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SAE J1503 JUL86

**Performance Test for
Air Conditioned,
Heated, and
Ventilated Off-Road
Self-Propelled Work
Machines**

SAE Recommended Practice
Issued July 1986

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**PERFORMANCE TEST FOR AIR CONDITIONED, HEATED, AND VENTILATED
OFF-ROAD SELF-PROPELLED WORK MACHINES**

1. **PURPOSE:** This recommended practice outlines a test procedure for off-road self-propelled work machines providing a uniform measurement of operator environmental temperature and humidity provided by a complete air handling system operating in a specified ambient environment; and establishes minimum performance levels for the operator enclosure's heater, ventilation, and air conditioning system.
2. **SCOPE:** This recommended practice applies to off-road, self-propelled work machines as defined in SAE J1116 JUN85, categories one thru five; and establishes the following minimum performance levels in the operator's environment for the seated position.
 - 2.1 Minimum operator enclosure pressurization and ventilation levels in the operator's environment for the seated position.
 - 2.2 Maximum humidity and minimum temperature differential under air conditioning operation.
 - 2.3 Minimum temperature differential under heater operation.
3. **DEFINITIONS:**
 - 3.1 **Air Handling System:** Any system which lowers or raises the effective temperature of the air within an operator enclosure by use of air conditioning, heating, or ventilating systems.
 - 3.2 **Comfort Chart:** Operator Comfort Chart as shown in Fig. 1.
 - 3.3 **Operator Environment:** The space surrounding the operator as defined by the temperature measurement locations described in Fig. 2.
 - 3.4 **Air Conditioning System:** Any system which lowers the effective temperature of the air within the operator's environment by means of a refrigerant.

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- 3.5 Heating System: Any system which raises the effective temperature of the air within the operator's environment.
- 3.6 Ventilating System: Any system which provides fresh air to, and maintains air circulation within the operator's environment.
4. TEST EQUIPMENT AND INSTRUMENTATION RECOMMENDATION:
- 4.1 A room sufficiently large to contain the base machine with provisions to circulate conditioned air and to load the machine's engine and transmission.
- 4.1.1 Field test conditions may be used.
- 4.1.2 If it is not practical to test the base machine due to physical size limitations, the enclosure may be bench tested with the loads imposed by the base machine on the enclosure simulated. If this procedure is used, the base machine should be field tested to verify performance.
- 4.2 Thermometers or other temperature measuring devices. Maximum error should not exceed $\pm 0.5^{\circ}\text{C}$.
- 4.3 Pressure gages or other pressure measuring devices. Maximum error should not exceed 2% of the reading.
- 4.4 Psychrometer to obtain wet bulb temperature reading in system. Maximum error should not exceed $\pm 0.5^{\circ}\text{C}$.
- 4.5 Manometer to measure enclosure pressurization. Maximum error should not exceed 10% of the reading.
5. MEASUREMENT LOCATIONS:
- 5.1 The ambient air temperatures shall be measured at a location where the ambient air is not affected by the machine and at a height equivalent to the air intake height on the operator enclosure.
- 5.2 The operator enclosure pressurization shall be measured according to SAE J1012.
- 5.3 Dry bulb temperatures shall be measured as close as practical to positions 1-6 in Fig. 2.
- 5.3.1 Wet bulb temperature shall be measured at position 6 in Fig. 2.
- 5.4 The refrigerant pressure shall be measured at both the inlet and outlet connections of the compressor.

NOTE: If an alternate operator station is available, the alternate positions should also be tested. (Ex. Backhoe-Loader.)

6. MINIMUM PERFORMANCE LEVELS COMMON FOR HEATING, VENTILATING, AND/OR AIR CONDITIONING SYSTEMS:

- 6.1 The operator enclosure should be capable of being pressurized at a minimum level of 5 mm of water pressure, as outlined in SAE J1012.
- 6.2 Under all conditions of heating, ventilating, and air conditioning, a minimum of 43 m³/h of filtered fresh air per enclosure occupant should be provided.
- 6.3 Under all conditions of heating, ventilating, and air conditioning, the temperatures measured in the operator's environment should be uniform within 5°C.
- 6.4 Filtered fresh air should be passed through a filter that is 96% efficient using A.C. fine test dust and test procedure defined under Air Cleaner Test Code SAE J726.

7. TEST PROCEDURE:

- 7.1 The test conditions are to be maintained throughout the duration of the test.
- 7.2 Record the operator enclosure temperatures as described in paragraph 5.3 in intervals not greater than 5 min.
- 7.3 The operator enclosure dry bulb temperatures from all six locations shall be averaged to obtain enclosure dry bulb temperature for each reading interval.
- 7.4 The test shall be considered terminated when either of the following conditions are fulfilled:
 - 7.4.1 The minimum temperature recorded in paragraph 7.3 does not vary more than 0.5°C in 15 min.
 - 7.4.2 One hour of test operation.
- 7.5 The data obtained at the termination of test should be compared to the Operator Comfort Chart (Fig. 1).

8. AC PERFORMANCE TEST:

8.1 Minimum Air Conditioning Performance Under The Test Conditions As Outlined Below:

NOTE: Sun loading is not a test requirement.

- 8.1.1 The air conditioning system should be capable of reducing the operator environment temperature to the comfort zone of the Operator Comfort Chart (Fig. 1) or a minimum of 11°C below the ambient for ambient temperatures of 38° C to the highest ambient temperature at which the machine is designed to operate.

8.2 Test Conditions:

- 8.2.1 The air conditioning system shall be tested in the intended production configuration, adjusted within the manufacturer's specifications.
- 8.2.2 The ambient conditions for moderate temperature, high humidity shall be:
- Minimum Dry Bulb temperature: 32°C.
Minimum Wet Bulb temperature: 25°C.
Maximum Air Velocity passing the machine from front to rear: 4.5 m/s.
- 8.2.3 Machine Load and Speed: The machine shall be operated at rated engine speed in a mode which will provide at least one-half engine load.
- 8.2.4 Prior to conducting tests on the air conditioning system, the machine shall be operated as specified in paragraph 8.2.3 for 30 min. with the air conditioning system not used, to provide a preliminary, stabilizing heat soak period. During this period, ambient temperature shall be as specified in paragraph 8.2.2.
- 8.2.5 The air conditioning system controls shall be adjusted to maximum position with maximum operator enclosure pressurization.
- 8.2.6 An operator may be in the enclosure throughout the duration of the test.

9. HEATER PERFORMANCE TEST:

9.1 Minimum Heating Performance Under The Test Conditions As Outlined Below:

- 9.1.1 The heating system should be capable of increasing the operator environment temperature to the comfort zone of the Operator Comfort Chart (Fig. 1), or a minimum of 36°C above ambient for ambient temperatures of -12°C to the lowest ambient temperature at which the machine is designed to operate.

9.2 Test Conditions:

- 9.2.1 The heater system shall be tested in the intended production configuration, adjusted within manufacturer's specifications.
- 9.2.2 The ambient conditions for heating tests shall be:
- Maximum Dry Bulb temperature: -7°C.
Maximum Air Velocity passing machine front to rear: 4.5 m/s.
- 9.2.3 Test machine should be cold soaked at the conditions outlined in 9.2.2 for a minimum of 10 h prior to start of the test.
- 9.2.4 Machine Load and Speed: The machine shall be operated at manufacturer's recommended warm-up speed for 5 min., then at rated speed under a maximum of 20% load.

9.2.5 The heater system controls shall be adjusted to maximum position with maximum operator enclosure pressurization.

9.2.6 An operator may be in the enclosure throughout the duration of the test.

10. VENTILATION TEST:

10.1 Minimum ventilation performance requirements are outlined in paragraph 6.

10.2 Test Conditions:

10.2.1 The ventilation system shall be tested in the intended production configuration, adjusted within the manufacturer's specifications.

10.2.2 The ambient conditions for ventilation test shall be:

Minimum Dry Bulb temperature: 27°C.

Maximum Air Velocity passing the machine from front to rear: 4.5 m/s.

10.2.3 Machine Load and Speed: The machine shall be operated at rated engine speed in a mode which will provide at least one-half engine load.

10.2.4 The ventilation system controls shall be adjusted to maximum position with maximum operator enclosure pressurization.

10.2.5 An operator may be in the enclosure throughout the duration of the test.

11. REFERENCES:

11.1 ASME Power Test Code, Pressure Measurement, PTC 19.2-1972.

11.2 ASME Power Test Code, Electrical Measurement, PTC 19.6-1955.

11.3 ASHRAE Temperature Measurement 4166.

11.4 ASHRAE Handbook of Fundamentals, 1981.

11.5 ISO 6097 - 1983(E) - Agricultural Tractors and Self-Propelled Machines - Performance of Heating and Ventilation Systems in Closed Cabs - Method of Test.

11.6 ISO 5353 - Earthmoving Machinery - Seat Index Point.

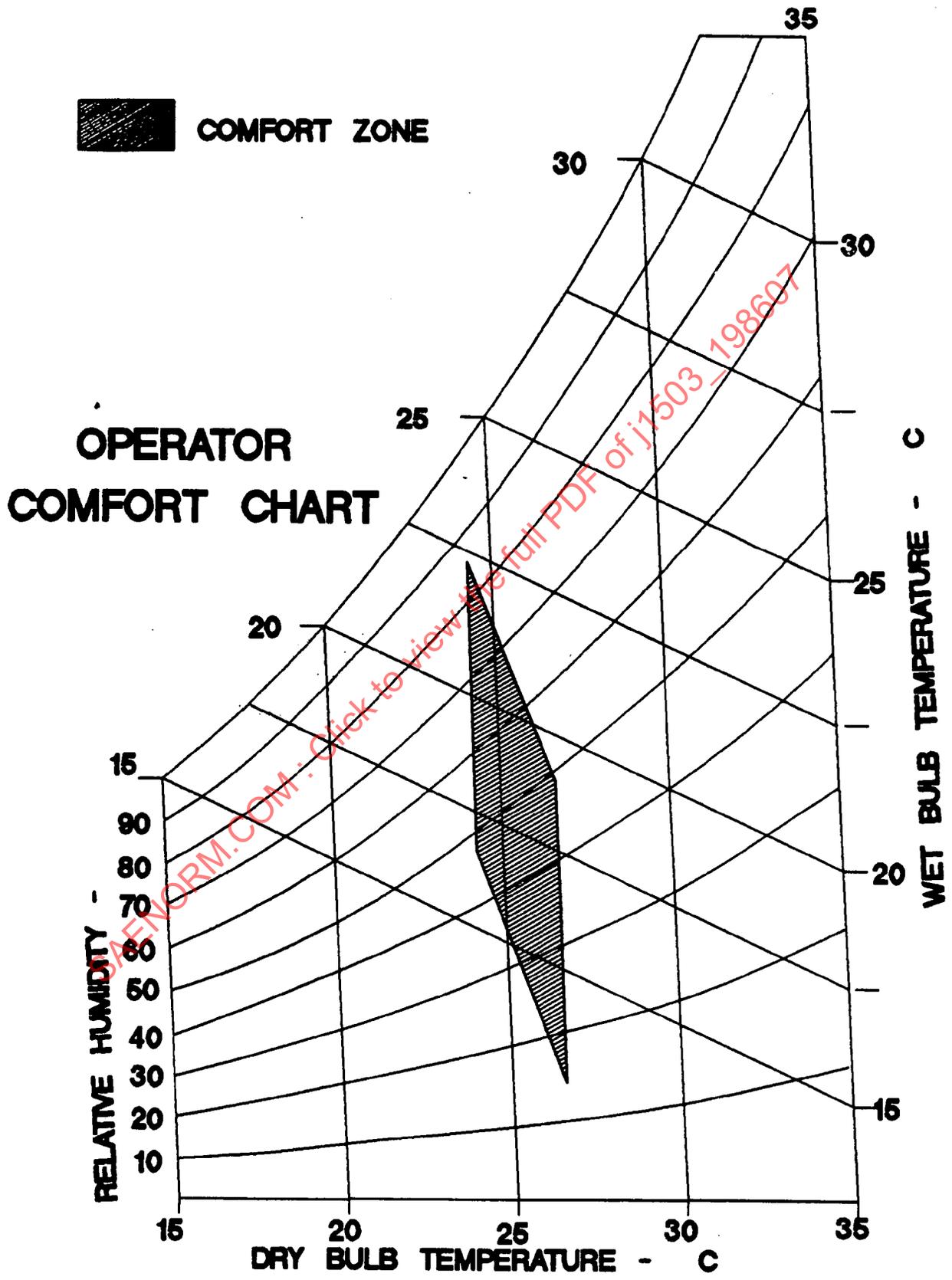


Fig. 1

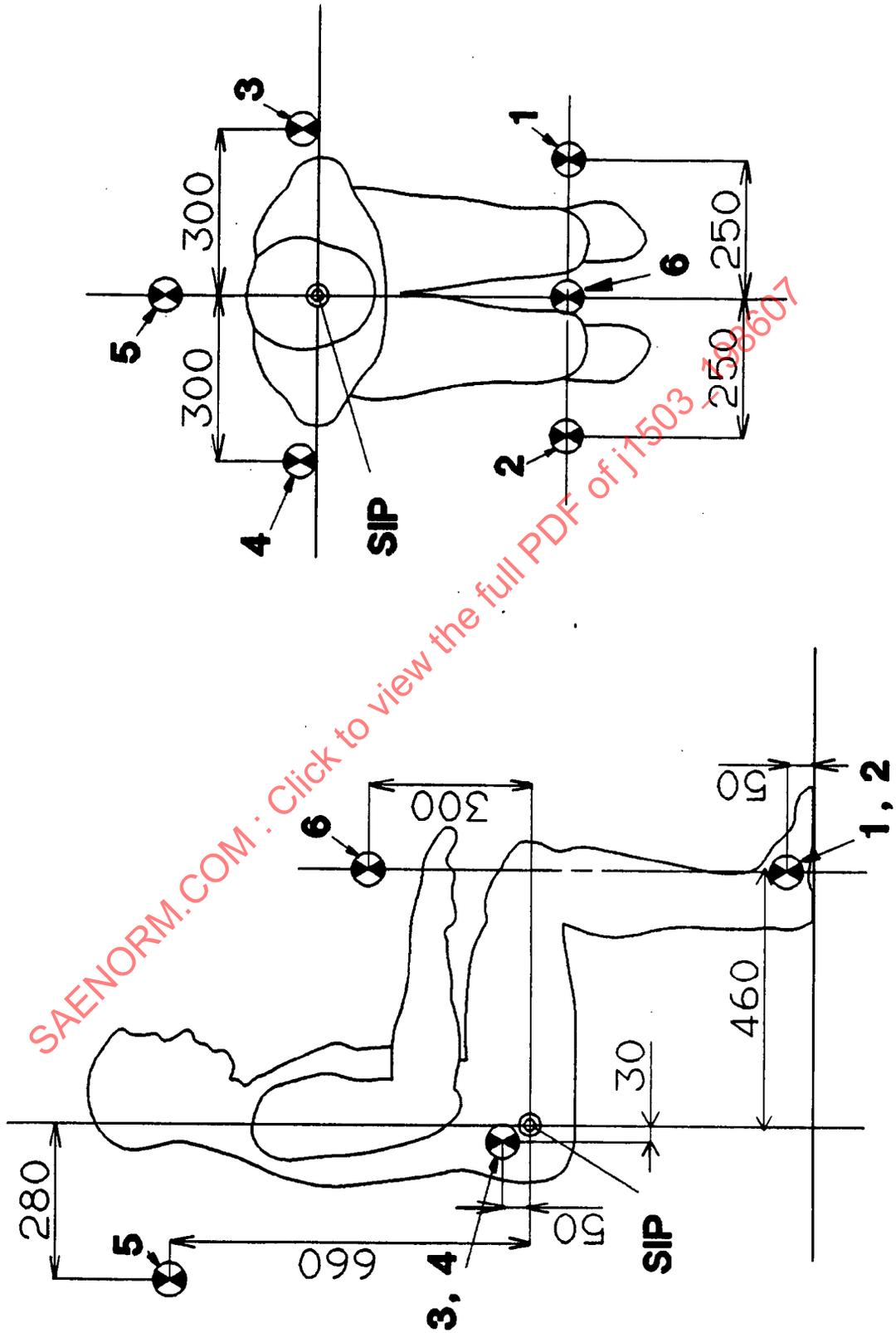


Fig. 2

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RATIONALE:

SAE J1503 - Performance Test for Air Conditioned, Heated, and Ventilated Off-Road Self-Propelled Work Machines was developed to combine into one document SAE J1006 - Performance Test for Air Conditioned Agricultural Equipment and SAE J1129 - Operator Cab Environment for Heated, Ventilated, & Air Conditioned Construction Equipment and also include all off-road, self-propelled work machines as defined in SAE J1116 (JUL85), categories 1-5, SAE J1503 includes both test procedures and recommended performance standards. Solar load was not a condition for test; however, the temperature and humidity test conditions include the anticipated load due to solar heating. A separate document is being developed to address solar load.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J726, Air Cleaner Test Code

SAE J1012, Agricultural Equipment Enclosure Pressurization System Test Procedure

SAE J1116 JUN85, Categories of Off-Road Self-Propelled Work Machines

ASME Power Test Code, Pressure Measurement, PTC 19.2-1972

ASME Power Test Code, Electrical Measurement, PTC 19.6-1955

ASHRAE Temperature Measurement 4166

ASHRAE Handbook of Fundamentals, 1981

ISO 6097 - 1983(E) - Agricultural Tractors and Self-Propelled Machines - Performance of Heating and Ventilation Systems in Closed Cabs - Method of Test

ISO 5353 - Earthmoving Machinery - Seat Index Point

APPLICATION:

This recommended practice applies to off-road self-propelled work machines as defined in SAE J1116 (JUN85), categories one through five; and establishes the following minimum performance levels in the operator's environment for the seated position:

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