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Measurement of noise emitted by accelerating road vehicles — Engineering method —

Part 2: L category

Mesurage du bruit émis par les véhicules routiers en accélération — Méthode d'expertise —
Partie 2: Catégorie L

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Foreword

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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 362-2 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This first edition of ISO 362-2, together with ISO 362-1, cancels and replaces ISO 362:1998 and ISO 7188:1994, which have been technically revised.

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ISO 362 consists of the following parts, under the general title *Measurement of noise emitted by accelerating road vehicles — Engineering method*:

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— *Part 1: M and N categories*

— *Part 2: L category*

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Introduction

From as early as 1994, the International Motorcycle Manufacturers Association (IMMA) has collected in-use data for vehicles of category L3 (two-wheeled motorcycles) to study motorcycle dynamics, rider attitude and behaviour. In 1999 and 2000, additional in-use data was collected through a tripartite project in which the Dutch Ministry of the Environment (VROM), the Dutch research institute TNO-Automotive and the IMMA took part. This project eventually led to the adoption of the Worldwide Motorcycle Exhaust Emission Test Cycle (WMTC) as a UNECE Global Technical Regulation under the 1998 Agreement (*Agreement concerning the establishing of global technical regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles*).

Though the aim of the WMTC project was to collect data with which to construct an exhaust emissions test cycle for motorcycles, the in-use data was equally suitable as a basis for the definition of a more representative and performance-based urban noise test procedure. From 2002 to 2004, additional in-use data for low-performance motorcycles was added to ensure the representativity of the in-use database for small engine displacement motorcycles. Additional wide-open-throttle acceleration data from large engine displacement motorcycles was collected in the course of 2005 to upgrade the acceleration equations. Prior to preparation of this part of ISO 362, an extensive test programme was conducted to verify the practicability and technical accuracy of the new noise test.

This noise test was developed in accordance with the following set of demands:

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— performance-based concept with prescribed acceleration rate prescriptions related to vehicle acceleration capability and engine speed corresponding to typical motorcycle usage in urban and conurban areas, i.e. where motorcycles are in closest proximity to the greater part of the population — this typically relates to motorcycle usage on roads with speed limits of 50 km/h and 70 km/h;

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— accurate simulation of noise source distribution (intake, exhaust, engine/gearbox …) in relation to the most relevant motorcycle operations;

— comparability with other vehicle types in the same operating environment;

— independency of vehicle design to allow future propulsion technologies to be tested.

The procedure uses two operating conditions, i.e. a wide-open-throttle acceleration phase and a constant speed phase, to simulate real-life partial throttle acceleration actually used in urban traffic. The combination of these two primary operating conditions was demonstrated to be equivalent in terms of noise generation to the partial throttle and partial power (engine load) acceleration. Both primary operating conditions are also more repeatable and reproducible than partial throttle/power acceleration.

The measurement procedure for categories L4 and L5, already contained in ISO 362:1998, is retained until in-use data for these categories that suggests the need for change becomes available.

Categories L6 and L7, previously not covered in ISO 362:1998, are excluded pending in-use data becoming available and thereby allowing a representative test procedure to be considered.

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Measurement of noise emitted by accelerating road vehicles — Engineering method —

Part 2: L category

1 Scope

This part of ISO 362 specifies an engineering method for measuring the noise emitted by road vehicles of categories L3, L4 and L5 under typical urban traffic conditions. It excludes vehicles of category L1 and L2, which are covered by ISO 9645, vehicles of categories M and N covered by ISO 362-1 and vehicles of categories L6 and L7.

The specifications are intended to reproduce the level of noise generated by the principal noise sources during normal driving in urban traffic, typically on roads with speed limits of 50 km/h and 70 km/h (see Annex A).

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The method is designed to meet the requirements of simplicity as far as they are consistent with reproducibility of results under the operating conditions of the vehicle.

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The test method requires an acoustical environment that is only obtained in an extensive open space. Such conditions are usually provided for

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— type approval measurements of a vehicle,

— measurements at the manufacturing stage, and

— measurements at official testing stations.

NOTE 1 The results obtained by this method give an objective measure of the noise emitted under the specified test conditions. It is necessary to consider the fact that the subjective appraisal of the noise annoyance of different classes of motor vehicles is not simply related to the indications of a sound measurement system. As annoyance is strongly related to personal human perception, physiological human conditions, culture and environmental conditions, there is a large variation and it is therefore not useful as a parameter to describe a specific vehicle condition.

NOTE 2 Spot checks of vehicles chosen at random are rarely made in an ideal acoustical environment. If measurements are carried out on the road in an acoustical environment which does not fulfil the requirements stated in this International Standard, the results obtained can deviate appreciably from the results obtained using the specified conditions.

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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 4106, *Motorcycles — Engine test code — Net power*

ISO 6726, *Mopeds and motorcycles with two wheels — Masses — Vocabulary*

ISO 7117, *Motorcycles — Measurement method for determining maximum speed*

ISO 10844, *Acoustics — Specification of test tracks for the purpose of measuring noise emitted by road vehicles*

IEC 60942, *Electroacoustics — Sound calibrators*

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

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

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For the purposes of this document, the terms and definitions given in ISO 6726 and the following apply.

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3.1 Vehicle mass

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3.1.1
kerb mass
complete shipping mass of a vehicle fitted with all equipment necessary for normal operation, plus the mass of the following elements:

— lubricants, coolant (if needed), washer fluid;

— fuel (tank filled to at least 90 % of the capacity specified by the manufacturer);

— other equipment if included as basic parts for the vehicle, such as spare wheel(s), wheel chocks, fire extinguisher(s), spare parts and tool kit

NOTE 1 Adapted from ISO 362-1:2007.

NOTE 2 The definition of kerb mass may vary from country to country, but in this part of ISO 362 it refers to the definition contained in ISO 6726.

3.1.2
test mass
mass as determined by Table 1

NOTE Adapted from ISO 362-1:2007.

3.1.3
driver mass
nominal mass of a driver

[ISO 362-1:2007, definition 3.1.6]

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3.2
power-to-mass ratio index
PMR
dimensionless quantity used for the calculation of acceleration according to the equation

$$\text{PMR} = \frac{P_\text{n}}{m_\text{t}} \times 1\,000 \quad (1)$$

where

P_n is the numerical value of the rated engine power as defined in ISO 4106, expressed in kilowatts;

m_t is the numerical value of the test mass, expressed in kilograms.

NOTE Adapted from ISO 362-1:2007.

3.3
rated engine speed
S
engine speed at which the engine develops its rated maximum net power as stated by the manufacturer

NOTE 1 If the rated maximum net power is reached at several engine speeds, S is used in this part of ISO 362 as the highest engine speed at which the rated maximum net power is reached.

NOTE 2 ISO 80000-3 defines this term as "rated engine rotational frequency". The term "rated engine speed" was retained due to its common understanding by practitioners and its use in government regulations.

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[ISO 362-1:2007, definition 3.3]

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3.4 Vehicle categories

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3.4.1
category L
motor vehicles with fewer than four wheels

[ISO 362-1:2007, definition 3.4.1]

3.4.1.1
category L1 and L2
mopeds

[ISO 362-1:2007, definition 3.4.1.1]

NOTE See ISO 9645 for further details.

3.4.1.2
category L3
two-wheeled motor vehicles with an engine cylinder capacity greater than 50 cm^3 or maximum speed greater than 50 km/h

[ISO 362-1:2007, definition 3.4.1.2]

3.4.1.3
category L4
three-wheeled motor vehicles with an engine cylinder capacity greater than 50 cm^3 or maximum speed greater than 50 km/h, the wheels being attached asymmetrically along the longitudinal vehicle axis

[ISO 362-1:2007, definition 3.4.1.3]

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3.4.1.4
category L5
three-wheeled motor vehicles with an engine cylinder capacity greater than 50 cm^3 or maximum speed greater than 50 km/h, having a gross vehicle mass rating not exceeding 1 000 kg and wheels attached symmetrically along the longitudinal vehicle axis

[ISO 362-1:2007, definition 3.4.1.4]

3.4.1.5
category L6
four-wheeled vehicles whose unladen mass is not more than 350 kg, not including the mass of the batteries in the case of electric vehicles, whose maximum design speed is not more than 45 km/h, and whose engine cylinder capacity does not exceed 50 cm^3 for spark (positive) ignition engines, or whose maximum net power output does not exceed 4 kW in the case of other internal combustion engines, or whose maximum continuous rated power does not exceed 4 kW in the case of electric engines

[ISO 362-1:2007, definition 3.4.1.5]

3.4.1.6
category L7
four-wheeled vehicles, other than those classified for the category L6, whose unladen mass is not more than 400 kg (550 kg for vehicles intended for carrying goods), not including the mass of the batteries in the case of electric vehicles, and whose maximum continuous rated power does not exceed 15 kW

[ISO 362-1:2007, definition 3.4.1.6]

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3.5
reference point
front end of the vehicle

NOTE Adapted from ISO 362-1:2007.

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3.6
target acceleration
acceleration at a partial throttle condition in urban traffic, derived from statistical investigations

[ISO 362-1:2007, definition 3.6]

NOTE Refer to Annex A for more detailed explanations.

3.7
reference acceleration
required acceleration for the acceleration test on the test track

[ISO 362-1:2007, definition 3.7]

NOTE Refer to Annex A for more detailed explanations.

3.8
gear ratio weighting factor
k
dimensionless quantity used to combine the test results of two gear ratios for the acceleration test and the constant speed test

[ISO 362-1:2007, definition 3.8]

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3.9
partial power factor
k_P
dimensionless quantity used for the weighted combination of the test results of the acceleration test and the constant speed test

NOTE 1 Adapted from ISO 362-1:2007.

NOTE 2 Refer to Annex A for more detailed explanations.

3.10
pre-acceleration
application of acceleration control device prior to the position AA′ for the purpose of achieving stable acceleration between AA′ and BB′

[ISO 362-1:2007, definition 3.10]

NOTE See Figure 1 for additional details.

3.11
locked gear ratio
control of transmission such that the transmission gear cannot change during a test

[ISO 362-1:2007, definition 3.11]

3.12
engine
power source without detachable accessories

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[ISO 362-1:2007, definition 3.12]

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3.13
test track length
l_{10}
length of test track used in the calculation of acceleration from points PP′ to BB′

[ISO 362-1:2007, definition 3.13]

3.14
test track length
l_{20}
length of test track used in the calculation of acceleration from points AA′ to BB′

[ISO 362-1:2007, definition 3.14]

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4 Symbols and abbreviated terms

Table 1 lists the symbols used in this document and the clause where they are used for the first time.

Table 1 — Symbols used and corresponding clauses

Symbol	Unit	Clause	Explanation
AA′	—	3.10	line perpendicular to vehicle travel which indicates beginning of zone to record sound pressure level during test
$a_{\text{wot 50}}$	m/s^2	A.4	wide-open-throttle acceleration at 95th percentile of engine speed ratio and applicable test speed
$a_{\text{wot }i}$	m/s^2	5.1	acceleration at wide-open-throttle in gear i
$a_{\text{wot }(i+1)}$	m/s^2	5.1	acceleration at wide-open-throttle in gear $i + 1$
$a_{\text{wot test}}$	m/s^2	5.1	acceleration at wide-open-throttle in single gear test cases
$a_{\text{wot ref}}$	m/s^2	5.4	reference acceleration for the wide-open-throttle test
a_{urban}	m/s^2	5.3	target acceleration representing urban traffic acceleration
BB′	—	3.10	line perpendicular to vehicle travel which indicates end of zone to record sound pressure level during test
CC′	—	8.1	line of vehicle travel through test surface defined in ISO 10844
$\delta_1 - \delta_7$	dB	B.2	input quantities to allow for any uncertainty
gear i	—	8.3.1.3.2	first of two gear ratios for use in the vehicle test
gear $(i + 1)$	—	8.3.1.3.2	second of two gear ratios, with an engine speed lower than gear ratio i
j	—	5.2.1	index for single test run within overall acceleration or constant speed test series i or $(i + 1)$
k_{P}	—	3.9	partial power factor
k	—	3.8	gear ratio weighting factor
k_n	—	A.4	interpolation factor between gears
l_{ref}	m	5.1	reference length
l_{veh}	m	5.1	length of vehicle
l_{10}	m	3.13	length of test track section from PP′ to BB′ for calculation of acceleration from PP′ to BB′
l_{20}	m	3.14	length of test track section from AA′ to BB′ for calculation of acceleration from AA′ to BB′
$L_{\text{crs }i}$	dB	8.4.3.2	vehicle sound pressure level at constant speed test for gear i
$L_{\text{crs}(i+1)}$	dB	8.4.3.2	vehicle sound pressure level at constant speed test for gear $i + 1$
$L_{\text{crs rep}}$	dB	8.4.3.2	reported vehicle sound pressure level at constant speed test
$L_{\text{wot }i}$	dB	8.4.3.2	vehicle sound pressure level at wide-open-throttle test for gear i
$L_{\text{wot }(i+1)}$	dB	8.4.3.2	vehicle sound pressure level at wide-open-throttle test for gear $i + 1$
$L_{\text{wot rep}}$	dB	8.4.3.2	reported vehicle sound pressure level at wide-open-throttle
L_{urban}	dB	8.4.3.2	reported vehicle sound pressure level representing urban operation
m_{d}	kg	8.2.2	mass of driver
m_{kerb}	kg	8.2.2	kerb mass of the vehicle

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Table 1 (*continued*)

Symbol	Unit	Clause	Explanation
m_{ref}	kg	8.2.2	kerb mass + 75 kg ± 5 kg for the driver
m_t	kg	3.2	test mass of the vehicle
n	1/min	A.3	engine speed of the vehicle
$n_{PP'}$	1/min	9	engine speed of the vehicle when the front of the vehicle passes PP′
$n_{BB'}$	1/min	9	engine speed of the vehicle when the front of the vehicle passes BB′
$(n/S)_{95}$	—	A.3	95th percentile dimensionless engine speed ratio
PMR	—	3.2	power-to-mass ratio index to be used for calculations
P_n	kW	3.2	rated engine power
PP′	—	3.13	line perpendicular to vehicle travel which indicates location of microphones
S	1/min	3.3	rated engine speed in revs per minute, synonymous with the engine speed at maximum power
$v_{AA'}$	km/h	5.1	vehicle speed when the front of the vehicle passes line AA′
$v_{BB'}$	km/h	5.1	vehicle speed when the rear of the vehicle passes line BB′
v_{max}	km/h	8.3.1.2	maximum vehicle speed as defined in ISO 7117
$v_{PP'}$	km/h	5.1	vehicle speed when front of the vehicle passes line PP′
v_{test}	km/h	8.3.1.2	target vehicle test speed

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5 Specification of the acceleration for vehicles of category L3 with PMR > 25

5.1 General

All accelerations are calculated using different speeds of the vehicle on the test track. The formulas given in 5.2 are used for the calculation of $a_{wot\ i}$, $a_{wot\ (i+1)}$ and $a_{wot\ test}$. The speed either at AA′ ($v_{AA'}$) or PP′ ($v_{PP'}$) is defined by the vehicle speed when the reference point passes AA′ or PP′. The speed at BB′ ($v_{BB'}$) is defined when the rear of the vehicle passes BB′. The method used for determination of the acceleration shall be indicated in the test report.

With the front of the vehicle as the reference point, $l_{ref} = l_{veh}$ is the length of vehicle.

The dimensions of the test track are used in the calculation of the acceleration. These dimensions are defined as follows: l_{20} = 20 m, l_{10} = 10 m.

Due to the large variety of technologies, it is necessary to consider different modes of calculation. New technologies (such as continuously variable transmission) and older technologies (such as automatic transmission) which have no electronic control, require a more specific treatment for a proper determination of the acceleration. The given possibilities for calculation of the acceleration shall cover these needs.

5.2 Calculation of acceleration

5.2.1 Calculation procedure for vehicles with manual transmission, automatic transmission, adaptive transmission and continuously variable transmission (CVT) tested with locked gear ratios

The value of $a_{wot\ test}$ used in the determination of gear selection shall be the average of the four $a_{wot\ test,\ j}$ values during each valid measurement run.

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