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SAE INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

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Submitted for recognition as an American National Standard

PASSENGER CAR BACKLIGHT DEFOGGING SYSTEM

***Foreword*—**This Reaffirmed Document has been changed only to reflect the new SAE Technical Standards Board Format. Definitions have been changed to Section 3. All other section numbers have changed accordingly. To comply with the format, most English units have been deleted unless where appropriate.

***1. Scope*—**The scope of this SAE Recommended Practice is to establish uniform test procedures for passenger cars, to determine whether the system is defined as a defroster or defogger, and to establish minimum performance requirements for each system. A defroster for purposes of this practice is a system which will remove moisture and/or frost from the interior surface of the backlight at −18 °C. A defogger is a system which will remove moisture and/or fog from the interior surface of the backlight at 4 °C. The test procedure is intended to simulate actual conditions by utilizing either a cold room with an appropriate device to introduce air flow over the backlight or a sufficiently large wind tunnel with ambient temperature control. The test procedure and the minimum performance requirements are based on currently available engineering data.

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

SAE J1050—Describing and Measuring the Driver's Field of View
SAE J1100—Motor Vehicle Dimensions

3. Definitions

3.1 Frost—Water vapor deposited on a surface as a translucent layer of ice crystals.

3.2 Defrost—To remove frost deposited on the inside surface of the glass. A surface which has been defrosted will be clean, dry, and free from any moisture and/or fog.

3.3 Defog—To remove fog deposited on the inside surface of the glass. A surface which has been defogged will be clean, dry, and free from any moisture and/or fog.

3.4 Backlight Defroster System—Means intended to defrost/defog the interior surface of the vehicle backlight.

3.5 Backlight Defogger System—Means intended to defog the interior surface of the vehicle backlight.

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3.6 Backlight—The window located at the rear of the roof panel.

3.7 Cleared Vision Area—That area of the passenger car backlight which has been cleared of frost and/or fog.

3.8 Rear Vision Area—This is the 'Indirect Field of View' afforded by the inside rear view mirror as measured by SAE J1050. The mirror vision through the backlight should provide a minimum of an unobstructed 20 degree horizontal field of view, and an unobstructed vertical field of view which includes the horizon and the road 200 ft rearward of the driver's SgRP. When conducting the Backlight Defroster/Defogger Test, this rear vision area, measured using SAE J1050, should be outlined on the backlight glass. Only the sections cleared within this boundary shall be used in calculating the percentage cleared..

4. General Requirements

4.1 Performance—After 30 min of operation, a minimum of 75% of the rear vision area must be cleared.

If the 75% cleared area is obtained at 4 °C ambient, the system shall be identified as a "Rear Window Defogger." If the 75% cleared area is obtained at −18 °C ambient, the system shall be identified as a "Rear Window Defroster."

5. Defrosting/Defogging Tests

5.1 Test Equipment

5.1.1 Wind tunnel or cold chamber sufficiently large to contain the basic vehicle, with provision for circulating cold air and maintaining −18 °C temperature for defroster and 4 °C for defogger.

5.1.2 Means for recording the boundaries of the backlight area which is being defrosted or defogged. A felt marking pencil is commonly used for outlining cleared areas. A camera located 90 degrees to the surface of the glass to take suitable photographs for determining the cleared areas may be utilized when a grid type of electric system is tested.

5.1.3 Engine tachometer

5.1.4 Stop watch or other timing device

5.1.5 Thermometers or other temperature measuring devices

5.1.6 Throttle control device (if desired)

5.1.7 Device for introducing water vapor into the vehicle interior at a controlled rate (see Appendix A for description of a typical device).

5.1.8 If a cold chamber is used, a device for introducing wind over the exterior surface of the backlight at a controlled and uniform rate is required (see Appendices B and C for description of a typical device).

5.1.9 Device for measuring air velocity

5.1.10 Auxiliary power supply for system to be tested

5.2 Test Parameters

5.2.1 TEST CHAMBER TEMPERATURE— −18 °C $^{+0^\circ}_{-3^\circ}$ C for defroster and 4 °C $^{+0^\circ}_{-3^\circ}$ C for defogging.

5.2.2 ENGINE SPEED AND LOAD

5.2.2.1 *Cold Room*—Engine load and speed to obtain normal engine operating temperatures. 1500 rpm ± 50 rpm in neutral gear, or any speed and load not to exceed 40 km/h road load condition in the manufacturer's recommended gear.

5.2.2.2 *Wind Tunnel*—Vehicle should be operated at 65 km/h road load.

5.2.2.3 *Road Load*—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:

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

where:

F = air resistance force, N
= 0.0035 A
A = vehicle cross-sectional area, cm^2

then for:

0.0389 A = 40 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 front wheels of the test vehicle compensates for the fact that the rear wheels on the dynamometer rolls result in greater rolling friction than that existing on a level road.

$$F^1 = C_D Q A \qquad \text{(Eq. 2)}$$

where:

C_D = coefficient of drag (use 0.45 as a typical value)
Q = dynamic pressure
= $1/2\rho V^2$ = 40 km/h at 78.5 N/m^2

where:

ρ = mass density, kg/m^3
V = air velocity, m/s

$$F = \frac{0.45 \times 75.5A}{10000} = 0.0035A \qquad F = \frac{0.45 \times 1.64A}{144} = 0.0051A$$

5.2.3 WIND VELOCITY

5.2.3.1 *Cold Room*—8 km/h maximum over surface of vehicle excluding backlight. See Appendix D for the velocity of the air over the backlight.

5.2.3.2 *Wind Tunnel*[1]—65 km/h measured 61 cm above ground surface and 61 cm in front of forwardmost portion of vehicle. (No special conditions apply to the backlight when tested in the wind tunnel.)

5.2.4 SOAK TIME—8 h minimum (see 5.4.2).

5.2.5 NUMBER OF VEHICLE OCCUPANTS PER TEST—Maximum of two occupants.

5.2.6 TEST VOLTAGE—The electrical system should be operated at the manufacturer's recommended nominal voltage as measured at the battery. The system control switch should be with the normal vehicle wiring.

If the switch is operated with an external voltage source, the test voltage should be the difference produced by the entire circuit loss between the switch and the battery.

5.2.7 All engine, heater, windshield defroster/defogger, and backlight defroster/defogger systems shall be standard production parts adjusted to specified limits.

5.2.8 Engine hood, doors, windows, and ventilation vents (except heater intake) should be closed. Designed intent body exhaust vents should be operable.

5.2.9 Both inner and outer surfaces of the backlight shall be thoroughly cleaned, prior to placing the vehicle in the cold room, using a 3 to 10% ammonia-water solution. The solution shall be applied with a clean cheesecloth and then dried and polished with another clean, dry cheesecloth.

5.3 Test Instrumentation

5.3.1 The temperature of the engine coolant shall be measured in the front heater system water inlet hose.

5.3.2 The temperature of the engine lubricant shall be measured in the approximate center of the oil reservoir. This may be approximated by measuring the temperature at the end of the oil dipstick (optional).

5.3.3 For rear heater blower systems, the temperature of the coolant entering and leaving the heater unit shall be measured as close to the unit inlet and outlet as possible.

5.3.4 When the backlight defroster/defogger incorporates an air blower, the temperature of the air shall be measured at the outlet. The use of multiple temperature measurement 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.

5.3.5 The ambient air temperature outside the backlight shall be measured at a point 2.5 cm above the exterior surface of the backlight and at the physical center of the glass.

1. The air discharge nozzle in the wind tunnel must be at least 25% larger than the frontal cross-sectional area of the vehicle being tested.

5.3.6 For cold room test, with backlight air flow over the exterior surface of the backlight, air velocity shall be measured on a line 1 cm above the surface and halfway between the top and bottom edges of the backlight vision area. In the initial test setup, five readings shall be taken and averaged to insure that the proper air flow is obtained. These readings shall be taken at the longitudinal centerline of the backlight vision area at each edge (left and right) of the backlight vision area, and halfway between the edge and the centerline of the backlight vision area (see Appendix E for visual description).

Variation of the velocity measured at each of the five points must not exceed 10% of the average reading.

5.3.7 Vehicle interior temperature shall be measured above each outboard seating position located approximately at breath level.

5.3.8 The vapor generator shall be located on the vehicle longitudinal centerline immediately back of the front seat (in its mid-position) with its discharge at breath level.

5.4 Test Procedure

5.4.1 The cold chamber shall have been maintained at or below the specified test temperature for not less than 8 h preceding the vehicle soak period.

5.4.2 VEHICLE SOAK PERIOD—The vehicle shall stand inoperative in the test chamber at the specified temperature for a period of not less than 8 h as prescribed in 5.2.1.

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

5.4.3 Fill the container of the vapor generator with 2.84 L of water and place generator in the cold chamber (outside of the vehicle) prior to beginning of test. Start vapor generator and bring the water to a full boil using high power setting. Reduce power setting to maintain incipient boil 99 °C until needed for test.

5.4.4 Determine the input wattage from the Vapor Generator Calibration Curve which will produce the following amount of water vapor: (number of passengers which vehicle is rated to carry, minus the number of occupants in vehicle during test) x 1000 grains/h.

5.4.5 Five minutes prior to installing the vapor generator in vehicle, increase wattage setting to that determined in 5.4.4. Install the generator and the test personnel simultaneously into the vehicle and close all doors and windows.

5.4.6 Allow the vehicle to soak for a period of 5 min prior to starting the vehicle.

5.4.7 Set the heater system to direct all possible airflow out of the heater outlets. Set controls for maximum blower speed and maximum temperature.

5.4.8 Start engine and operate as per 5.2.2.

5.4.9 Set the backlight defroster/defogger system to the specified voltage (see 5.2.6).

5.4.10 When vehicle interior temperature (as measured in 5.3.7) reaches 24 °C, adjust the heater control to maintain 24 °C $^{+3^\circ}_{-0^\circ}$ C. The highest blower speed obtainable as designed shall be maintained at all times.

5.4.11 Record at 5 min intervals (from vehicle start up) the extent of the cleared areas, until the backlight is completely clear or for a maximum of 30 min.

5.4.12 RECORDING OF TEST DATA—Appendix F illustrates a typical form for recording test data.

PREPARED BY THE SAE INTERIOR CLIMATE CONTROL STANDARDS COMMITTEE

APPENDIX A

REAR WINDOW DEFOGGER VAPOR GENERATOR

A.1 ***Description—***The "vapor generator" consists of the following (See Figure A1):

1. An insulated container.
2. Submerged heating element(s) to heat the water to boiling.
3. Vapor disperser assembly.

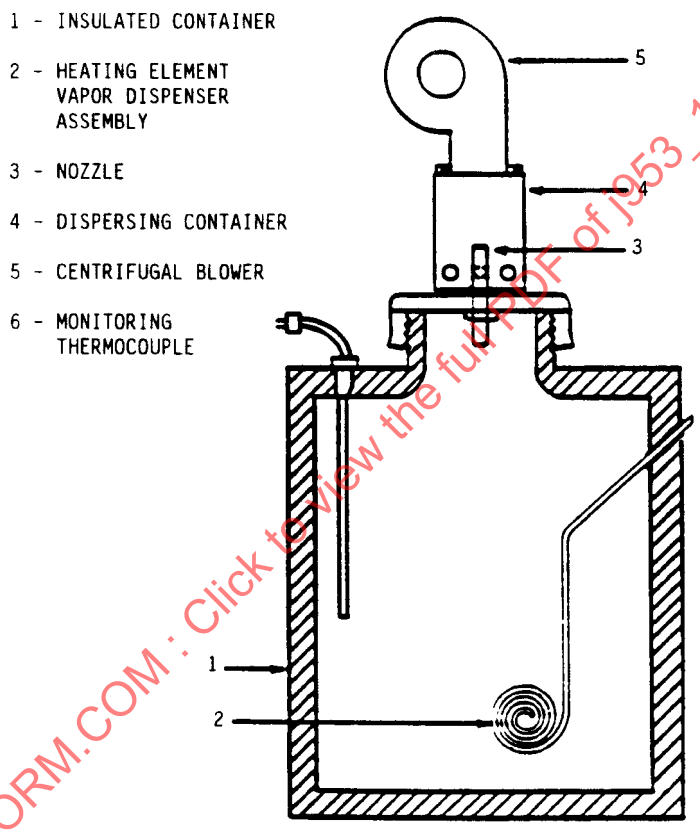

FIGURE A1—SCHEMATIC OF VAPOR GENERATOR

The power supply equipment consists of:

1. An auto-transformer for controlling the input voltage to the heating elements.
2. A wattmeter to measure the number of watts supplied to the element(s).

A.2 ***Calibration—***The vapor generator shall be calibrated at two different ambient temperatures, –18 °C and 24 °C. Calibration is performed as follows: The generator shall be weighed with water (approximately 2/3 full) before and after 1 h of operation at each ambient temperature. A minimum of 3 points over the range of 0 to 500 W must be obtained for each ambient temperature.

A.3 Vapor Generator Specifications

1. Water Container

   a. Capacity—3.8 L.
   b. Heat Loss—Not to exceed 75 W at water boiling temperature and –18 °C ambient temperature.

2. Heating Elements

   a. Capacity—500 W total.
   b. Monitoring Thermocouple.

3. Vapor Dispenser Assembly

   a. Nozzle

      1. Length—10 cm.
      2. Inside Diameter—1.5 cm.
      3. Material—Brass.

   b. Dispersing Container

      1. Length—11.5 cm.
      2. Diameter—7.5 cm.
      3. Holes—Six 0.63 cm holes, 2.5 cm above bottom of container, evenly spaced.
      4. Material—Brass pipe 0.38 cm wall thickness.

   c. Centrifugal Blower—Must be wired to operate whenever heating element is "on."

      1. Capacity—Air FLow 1.2 to 1.7 l/s at 0.05 kPa static pressure.

APPENDIX B

B.1 See Figure B1.

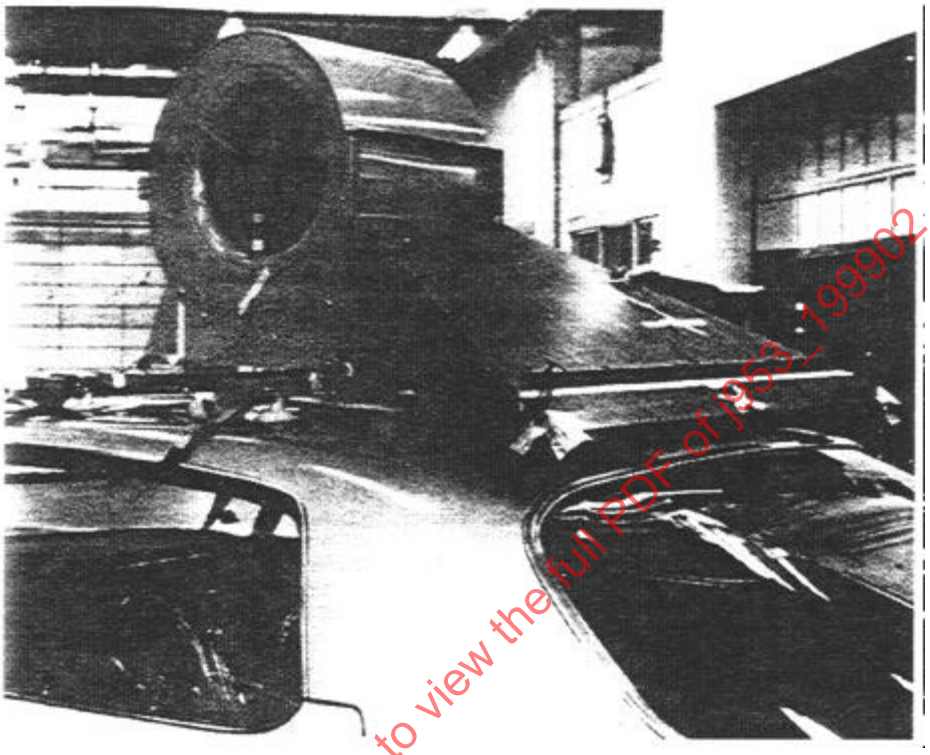

FIGURE B1—DEVICE FOR INTRODUCING WIND OVER THE EXTERIOR SURFACE OF THE BACKLIGHT—SIDE VIEW

APPENDIX C

C.1 See Figure C1.

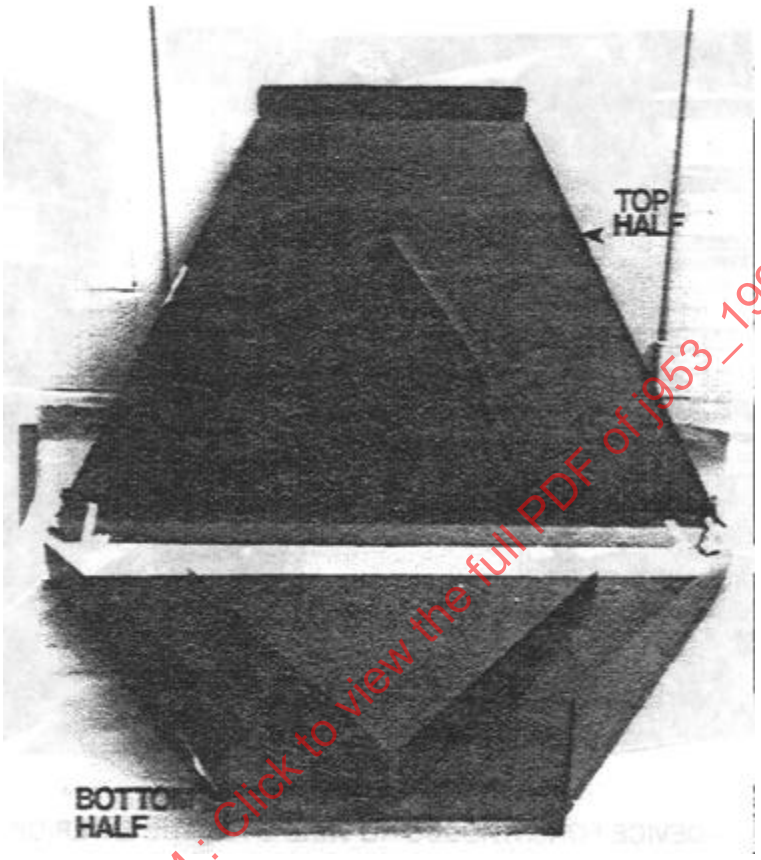

FIGURE C1—DEVICE FOR INTRODUCING WIND OVER THE EXTERIOR SURFACE OF THE BACKLIGHT—TOP VIEW

APPENDIX D

PASSENGER CAR BACKLIGHT DEFROSTER/DEFOGGER SYSTEM (FOR COLD ROOM USE WITH AUXILIARY AIRFLOW ONLY)

D.1 See Figure D1.

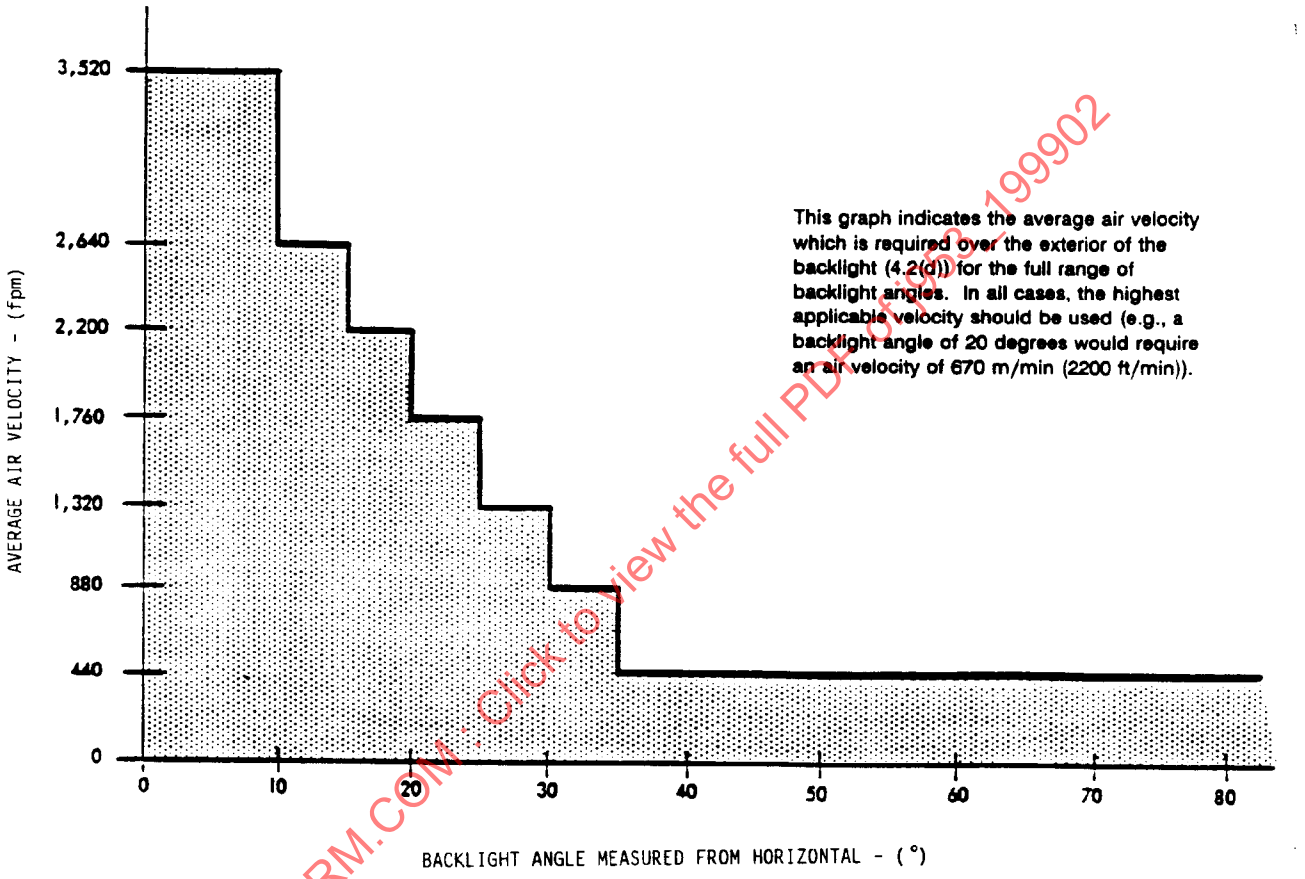

FIGURE D1—PASSENGER CAR BACKLIGHT DEFROSTER/DEFOGGER SYSTEM (FOR COLD ROOM USE WITH AUXILIARY AIRFLOW ONLY)