
International Standard



6097

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Agricultural tractors and self-propelled machines — Performance of heating and ventilation systems in closed cabs — Method of test

Tracteurs et machines automotrices agricoles — Performance des systèmes de chauffage et de ventilation dans les cabines fermées — Méthode d'essai

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6097 was developed by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, and was circulated to the member bodies in July 1983.

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It has been approved by the member bodies of the following countries:

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Belgium	Italy	South Africa, Rep. of
Bulgaria	Korea, Dem. P. Rep. of	Spain
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The member bodies of the following countries expressed disapproval of the document on technical grounds:

Canada
Finland
United Kingdom

Agricultural tractors and self-propelled machines — Performance of heating and ventilation systems in closed cabs — Method of test

1 Scope and field of application

This International Standard specifies a method of testing the performance of heating and ventilation systems in closed cabs of agricultural tractors and self-propelled machines.

The method allows comparison of cab heating and ventilation systems and determination of the climate inside the cab with respect to specified requirements for temperature and air velocity. This can be achieved by means of two different, but equivalent, procedures :

- a) testing in a cold-chamber;
- b) testing without a cold-chamber.

In the latter case, it is essential that the requirements for air velocity (see clause 5) are observed (this may be achieved, for example, by the use of fans) and that the results of the test are not influenced by ambient radiant energy (for example direct sunlight).

The two basic principles of heating systems are also considered :

- a) heating independent of the engine : in this case, the heating system shall be controlled in accordance with the manufacturers' instructions;
- b) heating dependent on the engine : in this case, the heating system shall be tested with the engine loaded under specified conditions (see 5.4.5), corresponding approximately to the engine load of a tractor with an empty trailer travelling on a road.

2 References

ISO 2288, *Agricultural tractors and machines — Engine test code (bench test) — Net power.*

ISO 3462, *Tractors and machinery for agriculture and forestry — Seat reference point — Method of determination.*

ISO 3737, *Agricultural tractors and self-propelled machines — Test method for enclosure pressurization systems.*

3 Apparatus

3.1 Remote temperature measuring devices, for example, thermocouples, accurate to $\pm 0,5$ °C.

3.2 Anemometer, with a reading accuracy of 10 %, for measuring air velocities inside the cold-chamber and the cab.

3.3 Sensitive manometer, with a reading accuracy of 10 %, for measuring enclosure pressurization.

3.4 Water flow meter (optional), such that the pressure drop does not exceed 500 Pa, with a reading accuracy of 2 %.

3.5 Timer, accurate to 0,5 s.

3.6 Tachometer, with a reading accuracy of 2 %, for measuring the engine speed.

3.7 Cold-chamber (optional), large enough to contain the entire tractor/machine, and equipped with a device to provide and maintain the temperature and air velocity around the cab at the values specified in 5.1.

3.8 Equipment for loading the engine (only when a system using heating dependent on the engine is tested).

4 Measuring locations

4.1 Measurements of ambient temperatures

4.1.1 Engines with a suction fan

Measurements shall be made :

- a) 1 to 1,5 m in front of the tractor or machine and approximately 1,5 m above the floor;
- b) in the air intake to the heater. In the case of systems using more than one air intake, the air temperature shall be measured in at least one air intake, that chosen being the one least influenced by external heat sources.

4.1.2 Engines with a pressure fan

Measurements shall be made :

- a) at a location giving a temperature equivalent to that in 4.1.1 a);
- b) in the air intake to the heater as described in 4.1.1 b).

4.2 Measurements of engine temperatures

(optional)

The temperature of the coolant, if measured, shall be measured at the outlet of the cylinder block or at the cylinder top before the coolant reaches the thermostat.

In the case of air cooled engines, the engine temperature shall be measured at a location specified by the manufacturer.

4.3 Measurements of heater temperatures and coolant flow (optional)

4.3.1 The temperature of the coolant entering the heater, if measured, shall be measured as close to the inlet pipe as possible. For systems using more than one heater, the temperature of the coolant shall be measured at the inlet pipe of the first heater unit receiving the coolant flow.

4.3.2 The temperature of the coolant leaving the heater, if measured, shall be measured as close to the outlet pipe as possible. For systems using more than one heater, the temperature of the coolant shall be measured at the outlet pipe of the last heater.

4.3.3 The coolant flow may be measured for calculating the heat capacity. If measuring waterflow, the flow shall be measured by means of the flow meter (3.4).

4.3.4 The temperature of the air from the heater, if measured, shall be measured in at least one outlet, 10 mm inside the outlet. Use of multiple temperature measurements is recommended as a means of obtaining an average temperature in large heater outlet units.

4.4 Measurements of air temperatures inside the cab (see the figure)

Measurements shall be made :

- a) on the left hand side : 50 mm above the floor, 100 mm behind the centre of the clutch pedal and in line with the outer edge of the clutch pedal. (For left foot; see the figure, position 1);
- b) on the right hand side : 50 mm above the floor, 100 mm behind the centre of the right brake pedal and in line with the outer edge of the right brake pedal. (For right foot; see the figure, position 2);
- c) on the left hand side : 150 mm above and 100 mm in front of the seat reference point, 300 mm from the central

longitudinal plane of the seat. (For left hip; see the figure, position 3);

d) on the right hand side : 150 mm above and 100 mm in front of the seat reference point, 300 mm from the central longitudinal plane of the seat. (For right hip, see the figure, position 4);

e) 760 mm above and 150 mm behind the seat reference point. (For the operator's head; see the figure, position 5);

f) in the centre of the steering wheel rim. (See the figure, position 6).

4.5 Measurements of air velocity inside the cab

(see the figure)

The air velocities shall be measured in the direction which gives the maximum air velocity :

a) 760 mm above and 150 mm in front of the seat reference point. (For the operator's head; see the figure, position 5);

b) 150 mm in front of and 760 mm above the seat reference point. (For the operator's eye level; see the figure, position 7).

4.6 Measurements of air velocity outside the cab

Measurements shall be made 1 to 1,5 m in front of the tractor or machine and approximately 1,5 m above the floor.

5 Procedure

5.1 General

The heating capacity shall be tested at an ambient temperature of $-5\text{ }^{\circ}\text{C}$ or $-15\text{ }^{\circ}\text{C}$. The ambient temperature shall be kept within $\pm 3\text{ }^{\circ}\text{C}$. The choice as to which of the above ambient temperatures is to be used is left to the person carrying out the test. The air velocity in front of the cab shall be $5 \pm 1\text{ m/s}$. The main direction of air velocity is specified as being just forward of the front windscreen of the cab.

5.2 Adjustment of seat and steering wheel

5.2.1 Seat reference point

The seat reference point shall be determined in accordance with ISO 3462. The seat shall be adjusted to its rearmost position, with the vertical adjustment in its mid-position and the suspension loaded to its mid-position.

5.2.2 Steering wheel

Adjustable steering wheels shall be in the normal position for a seated operator.

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5.3 Soak period

The tractor/machine shall be maintained, with the engine stopped, at the specified test temperature for a period of not less than 10 h. This period may be reduced if instruments are available to check that the engine coolant and lubricant are stabilized at the specified test temperature.

5.4 Starting and loading the engine

5.4.1 After the specified soak period (see 5.3) the engine may be started by any external means.

5.4.2 Starting the engine shall be taken as the start of the test period.

5.4.3 For the first 5 min of the test, the engine speed may be in accordance with the manufacturer's recommendation for warming up when starting in cold weather.

5.4.4 The operator's engine speed control shall be set at the position for maximum engine speed.

5.4.5 Any suitable external load equal to $20 \pm 5\%$ of the rated bare engine (net) power, measured in accordance with ISO 2288, may be used.

5.5 Adjustment of the heating system ISO 6097:1983

5.5.1 The heating system shall be adjusted for maximum heating capacity.

5.5.2 The heating fan may be switched on at any time during the test.

5.6 Recording of results

All temperatures shall be recorded continuously or at intervals of not more than 5 min. At the end of the test, measure the enclosure pressurization in accordance with ISO 3737.

The air velocity may be measured after the test, under the same conditions as were used during the test.

5.7 Duration of test

The test shall be interrupted when at least one of the following conditions has been fulfilled :

- a) the highest measured air temperature inside the cab increases by less than 1 °C in 5 min;
- b) 60 min from the beginning of the test.

6 Test report¹⁾

The test report shall include the following information if the specimen test report in the annex is not used :

- a) tractor/machine make and model (indicate if radiator shutters, viscous clutch fan or radiator blockage were used to increase the coolant temperature);
- b) tractor/machine engine thermostat opening temperature;
- c) cab make and model;
- d) heating and ventilation system make and model;
- e) ambient air temperature;
- f) a graph showing the mean temperature inside the cab as a function of time;
- g) stabilized temperatures at all measuring locations inside the cab and the time when the stabilized condition was reached;
- h) stabilized temperature difference between right and left foot (positions 1 and 2) and the maximum difference between foot and head level (position 1 or 2 and position 5);
- j) air velocities at the two measurement locations inside the cab;
- k) cab pressurization;
- m) where applicable, engine coolant temperature at the end of the test;
- n) where applicable, the flow (4.3.3) and the in- and outlet temperatures of the heater (4.3.1 and 4.3.2).

1) A specimen test report form is given in the annex.

Dimensions in millimetres

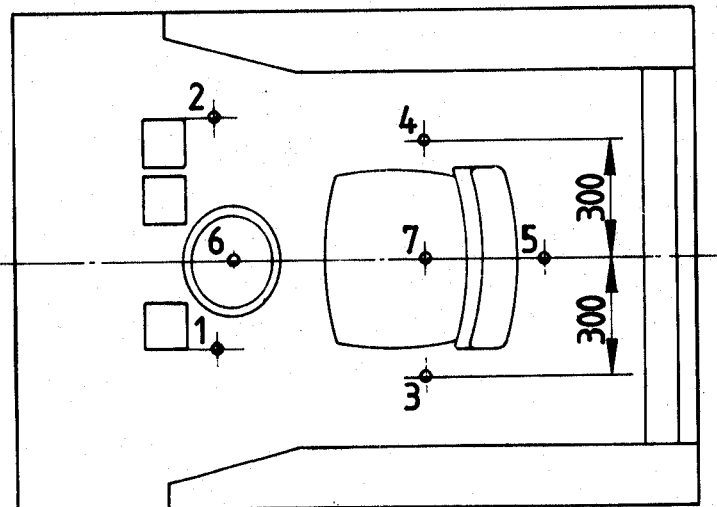
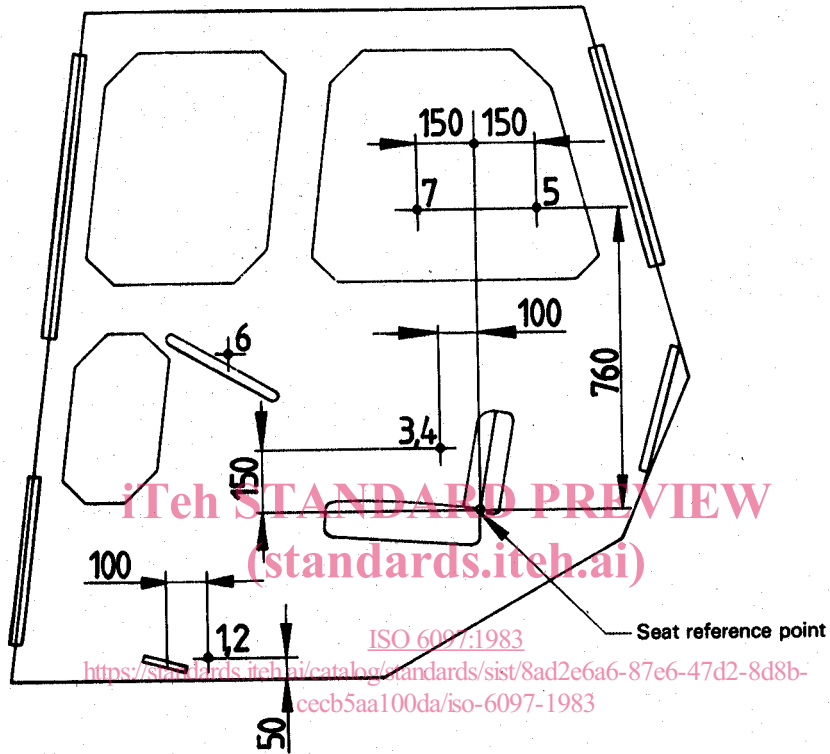


Figure — Measuring locations in the cab

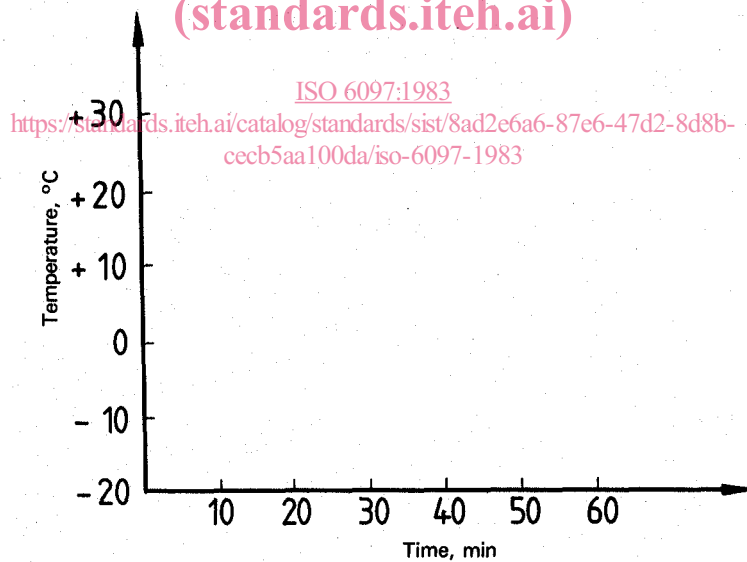
Annex

Specimen test report form

- 1 Test No. : Date :
- 2 Entrant :
- 3 Machine/tractor¹⁾ make and model :
 Thermostat opening temperature : °C
 Special features :
 Indicate if radiator shutters, viscous clutch fan or radiator blockage were used during the test. :
- 4 Cab make and model :
 Description (cladding etc.) :
- 5 Heating system make and model :
- 6 Ambient air temperature during the test : °C
- 7 Cab mean temperature (graphical presentation as a function of time)

NOTE — Mean temperature is average of six locations listed in clause 8 below.

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- 8 Stabilized temperatures inside cab
- | | | |
|------------|------------------------------------|-----|
| Left foot | : °C was reached after | min |
| Right foot | : °C was reached after | min |
| Left hip | : °C was reached after | min |
| Right hip | : °C was reached after | min |
| Head level | : °C was reached after | min |
| Hand level | : °C was reached after | min |

1) Delete as appropriate.

- 9 Stabilized temperature variations within the cab
Temperature difference between left and right foot : °C
Temperature difference between left/right¹⁾ foot and head level : °C
- 10 Air velocities inside cab
Eye level : m/s
Head level : m/s
- 11 Enclosure pressurization : Pa
- 12 Engine coolant temperature : °C
- 13 Heater capacity
Temperature of coolant entering the heater : °C
Temperature of coolant leaving the heater : °C
Coolant flow through the heater : dm³/s

NOTE — If the coolant is air, cubic metres per hour may be more appropriate.

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1) Delete as appropriate.