INTERNATIONAL STANDARD

ISO 362

Third edition
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Acoustics — Measurement of noise emitted by accelerating road vehicles — Engineering method

Acoustique — Mesurage du bruit émis par les véhicules routiers en accélération — Méthode d'expertise

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Contents

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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.

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

This third edition cancels and replaces the second edition (ISO 362:1994), which has been technically revised. The method has been modified in relation to earlier editions in order to improve the reproducibility.

Annexes A and B of this International Standard are for information only.

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

1 Scope

This International Standard specifies an engineering method for measuring the noise emitted by accelerating road vehicles.

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.

The specifications are intended to reproduce the noise levels which are produced during the use of intermediate gears with full utilization of the engine power available as may occur in urban traffic.

The test method requires an acoustical environment which can only be obtained in an extensive open space. Such conditions can usually be provided for:

— type approval measurements of vehicle;

— measurements at the manufacturing stage; and

— measurements at official testing stations.

NOTE It should be noted that spot checking of vehicles chosen at random can rarely be made in an ideal acoustical environment. If measurements have to be carried out on the road in an acoustical environment which does not fulfil the requirements stated in this International Standard, it should be recognized that the results obtained may deviate appreciably from the results obtained using the specified conditions.

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 edition indicated was 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 edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10844:1994, *Acoustics — Test surface for road vehicle noise measurements*

IEC 60651:1979, *Sound level meters*

IEC 60942:1988, *Sound calibrators*

3 Definitions

For the purposes of this International Standard, the following definitions apply:

3.1
automatic downshift
gear change to a lower gear (higher transmission ratio) which can be initiated at the will of the driver

NOTE An automatic downshift may be initiated, for example, by a change of pressure on or position of the accelerator control, thereby activating a special programme which effects downshifts to gears which are lower than those normally used in urban driving.

3.2
intermediate result
value calculated from the test series measurements and used to determine the reported value

3.3
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 The definition of kerb mass may vary from country to country, but in this International Standard it refers to the definition contained in ISO 1176.

3.4
rated engine speed, *S*
engine speed at which the engine develops its rated maximum net power as stated by the manufacturer

4 Vehicle categories

4.1 Category L: motor vehicles with less than four wheels:

— L1 and L2: mopeds (see ISO 9645 for further details),

— L3: two-wheeled motor vehicles with an engine cylinder capacity > 50 cm^3 or maximum speed > 50 km/h,

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

— L5: three-wheeled motor vehicles with an engine cylinder capacity > 50 cm^3 or maximum speed > 50 km/h, having a gross vehicle mass rating < 1 000 kg and wheels attached asymmetrically along the longitudinal vehicle axis.

4.2 Category M: motor vehicles with at least four wheels, used for the carriage of passengers:

— M1: vehicles used for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat,

— M2: vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 t,

— M3: vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 t.

4.3 Category N: motor vehicles with at least four wheels used for the carriage of goods:

— N1: vehicles used for the carriage of goods and having a maximum authorized total mass not exceeding 3,5 tonnes,

— N2: vehicles used for the carriage of goods and having a maximum authorized total mass exceeding 3,5 tonnes but not exceeding 12 tonnes,

— N3: vehicles used for the carriage of goods and having a maximum authorized total mass exceeding 12 tonnes.

5 General considerations

5.1 Driving conditions

This International Standard is based on a test with vehicles in motion. Measurements shall be related to operating conditions of the vehicle which give the highest noise level which may occur during urban driving and which lead to reproducible noise emission. Therefore, an acceleration test from a stated vehicle speed is specified.

5.2 Interpretation of results

The results obtained by this method give an objective measure of the noise emitted under the specified conditions of test.

NOTE It is necessary to consider the fact that the subjective appraisal of the annoyance of different classes of motor vehicles is not simply related to the indications of a sound measurement system.

6 Instrumentation

6.1 Instruments for acoustical measurement

6.1.1 General

The sound level meter or the equivalent measuring system, including the windscreen recommended by the manufacturer shall at least meet the requirements of Type 1 instruments in accordance with IEC 60651.

The measurements shall be made using the frequency weighting A, and the time weighting F.

When using a system that includes a periodic monitoring of the A-weighted sound pressure level, a reading should be made at a time interval not greater than 30 ms.

6.1.2 Calibration

At the beginning and at the end of every measurement session, the entire measurement system shall be checked by means of a sound calibrator that fulfils the requirements for sound calibrators of at least precision Class 1 according to IEC 60942. Without any further adjustment the difference between the readings of two consecutive checks shall be less than or equal to 0,5 dB. If this value is exceeded, the results of the measurements obtained after the previous satisfactory check shall be discarded.

6.1.3 Compliance with requirements

The compliance of the sound calibration device with the requirements of IEC 60942 shall be verified once a year and the compliance of the instrumentation system with the requirements of IEC 60651 shall be verified at least every 2 years, by a laboratory which is authorized to perform calibrations traceable to the appropriate standards.

6.2 Instrumentation for speed measurements

The rotational speed of the engine and the road speed of the vehicle during the constant speed approach shall be measured with instruments meeting specification limits of ±2 % or less.

6.3 Meteorological instrumentation

The meteorological instrumentation used to monitor the environmental conditions shall include the following:

— a temperature-measuring device meeting specification limits of ±1 °C or less;

— a wind speed measuring device meeting specification limits of ±1,0 m/s.

7 Acoustical environment, meteorological conditions and background noise

7.1 Test site

The test site should be constructed according to the requirements given in ISO 10844.

The test site shall be substantially level. The surface of the test track shall be dry and its texture such that it does not cause excessive tyre noise. The test track surface shall meet the requirements of ISO 10844.

The test site shall be such that when a small omnidirectional noise source is placed in its surface at the central point (intersection of the microphone line and the centre of the vehicle lane), see figure 1, deviations from hemispherical divergence shall not exceed ±1 dB.

This condition is deemed to be satisfied if the following requirements are met:

a) within a radius of 50 m around the centre of the track, the space shall be free of large reflecting objects, such as fences, rocks, bridges or buildings;

b) the test track and the surface of the site shall be dry and free from absorbing materials, such as powdery snow or loose debris;

c) in the vicinity of the microphone, there shall be no obstacle that could influence the acoustical field and no person shall remain between the microphone and the noise source. The meter observer shall be positioned so as not to influence the meter reading.

NOTE It is recommended that the test area be a substantially flat plane, particularly in the portion of the area between the vehicle path and the microphone location (see figure 1).

7.2 Meteorological conditions

The meteorological instrumentation should be positioned adjacent to the test area at a height representative of the site, except as noted below.

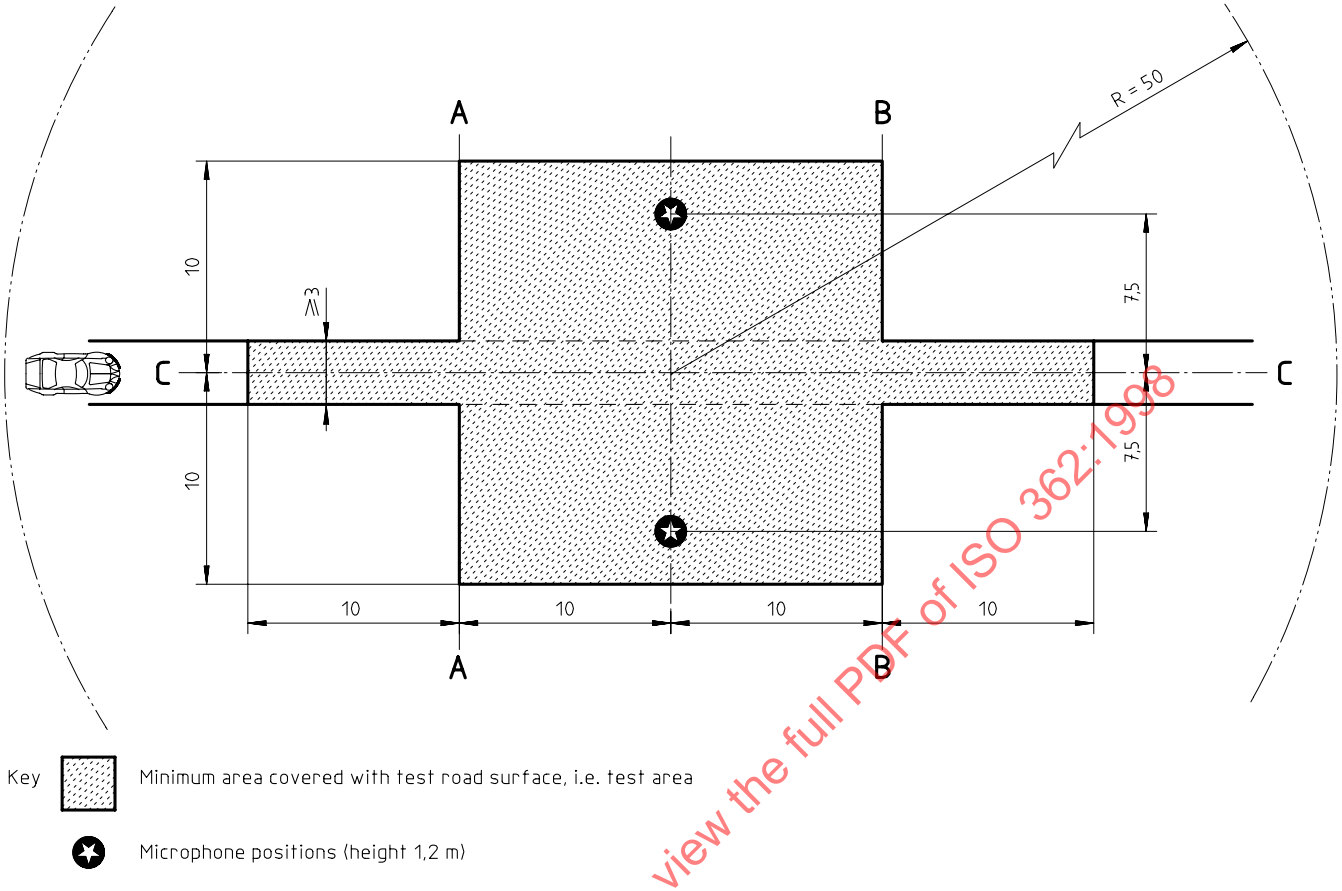
It is recommended that the measurements be made when the ambient air temperature is within the range from 0 °C to 40 °C.

It is recommended that tests should not be carried out if the wind speed, including gusts, at microphone height exceeds 5 m/s during the sound measurement interval.

It is recommended that a value representative of temperature, wind speed and direction, relative humidity, and barometric pressure be recorded during the sound measurement interval.

NOTE When comparing data under different environmental conditions, the effects of temperature and other factors should be considered.

Dimensions in metres



Key Minimum area covered with test road surface, i.e. test area

Microphone positions (height 1,2 m)

NOTE Shaded area ("test area") is the minimum area to be covered with a surface complying with ISO 10844.

Figure 1 — Test site dimensions

7.3 Background noise

It is recommended that the A-weighted background noise (including any wind noise) be 15 dB below the emissions produced by the vehicle under test, but it shall always be at least 10 dB below.

8 Procedure

8.1 Microphone positions

The distance from the microphone positions to the centreline of travel CC (see figure 1) on the test track shall be 7,5 m ± 0,05 m.

The microphone shall be located 1,2 m ± 0,02 m above the ground level. The reference axis for free-field conditions (see IEC 60651) shall be horizontal and directed perpendicularly towards the path of the centreline of travel CC.

8.2 Number of measurements

Make at least four measurements on each side of the vehicle.

8.3 Conditions of the vehicle

The vehicle shall be supplied with fuel, spark plugs, a fuel supply system, etc., as specified by the vehicle manufacturer.

Measurements shall be made on vehicles at kerb mass plus the driver and measuring equipment. Except for the case of non-separable vehicles, measurement shall be made without a trailer or semi-trailer.

The tyres used for the test are selected by the vehicle manufacturer. They shall correspond to one of the tyre sizes designated for the vehicle by the vehicle manufacturer. In the case of M1 through N3 vehicles, tyres shall not be used with a tread depth less than 1,6 mm. The tyres shall be inflated to the pressure recommended by the manufacturer for the test mass of the vehicle.

Before the measurements are started, the vehicle shall be brought to its normal operating conditions with respect to temperatures and tuning.

8.4 Operating conditions

8.4.1 General conditions

The vehicle shall approach the line AA with the path of its centreline following as closely as possible the line CC (see figure 1) at the speed and in the gear specified in 8.4.2 to 8.4.5, as appropriate.

When the front of the vehicle reaches the line AA, the accelerator control shall be fully engaged as rapidly as practicable (without operating the automatic downshift to a lower range than normally used in urban driving) and held fully engaged until the rear of the vehicle reaches line BB. The accelerator control shall then be released. The engagement of the accelerator control shall occur as close as possible to the line AA.

Any trailer which is not readily separable from the towing vehicle shall be ignored when considering the crossing of the line BB.

If the vehicle is fitted with more than two-wheel drive, test it in the drive which is intended for normal road use.

If the vehicle incorporates equipment such as a concrete mixer, a compressor, etc., do not operate this equipment during the test.

8.4.2 Automatic transmission vehicles, categories M and N

If a vehicle is equipped with an automatic transmission with a manual selector, conduct the test with the selector in the position recommended by the manufacturer for normal driving.

8.4.2.1 Approach speed

The vehicle shall approach the line AA at a steady speed corresponding to the lower of the following speeds with a tolerance of ±1 km/h; in cases where the controlling factor is engine speed, the tolerance shall be the larger of ±2 % or ± 50 r.p.m.:

a) 50 km/h;

b) the vehicle speed corresponding to three-quarters of the rated engine speed, *S*, in the case of vehicles of category M1, and in the case of vehicles of the other categories having an engine power not greater than 225 kW;

c) the speed corresponding to half the rated enigne speed *S* in the case of vehicles not belonging to category M1 and having an engine power greater than 225 kW.

8.4.2.2 Prevention of downshift

Some vehicles equipped with an automatic transmission (two or more discrete ratios) may downshift to a gear ratio not normally used in urban driving, as defined by the manufacturer. A gear ratio not used for urban driving includes a gear ratio intended for slow movement, parking or braking. In these cases the operator may select any of the following modifications:

a) increase the speed, *v*, of the vehicle to a maximum of 60 km/h in order to avoid such a change down;

b) maintain the vehicle speed v at 50 km/h and limit the fuel supply to the engine to 95 % of the supply necessary for full load; this condition is considered to be satisfied

— in the case of a spark-ignition engine, when the angle of the throttle opening is 90 % of the full angle,

— in the case of a compression-ignition engine, when the fuel supply to the injection pump is limited to 90 % of its maximum supply;

c) establish and use an electronic control that will prevent a downshift to gears lower than those used in normal urban driving as defined by the manufacturer.

8.4.3 Other automatic transmissions

If the vehicle is equipped with an automatic transmission which cannot be tested with the above procedure, it shall be tested at different approach speeds, namely 30 km/h, 40 km/h and 50 km/h, or at three-quarters of the maximum vehicle speed as specified by the manufacturer if this value is lower. The final reported value is that determined in 8.5.

8.4.4 Manually operated, non-automatic gearboxes

8.4.4.1 Approach speed

The vehicle shall approach the line AA at a steady road speed corresponding to the lower of the following velocities with a tolerance of ±1 km/h; where the controlling factor is engine speed, the tolerance shall be the larger of +2 % or ±50 r.p.m.:

a) 50 km/h;

b) the vehicle speed corresponding to an engine speed equal to three-quarters of the rated engine speed S in the case of vehicles of category M1, and in the case of vehicles of the other categories having an engine power not greater than 225 kW;

c) the engine speed corresponding to an engine speed equal to half the rated engine speed S in the case of vehicles not belonging to category M1 and having an engine power greater than 225 kW.

8.4.4.2 Choice of gear ratios for M1 and N1

Vehicles in categories M1 and N1 equipped with a manually operated gearbox having not more than four forward gear ratios shall be tested in second gear.

Vehicles in these categories equipped with a manually operated gearbox having more than four forward gear ratios shall be tested in second and third gears successively. Only overall gear ratios intended for normal road use are considered. The final reported value is that determined in 8.5.

If during the test in second gear the engine speed exceeds the rated engine speed S, the test shall be repeated with the approach engine speed reduced by steps of 5 % of S until the engine speed attained no longer exceeds S. If the rated engine speed S is still attained with an approach engine speed corresponding to the idle speed, then the test shall be performed only in third gear and the relevant measurement reported as in 8.5.

However, vehicles in category M1 having more than four forward gears and equipped with an engine developing a maximum power greater than 140 kW, and whose permissible maximum-power/maximum-mass ratio exceeds 75 kW/t, may be tested in third gear only, provided that the vehicle road speed change during the acceleration is greater than 11 km/h over a distance of 20 m plus the vehicle length.

8.4.4.3 Choice of gear ratios in categories other than M1, N1 and L

Vehicles other than those in categories M1, N1 and L, in which the total number of forward gear ranges is x (including the ranges obtained by combining the transmission ratios and the gear ratios added by means of an auxiliary transmission or multiple ratio drive axle) shall be tested, sequentially, using the range equal to or higher than x/n, where $n = 2$ for vehicle having a rated engine power not greater than 225 kW and $n = 3$ for vehicles having a rated engine power greater than 225 kW.

Carry out initial testing using the range which is gear (*x/n*) or the next higher gear range if (*x/n*) is not an integer. The testing shall continue from the gear (*x/n*) to the next higher gear.

Shifting up gear ranges from (*x/n*) shall be terminated in the gear *X* in which the rated engine speed is reached just before the rear of the vehicle has passed the line BB.

EXAMPLE: There are 16 forward ranges for a drive train having a transmission with 8 ratios and an auxiliary transmission with 2 ratios. If the engine has 230 kW then (*x/n*) = (8 x 2)/3 = 16/3 = 5 1/3. The initial test gear range is 6th (includes the ratios from both the main transmission and auxiliary which is 6th out of the 16 total gear ranges), with the next gear range is 7th up to range *X*.

In the case of vehicles having different overall gear ratios (including a different number of gear ranges), the representativity of the type by the test vehicle is determined as follows:

— if the highest sound pressure level is obtained between the range *x*/*n* and range *X*, the vehicle selected is deemed representative of its type for those vehicles which have the same gear ratios in the same ranges,

— if the highest sound pressure level is obtained at range *x/n*, the vehicle selected is deemed representative of its type only for those vehicles which have a lower overall gear ratio at range *x/n*,

— if the highest sound pressure level is obtained at range *X*, the vehicle selected is deemed representative of its type only for those vehicles which have a higher overall gear ratio than the gear ratio at range *X*.

However the vehicle is also deemed representative of its type if, at the applicant's request, the tests are extended over more ratios and the highest sound pressure level is obtained between the extreme ratio tested.

8.4.5 Vehicles classified as motorcycles category L

In all cases, the special selector positions for slow movements, parking or braking shall be excluded.

8.4.5.1 Automatic transmission

8.4.5.1.1 Approach speed

The vehicle shall approach the line AA at a steady road speed corresponding to the lower of the following velocities with a tolerance ± 1 km/h; where the controlling factor is engine speed, the tolerance shall be the larger of ± 2 % or ± 50 r.p.m.:

a) 50 km/h;

b) the vehicle speed corresponding to an engine speed equal to three-quarters of the rated engine speed *S*.

Nevertheless, if there is a downshift to first gear during the test, the motorcycle speed can be increased up to a maximum of 60 km/h to avoid the downshift.

8.4.5.1.2 Choice of gear ratios

The test shall be performed with the manual selector in the highest position. If an automatic downshift occurs to the first gear, it shall be excluded. If an automatic downshift occurs to the highest minus 1 or the highest minus 2, the selector shall be placed in the highest position allowing the test to be performed without an automatic downshift.

If an electronic transmission cannot be tested, a programme shall be established and used that prevents a downshift to a gear not normal for urban driving.

8.4.5.2 Motorcycle with a manually operated gear box

8.4.5.2.1 Approach speed

The vehicle shall approach the line AA at a velocity corresponding to the lower of the following velocities with a tolerance ±1 km/h; except where the controlling factor is engine speed the tolerance shall be the larger of ± 2 % or ± 50 r.p.m.:

a) 50 km/h,

b) the vehicle speed corresponding to an engine speed equal to three-quarters of the rated speed *S*.

8.4.5.2.2 Choice of gear ratios

Motorcycles, whatever the engine cylinder capacity, when fitted with a gearbox having not more than four gears, shall be tested in second gear with the following exception. If, during the test carried out in second gear, the engine speed at the line BB exceeds *S*, the test shall be carried out in third gear only.

Motorcycles fitted with a five-speed or more gearbox shall be tested in the following gears.

a) Motorcycles fitted with an engine having a cylinder capacity not exceeding 175 cm^3 shall be submitted to one test only in third gear.

b) Motorcycles fitted with an engine having a cylinder capacity exceeding 175 cm^3 shall be tested in second gear then in third gear.

c) If, during the test carried out in second gear, the engine speed at the line BB exceeds *S*, the test shall be carried out in third gear only.

8.4.5.3 Other automatic transmissions

Motorcycles without a manual selector shall approach the line AA at the various uniform speed of 30 km/h, 40 km/h, 50 km/h or at three-quarters of the maximum vehicle speed as specified by the manufacturer, if this value is lower.

The final reported value is that as determined in 8.5.

8.5 Readings to be taken and reported values

The maximum A-weighted sound pressure level indicated during each passage of the vehicle between the two lines AA and BB (see figure 1) shall be noted. If a sound peak obviously out of character with the general sound pressure level is observed, the measurement shall be discarded.

The results shall be considered valid when four consecutive measurements on each side of the vehicle are within 2 dB. If not, additional runs shall be made until four consecutive measurements on either side are within 2 dB of each other.

NOTE The spread of results between runs may be reduced if there is a 1 min wait, at idle in neutral, between runs.

Average the results of each side separately. Take as the intermediate result the higher of the two averages.

The final reported value for the vehicle is as indicated below.

a) For vehicles in categories M1, N1 and L3 to 5, tested in a single gear: the intermediate result.

b) For vehicles in categories M1, N1 and L3 to 5, tested in two gears: the arithmetic average of the intermediate results for each gear.

c) For vehicles in all categories other than M1, N1 and L3 to 5, tested in multiple gears: the highest intermediate result from the gear ranges tested.

d) For vehicles tested at multiple speeds in all categories: the highest intermediate result.

8.6 Measurement uncertainty

Measurements made in conformity with this International Standard result in levels that are influenced by climatic conditions. The climatic conditions can affect the performance of the vehicle powertrain, modify the sound level of the tyres, and disturb the propagation path of the sound. In addition, the use of the asphalt test surface specified in ISO 10844 has reduced, but not eliminated, the variations traditionally encountered from different sites. Tests of a

vehicle at the same site, in similar climatic conditions, will result in sound pressure levels that are within ± 1 dB. However, testing over the entire range of temperature and wind conditions allowed in this International Standard may result in larger variation. This International Standard encourages the acquisition of additional environmental conditions, to develop a better understanding of these factors on the measurement, and offers some suggestions to reduce the variations. Refer to annex A for further details.

9 Test report

The test report shall include the following information:

a) reference to this International Standard;

b) details of the test site, site orientation and weather conditions including wind speed and air temperature; wind direction, barometric pressure, humidity and track surface temperature are optional measurements but should also be recorded if available;

c) the type of measuring equipment including the windscreen;

d) the A-weighted sound pressure level typical of the background noise;

e) the identification of the vehicle, its engine, its transmission system, including available transmission ratios, size and type of tyres, tyre pressure, tyre tread depth, test mass and vehicle length;

f) the transmission gears or gear ratios used during the test;

g) the vehicle speed and engine speed at the beginning of the period of acceleration, and the location of the beginning of the acceleration;

h) the vehicle speed and engine speed at the end of the acceleration;

i) the auxiliary equipment of the vehicle, where appropriate, and its operating conditions;

j) all valid A-weighted sound pressure level values measured, listed according to the side of the vehicle and the direction of the vehicle movement on the test site.