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

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

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 2, *Common tests*.

This third edition cancels and replaces the second edition (ISO 5131:1996), which has been technically revised for technical harmonization with OECD Code 5: July 2014.

Introduction

Technical harmonization with OECD is ensured by the Maintenance Agency operating as specified in Annex C.

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

1 Scope

This International Standard specifies a method for the measuring and reporting of the noise at the operator(s) position of a tractor used in agriculture and forestry. The measured noise relates only to the basic machine and applies to tractors with machine-carried operators. The results provide information to the operator(s) in order to avoid exposing themselves to noise levels that could put their hearing at risk.

The conditions specified for the operation of the machines during the measurements are defined to provide a realistic and repeatable assessment of the maximum noise an operator should be subjected to when operating a machine. The test procedures specified in this International Standard are survey methods as defined in ISO 12001.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 6395:2008, *Earth-moving machinery — Determination of sound power level — Dynamic test conditions*

ISO 12001, *Acoustics — Noise emitted by machinery and equipment — Rules for the drafting and presentation of a noise test code*

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61672-1, *Electroacoustics — Sound level meters*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
agricultural tractor
self-propelled agricultural vehicle having at least two axles and wheels, or endless tracks, particularly designed to pull agricultural trailers and pull, push, carry, and operate implements used for agricultural work (including forestry work), which may be provided with a detachable loading platform

Note 1 to entry: The agricultural vehicle has a maximum design speed of not less than 6 km/h and may be equipped with one or more seats.

[SOURCE: ISO 12934:2013, 3.1]

3.2
power take-off power
power measured at the dynamometer coupled to any shaft (with the tractor stationary) designed by the tractor manufacturer to be used as a power take-off

[SOURCE: ISO 789-1:1990, 3.2]

3.3
roll-over protective structure
ROPS
framework (safety cab or frame) protecting drivers of tractors for agricultural and forestry that avoids or limits risk to the driver resulting from accidental overturning during normal operation

Note 1 to entry: The ROPS is characterized by the provision of space for a clearance zone either inside the envelope of the structure or within a space bounded by a series of straight lines from the outer edges of the structure to any part of the tractor that might come into contact with flat ground and that is capable of supporting the tractor in that position if the tractor overturns.

[SOURCE: ISO 5700:2013, 3.1]

3.4
unballasted tractor mass
mass of the tractor in working order with tanks and radiators full, roll-over protective structure with cladding, and any track equipment or additional front-wheel drive components required for normal use

Note 1 to entry: Not included are the operator, optional ballast weights, additional wheel equipment, special equipment and loads.

[SOURCE: ISO 5700:2013, 3.2]

4 Measurements units and tolerances

The following units and tolerances apply to the maximum value measured:

—	rotational frequency (r/min)	± 0,5 % ;
—	time (s)	± 0,2 s ;
—	distance (m or mm)	± 0,5 % ;
—	force (N)	± 1,0 % ;
—	mass (kg)	± 0,5 % ;
—	atmospheric pressure (kPa)	± 0,2 kPa ;
—	tyre pressure (Pa)	± 5 % .

5 Instrumentation

5.1 A precision quality sound level meter shall be used meeting or exceeding the requirements of IEC 61672-1 for a class 1 instrument. If alternative measuring equipment is used, the tolerances shall not exceed those given in the relevant clauses of IEC 61672-1 for a class 1 instrument. Measurement shall be carried out with a frequency weighting network in conformity with curve A and set to give slow response as described in IEC 61672-1.

5.2 The calibration of the equipment at the time of measurement shall be in accordance in all respects with the specifications of IEC 61672-1 for a class 1 instrument. Checking of the calibration shall be carried out at appropriate intervals and at least before and after each measurement session, using an acoustical calibrator in accordance with the specifications of IEC 60942 for a class 1 instrument. The calibrator shall be checked annually to verify its output and its calibration shall be traceable to a national standards laboratory.

5.3 An adequate technical description of the measuring equipment shall be given in the test report.

6 Circumstances for testing

6.1 Acoustical environment

6.1.1 Measurements shall be made in a sufficiently silent, flat, and open zone. The last 20 m next to the test zone shall be essentially level and there shall be no obstacle in this area likely to reflect significant sound, such as a building, solid fence, tree or other machine.

6.1.2 The surface of the test zone shall be of a kind where pneumatic tyres or endless rubber tracks do not cause excessive noise. It shall be made of concrete, asphalt or a similar material unless otherwise specified. The surface shall be as clean and dry as possible (e.g. free of gravel, leaves, snow, etc.).

6.1.3 For endless metal tracks, the surface of the test zone shall be of a kind where they do not cause excessive noise. In this case, it shall be a layer of humid sand as specified by ISO 6395:2008, 5.3.2.

6.2 Ambient conditions

6.2.1 Measurements shall be made in fine weather with little or no wind. The level of background noise and the level of wind noise at the microphone location shall be at least 10 dB(A) below the noise level measured during the test. Any extraneous noise that occurs while obtaining data, which is not connected to general sound level measurement, shall not be taken into consideration.

6.2.2 No corrections shall be made to the test results for the atmospheric conditions or other factors. Atmospheric pressure shall not be less than 96,6 kPa. If this is not possible because of conditions of altitude, a modified injection pump setting may have to be used, details of which will be included in the report.

6.3 Operator

6.3.1 No person other than the operator of the tractor shall be in the cab during measurements. However, when the noise is being measured at additional operator positions on the machine, the usual number of operators shall be present. No person other than the operator(s) shall be in a position to influence the noise measurements.

6.3.2 The operator shall not wear abnormally thick clothing or any additional attire, such as a hat or scarf, which could influence the sound measurement.

7 Condition of tractor

7.1 Selection

7.1.1 In the case of a third party performing the assessment, the manufacturer and the third party shall work together to select a tractor to be submitted for testing. The tractor shall comply with the manufacturer's product specification, and shall be operated in accordance with the manufacturer's instructions.

7.1.2 Annex A specifies conditions for agricultural tractors covered by this International Standard.

7.2 Running-in and preliminary adjustment

7.2.1 The tractor shall be new and run in prior to the test in accordance with the manufacturer's usual instructions. If a third party is responsible for the testing, the third party itself may run in the tractor

provided the authority of the manufacturer or their representative, who will remain responsible for the running-in, is obtained.

7.2.2 The adjustment of the carburetor or the injection pump as well as the setting of the governor shall conform to the specifications provided by the manufacturer. The manufacturer may make adjustments in conformity with these specifications prior to testing, but adjustments shall not be made during the test.

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 forward. The centre of the microphone shall be 700 mm ± 20 mm above the seat index point (SIP) and 100 mm ± 20 mm forward of that point.

8.2 The SIP shall be determined in accordance with ISO 5353.

8.3 For the seat location and adjustment of the seat, any suspension of the seat shall be depressed until the seat reaches the midpoint of its dynamic range. Where the position of the seat is adjustable only lengthwise and vertically, the longitudinal axis passing through the seat index point shall be parallel with the vertical longitudinal plane of the tractor passing through the centre of the steering wheel and not more than 100 mm from that plane.

9 Common noise measurement practice

9.1 During the entire test, the throttle lever shall be set fully open unless otherwise specified.

9.2 Once the test has started, the tractor shall never be operated in a way that is not in accordance with the manufacturer's published instructions in the operator's manual.

9.3 A 10 s period of stabilized running shall occur before any measurements are recorded.

9.4 All sound level measurements shall be recorded in dB(A) to three significant figures.

9.5 Make at least three measurements at each microphone position, as defined in Clause 8, and for each operating condition. If the range of the sound level results obtained under each measuring condition exceeds 3 dB, further measurements shall be made until the readings of three successive measurements fall within 3 dB. The maximum value of these three readings will be used as the test result.

9.6 When the characteristics of the machine cause the sound pressure levels to fluctuate widely and the 3 dB requirement for successive readings cannot be met, the number of separate measurements shall be greater than the fluctuation range in decibels. The maximum value of these readings will be used as the test result.

9.7 In all cases, any measurement clearly out of range with the general sound pressure levels being read shall be disregarded.

9.8 Tests shall not be made in gears in which the forward speed will then exceed the safety limits of the testing equipment.

10 Test report

A specimen report form for the reporting of results is given in Annex B.

Annex A
(normative)

Agricultural tractors

A.1 General requirements

A.1.1 The tractor shall be unballasted. Wheeled tractors shall be fitted with normal agricultural pneumatic tyres, not more than 50 % worn.

A.1.2 For all tests, auxiliary components such as the hydraulic lift pump or air compressor may be disconnected only if it is practicable for the operator to do so as normal practice in work. Disconnection of any auxiliary shall be done in accordance with the operator's manual without using tools, unless otherwise specified for a particular test. If not, they should remain connected and operate at minimum load.

A.1.3 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.1.4 The optional test with the drawbar loaded should, preferably, be carried out using a draught load provided by a dynamometer vehicle positioned to eliminate interference with the sound field caused by the tractor.

NOTE This is not applicable for agricultural tractors with endless metal tracks.

A.1.5 Wheel slip during the optional test with the drawbar loaded shall not exceed 15 % and track slip shall not exceed 7 %.

NOTE This is not applicable for agricultural tractors with endless metal tracks.

A.2 Tractor options

A.2.1 If the tractor is fitted with a cab, all openings such as doors and windows shall be closed. The test may be repeated with them open provided they have been designed to operate in the open position and they do not cause a hazard during normal use of the machine. The windscreen shall remain in place, closed.

NOTE 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.

A.2.2 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, ventilating fans heating and, power take-off) shall not be functioning.

A.2.3 If the tractor is equipped with a reverse driving position, the noise test may be repeated in the reverse position, in accordance with A.3, subject to the manufacturer's instructions for driving in the reverse position as stated in the operator's manual. The windscreen of the tractor shall remain in place, closed.

A.2.4 For tractors that could be fitted with optional seats, the microphone shall be set relative to a seat index point chosen from the range available for fitting to a tractor. The results will also apply to any of the available seats that give a microphone position within a 50 mm radius sphere of this reference point. If any seat gives a microphone position outside this sphere, it shall be dealt with separately.

A.2.5 In the case of measurements on a tractor capable of operating as both a two-wheel drive and four-wheel drive tractor, the sound level shall be measured separately with the front axle engaged and disengaged.

A.2.6 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.2.7 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.

A.3 Required test procedures

A.3.1 Preliminary method

A.3.1.1 A preliminary test shall be made to determine the side of the operator encountering the highest sound pressure level (as mentioned in 8.1 and 8.2) by operating the tractor without load in the gear or condition giving a forward speed as near as possible to 7,5 km/h.

NOTE For endless metal tracks, the gear or condition giving a forward speed as near as possible to 5 km/h.

A.3.2 No-load method

A.3.2.1 The noise shall be measured and reported while driving forward with no load in the gear or condition giving a speed as near as possible to 7,5 km/h.

NOTE For endless metal tracks, the gear or condition giving a forward speed as near as possible to 5 km/h.

A.3.2.2 The noise shall be measured and reported while driving forward with no load at the maximum design speed of the tractor.

A.4 Optional test procedures

A.4.1 Drawbar-load method

NOTE This is not applicable for agricultural tractors with endless metal tracks.

A.4.1.1 Measure

A.4.1.1.1 Geared transmissions

For geared transmissions, the noise shall be measured when the drawbar pull gives the maximum sound level in every forward gear. 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 corresponding engine speeds shall be recorded for each gear.

A.4.1.1.2 Continuously variable transmissions

For continuously variable transmissions, noise measurements shall be made for at least 7 equally spaced speeds over the range of 2,5 km/h to 17,5 km/h. 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 corresponding engine speeds shall be recorded for each.

A.4.1.2 Report

The noise shall be reported in the forward gear or condition giving the nearest nominal speed to 7,5 km/h at which the drawbar pull gives the maximum sound level. Noise shall also be reported in any gear or condition giving a sound level of at least 1 dB(A) greater.

A.5 Test report

The test report shall contain the results of measurements made according to Clauses 9 and A.3. Annex B provides an acceptable test report format.

Annex B
(informative)

Specimen report form

Noise test in accordance with ISO 5131			
GENERAL INFORMATION			
Report number:		Date:	
Location of test:			
Submitted for test by:			
Selected for text by:			
Name and address of manufacturer:			
Name and address of manufacturer of protective structure:			
TEST CONDITIONS			
Description of surface on which the tractor or machine was tested:			
Atmospheric pressure (kPa):			
Make/ type/ serial no. of sound meter used:			
SPECIFICATIONS OF TEST TRACTOR OR MACHINE			
Make:			
Model (trade name):			
Model denomination(s) for other countries:			
1st Serial no. or prototype no.:			
Rated PTO power and corresponding speed:			
Max. no-load engine speed:			
Transmission type or gears x ranges:			
Type *(2 WD or 4WD; rubber or steel tracks (if applicable); articulated 4WD or articulated 4WD with twin (dual) wheels (if applicable)*:			
Reversible driver's position:		Y	N

SPECIFICATIONS OF PROTECTIVE STRUCTURE		
Make of the protective structure:		
Model of the protective structure:		
Brief description:		
Interior padding (*material and sizes*):	Roof:	
	Doors:	
	Floor:	
	Front panel:	
	Rear panel:	
	Side panels:	
	Instrument panel and steering column:	
Draught proofing (*material and sizes*):		
Glass (*material and sizes*):		
Heaters and ventilators (*make and type*):		
Windscreen wipers (*make and type*):		
Direction indicators (*make and type*):		

TEST RESULTS				
No-load procedure				
A) Measure noise while driving forward with no load in the gear or condition giving a speed as close as possible to 7,5 km/h				
All openings closed				
Gear number	Engine speed (rev/min)	Measured travelling speed (km/h)	Number of driving wheels (2 or 4)	Sound level dB(A)
All openings open (optional)				
Gear number	Engine speed (rev/min)	Measured travelling speed (km/h)	Number of driving wheels (2 or 4)	Sound level dB(A)
B) Measure noise while driving forward with no load at the maximum design speed of the tractor.				
All openings closed				
Gear number	Engine speed (rev/min)	Measured travelling speed (km/h)	Number of driving wheels (2 or 4)	Sound level dB(A)
All openings open (optional)				
Gear number	Engine speed (rev/min)	Measured travelling speed (km/h)	Number of driving wheels (2 or 4)	Sound level dB(A)