



Tractors and self-propelled machines for agriculture and forestry — Test method for performance of air-conditioning system

Tracteurs et machines automotrices agricoles et forestiers — Méthode d'essai des performances des systèmes de conditionnement d'air

iTeh STANDARD PREVIEW

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- type 1, when the necessary support within the technical committee cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development requiring wider exposure;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical reports are accepted for publication directly by ISO Council. Technical reports types 1 and 2 are subject to review within three years of publication, to decide if they can be transformed into International Standards. Technical reports type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 8953 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*.

The reasons which led to the decision to publish this document in the form of a technical report type 1 are explained in the Introduction.

0 Introduction

0.1 This document is issued as a Technical Report because it possesses the following limitations to being regarded as an International Standard; agreement could not therefore be reached for its publication as a Standard.

- a) Reproducible results can be anticipated only when the ambient environment is controlled. This is possible with tractors which may be fully enclosed in environmental chambers during testing, but may not be possible for machines, such as combine harvesters, which are too large for most environmental chambers. There is therefore a need to conduct the tests in uncontrolled environments (such as under a canopy for large machines).
- b) The method specifies engine loading. Although this is necessary for tractors where engine and transmission heating will affect cab heat load, it may not be necessary for combine harvesters.
- c) Although a loaded engine test compensates for solar heat load in a tractor test, no such compensation is possible in tests on a combine harvester.

There was general agreement that more information and experience is needed before an International Standard can be established. It was also agreed however that publication as a Technical Report would be useful in outlining an accepted preferred test method for air-conditioning systems.

0.2 The purpose of this Technical Report is to establish, for tractors and self-propelled machines for agriculture and forestry, a uniform test method to measure the contribution to operator environmental temperature and humidity provided by an air-conditioning system operating in a specified ambient environment. The method does not determine the complete climatic environment of the operator since this is also affected by heat radiation from sources other than those on the machine, for example solar radiation.

1 Scope and field of application

This Technical Report specifies a test method to evaluate the performance of air-conditioning systems on tractors and self-propelled machines for agriculture and forestry.

NOTE — The term "vehicle" in this Report refers to tractors and self-propelled machines for agriculture and forestry and is used for editorial clarity and conciseness.

The term "air-conditioning system" refers to any electro-mechanical refrigeration system intended to reduce air temperatures in the operator's enclosure.

This recommended procedure can be used to evaluate any air-conditioning system; it does not apply to ventilating systems using ambient temperature air.

2 References

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

ISO 5353, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point.*

3 General requirements

The air-conditioning system shall be powered only by standard equipment on the test vehicle. Components, filters and blowers shall be standard production parts or the equivalent, adjusted within the vehicle manufacturer's specification limits.

4 Apparatus

The apparatus shall comprise the following.

4.1 Eight thermometers or other temperature-measuring devices, having an accuracy of $\pm 0,5$ °C, of which seven thermometers or devices are for use within the cab of the vehicle, and the eighth for measuring ambient dry bulb temperatures.

4.2 Devices for measuring ambient and cab wet bulb temperatures, having an accuracy of $\pm 0,5$ °C.

NOTE — A motor driven psychrometer is recommended.

- 4.3 Two pressure gauges or other pressure-measuring devices**, having an accuracy of $\pm 2\%$ of the reading (to be used for the measurement specified in 8.3).
- 4.4 Manometer**, having an accuracy of $\pm 1\%$ of the reading.
- 4.5 Voltmeter**, having an accuracy of $\pm 2\%$ of the reading.
- 4.6 Time-measuring device**, having an accuracy of $\pm 0,5$ s.
- 4.7 Tachometer**, having an accuracy of ± 20 r/min, to be used for measuring engine speed.
- 4.8 Equipment to load the vehicle's engine**, if required.
- 4.9 Anemometer**, to read air velocity outside the vehicle, having an accuracy of $\pm 0,3$ m/s.
- 4.10 Test room**: if used, it should be large enough to contain the entire vehicle and possess devices to provide and maintain the temperature, air velocity, and relative humidity around the cab at the values stated in clause 5.

5 Ambient conditions, outside operator enclosure

- 5.1** The test conditions of the air in the vicinity of the vehicle and operator enclosure shall be a dry bulb temperature of 32 to 35 °C and a humidity of 18 ± 1 mg moisture/g dry air.
- 5.2** The air velocity passing front to rear of the vehicle shall be at least 1 m/s but shall not exceed 3 m/s.
- 5.3** There shall be no direct sunlight or other thermal radiation from outside on the operator enclosure.

6 Preparation of vehicle

- 6.1** Temperature-measuring instruments shall be located in the operator enclosure as shown in the figure.

6.2 Before the test, to ensure preliminary stabilizing under set ambient conditions, the vehicle shall be operated for not less than 120 min in a mode which will provide maximum engine load at the manufacturer's rated engine speed, with the air-conditioning system not operating. This mode shall be achieved by operating the vehicle at its maximum no-load governed speed and then applying load until the rated engine speed is reached. Doors and windows shall be closed and other ventilation systems shall be turned off.

NOTE — Maximum loading of the engine through the transmission is recommended. Engine loading is recommended only when engine or component temperatures (such as transmission temperature) influence the environment within the operator enclosure.

- 6.3** The steering-wheel, if adjustable, shall be in a normal position for a seated operator.

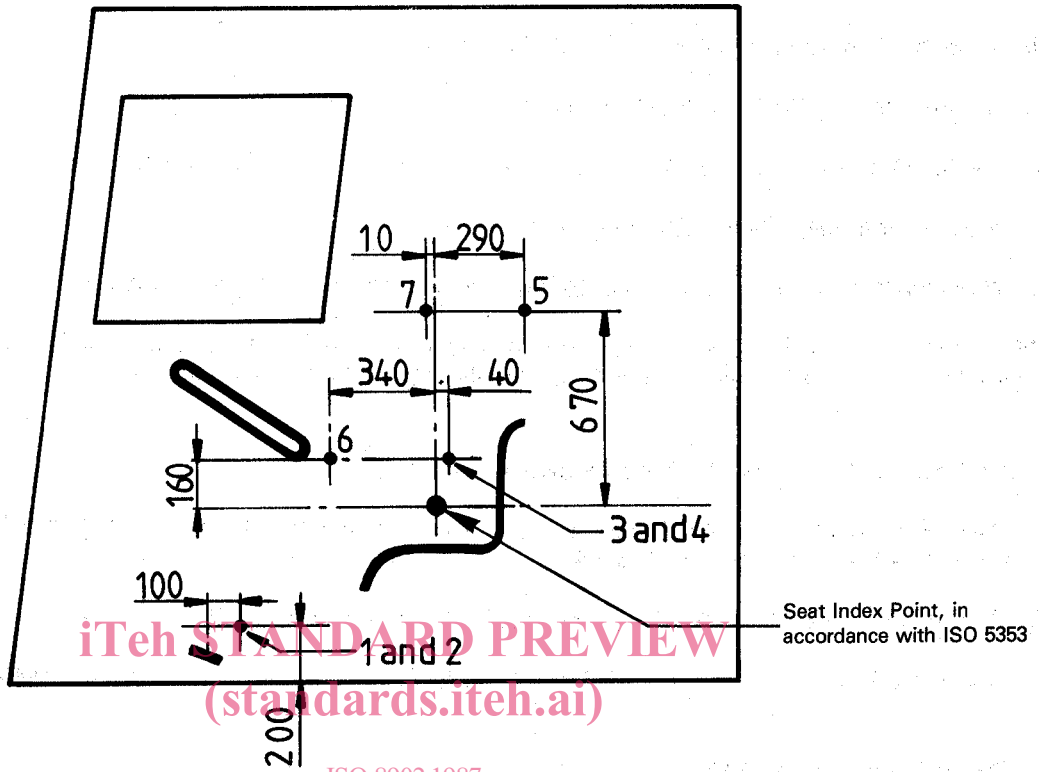
7 Test conditions

- 7.1** During the test, the vehicle shall be operated as in 6.2 but with the air-conditioning system operating with the controls set to the manufacturer's recommended setting for maximum cooling performance. The requirements of clauses 3 and 5 shall also be maintained during the test.
- 7.2** No operator shall be present in the cab enclosure during the test.
- 7.3** The refrigerant pressures shall not exceed the operating range of any component.

8 Procedure

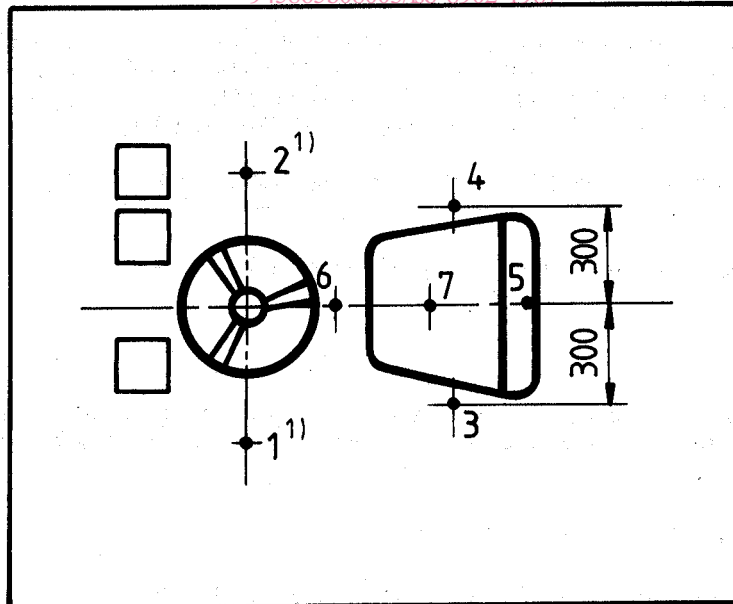
- 8.1** The test starts as soon as the heat reduction system is turned on.
- 8.2** Measure the ambient dry air and wet bulb temperatures and ambient air velocity at a location where they are not affected by the vehicle and at the same height as that of the air intake to the operator enclosure.

Dimensions in millimetres



ISO 8902:1987

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1) Within 200 mm of the normal position of a seated operator's legs.

Figure — Temperature measurement locations

- 8.3** Measure the pressure in the operator enclosure in accordance with ISO 3737.
- 8.4** Measure the refrigerant pressures at the inlet and outlet connections of the compressor.
- 8.5** Measure the dry bulb temperatures at points 1 to 7 shown in the figure and the wet bulb temperature at point 5.
- 8.6** Immediately before starting the test and at intervals of 5 min after starting, repeat the measurements in 8.2, 8.4 and 8.5 until the average temperature does not drop more than 0,5 °C in each of three successive intervals or until 1 h after the first measurements, whichever is sooner.
- 8.7** Calculate the average of the dry bulb temperatures in 8.5 for each measurement interval.
- 8.8** Calculate the enclosure temperature depression, defined as the difference between ambient dry bulb temperature and average stabilized dry bulb cab temperature, or average dry bulb temperature after 1 h.

9 Test report

The test report shall include the following details :

- a) name and address of manufacturer;
- b) type, model and serial number of tractor or self-propelled machine;
- c) type of air-conditioning system and type of refrigerant used;
- d) ambient conditions outside operator enclosure (i.e. humidity, temperature, air velocity);
- e) setting of adjustable controls (i.e. air-conditioner, blower);
- f) enclosure pressure;
- g) refrigerant pressures at compressor inlet and outlet connections;
- h) average dry bulb temperature in enclosure at each reading;
- i) enclosure wet bulb temperature at each reading;
- j) duration of test to achieve final results;
- k) compressor cycling (if this occurred during the test);
- l) test voltage of blower and compressor clutch;
- m) enclosure temperature depression (see 8.8).

A suitable test report is shown in the annex.

Presentation of a graph showing average dry bulb temperature inside the cab enclosure as a function of test time is also recommended.

Annex

Test report — Tractors and self-propelled machines for agriculture and forestry — Performance of air-conditioning system

Manufacturer's name and address :

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Tractor or self-propelled machine¹⁾ —

Type :

Model :

Serial No. :

Type of air-conditioning system :

Type of refrigerant :

Ambient air conditions —

Dry bulb : °C

Wet bulb : °C

Humidity : mg moisture/g dry air

Air velocity : m/s

Enclosure pressure : Pa

Test voltage —

Compressor clutch : V

Blower : V

Refrigerant pressures at compressor connections —

Inlet : kPa

Outlet : kPa

Setting of adjustable controls :

Method of engine loading (if applicable) :

Enclosure temperatures (see table)

Reading No.	0	1	2	3	4	5	6	7	8	9	10	11	12
Dry bulb (average), °C													
Wet bulb, °C													

Enclosure temperature depression : °C

Duration of test : min Date of test :

Compressor cycling (time to first occurrence during test) : min

Description of test site — Outdoor site or chamber¹⁾
(Use photographs, where desirable.)

1) Delete as appropriate.

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