INTERNATIONAL STANDARD

ISO 5131

Second edition
1996-08-01

Acoustics — Tractors and machinery for agriculture and forestry — Measurement of noise at the operator's position — Survey method

Acoustique — Tracteurs et matériels agricoles et forestiers — Mesurage du bruit au poste de conduite de l'opérateur — Méthode de contrôle

INTERNATIONAL ISO

Reference number
ISO 5131:1996(E)

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Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5131 was prepared jointly by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*, and ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 3, *Safety and comfort of the operator*.

This second edition cancels and replaces the first edition (ISO 5131:1982), which has been technically revised (see Introduction).

Annexes A to D form an integral part of this International Standard. Annex E is for information only.

Introduction

0.1 In this revision of ISO 5131, the "Seat Index Position" (SIP) has been adopted in place of the "Seat Reference Point" (SRP). The mean seat position now used in this test is in accordance with ISO 5353. The test seat is therefore moved to the mean horizontal position instead of the rearmost position used in the previous edition. The adjustment figure used is half the minimum horizontal adjustment as stated in ISO 4253:1993, *Agricultural tractors — Operator's seating accommodation — Dimensions.*

To adopt the seat index point (SIP) in place of the seat reference point (SRP), the relationship of SIP 90 mm above and 140 mm in front of the SRP has been used. This relationship should be used when converting from SRP to SIP or vice versa.

ISO 3462:1980, *Tractors and machinery for agriculture and forestry — Seat reference point — Method of determination,* used a relationship of SIP 97 mm above and 130 mm in front of the seat reference point. In a practical comparison, however, it has been found that the 90 mm vertical and 140 mm horizontal relationship gives the most accurate conversion.

Variations from ISO 3462 arise from the following:

a) seat cushions are not horizontal in practice;

b) the angle of the seat cushion to the backrest is not 90°;

c) the curvature on the backrest places the SIP device slightly forward of the SRP device.

0.2 When the first edition of ISO 5131 was initially reviewed, the objective was to produce a consistent, meaningful and simple low-cost test. Cab designs from the major manufacturers were such that A-weighted sound pressure levels were all well below the critical 90 dB level and this was a reason for dropping the drawbar-load in favour of a simple no-load test.

More recent requirements, however, propose that operators should be made aware of the levels of noise to which they may be exposed during normal work so that the operators or their employers may take necessary action. To achieve this, it has been necessary to reinstate the drawbar-load test and further to include an optional "doors and windows open" test.

Acoustics — Tractors and machinery for agriculture and forestry — Measurement of noise at the operator's position — Survey method

1 Scope

This International Standard specifies a method for the measurement of the noise at the position of the operator(s) of a tractor or machine used in agriculture and forestry. The measured noise relates only to the basic machine and applies to self-propelled tractors and machines with either machine-carried or pedestrian operators. The results will provide information which will enable operators to avoid exposing themselves to noise levels which could put their hearing at risk.

The test procedures specified in this International Standard are survey methods as defined in ISO 2204.

This International Standard also specifies the general conditions for measuring and reporting the noise at an operator's position on agricultural and forestry tractors and field machines.

Additional conditions for measurements in connection with particular types of machines are specified in annexes as follows:

Annex A — Agricultural and forestry tractors

Annex B — Self-propelled agricultural machines

Annex C — Pedestrian-controlled agricultural machines

Annex D — Forestry forwarders and skidders

The conditions specified for the operation of the machines during the measurements are designed to provide a realistic and repeatable assessment of the maximum noise to which an operator should be subjected when operating a machine.

NOTE 1 Further annexes specifying, for example, additional conditions for other types of agricultural and forestry machinery may be included in future revisions of this International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2204:1979, *Acoustics — Guide to International Standards on the measurement of airborne acoustical noise and evaluation of its effects on human beings.*

ISO 5353:1995, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point.*

IEC 651:1979, *Sound level meters.*

IEC 942:1988, *Sound calibrators.*

IEC 1260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters.*

3 Measurement requirements

3.1 All readings of the sound level meter shall be taken with the time weighting S.

3.2 The values measured shall be A-weighted sound pressure levels for the overall sound levels, expressed in decibels.

3.3 Spectral analysis is optional. When it is required, the values measured shall be octave-band sound pressure levels, in decibels.

4 Measuring equipment

4.1 A sound level meter which meets at least the requirements of IEC 651 for a type 1 instrument shall be used, although compliance in this respect will not necessarily be sufficient to meet the requirement for precision stated by the user of this International Standard or by the regulatory authority.

4.2 If alternative measuring equipment, including for example a tape recorder and/or level recorder, is used, the tolerances of the several sections of the measuring chain shall not exceed the tolerances given in the relevant clauses of IEC 651. If a tape recorder is used as part of the measuring equipment, it may be necessary to include suitable weighting networks for recording and reproduction to provide an adequate signal-to-noise ratio over the whole frequency range of interest.

4.3 Measurement of the sound frequency spectrum shall be carried out using a frequency analyser fitted with octave filters in accordance with the requirements of IEC 1260 for a class 1 filter.

NOTE 2 Care should be taken, particularly when a microphone with a diameter of more than 13 mm is used, to ensure that microphone characteristics do not lead to errors when the sound is directional. It is recommended that, when necessary, a random incidence adaptor be used to ensure that the omnidirectionality is not worse than that of a type 2 sound level meter as specified in IEC 651. Within a cab the multidirectional nature of the sound will normally avoid errors due to the microphone directional characteristics.

4.4 The calibration of the equipment at the time of the measurements shall be in accordance in all respects with IEC 651. Checking of the equipment shall be carried out at appropriate intervals and at least immediately before and after the measuring session using a sound calibrator in accordance with the requirements of IEC 942 for a class 1 calibrator.

The calibrator shall be checked annually to verify its output and its initial calibration shall be traceable to national standards.

5 Acoustical environment, weather conditions and background noise

5.1 The test area shall be a flat open space and shall be within at least 20 m of the test machine. There shall be no obstacle likely to reflect significant sound, such as a building, solid fence, tree or other vehicle. Where a dynamometer vehicle or recording vehicle is used, this shall be towed or driven to a distance remote enough to avoid interference.

5.2 The air temperature shall be in the range from –5 °C to 30 °C and the wind velocity shall not exceed 5 m/s at the operator's position. Other meteorological conditions shall be such that they do not influence the measurements.

5.3 The level of the background noise and the A-weighted sound pressure level of the noise of the wind shall be at least 10 dB below the level measured during the test. Where a spectral analysis is required, the level of background noise shall be at least 10 dB below the corresponding level in each frequency band measured during the test.

5.4 No person other than the operator of the tractor or machine shall be in the driving position or cab during measurements. Where the noise at the position of other operators on the machine is being measured, the usual number of operators shall be present. No person other than the operator(s) shall be in such a position as to influence the noise measurements.

6 Condition of tractor or machine

The tractor or machine shall comply with the manufacturer's product specification and shall be operated in accordance with his instructions. Engine, transmission and hydraulic systems shall be operated as appropriate to stabilize temperatures before making the measurements.

Specific conditions for the particular types of machines covered by this International Standard are given in annexes A to D.

7 Operators

For pedestrian-controlled machines and those with a standing operator, the operator shall be chosen to have a stature of 1,72 m $^{+0,15}_{-0,10}$ m. Operators shall not wear abnormally thick clothing or any hat or scarf which might influence the sound measurement.

8 Microphone location

8.1 For seated operators, the microphone shall be located 250 mm ± 20 mm to the side of the centre

plane of the seat, the side being that on which the higher sound pressure level is encountered. The axis of the microphone shall be horizontal and the diaphragm shall face forwards. The centre of the microphone shall be 700 mm ± 20 mm above the seat index point and 100 mm ± 20 mm forward of that point. Excessive vibration of the microphone shall be avoided.

The seat index point shall be determined in accordance with ISO 5353.

8.2 For standing and pedestrian operators, the microphone shall be mounted on an open-frame helmet worn on the operator's head or on a shoulder harness, in such a way that the microphone axis is horizontal and its diaphragm is 250 mm ± 20 mm to the side of the centre plane of the operator's head, in the same vertical plane as his eyebrows and facing forwards. The side of the head chosen for the microphone shall be that for which the higher sound pressure level is encountered. The operator shall continue to face forwards during the noise measurement.

9 Noise measurement procedure

Make at least three measurements at each microphone position, as defined in clause 8, and for each operating condition. If the spread of results of the A-weighted sound pressure level obtained under the measuring conditions exceeds 3 dB, make further measurements until the readings of three successive measurements fall within 3 dB. Take the arithmetic mean value of these three readings as the test result.

Measure the level of the noise obtained with the tractor or machine operating as specified in the appropriate annex. State the frequency weighting A and the time weighting S settings of the meter clearly in reports of the measurements. Take measurements after a 10 s period of stabilized running.

When sound pressure levels fluctuate widely because of the characteristics of the machine type and the 3 dB requirement for successive readings, specified above, cannot be met, the number of separate measurements shall be greater than the fluctuation range in decibels. Take the arithmetic mean as the test result.

In all cases, any peak which is obviously out of character with the general sound pressure level being read shall be ignored.

Give as the reported value the integer part of the result obtained from the above procedures.

NOTE 3 Optionally, at the manufacturer's request, octave-band pressure levels over the centre frequency range 31,5 Hz to 8 000 Hz may be determined and reported in addition to A-weighted sound pressure levels.

10 Test report

The test report shall include the following particulars:

a) reference to this International Standard;

b) report number and date when tested;

c) all necessary information for the complete identification of the tractor or machine;

d) all necessary information for the complete identification of the cab, if fitted;

e) place where tested;

f) surface condition and nature of the ground on which the tractor or machine was tested;

g) instrumentation used for the test;

h) engine speed appropriate to the test conditions; forward speed of tractor, or forward speed of machine, if appropriate; results of measurements obtained from the test in accordance with the appropriate annex;

i) in addition to the above, the test report may also include details of the operator who performs the test, including working position;

j) testing authority.

A specimen report form for the reporting of results is given in annex E.

Annex A
(normative)

Agricultural and forestry tractors

A.1 General

For tractors, the measurements shall be made away from agricultural or forestry work. The test with the tractor loaded should, preferably, be carried out using a draught load provided by a dynamometer vehicle.

A.2 Tractor operation

For these measurements, tractors with pneumatic tyres shall be operated on a dry, concrete or tar-macadam surface, horizontal to within 2°, free from gravel, leaves, snow, etc. Tracked and metal-wheeled tractors shall be operated on a smooth, horizontal grassland or soil surface free from long grass and vegetation. The test track or course shall have a straight section of at least 150 m to ensure that the tractor speed is stabilized for an adequate time for measurements to be made.

The tractor shall be unballasted. Wheeled tractors shall be fitted with normal agricultural pneumatic tyres, not more than 50 % worn. Before the noise measurement, it shall be established by a power take-off power test or other means that the power of the tractor is within 5 % of the manufacturer's rated value.

A.3 Cabs and auxiliaries

A.3.1 If a cab is fitted, the sound pressure level shall be measured with all openings, doors, windows, hatches and windscreen closed.

An additional optional set of measurements may be taken with all openings open, providing that they have been designed to operate in the open position and that they do not cause a hazard during normal use of the tractor. The exception to this is that the windscreen shall remain closed.

NOTE 4 Measurements with doors, windows and hatches open are made for information purposes only, to ensure that the user is made aware of any operating conditions where sound pressure levels could be harmful and exceed those measured in a closed cab.

When the measurements are being made, parts which normally operate at the same time as the engine (e.g. engine cooling fan) shall be functioning, but extra equipment powered by the engine or self-powered (e.g. windscreen wipers, heating and ventilating fans, power take-off) shall not be functioning.

A.3.2 Additional noise measurements may optionally be made with the engine running at maximum speed and all auxiliary air-conditioning equipment working. The heating or ventilating fans shall run at the maximum setting.

A.3.3 Additional noise measurements may optionally be made with the engine stopped and auxiliaries such as ventilating fans, defrosters and other electrical facilities working at maximum settings. It shall be confirmed that at least the nominal energy input of the auxiliary equipment is applied to the equipment terminals.

A.4 Noise measurements

A.4.1 General

Noise measurements shall be made whilst operating the tractor either

a) with no drawbar load, or

b) with a load applied to the drawbar.

Wheel slip during these measurements shall not exceed 15 % and track slip shall not exceed 7 %.

In the case of measurements made on a four-wheel drive (4WD) tractor, the sound pressure level assigned to the two-wheel drive (2WD) version shall be taken as the higher of the two measurements recorded with and without the front axle engaged.

A.4.2 No-load method

The microphone shall be placed at that side of the operator giving the highest sound pressure level, as

determined in a preliminary check made with the tractor operating with no load in the gear or condition giving a forward speed as near as possible to 7,5 km/h at the manufacturer's rated engine speed.

The noise measurements shall be made operating with no load in the gear or condition giving a forward speed as near as possible to 7,5 km/h at the manufacturer's rated engine speed.

The throttle shall be fully open or the governor control lever set for maximum engine speed, as appropriate.

The stabilized level of noise found during the run shall be recorded together with an optional octave analysis.

A.4.3 Drawbar-load method

A.4.3.1 The microphone shall be placed at that side of the operator giving the highest sound pressure level as determined in a preliminary check made with the tractor operating under load with the throttle lever fully open, or governor control lever set for maximum engine speed, as appropriate, in the gear or condition giving a forward speed as near as possible to 7,5 km/h at the manufacturer's rated engine speed.

A.4.3.2 The A-weighted sound pressure level measurement with an optional octave analysis shall be made in the gear or condition giving a speed as near as possible to 7,5 km/h at the manufacturer's rated engine speed.

The governor control lever shall be fully open. Starting with no load, the load shall be increased until the maximum sound pressure level is found. After each increase of load, time shall be allowed for the level of noise to stabilize before making the measurements. The load condition shall be such that the engine is always operating under the control of the governor.

A.4.3.3 The noise shall be measured in all other gears or conditions using the same procedure. Only sound pressure levels exceeding that recorded in 4.3.2 by more than 1 dB shall be recorded, together with an optional octave analysis.

For infinitely variable transmissions, noise measurements shall be made at four equally spaced speeds over the range from 4 km/h up to 16 km/h.

A.4.3.4 The noise shall also be measured and reported at the maximum design speed of the tractor but with no load applied.

A.5 Test report

The test report shall be in accordance with clause 10 and shall contain the results of measurements made according to clause 9 and A.4.