SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Engine-Off Cab Heating and Air Conditioning Systems Test Procedure and Performance Requirements - Trucks with and without Sleepers

RATIONALE

This document is being revised to better define the test procedure steps required.

1. SCOPE

This SAE Recommended Practice establishes uniform test procedures and performance requirements for engine-off heating, ventilation, and air conditioning (HVAC) systems in order to achieve driver thermal comfort in both winter and summer rest periods. This specification will apply to heavy trucks with and without sleeper compartments, including but is not limited to Class 6, 7, and 8 powered vehicles.

1.1 Purpose

The purpose is to provide a standard test procedure for comparison and evaluation of truck heating and air-conditioning performance with truck engine off.

2. REFERENCES

2.1 Applicable Documents

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.

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1163 Determining Seat Index Point

SAE J1559 Determination of Effect of Solar Heating

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
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SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J2918_202206/

2.2.2 ATA Publications

Available from Technology & Maintenance Council - American Trucking Associations, 950 N. Glebe Road, Arlington, VA 22203, Tel: 703-838-1763, http://tmc.truckline.com.

RP418 (T) Heavy-Duty In Cab R-134a Air Conditioning Systems

RP432 (T) Engine off HVAC Performance Requirements for Truck Cabs with Sleepers

RP 438 (T) Engine off HVAC Performance Requirements for Truck Day Cabs without Sleepers

3. DEFINITIONS

3.1 AMBIENT TEMPERATURE

Air temperature measured external to the vehicle and internal to the Vehicle Environmental Chamber.

3.2 ENGINE-OFF AIR CONDITIONING SYSTEM

Any air-conditioning system that maintains the cabin and/or sleeper air temperature without using main truck engine.

3.3 ENGINE-OFF HEATING SYSTEM

Any heating system that maintains the cabin and/or sleeper air temperature without using main truck engine.

3.4 DAY CAB AND FRONT CAB COMPARTMENT

A truck cab with single row front occupant space for a driver and one or two passengers.

3.5 FRONT CAB COMPARTMENT OR DAY CAB AVERAGE TEMPERATURE

The average of the six cab occupant probe locations for driver and passenger as show in Figure 1.

3.6 SLEEPER COMPARTMENT

The living and sleeping space at the back portion of a cab normally divided by a curtain from the seated and belted driver and occupant area.

3.7 SLEEPER COMPARTMENT AVERAGE TEMPERATURE

The average of the six probe locations as shown in Figure 2.

3.8 CREW CAB COMPARTMENT

The back seating portion of a four-door cab.

3.9 CREW CAB COMPARTMENT AVERAGE TEMPERATURE

The average of the head, lap and foot probe locations for each belted crew compartment occupant as shown in Figure 1.

4. TEST EQUIPMENT

4.1 Vehicle Environmental Chamber (VEC)

Environmental chamber large enough to contain the vehicle and test equipment. The chamber must have provisions to maintain ambient temperature, humidity, and solar intensity. Chamber capability shall maintain the following levels of accuracy:

Temperature: ±1.7 °C (±3 °F)
Relative Humidity: 3% (±1.5%)
Solar Load: ±50 W/m^2

4.2 Pyranometer

A device used to measure radiant energy from the solar load placed horizontal above the vehicle roof surface.

4.3 Temperature Measurement Devices

Devices used to measure temperature inside the VEC as well as inside and outside the vehicle to be used for calculating and comparison of cooling performance, i.e., thermocouples, RTDs, etc. Must have an accuracy of ±1.5 °C (±2.7 °F).

4.4 Air Velocity/Wind Speed

Anemometer to measure air velocity (with a measuring accuracy of 2% of observed values).

4.5 Data Acquisition System

System that will monitor and record all required test parameters and necessary measured conditions consistent with this specification at the required time interval.

4.6 Voltage/Current Shunt

Device used to measure voltage or current from the battery or HVAC system electrical components.

5. TEST PREPARATION

5.1 Air Outlet Louver Direction

All louvers shall be open and directed perpendicular to their mounting surface, however, none of the louvers should be directed at any of the thermal probes unless location of the louver is located directly at a probe when adjusted perpendicular to their mounting surface.

5.2 Vehicle Environmental Chamber Measurement Locations

The vehicle test chamber temperature shall be measured by four thermocouples. Two thermocouples are to be placed along the centerline of the vehicle, half way between the ground and the highest point of the vehicle (excluding bolt on items), 915 mm (3 feet) forward of the front of the vehicle and 915 mm (3 feet) away from the back of the vehicle. Left and right side vehicle ambient shall be measured at a point 150 mm (6 inch) away from left side and right side of the vehicle. If a vehicle does not have mirrors, take measurement 450 mm (18 inch) outward from left and right side window.

5.3 Air Inlet Temperature - Engine-Off System

A minimum of one temperature measurement device may be installed in the air-conditioning system air inlet as a means of monitoring the temperature rise across the system.

5.4 Air Outlet Louver Temperature

A minimum of one temperature measurement device shall be installed in the center of each louver. Install temperature measurement device 19 mm (0.75 inch) into the louver and secured not to block airflow exiting the louver. For larger louvers multiple temperature measurement devices may be used and averaged.

5.5 Air Temperature Probe Locations

Thermocouples for measuring interior temperatures will be used to determine HVAC system performance. Additional temperature measurements may be recorded at the discretion of the testing party to achieve further information related to the vehicle air-conditioning system.

Locate temperature probes at the driver and passenger positions relative to each Seat Index Point (SIP) (per Figure 1).

Locate temperature probes at the sleeper positions per Figure 2, Table 1.

6. TEST PROCEDURE - AIR CONDITIONING

6.1 Bring the test vehicle into the VEC and turn the engine OFF. Open the sleeper compartment curtains.

6.2 Close all test vehicle doors, windows and fresh air vents.

6.3 Heat the VEC and test vehicle and maintain it a 37.8 °C ± 1.7 °C (100 °F ± 3 °F) for the duration of the test. A vehicle soak period is not required. Maintain wind speed within the VEC, so that it does not exceed 8 km/h (5 mph) throughout the duration of the test. Maintain the relative humidity at 50% ± 1.5%. Record data at least once per minute when soaking is started.

6.4 Run the prepared test vehicle with the engine and air conditioning system ON, or use some other means to cool the area being tested until the average temperature is equal or below 20 °C (68 °F). Maintain this temperature for 30 minutes.

6.5 If engine and engine-driven air-conditioning to cool cab compartments, then turn them Off then turn on the Engine-Off air conditioning system.

Close sleeper compartment curtains.

6.6 Turn solar load on and adjust to 600 W/m^2 ± 50 W/m^2. Measure solar load at the roof's surface on the center of the truck cab.

6.7 Record data for all channels at least once every minute.

7. PERFORMANCE REQUIREMENTS - AIR CONDITIONING

7.1 Truck with Sleeper Compartment

Maintain a maximum sleeper temperature ≤24.4 °C (76 °F) at each defined location (Figure 2, Table 1) for 10 hours with average sleeper temperature (see 3.8 4) to be 22.8 °C + 1.6 °C/-2.8 °C (73 °F + 3 °F/-5 °F).

7.2 Truck Cab (Day Cab, or Front Cab Compartment, or Crew Cab Compartment)

Maintain a maximum day cab, front cab or crew cab compartments temperature ≤24.4 °C (76 °F) at each defined location (Figure 1) for 2.5 hours with average temperature (see 3.6 and 3.10) to be 22.8 °C + 1.6 °C/-2.8 °C (73 °F + 3 °F/-5 °F). At the end of the test, the temperature at each occupant head shall not exceed the temperature at the feet by more than 1.7 °C (3 °F).

7.3 At the end of the specified time frame, there shall remain enough battery power to restart the engine.

8. TEST PROCEDURE - HEATING SYSTEM

8.1 Cool the VEC and maintain it a 0.0 °C ± 1.7 °C (-17.8 °F ± 3 °F) for the duration of the test. A vehicle soak period is not required. Maintain wind speed within the VEC so that it does not exceed 8 km/h (5 mph) throughout the duration of the test. No solar load is required.

8.2 Run the prepared test vehicle with the engine and heater system ON, or use some other means to heat the area being tested until the average temperature is above 25.6 °C (78 °F).

8.3 Close all test vehicle doors, windows and fresh air vents.

8.4 Bring the test vehicle into the VEC and turn the engine OFF. Close the sleeper compartment curtains.

8.5 Seal the VEC, and return it to the test conditions.

8.6 Monitor the average interior cab temperature until it has cooled less or equal to 25.6 °C (78 °F) and none of the probes (Figure 1, Figure 2, and Table 1) is outside the range 22.8 °C ± 2.8 °C (73 °F ± 5 °F).

8.7 Turn the Engine-Off heating system ON.

8.8 Check that all measurement probe channels are reading properly.

8.9 Record data for all channels at least once every minute.

9. PERFORMANCE REQUIREMENTS - HEATING SYSTEM

9.1 Truck with Sleeper Compartment

Maintain a minimum sleeper temperature ≥20 °C (68 °F) at each defined location (Figure 2, Table 1) for 10 hours with a sleeper average temperature (see 3.6 4) to be 22.8 °C ± 2.8 °C (73 °F ± 5 °F).

9.1.1 Day Cab, Front Cab Compartment, Crew Cab Compartment Truck

Maintain a minimum day cab, front cab or crew cab compartments temperature ≥20 °C (68 °F) at each defined location (Figure 1) for 2.5 hours with an average temperature (see 3.6, 3.10) to be 22.8 °C ± 2.8 °C (73 °F ± 5 °F). At the end of the test, the temperature at each occupant head should not exceed the temperature at the feet by more than 1.7 °C (3 °F).

10. TEMPERATURE PROBE LOCATIONS

10.1 Occupant Seat Probe Locations

Locate temperature probes at the driver and passenger positions relative to each Seat Index Point (SIP) per Figure 1.