

**WINDSHIELD DEFROSTING SYSTEMS
TEST PROCEDURE - TRUCKS, BUSES, AND
MULTIPURPOSE VEHICLES**

1. SCOPE:

This SAE Recommended Practice establishes uniform test procedures for the defrosting systems of enclosed cab trucks, buses, and multipurpose vehicles. It is limited to tests that can be conducted on uniform test equipment in commercially available laboratory facilities. Current engineering practice prescribes that for laboratory evaluation of defroster systems, an ice coating of known thickness be applied to the windshield to provide more uniform and repeatable test results, even though under actual conditions such a coating would necessarily be scraped off before driving. The test condition, therefore, represents a more severe condition than the actual condition, where the defroster system must merely be capable of maintaining a cleared viewing area.

Because of the special nature of the operation of most of these vehicles (where vehicles are generally warmed up before or garaged in preparation for road operations) and since defrosting under steady-state, over-the-road operations is the main concern, test conditions have been adopted which eliminate the engine warmup phase of vehicle operation.

This recommended practice will be reviewed and revised as technological progress in vehicle defroster test procedure requires.

2. DEFINITIONS:

- 2.1 Defrost: Melt frost on inside or test coating on the outside surface of the glass with the defroster system.
- 2.2 Windshield Defroster System: Means intended to defrost the windshield.

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2.3 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.

2.4 Coolant: Liquid used for heat transfer composed of 50% glycol and 50% water by volume.

3. DEFROSTING TEST:

3.1 Test Equipment:

3.1.1 Cold chamber sufficiently large to contain the basic vehicle or basic vehicle body or partial body with provision for circulating cold air. If the road load test condition option is selected, a chassis dynamometer is required.

3.1.2 Means for recording the boundaries of the windshield areas defrosted. (A wax pencil is commonly used for outlining defrosted areas.)

3.1.3 Engine tachometer.

3.1.4 Stopwatch or other timing device.

3.1.5 Thermometers or other temperature measuring devices.

3.1.6 Throttle control device (if desired).

3.1.7 Stainless steel spray gun for applying water to the windshield with the following characteristics:

Fluid: water

Liquid nozzle size dia: 0.070 in (1.7 mm)

Operating gun gage pressure: 50 psi (345 kPa)

Airflow rate: 12 ± 1 ft³/min (0.0057 ± 0.0005 m³/s)

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

3.1.8 Device for measuring quantity of water applied to windshield.

3.1.9 Auxiliary power supply for blower motor.

3.1.10 Anemometer.

3.1.11 Independent coolant supply to provide controlled coolant flow to the heater-defroster system when an engine is not used for the coolant source.

3.2 Test Conditions: Either the engine in the test vehicle or an independent coolant supply may be used to provide coolant flow to the heater-defroster system under test.

3.2.1 Cold Chamber Temperature: $-0 \pm 5^{\circ}\text{F}$ ($-18 \pm 3^{\circ}\text{C}$).

3.2.2 Engine Load and Speed (when applicable):

Gasoline engines - 1500 ± 50 rpm in neutral gear or any load not to exceed 25 mph (40 km/h) road load.

Diesel engines - Governed or rated speed either in neutral gear or at any load not to exceed 25 mph (40 km/h) road load.

Load on the chassis dynamometer shall not exceed that calculated as follows:

The sum of one half the "rolling resistance horsepower" plus the "air resistance horsepower" as established according to the procedure specified in SAE J688, using Tables 3-6. A value equal to the minimum of the rated gvwt applicable to that defrosting system under test shall be used for the total gross vehicle weight and all calculated values will be for a speed of 25 mph (40 km/h) and an altitude of 1000 ft (0.30 km).

A sample calculation is provided in Fig. 1.

At road load, the vehicle shall be run in that transmission gear which will permit running the engine at its governed or rated speed at the closest possible speed to 25 mph but not to exceed 25 mph (40 km/h).

Truck model XXX

Minimum gvwt rating - 27 000 lb

Area factor from Table 4 of SAE J688 - 0.145

Velocity factor from Table 5 of SAE J688 - 31.3

Altitude factor from Table 6 of SAE J688 - 0.97

Rolling factor from Table 3 of SAE J688 - 0.657

$$\begin{aligned}\text{Air resistance hp} &= \text{Area factor} \times \text{Velocity factor} \times \text{Altitude factor} \\ &= 0.145 \times 31.3 \times 0.97 \\ &= 4.4\end{aligned}$$

$$\begin{aligned}\frac{1}{2} \text{ Rolling resistance hp} &= \frac{1}{2} (\text{Rolling factor} \times \text{Gross weight in 1000 lb}) \\ &= \frac{1}{2} (0.657 \times 27) \\ &= 8.9\end{aligned}$$

$$\text{Road load} = 4.4 + 8.9 = 13.3 \text{ hp (9.9 kW)}$$

Note: Data based on SAE J688-June, 1963.

Ø FIGURE 1 - Sample Calculation for Road Load

3.2.3 Heater-Defroster System Coolant Flow:

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With engine - That flow resulting from engine operation as prescribed in 3.2.2.

With independent coolant supply - Flow of coolant to be either $40 \pm 0 - 5$ lb/min ($18 \pm 0 - 2.25$ kg/min) or the flow that would be produced by the engine at 1500 rpm for the gasoline type and at governed speed for the diesel type, both for a closed engine thermostat condition.

3.2.4 Heater-Defroster System Coolant Temperatures:

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With engine - To be at 150°F (65.5°C) at the start of the test, or at the level off temperature of the coolant if below 150°F (65.5°C). Coolant temperature after the start of the test is to be a function of the engine control temperature characteristics at the test conditions.

With independent coolant supply - To be maintained at $150^\circ\text{F} \pm 5 - 0^\circ\text{F}$ ($65.5^\circ\text{C} \pm 3^\circ\text{C} - 0^\circ\text{C}$) for the entire test period.

3.2.5 Air Velocity: The maximum wind velocity shall not exceed 1 mph (1.6 km/h).

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3.2.6 Soak Time: 4 h.

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NOTE: If instrumentation is available to assure that the windshield and cab are stabilized at test temperature, a shorter soak time may be used.

3.2.7 Number of Vehicle Occupants During Test: Two maximum.

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3.2.8 Windshield Wipers: Wiper blades and arms are to be off the windshield glazing surface during ice application. Windshield wipers may be used during the test.

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3.2.9 Defroster and/or Heater System Air: On full, blower(s) on high speed.

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3.2.10 Test Voltage: To be 15% over nominal system rating at the blower motor (for example, 13.8 on 12 V system) or the supply end of motor dropping resistor.

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3.2.11 Temperature Control: Maximum position.

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

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3.2.13 Engine hood, doors, windows, and controllable vents shall be closed, except that one or two windows may be open to a total of 1 in (2.54 cm).

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3.2.14 If an auxiliary heater (or heaters) is part of the standard heater and defroster system, it may be operated.

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- 3.2.15 If the engine is used for supplying coolant, auxiliary means for preheating the engine, etc., is permissible to provide easier engine starting. Temperatures described in 3.4.4 must stay within specified limits.

3.3 Test Instrumentation:

- 3.3.1 The temperature of the engine coolant or the independent supply coolant shall be measured as near to the inlet pipe of the heater unit as possible. For those systems using more than one heater, it shall be measured at the inlet pipe of the heater unit getting the first coolant flow. The coolant flow may be measured at any convenient point in the independent coolant supply system.
- 3.3.2 The ambient air temperature shall be measured at a point that is located at the midpoint of the windshield 1 ft (30 cm) 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 1 in (2.54 cm) ahead of the windshield surface.
- 3.3.3 The windshield's interior surface temperature(s) shall be measured at a point located on the vertical and horizontal centerline(s) of the windshield(s).
- 3.3.4 The following temperature is solely for reference: The temperature of the defroster air shall be measured at a point in the defroster outlet (or outlets) that is in the main air flow and which is at least 1 in (2.54 cm) 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.
- 3.3.5 In all outboard seating positions, thermocouples should be placed at appropriate locations to measure ankle and breath level temperatures with the seat(s) in the rearmost and lowest position.
- (a) Ankle Level - Place on the floor at each outboard seating position, a thermocouple grid (minimum of 4 couples located in the corners of a 10 x 10 in (25 x 25 cm) square area). The couples shall be located 3 ± 0.5 in (7.5 ± 1.3 cm) above the floor surface, the grid being located in the geometric center of each floor position.
 - (b) Breath Level - Place a minimum of one thermocouple above each outboard seating position located approximately at breath level.

3.4 Test Procedure:

- 3.4.1 The cold 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 the cold chamber air and wall temperatures are stabilized, a shorter time may be used.

- 3.4.2 Vehicle Soak Period: The vehicle shall stand inoperative at the specified test temperature to soak for a period of not less than 4 h.

NOTE: If instrumentation is available to assure that windshield and cab are stabilized at test temperature, a shorter soak time may be used.

- 3.4.3 Ice Application: Following the vehicle soak period, a coating of ice shall be formed on the windshield(s) as follows: The windshield(s) shall be sprayed with 0.010 oz (0.046 mL) of water per square inch (square centimeter) of glass area applied by means of a spray gun with 50 ± 5 psi (345 ± 35 kPa) air pressure at the gun, measured while spraying to form an even coating of ice over the entire glass surface. The spray nozzle (adjusted to full fan pattern and maximum flow) is held perpendicular to and 8–10 in (20–25 cm) from the glass, and 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.

- 3.4.4 The test period begins when: (a) the engine coolant reaches 150°F (65.5°C) or level off temperature of the engine coolant, if less than 150°F (65.5°C) or (b) the independent supply coolant temperature reaches 150°F (65.5°C). Test conditions described in 3.2 are to be maintained throughout the duration of the test. Prior to the start of the test period, while the engine or independent coolant supply is being warmed up, the temperature at thermocouple locations specified in 3.3.2 and 3.3.3 shall not exceed +10°F (–12°C). As the test proceeds, the temperature at the thermocouple location specified in 3.3.2 shall not exceed +10°F (–12°C).

- 3.4.5 The observer(s) shall outline the defrosted areas on the inner surface of the windshield at intervals of 5 min as the test proceeds. All in-cab temperatures are also to be recorded at the same 5 min intervals.

- 3.4.6 At completion of the test, the defrosted pattern shall be recorded. It is suggested that the pattern be transferred to a transparent material by tracing. This record shall be marked to identify the driver's side.

- 3.4.7 Recording of Test Data: Fig. 2 illustrates a typical form for recording test data.

VEHICLE MODEL _____ DESCRIPTION OF HEATER-DEFROSTER _____
 VEHICLE TYPE _____ VEHICLE NO. _____
 TEST DATE _____ TEST NO. _____
 LOCATION _____
 OBSERVERS _____
 WINDSHIELD AREA _____ IN² _____ CM²

ICE APPLICATION
 WATER SPRAY GUN TYPE _____ SPRAY GUN PRESSURE _____ PSI _____ KPA _____
 NOZZLE TYPE _____ WATER USED: 0.010 OZ/IN² OF WINDSHIELD AREA _____
 SOAK PERIOD _____ H AT _____ °F _____ °C

TEST CONDITIONS CHECK LIST
 ENGINE LOAD AND SPEED: (WHEN APPLICABLE)
 GASOLINE 1500 RPM IN NEUTRAL GEAR ☐ OR AT ROAD LOAD _____ NOT TO
 EXCEED 25 MPH (40 KM/H) ROAD LOAD ☐
 DIESEL _____ GOVERNED SPEED IN NEUTRAL ☐ OR AT ROAD LOAD _____
 NOT TO EXCEED 25 MPH (40 KM/H) ROAD LOAD ☐
 COOLANT FLOW-INDEPENDENT SUPPLY (WHEN APPLICABLE) _____ LB/MIN ☐ KG/MIN ☐
 WIND VELOCITY AT WINDSHIELD _____ MPH _____ KM/H
 VOLTAGE TO HEATER MOTOR OR RESISTOR: _____ V (115% OF NOMINAL)
 CONTROL POSITION: MAX. TEMP ☐ FULL DEFROST ☐
 AUXILIARY HEATER OPERATING (WHEN APPLICABLE) ☐
 NO. OF PEOPLE IN VEHICLE _____ DOORS AND WINDOWS CLOSED TIGHTLY ☐
 ENGINE THERMOSTAT NOMINAL CONTROL TEMPERATURE _____ °F _____ °C WINDOWS OPEN 1 IN ☐

TEST DATA
 REMARKS: _____

TIME FROM START, MIN	TEMPERATURE, °F (°C)				INTERIOR TEMPERATURES				DEFROSTED AREA, %	
	ROOM	HEATER WATER IN	DEFROSTER AIR		BREATH		FLOOR			
			LEFT*	RIGHT*	DR.	PASS.	DR.	PASS.	A	C
0										
5										
10										
15										
20										
25										
30										
35										
40										

* IN HOLES

Ø FIGURE 2 - Form for Recording Test Data

The phi (Ø) symbol 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.

RATIONALE:

The SAE 5 year rule requires that each Practice/Standard should be reviewed and revised to reflect the latest technology and industry practice. The Subcommittee also has received a request from the American Trucking Association (ATA) to provide a method of determining in-cab temperature during the defrosting test. The ATA reported cases where the cab temperature was uncomfortably cold when the heater was in the defrost mode.

The Task Force added Section 3.3.5, the last sentence to 3.4.5 and revised Fig. 2 to require that in-cab temperatures be recorded during the defroster test. The balance of the test procedure, with the exception of adding the publication date to referenced standard J688, was found to still be current and no changes were necessary.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J688 JUN63, Truck Ability Prediction Procedure

APPLICATION:

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COMMITTEE COMPOSITION:

DEVELOPED BY THE SAE BODY ENGINEERING AND AUTOMOTIVE SAFETY COMMITTEES