SAE International™

# SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J902

REV. JUL2003

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Superseding J902 FEB1999

## Passenger Car Windshield Defrosting Systems

*1.* ***Scope***—This SAE Recommended Practice provides a test procedure and performance guideline for evaluating passenger vehicle 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 Vehicle Windshield Wiper Systems
SAE J941—Motor Vehicle Driver's Eye Location
SAE J1100—Motor Vehicle Dimensions

**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 ISO PUBLICATION—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

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





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2.2.2 EEC PUBLICATION—Available from UN Economic Commission for Europe, Information Office, Palais des Nations, CH - 1211 Geneva 10, Switzerland.

EEC Council Directive 78/317 on windshield defrost and defog

## *3. General*

**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 frozen 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.)

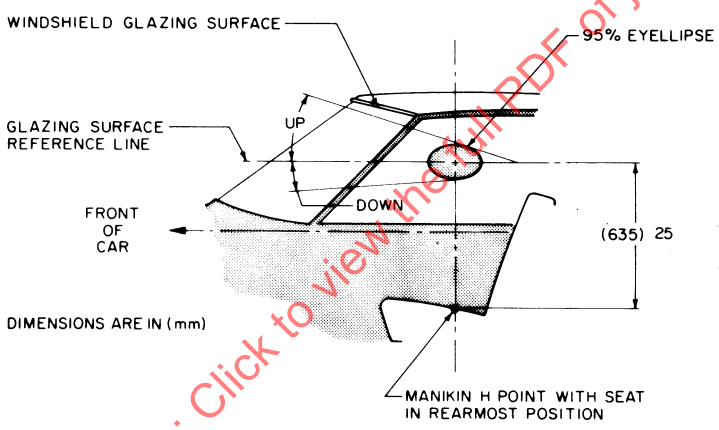


FIGURE 1—SIDE VIEW OF AREA GENERATION

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 x W7 + 0.075 x 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.)

**3.4 Coolant Mix**

3.4.1 For vehicles that use a glycol water mix for heating the air, the mix shall be set per the manufacturer's specification.

## *4. Defrosting Test*

**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 4.4, 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.

**4.2 Test Conditions**

4.2.1 SOAK TEMPERATURE——18 °C maximum °C (0 °F maximum)

4.2.2 ENGINE LOAD AND SPEED—(TO OBTAIN NORMAL OPERATING TEMPERATURES)

*4.2.2.1* Vehicle shall be operated either with engine RPM not to exceed 1500 rpm + 50 rpm in neutral gear, or any speed not to exceed the 40 km/h (25 mph) at road load condition in the manufacturer's recommended gear.

*4.2.2.2* For Electric Vehicles (or Other Vehicles with Electric Windshield)Test to be run in park with any electric drive motor off. The battery system should be at full charge prior to test.

*4.2.2.3* For Hybrid Electric VehiclesThe test should be run per 4.2.2.1 with the powertrain control logic per manufacturer's specification at –18 °C. The battery system should be at full charge prior to test.

*4.2.2.4* For vehicles with remote start installed by the OEM, the test should not be run using this feature.

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

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:

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

where:

F = air resistance force, [N]
= 0.00275 A

then for:

**F=CdQA

where:

Cd = coefficient of drag (use 0.35 as a typical value)

Q - dynamic pressure = $1/2\rho V^2$ = 78.5 N/m$^2$ @ 40 km/h

where:

$\rho$ = mass density in kg/m$^2$
V = velocity in m/s
A = vehicle cross-sectional area, cm$^2$
F = 0.35 x 78.5 x A/10000=0.00275 A

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.

4.2.3 AIR VELOCITY—8 km/h (5 mph) maximum, directed at the windshield parallel to the longitudinal centerline of the vehicle.

4.2.4 SOAK TIME—10 h (except as noted in 4.4.2).

4.2.5 NUMBER OF VEHICLE OCCUPANTS DURING TEST—Two maximum.

4.2.6 WINDSHIELD WIPERS—Turned off. Wiper blades and arms to be off the windshield glazing surface during ice application.

4.2.7 DEFROSTER SYSTEM AIR—Set blower speed on per 4.2.8. Systems employing an initial time delay in bringing the blower up to high speed are to function as designed.

4.2.8 TEST VOLTAGE

*4.2.8.1* Use the normal on board vehicle electrical system to supply voltage to the blower.

*4.2.8.2* *For Pulse Width Modulated and Linear Speed Controlled Motors*—Set Automatic control to DEF and request for the highest blower setting. Do not use auxiliary power supply.

*4.2.8.3* Vehicles equipped with an auxiliary blower for rear compartment heating shall have the blower turned off or at its lowest setting if off is not design intent.

4.2.9 TEMPERATURE CONTROL—System controls set to provide maximum available defroster discharge air temperature for the entire test procedure.

*4.2.9.1* Vehicle equipped with an auxiliary heater for rear compartment heating shall have the temperature set at the full hot.

4.2.10 All engine, heater, and defroster units shall be standard production parts or equivalent, adjusted to specified limits.

4.2.11 Engine hood, doors, windows, and operator controllable vents shall be closed. Body pressure relief valves shall be fully functional.

4.2.12 SUPPLEMENTAL ELECTRICAL SETTINGS

*4.2.12.1* If standard equipment, the rear window defrost device shall be turned on if the vehicle is so equipped at the beginning of test. It shall be allowed to time out if the vehicle system is designed to do this. If this is not a standard feature for this vehicle, and the vehicle being tested is so equipped, it shall be turned off during the duration of the test.

*4.2.12.2* If standard equipment, the heated seats shall be turned on highest setting. If this is not a standard feature for this vehicle, and the vehicle being tested is so equipped, it shall be turned off during the duration of the test.

*4.2.12.3* Headlamps shall be turned on low beam for the duration of the test.

*4.2.12.4* If the vehicle is equipped with an electronically controlled thermostat, the thermostat shall be set to run per normal warm-up conditions.

4.2.13 SUPPLEMENTAL HEAT SETTINGS

*4.2.13.1* If the vehicle is equipped (and this is standard equipment on this vehicle model) with a supplemental heat source such as Positive Temperature Coefficient (PTC) heaters or fuel operated heater, it shall be turned on per the vehicle system specification.

*4.2.13.2* If the vehicle is equipped with a heat storage device, it shall be fully charged prior to the test and set to discharge per the vehicle specification.

*4.2.13.3* If the vehicle is equipped with a supplemental water pump, it shall be set to operate if it would normally operate at speeds less than 40 km/h or 1500 engine RPM.

**4.3 Test Instrumentation**

4.3.1 If engine coolant is used as the heat source, the temperature of the engine coolant shall be measured at the engine outlet or appropriate location. If other liquid heat source (Fuel Operated Heater or heat storage device) is used on the vehicle the coolant temperature shall be measured as close the device outlet as possible.

4.3.2 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.

4.3.3 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.

4.3.4 The ambient air temperature shall be measured at a point that is located immediately above the most forward point of the bumper, at the centerline of the vehicle and at a height at the center of the windshield area.

4.3.5 The engine lubricant should be measured in the engine sump or at the end of the dipstick. Engine lubricant shall be -18°C +/- 3°C prior to test start. The temperature shall be recorded in the data table. Engine block heaters shall not be operational before or during the test.

**4.4 Test Procedure**

4.4.1 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.

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

4.4.2 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.

4.4.3 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 mL of water/$cm^2$ ± 0.005 mL of water/$cm^2$ (0.010 oz of water/in2 + 0.0001 oz of water/in2) of glass area applied by means of a spray gun described in 5.1.7 with 345 kPa + 34.5 kPa (50 Psig + 5 Psig) 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 (8 to 10 in) 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.

4.4.4 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 4.3.4 may increase due to the effect of engine heat. However, the temperature shall not exceed 15 °C (+5°F).

4.4.5 The observer(s) shall outline the defrosted areas on the inner side of the at 5-min intervals as the test proceeds for a total of 40 minutes.

4.4.6 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. (Digital photography may be used if available.)

4.4.7 Tests shall be run twice and averaged.

**4.5 Recording of Test Data—**Figure 4 illustrates a typical form for recording test data.

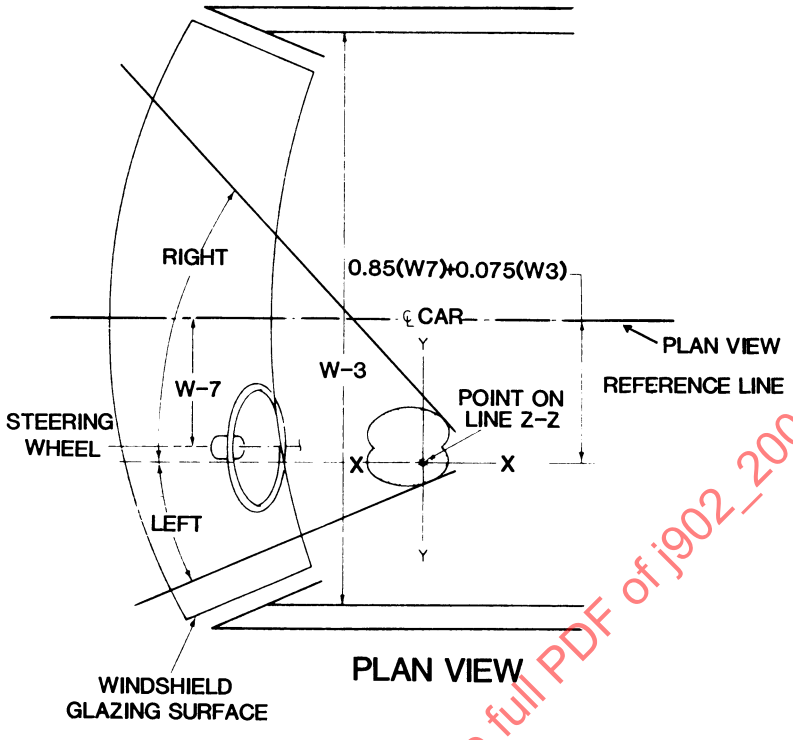


FIGURE 2—PLAN VIEW OF AREA GENERATION (REFERENCE SAE J1100)

**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.

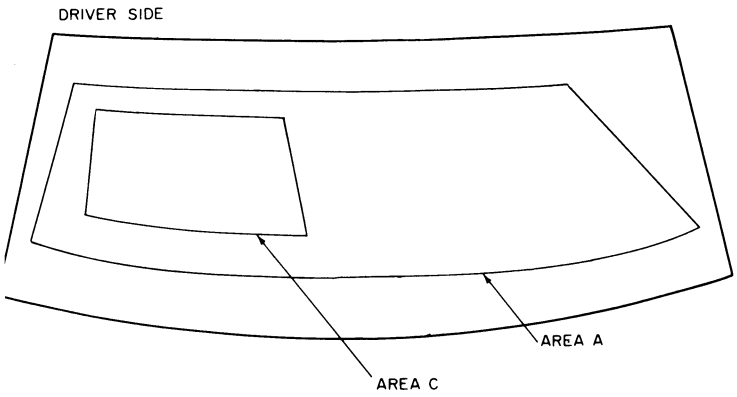


FIGURE 3—TYPICAL LOCATION OF AREAS A AND C AS VIEWED FROM INTERIOR OF VEHICLE

## *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 (0.070 in)
c. Operating gun gage pressure—345 kPa (50 psi)
d. Airflow rate—0.0056 $m^3/s \pm 0.0004$ $m^3/s$ (12 $ft^3/min \pm 1$ $ft^3/min$)

Pattern at 200 mm (8 in) from surface—300 mm ± 50 mm (10 in ± 2 in) wide

5.1.8 Device for measuring quantity of water

5.1.9 Auxiliary power supply for blower motor

5.1.10 Anemometer for measuing air velocity

**5.2 Recording of Test Data**—Figure 4 illustrates a typical form for recording test data.