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Earth-moving machinery — Determination of emission sound pressure level at operator's position — Dynamic test conditions

Engins de terrassement — Détermination du niveau de pression acoustique d'émission au poste de conduite — Conditions d'essai dynamique

Reference number
ISO 6396:2008(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6396 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety requirements and human factors*, in collaboration with Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This second edition cancels and replaces the first edition (ISO 6396:1992), which has been technically revised.

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Introduction

This International Standard is a specific test code for earth-moving machinery as defined in ISO 6165.

A simulated dynamic test condition, rather than an actual work cycle, is used. Simulated dynamic test conditions provide noise emission data which are repeatable and representative. Actual work cycle tests are complex and repeatability can be a problem.

Specific procedures are described in this International Standard to enable the time-averaged A-weighted emission sound pressure level in dynamic test conditions to be determined in a manner which is repeatable. Attachments (bucket, dozer, etc.) for the manufacturer's production version are intended to be fitted since this is the configuration most likely to exist when the machine is in actual use.

This International Standard enables compliance with noise limits to be determined, if applicable. It can also be used for evaluation purposes in noise reduction investigations.

A complementary test code is given in ISO 6395. This other specific test code is intended to be used to determine the noise emitted by earth-moving machinery in terms of the A-weighted sound power level, with the machine under dynamic test conditions.

Corresponding measurements of noise emitted to the environment and noise at the operator's position under stationary test conditions are described in ISO 6393 and ISO 6394, respectively.

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Earth-moving machinery — Determination of emission sound pressure level at operator's position — Dynamic test conditions

1 Scope

This International Standard specifies a method for determining the emission sound pressure level of earth-moving machinery at the operator's position, measured in terms of the time-averaged A-weighted emission sound pressure level while the machine is operating under dynamic test conditions.

It is applicable to earth-moving machinery as defined in ISO 6165 and as specified in ISO 6395:2008, Annex A.

2 Normative references

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

ISO 3411, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope*

ISO 6165, *Earth-moving machinery — Basic types — Identification and terms and definitions*

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

ISO 9249, *Earth-moving machinery — Engine test code — Net power*

ISO 11201, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11201, ISO 6165 and the following apply.

3.1
time-averaged A-weighted sound pressure level
$L_{p\mathrm{A},T}$
A-weighted sound pressure level averaged on an energy basis over the whole measurement period, T

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4 Instrumentation

The instrumentation shall be capable of being used to carry out measurements as described in Clause 8. The preferred instrumentation system for acquiring the data is an integrating-averaging sound level meter complying with the requirements of IEC 61672-1 for a class 1 instrument.

5 Test environment

For the purposes of this International Standard, the test environment specified in ISO 6395 applies.

6 Measurement of time-averaged A-weighted sound pressure levels

6.1 Operator stature

The operator shall have a stature between that of the small operator and the large operator as defined in ISO 3411. See also 6.2.2.2.

6.2 Operator presence

6.2.1 Ride-on machines

6.2.1.1 Operator's position

The operator shall be in the driving position and observers shall not be in close proximity or in the cab during sound measurement. The operator shall wear neither abnormally sound-absorptive clothing nor any hat or scarf (other than a protective helmet used for safety reasons, or a helmet or frame used to support a microphone) which might influence the noise measurement.

6.2.1.2 Seat adjustment

The seat shall be set at, or as near as possible to, the midpoint of its horizontal and vertical adjustment. Any seat suspension shall be adjusted to the operator's weight.

6.2.2 Pedestrian-controlled machines

6.2.2.1 Operator's position

The operator shall be in the usual working position specified by the manufacturer and observers shall not be in close proximity to the operator during sound measurement. The operator shall wear neither abnormally sound-absorptive clothing nor any hat or scarf (other than a protective helmet used for safety reasons, or a helmet or frame used to support a microphone) which might influence the noise measurement.

6.2.2.2 Standing operator

The standing operator shall have a stature of 1 715 mm $\pm$ 50 mm.

6.3 Microphone

6.3.1 Microphone orientation

The microphone shall be oriented horizontally, with its reference direction — as specified by the microphone manufacturer — pointing in the direction in which a person occupying the operator's position would normally look.

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6.3.2 Microphone position

As a preliminary sound pressure level data check point, the microphone shall be located 200 mm ± 20 mm from the median plane of the head of the operator and in line with the eyes, on the left side and on the right side of the head of the operator, during the maximum governor engine speed (high idle) condition and with the machine in a static mode, as a preliminary sound pressure level data check point. Whichever side yields the highest reading shall be used for the dynamic check. If both initial sound pressure level checks are the same, the right side location shall be used.

6.3.3 Microphone mounting

The microphone can conveniently be mounted on a frame or on the helmet, or on a shoulder harness worn by the operator.

6.3.4 Microphone vibration precautions

Care shall be taken to isolate the microphone from vibrations which could affect the measurements. If the microphone is moved during the measurements, care shall be exercized to avoid introducing acoustical noise (for example, noise due to the microphone rubbing against the operator's clothing) or electrical noise (for example, due to a flexing cable) that could interfere with the measurements.

6.3.5 Precautions against microphone-reflected noise

6.3.5.1 Care shall be taken to minimize the effect of reflected noise which could affect microphone measurements. The recommendations given in 6.3.5.2 and 6.3.5.3 will minimize the effect of reflected noise.

6.3.5.2 Once the microphone location has been determined, a positional tolerance should be maintained of ± 50 mm from this location in any direction during the test.

6.3.5.3 The microphone should be placed a minimum of 100 mm from the side of the head and a minimum of 50 mm above the clothing on the shoulder during the test.

7 Set-up and operation of machine, and operator's position set-up

7.1 Set-up and operation of machine

The set-up and operation of the machine shall be as specified in ISO 6395:2008, Clause 7.

Based on the type of machine, measurements are made in

— a travel mode,

— a stationary work cycle mode, or

— a combination of travel/stationary work cycle modes.

The positioning of the machine and travel length shall be as specified in ISO 6395:2008, 6.1 and 6.3. The machine operation and travel path shall be as specified in ISO 6395:2008, Annexes B to L.

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7.2 Setting-up operator's position for machines with cab

7.2.1 Cab with air-conditioning and/or pressurized ventilation system(s)

Measurements shall be taken with the doors and windows closed and the air-conditioning and/or ventilation system(s) in operation. If there is more than one operating speed available, the air conditioning and/or the pressurized ventilation system(s) shall be operated at the second speed for systems with up to four speeds.

For systems with more than four speeds, the third speed shall be used and, for systems with infinitely variable speeds, the mid-range speed.

If the air-conditioning and/or ventilation systems have a recirculate and outside air position control, the control shall be set for outside air.

7.2.2 Cab without air-conditioning or pressurized ventilation system(s)

Measurements shall be taken with the doors and windows closed, then repeated with the doors and windows open. The higher measurement result from the two sets of data obtained shall be used as the reported value.

8 Acoustic measurements

8.1 Measurement procedure

The time-averaged A-weighted emission sound pressure level at the operator's position shall be determined in accordance with ISO 11201.

For each mode of operation, as defined in ISO 6395:2008, Annexes B to L, for the particular machine, the time-averaged A-weighted emission sound pressure level shall be measured at the microphone position at least three times.

From these measurements, emission sound pressure levels (at least three) are calculated in accordance with ISO 11201 for the combined work cycle (see ISO 6395:2008, Annexes B to L) of the particular machine.

In order to meet the requirements of 8.2, measurements of additional work cycles may be necessary.

8.2 Determination of measurement result

If two of the three A-weighted values so obtained do not differ by more than 1 dB, further measurements are unnecessary. If this is not the case, continue taking measurements until two values within 1 dB of one another are obtained. The time-averaged A-weighted emission sound pressure level to be reported is the arithmetic mean of the two highest values that are within 1 dB of each other.

9 Information to be recorded

The following information shall be recorded.

a) Machinery under test:

- machine manufacturer;
- machine model number;
- machine serial number;

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— type of fan-drive system(s), test method(s) used, as specified in ISO 6395:2008, 7.3 a), b) and c), including corresponding system maximum fan speed and fan speed(s) used during the test for each fan;

— machine arrangement, including major equipment and attachments, engine speed at maximum governor position (high idle), and gear ratios or control settings;

— set-up configuration and fan speed setting used as specified in 7.2 for machines with cabs;

— engine net power, in kilowatts, at the corresponding speed, as defined in ISO 9249.

b) Acoustic environment:

— description of the test site and the type of test site measurement ground surface used, including a sketch showing the position of the machine;

— air temperature, barometric pressure, relative humidity and wind velocity at the test site.

c) Instrumentation:

— instrumentation used for the acoustical measurements, including name, type, serial number and manufacturer;

— method used to calibrate the instrumentation system;

— date and place of calibration of the acoustical calibrator.

d) Acoustical data:

— location of the microphone in relation to the operator's ear, and presence or absence of any object which could influence the operator's noise exposure (such as a protective helmet);

— time-averaged A-weighted sound pressure level at the microphone position for each measurement carried out in accordance with 8.1;

— time-averaged A-weighted sound pressure level of the background noise at the microphone position;

— final value of the time-averaged A-weighted emission sound pressure level at the operator's position, determined in accordance with 8.2.

10 Information to be reported

10.1 Information

The following information shall be reported:

a) machine manufacturer, model number, serial number, engine net power at rated speed (in kilowatts, as defined in ISO 9249), machine arrangement, including major attachments, and the type of test site measurement ground surface used;

b) time-averaged A-weighted emission sound pressure level at the operator's position, determined in accordance with 8.2, rounded to the nearest whole number (use the lower number for values $< 0{,}5$; use the higher number for values $\geqslant 0{,}5$) for the configuration(s) of operator's position depending on how the machine is equipped;

c) engine speed at maximum no load governor control position (high idle), with the machine stationary and transmission in neutral;

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d) type of fan-drive system(s), test method(s) used as specified in ISO 6395:2008, 7.3 a), b) or c), including the corresponding system maximum fan speed and fan speed(s) used during the test for each fan;

e) set-up of configuration and fan speed setting used as specified in 7.2 for cab-equipped machines.

10.2 Declaration of sound emission data and uncertainty

In some markets, the additional requirements listed in the normative Annex A apply. The declaration of sound emission data and uncertainty shall be made in accordance with Annex A, if relevant.

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Annex A
(normative)

Declaration of sound emission data and uncertainty

If a declaration of sound emission data and uncertainty is to be made, for example for compliance with regulatory requirements, the following shall be observed.

The measurement uncertainty and, in the case of series machines, the uncertainty due to production variations shall be considered when determining the value of the time-averaged A-weighted emission sound pressure level at the operator's position.

The maximum value of the standard deviation of reproducibility of the measured time-averaged A-weighted emission sound pressure level at the operator's position is $\leqslant$ 2,5 dB, in accordance with ISO 11201 (see also ISO 11200:1995, Table 1). The standard deviation of reproducibility is as defined in ISO 4871:1966, 3.21 (repeated application of the same noise emission measurement method at the same noise source at different times and under different conditions).

Guidelines on declaration of sound emission values are given in ISO 4871:1996, Annex A.

The time-averaged A-weighted emission sound pressure level and the associated uncertainty shall be declared separately (dual-number noise emission data declaration), as shown, for example, in ISO 4871:1996, B.2, or other methods for declaration can be used.

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