse in accordance with SAE J941 shall be used.
- 3.3.3 The plan view reference line is defined as the plan view line outboard of the steering wheel centerline and parallel to the vehicle centerline. The dimension can be determined by: $0.85 \times W7 + 0.075 \times W3$, where $W3$ and $W7$ are defined by SAE J1100 (see Figure 2.)
- 3.3.4 The glazing surface reference line which is defined as the line of intersection of the glazing surface with the horizontal plane 635 mm above the manikin H-point as defined in SAE J826 (see Figure 1.)

4. General

- 4.1 Area to be Defrosted**—The minimum windshield area that shall be defrosted is described by the use of two specified areas identified in Table 1 as areas A and C. Each area has been established using the angles of Table 1 applied as shown in Figures 1 and 2. In Figure 1, the upper and lower boundaries of the area are established by the intersection of two planes, tangent to the upper and lower sides of the eye range contour, with the windshield glazing surface. The planes are fixed by angles above and below the glazing surface reference line. In Figure 2, the left and right boundaries of the area are established by the intersection of two planes tangent to the left and right sides of the eye range contour. The planes are fixed by angles to the left and right of the plan view reference line. Using the test procedures established in 5.4, a minimum of 80% of area A and 100% of area C should be defrosted in 30 min. The areas used in determining the percentage of defrosted area are those areas on the exterior glazing surface which are not within 25.4 mm of the edge of the daylight opening (pillar, division bar, header, etc.). Figure 3 illustrates all of the areas on a typical windshield. The percentage is the ratio of the defrosted area within the defined area to the defined area.

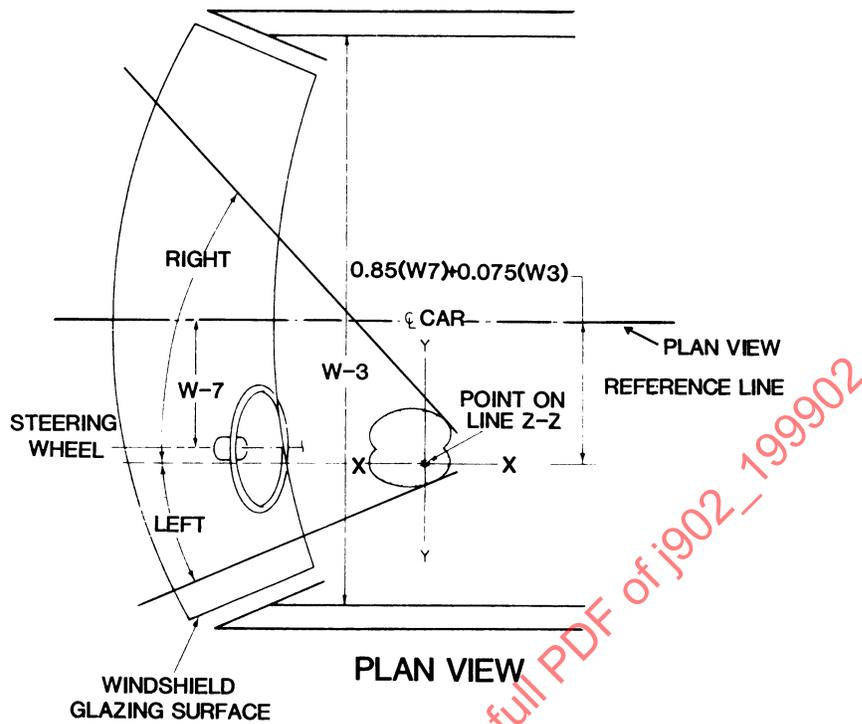


FIGURE 2—PLAN VIEW OF AREA GENERATION (REFERENCE SAE J1100)

TABLE 1—AREAS TO BE DEFROSTED
(REFERENCE SAE J903C)

Area	Minimum Percent Defrosted in 30 min	Angles, degrees ⁽¹⁾ Left	Angles, degrees ⁽¹⁾ Right	Angles, degrees ⁽¹⁾ Up	Angles, degrees ⁽¹⁾ Down
A	80	18	56	10	5
C	100	10	15	5	1

1. See Figures 1 and 2.

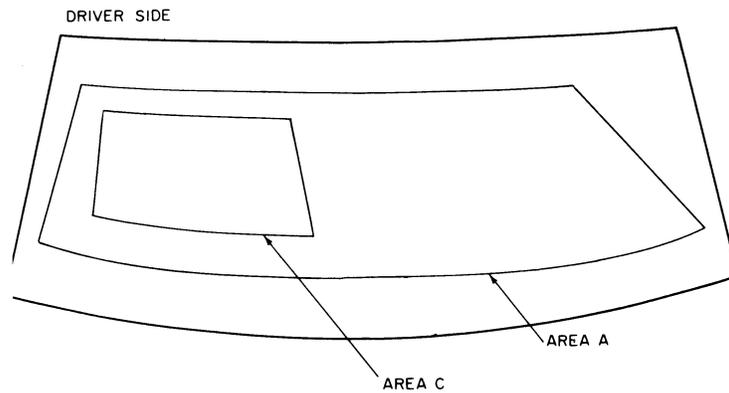


FIGURE 3—TYPICAL LOCATION OF AREAS A AND C AS VIEWED FROM INTERIOR OF VEHICLE

5. Defrosting Test

5.1 Test Equipment

- 5.1.1 Test chamber sufficiently large to contain the basic vehicle, with provision for circulating cold air.
- 5.1.2 Means for recording the boundaries of the windshield areas defrosted. (A wax pencil is commonly used for outlining defrosted areas.)
- 5.1.3 Engine tachometer
- 5.1.4 Stopwatch or other timing device
- 5.1.5 Thermometers or other temperature measuring devices
- 5.1.6 Throttle control device (if desired)
- 5.1.7 Stainless steel spray gun for applying water to the windshield with the following characteristics:
 - a. Fluid—water
 - b. Liquid nozzle size diameter—1.7 mm
 - c. Operating gun gage pressure—345 kPa
 - d. Airflow rate— $0.0056 \text{ m}^3/\text{s} \pm 0.0004 \text{ m}^3/\text{s}$Pattern at 200 mm from surface— $300 \text{ mm} \pm 50 \text{ mm}$ wide
- 5.1.8 Device for measuring quantity of water
- 5.1.9 Auxiliary power supply for blower motor
- 5.1.10 Anemometer

5.2 Test Conditions

- 5.2.1 TEST CHAMBER TEMPERATURE— $18 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$.
- 5.2.2 ENGINE LOAD AND SPEED—(TO OBTAIN NORMAL OPERATING TEMPERATURES)— $1500 \text{ rpm} \pm 50 \text{ rpm}$ in neutral gear, or any speed and load not to exceed the 40 km/h road load condition in the manufacturer's recommended gear.

The chassis dynamometer load used to simulate road load shall be calculated as follows:

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Using the product of the overall width (W117) and overall height (H101), as defined by SAE J1100, to approximate the vehicle cross-sectional area, determine the vehicle air resistance horsepower using Equation 1:¹

$$W = \frac{F^{(1)} \times \text{km/h}}{3.6} \quad (\text{Eq. 1})$$

where:

F = air resistance force, N
= 0.0035 A

A = vehicle cross-sectional area, cm²

then for:

$$0.0395 A = 40 \text{ km/h, } W$$

NOTE—The calculated air resistance horsepower is the maximum load that is to be applied to the chassis dynamometer. The absence of the rolling friction of the nondriving wheels of the test vehicle compensates for the fact that the driving wheels on the dynamometer rolls result in greater rolling friction than that existing on a level road.

- 5.2.3 AIR VELOCITY—3.2 km/h maximum, directed at the windshield parallel to the longitudinal centerline of the vehicle.
- 5.2.4 SOAK TIME—10 h (except as noted in 5.4.2).
- 5.2.5 NUMBER OF VEHICLE OCCUPANTS DURING TEST—Two maximum.
- 5.2.6 WINDSHIELD WIPERS—Turned off. Wiper blades and arms to be off the windshield glazing surface during ice application.
- 5.2.7 DEFROSTER SYSTEM AIR—On full. Blower on high speed. Systems employing an initial time delay in bringing the blower up to high speed are to function as designed.

1. $F = C_D Q A$

where:

C_D = coefficient of drag (use 0.45 as a typical value)

Q = dynamic pressure
= $1/2 \rho V^2 = 78.5 \text{ N/m}^2$ at 40 km/h

where:

ρ = mass density, kg/m³
V = air velocity, m/s

$$F = \frac{0.45 \times 1.64A}{144} \quad F = \frac{0.45 \times 78.5A}{10000}$$
$$= 0.0051A \quad = 0.0035A$$

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- 5.2.8 TEST VOLTAGE—To be $15\% \pm 1.5\%$ over nominal system rating at the blower motor (for example, 13.8 on a 12 V system) or the supply end of motor dropping resistor.
- 5.2.9 TEMPERATURE CONTROL—System controls set to provide maximum available defroster discharge air temperature for the entire test procedure.
- 5.2.10 All engine, heater, and defroster units shall be standard production parts or equivalent, adjusted to specified limits.
- 5.2.11 Engine hood, doors, windows, and controllable vents shall be closed.

5.3 Test Instrumentation

- 5.3.1 The temperature of the engine coolant may be measured upstream of the engine thermostat.
- 5.3.2 The temperature of the coolant entering and leaving the heater unit shall be measured as close to the unit inlet and outlet pipes as possible.
- 5.3.3 The temperature of the defroster air shall be measured at a point in the defroster outlet (or outlets) that is in the main airflow and which is at least 25 mm below (upstream of) the plane of the defroster outlet opening. The use of multiple temperature measurements is recommended as a means of obtaining an average temperature in large defroster outlet units. At least one temperature measurement shall be made in each outlet unit.
- 5.3.4 The ambient air temperature shall be measured at a point that is located at the midpoint of the windshield 0.3 m ahead of the windshield surface. The air velocity at the windshield shall be measured at a point that is located at the midpoint of the windshield 25 mm ahead of the windshield surface.

5.4 Test Procedure

- 5.4.1 The test chamber shall have been maintained at or below the specified test temperature for not less than 24 h preceding the vehicle soak period.
- 5.4.2 VEHICLE SOAK PERIOD—The vehicle shall stand inoperative at the specified test temperature to soak for a period of not less than 10 h.

NOTE—If instrumentation is available to assure that engine coolant and lubricant are stabilized at test temperature, a shorter soak time may be used.

- 5.4.3 ICE APPLICATION—Following the vehicle soak period, a test coating of ice shall be formed on the outer surface of the windshield as follows: With specified ambient temperature, the windshield shall be sprayed with an average of $0.046 \text{ mL of water/cm}^2 \pm 0.005 \text{ mL of water/cm}^2$ of glass area applied by means of a spray gun with $345 \text{ kPa} \pm 34.5 \text{ kPa}$ air pressure at the gun while spraying to form an even test coating of ice over the entire glass surface.

The spray nozzle (adjusted to full fan pattern and maximum flow) is held perpendicular to and 200 to 250 mm from the glass, stroked back and forth evenly in horizontal overlapping layers until the specified quantity of liquid is applied. Upon completion of the icing process, an additional soak period of not less than 30 min, and not more than 40 min, shall have elapsed before start of the test.

- 5.4.4 With observer(s) in the vehicle, the engine shall be started. This shall mark the start of the test period. Test conditions described in 4.2 are to be maintained throughout the duration of the test. As the test proceeds, the temperature at thermocouple location specified in 5.3.4 may increase due to the effect of engine heat. However, the temperature shall not exceed $-12 \text{ }^\circ\text{C}$.

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- 5.4.5 The observer(s) shall outline the defrosted areas on the inner side of the windshield at the 30 min time interval. For engineering evaluation, the observer can make an outline at 5 min intervals as the test proceeds.
 - 5.4.6 At completion of the test, the defrosted pattern shall be transferred to vellum by tracing. The vellum shall be marked to identify the driver's side. If an interior auxiliary light source is used to aid in the transfer of lines, it should be placed as far to the rear of the vehicle as possible to minimize any effect of parallax.
 - 5.4.7 Tests may be run twice and averaged.
- 5.5 Recording of Test Data**—Figure 4 illustrates a typical form for recording test data.

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