
International Standard



5131

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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

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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 5131 was developed by Technical Committee ISO/TC 43, *Acoustics*, and was circulated to the member bodies in February 1980.

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

Austria	Israel	South Africa, Rep. of
Belgium	Italy	Spain
Canada	Japan	Sweden
Czechoslovakia	Netherlands	Switzerland
Denmark	New Zealand	USA
Finland	Norway	Yugoslavia
Hungary	Poland	
Ireland	Romania	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
Germany, F. R.
United Kingdom
USSR

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 of measurement of the noise at the position of the operator(s) of a tractor or machine used in agriculture and forestry. The results may be useful when considering the risk of damage to the operator's hearing (see ISO 1999).

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

2 Field of application

In the case of a tractor, the noise measured relates only to the basic machine. The machines to which this International Standard applies are self-propelled, pedestrian-controlled machines being included. The measurements described in this International Standard might be undertaken as part of a type test.

3 References

ISO 1999, *Acoustics — Assessment of occupational noise exposure for hearing conservation purposes*.

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

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

IEC Publication 225, *Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations*.

IEC Publication 651, *Sound level meters*.

4 General

The main body of this International Standard specifies the general conditions of measurement and reporting of the noise at the operator's position on agricultural tractors and field machines. The precision required of the values determined is to

be stated by the user of this International Standard or by the regulatory authority.

Additional conditions for measurements in connection with particular types of machines are specified in the annexes¹⁾ as follows :

Annex A : Agricultural tractors.

Annex B : Self-propelled agricultural machines.

Annex C : Pedestrian-controlled agricultural machines.

The conditions specified for the operation of the machine during the measurements are designed so that the noise to which an operator may be subjected from the tractor or machine during work is determined.

5 Measured quantities

5.1 All readings of the sound level meter shall be taken with the time weighting characteristic "S".

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

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

6 Measurement equipment

6.1 A sound level meter which meets at least the requirements of IEC Publication 651 for a type 1-instrument shall be used, though 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. A wind screening attachment to the microphone may be used provided that this is allowed for, if necessary, in the calibration and does not significantly alter the measured sound level as a consequence of its effect on the omnidirectional characteristics of the microphone.

1) Further annexes specifying conditions for other types of machines are in the course of preparation and will be included at a later stage.

6.2 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 of the relevant clauses of IEC Publication 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.

6.3 Measurement of the sound frequency spectrum shall be carried out using a frequency analyser fitted with octave filters in accordance with IEC Publication 225.

NOTE — Care shall 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 microphone as specified in IEC Publication 651.

6.4 The calibration of the equipment at the time of the measurements shall be in accordance in all respects with IEC Publication 651. Checking of the calibration shall be carried out at appropriate intervals and at least before and after each measuring session using an acoustical calibrator with an accuracy of $\pm 0,5$ dB at a known frequency in the range 250 to 1 000 Hz.

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

7 Acoustical environment, weather conditions, background noise

7.1 The test area shall be a flat and open space and, 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 employed, this shall be towed or driven at a distance remote enough to avoid interference.

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

7.3 The level of the background noise shall be at least 10 dB below the level measured during the test. Where spectral analysis is required, the level of the background noise shall be at least 10 dB below the corresponding level in each frequency band as measured during the test.

7.4 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 sound level measurements.

8 Tractor or machine condition

The tractor or machine shall comply with the manufacturer's product specification and shall be operated in accordance with his published instructions.

9 Operator

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

10 Microphone location

10.1 For seated operators the microphone shall be located 200 ± 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 microphone diaphragm shall be face forward and the centre of the microphone shall be 790 ± 50 mm above the seat reference point and 150 ± 20 mm forward of that point. Excessive vibration of the microphone must be avoided.

The seat reference point shall be determined in accordance with ISO 3462, with the seat set at or as near as possible to the mid-point of its horizontal and vertical adjustment. Any suspension of the seat shall be depressed until the seat reaches the mid-point of its dynamic range.

10.2 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 200 ± 20 mm to the side of the centre plane of the operator's head, in the same vertical plane as his eyebrows and facing forward. The side of the head chosen for the microphone shall be that for which the higher sound level is encountered. The operator shall continue to face forward during the noise measurement.

NOTE — Attention is drawn to the possibility, particularly when a cab is fitted, of standing waves being present within 300 mm of the operator's ear position. Checks should be made by moving the microphone around in this area to delete such standing waves.

11 Noise measurement procedure

The noise level obtained with the tractor or machine operated as in the appropriate annex shall be measured, the A frequency weighting and time weighting characteristic "S" of the meter being clearly referred to in reports of measurements. Each reading shall be taken over a 5 s period of stabilized running. The number of readings to be taken shall exceed the range, in decibels, of observed fluctuations. For type tests, at least three measurements shall be made at each microphone position as defined in clause 10 and for each operating condition. If the spread of results of the A-weighted sound pressure level obtained under any measuring condition exceeds 3 dB, further measurements shall be made until the readings of three successive measurements fall within 3 dB; the arithmetic mean value of these three readings shall be taken as the test result.

For monitoring purposes, it is sufficient to perform one measurement under each of the specified measuring conditions at selected microphone positions.

Any peak which is obviously out of character with the general sound pressure level being read shall be ignored.

The values reported shall be rounded to the integer part of the mean of the readings for type tests, or of the reading, for monitoring tests.

Optionally, at the manufacturer's request, octave band pressure levels over the centre frequency range 31,5 to

8 000 Hz may be reported in addition to A-weighted sound pressure level.

The precision of the measured values shall be determined and reported in terms similar to those of the precision limits which are imposed.

12 Reporting of results

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

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Annex A

Agricultural tractors

(This annex forms part of the standard.)

A.1 General

For tractors, the measurements shall be made away from agricultural work. For maximum precision, 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, horizontal concrete or tarmac surface 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, particularly in the higher gears.

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 10 % of the manufacturer's rated value.

A.3 Cabs and auxiliaries

The measurement procedure applies whether or not the tractor is fitted with a cab. If a cab is fitted, the noise shall be measured with all doors and windows closed. The noise measurements may optionally be repeated with all windows open.

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.4 Location of the microphone

The microphone shall be placed at the side giving the highest sound level as determined in a preliminary check made with the tractor operating in the gear giving the nearest forward speed to 7,5 km/h, with the maximum drawbar pull exerted, with a wheel slip of not more than 15 % and with the engine speed not falling below the manufacturer's rated value.

A.5 Noise measurement

A-weighted sound pressure level measurements shall be made in all field gears giving a rated speed from 4 km/h up to 17 km/h. These measurements shall be made in each gear with the governor control lever fully open, at the maximum drawbar pull attainable with wheel slip of not more than 15 % or engine speed not falling below the manufacturer's rated value, and at 25 % and 70 % of this pull.

For infinitely variable transmissions, measurement shall be made at four transmission speeds equally distributed over the range of 4 km/h up to 17 km/h.

The arithmetic mean of all the measurements shall be calculated and reported together with the A-weighted sound pressure level at the load resulting in maximum noise in the gear giving a speed nearest to 7,5 km/h, and any other gear for which the sound pressure level is 1 dB or greater above the sound level obtained in the former gear.

When octave band sound pressure levels are measured, it is recommended that the machine be operated at the speed and under the load which give the highest sound level.

Annex B

Self-propelled agricultural machines

(This annex forms part of the standard.)

B.1 Operation of the machine

Except where there is evidence that the noise level of the machine at work differs significantly from that when stationary but with all normal operating mechanisms functioning, noise measurements shall be made with the machine stationary on a short-grass or soil surface complying with the acoustic requirements of clause 7. The engine of the machine shall be operating at the manufacturer's rated speed and all mechanisms shall be functioning as in normal continuous field work but without crop or other materials passing through the machine¹⁾. All tanks or hoppers for crop or other materials shall be empty.

Where the noise in work is assessed to be significantly different from that when stationary, the noise measurements shall be made with the machine at work. In either case the report shall clearly describe the operating condition of the machine, engine and, where applicable, forward speed and the nature of the ground surface or crops.

B.2 Cabs and auxiliaries

The measurement procedure applies whether or not the machine is fitted with a cab. If a cab is fitted, the noise shall be measured with all doors and windows closed. The noise measurements may optionally be repeated with all windows open.

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.

B.3 Noise measurement

The A-weighted sound pressure level and, optionally, octave band sound pressure levels, shall be measured and reported at the one operation condition defined above.

1) From the information available in the case of combine harvesters, it appears that the noise level measured with the machine stationary and with all mechanisms operating will not significantly be exceeded at work.

Annex C

Pedestrian-controlled agricultural machines¹⁾

(This annex forms part of the standard.)

C.1 Operation of the machine

Except where there is evidence that the noise level of the machine at work differs significantly from that when stationary but with all normal operating mechanisms functioning, noise measurements shall be made with the machine stationary on a short-grass or soil surface complying with the acoustic requirements of clause 7. The engine of the machine shall be operating at the manufacturer's rated speed and all mechanisms shall be functioning as in normal field work. Tillage or moving components shall not engage with the soil or crop.

Where the noise in work is assessed to be significantly different from that when stationary, the noise measurements shall be

made with the machine at work. In either case the report shall clearly describe the operating condition of the machine, the engine and, where applicable, forward speed and the nature of the ground surface or crops.

C.2 Noise measurement

The A-weighted sound pressure level and, optionally, octave band sound pressure levels, shall be measured and reported at the one operating condition defined above. If the noise varies owing to normal movement of the pedestrian operator or other causes, the mean value shall be reported together with the range of variation.

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¹⁾ Excluding equipment which is carried by the operator in work.

Annex Z

Specimen report form

(This annex forms part of the standard.)

NOISE TEST TO ISO 5131

TRACTORS AND MACHINERY FOR AGRICULTURE AND FORESTRY — MEASUREMENT OF NOISE AT THE OPERATOR'S POSITION — SURVEY METHOD

1 TEST No..... DATE

2 CLIENT

3 MACHINE¹⁾/TRACTOR MAKE AND MODEL

SPECIAL FEATURES

4 CAB MAKE AND MODEL

DESCRIPTION (Cladding, etc.)

WORKING CONDITION (Open/Closed, etc.)

5 TEST SITE

6 SURFACE CONDITION

NATURE OF GROUND

CROP

7 INSTRUMENTATION	Type	Serial No.
Sound level meter
Microphone
Octave filter set
Microphone wind screen
Tape recorder
Acoustical calibrator

8 OPERATOR

HEIGHT.....WORKING POSITION¹⁾ : SEATED/STANDING/PEDESTRIAN

9 MICROPHONE POSITION¹⁾

To ISO . . . re.seat reference point/To ISO . . . re.operator's head frame

Position recentre line¹⁾ : LEFT/RIGHT Exhaust side/Side opposite to exhaust

1) Delete as appropriate.