# GB

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 13.140

Z 32

# GB 1495-2002

Replacing GB 1495, partially replacing GB 1496-79

# Limits and measurement methods for noise emitted by accelerating motor vehicles

汽车加速行驶车外噪声限值及测量方法

**Issued on: January 04, 2002** **Implemented on: October 01, 2002**

**Issued by: State Environmental Protection Administration;**

**General Administration of Quality Supervision, Inspection and Quarantine.**

# Table of Contents

# Limits and measurement methods for noise emitted by accelerating motor vehicles

## 1 Scope

This Standard specifies the limits for noise emitted by accelerating new produced motor vehicles.

This Standard specifies the measurement methods for noise emitted by accelerating new produced motor vehicles.

This Standard is applicable to Category-M and Category-N[1] motor vehicles.

## 2 Normative references

The following standards contain the provisions which, through reference in this Standard, constitute the provisions of this Standard. For dated references, subsequent amendments (excluding corrections) or revisions do not apply to this Standard. However, the parties who enter into agreement based on this Standard are encouraged to investigate whether the latest versions of these documents are applicable.

GB 3785-83, *Electroacoustics - Sound level meters*

GB/T 15173-94, *Sound calibrators*

GB/T 12534-90, *Motor vehicles - General rules of road test method*

ISO 10844-1994, *Acoustics - Specification of test tracks for the purpose of measuring noise emitted by road vehicles* [2]

ISO 10534 1996, *Acoustics - Determination of sound absorption coefficient and impedance in impedance tubes - Part 1: Method using standing wave ratio* [3]

GB/T 17692-1999, *Measurement methods of net power for automotive engines*

---

[1] The classification for motor vehicles is in accordance with GB/T 15089-1994 “Classification of power-driven vehicles and trailers”.
[2] This Standard is under the jurisdiction of National Technical Committee on Acoustics of Standardization Administration of China.
[3] This Standard is under the jurisdiction of National Technical Committee on Acoustics of Standardization Administration of China.

# 3 Definitions

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

## 3.1 Motor vehicle's category

In terms of noise outside the motor vehicle, a category of motor vehicle refers to a category of motor vehicles that have no difference in the following main aspects.

**3.1.1** Body shape or structural material (especially the engine compartment and its sound insulation material).

**3.1.2** Length and width of motor vehicle.

**3.1.3** Engine type (ignition or compression ignition, two-stroke or four-stroke, reciprocating or rotary piston), number of cylinders and displacement, number of carburetor and type or fuel injection system type, valve arrangement, rated power and corresponding speed; or the category of drive motor (for electric vehicles).

**3.1.4** Drive train, gear number and its speed ratio.

**3.1.5** Noise reduction system or components as defined in 3.2 and 3.3 below.

**3.1.6** For vehicles other than Category-$M_1$ and Category-$N_1$, if the difference between 3.1.2 and 3.1.4 does not result in a change in the noise measurement method (such as gear selection), the engine of the same type and (or) when the total transmission ratio is different, it can be regarded as the same category.

## 3.2 Noise reduction system

Noise reduction system refers to the complete set of components necessary to limit the motor vehicle and its exhaust noise. When the noise reduction component's designations or trademarks in the system are different, or the size and shape of the components, material properties, assembly, working principle are different, or the number of intake/exhaust mufflers is different, the system shall be regarded as different types of noise reduction systems.

## 3.3 Noise reduction system components

The noise reduction system component refers to one of the individual components that constitute the noise reduction system, such as the exhaust pipe, the expansion chamber, the muffler, etc. It is considered a component of the noise reduction system when the presence of the air filter is essential to ensure that the specified noise limits are met. The exhaust manifold shall not be considered as a component of the noise reduction system.

# Annex A

(Normative)

**Measurement methods for noise emitted by accelerating motor vehicles**

## A.1 Measuring instruments

### A.1.1 Acoustic measurement

**A.1.1.1** The sound level meter for measurement or other equivalent measurement system shall not be lower than the requirements of the Type 1 sound level meter specified in GB 3785. “A” frequency weighting characteristics and “F” time weighting characteristics shall be used for measurement. When using a system that automatically samples and measures the A-weighted sound level, the reading interval shall not exceed 30 ms.

**A.1.1.2** Before and after measurement, the sound level meter must be calibrated according to the manufacturer's specifications with a Level 1 acoustic calibrator in accordance with GB/T 15173. If no adjustment is made, if the difference between the previous calibration reading and the previous calibration reading exceeds 0.5 dB, the measurement result after the previous calibration is considered invalid. The readings during calibration shall be recorded in the form in Annex AB.

### A.1.2 Measurements of rotating speed, vehicle speed

An engine tachometer or vehicle speed measuring instrument with an accuracy better than ±2% must be used to monitor the rotating speed or vehicle speed. Do not use the same type of instrument on the vehicle.

### A.1.3 Meteorological parameter measurement

The accuracy of the thermometer shall be within ±1°C. The accuracy of the anemometer shall be within ±1.0 m/s.

**A.1.4** All measuring instruments shall be periodically inspected in accordance with the relevant national standards for measuring instruments.

## A.2 Measuring conditions

### A.2.1 Measuring site

**A.2.1.1** The sound field conditions that shall be achieved at the measuring site (see Figure 1) are: when placing a non-directional small sound source at the center of the site (point O), the sound level deviation in all directions on the

hemisphere does not exceed ±1dB. If the following conditions are met, the venue can be considered to have reached this sound field condition:

a) there are no large acoustic reflectors, such as fences, rocks, bridges or buildings, within a radius of 50m based on the center of the measurement site (point O);

b) the surface of the test road and the rest of the site are dry, and there is no sound absorbing material such as snow, tall grass, loose soil or slag;

c) there are no obstacles affecting the sound field near the microphone, and no one is standing between the sound source and the microphone; the observer conducting the measurement shall also be in a position that does not affect the measured value of the instrument.

**A.2.1.2** The measurement site shall be substantially horizontal, solid, and flat, and the test road shall not produce excessive tire noise. This road surface shall meet the requirements of Annex AA

**A.2.2 Meteorological conditions**

Measurements shall be carried out in good weather. The wind speed at the height of the microphone shall not exceed 5 m/s when measuring. Note that the measurement results are not affected by gusts. A suitable hood can be used, but its influence on the sensitivity and directionality of the microphone shall be considered.

The measuring instrument for meteorological parameters shall be placed near the measuring site with a height of 1.2 m.

**A.2.3 Background noise**

The background noise (A-weighted sound level) shall be at least 10 dB lower than the measured vehicle noise.

**A.2.4 Vehicle**

**A.2.4.1** The vehicle to be tested shall be empty, without trailer or semi-trailer (except for vehicles that cannot be decomposed).

**A.2.4.2** The tires used in the vehicle to be tested are selected by the vehicle manufacturer and must be one of the types specified for the vehicle. The tires with any partial depth less than 1.6 mm must not be used. The tire must be charged to the factory's no-load air pressure.

**A.2.4.3** Before starting the measurement, the technical condition of the vehicle under test shall comply with the technical conditions of the vehicle (especially the acceleration performance of the vehicle) and the relevant provisions of GB/T

### A.3.2 Determinations of vehicle gear selection and approach speed

The meanings of the symbols used in this article are as follows:

S: Engine rated rotating speed;

$N_A$: Steady rotating speed of the engine when approaching Line AA'.

#### A.3.2.1 Manual transmission

##### A.3.2.1.1 Gear selection

a) For $M_1$ and $N_1$ vehicles, when using a transmission with no more than four forward gears, apply the second gear for measurement;

b) For $M_1$ and $N_1$ vehicles, when using a transmission with more than four forward gears, measurements shall be made in the second and third gears respectively.

If the engine speed exceeds S when passing Line BB' when measuring with the second gear, the $N_A$ shall be reduced by 5%S successively until the engine speed exceeds S through Line BB'. If the $N_A$ drops to idle speed and the speed through Line BB' still exceeds S, then only the third gear is used.

However, for $M_1$ vehicles with more than four forward gears and engines with a rated power greater than 140kW and a rated power/maximum mass ratio greater than 75 kW/t, if the vehicle uses the third gear, its tail end passes Line BB' at a speed greater than 61 km/h, only the third gear shall be used for measurement.

c) For vehicles other than $M_1$ and $N_1$, vehicles with a total number of forward gears X (including speed ratios obtained by the auxiliary or multi-speed ratio drive axle) shall be measured separately for each gear equal to or greater than X/n. For vehicles with an engine rated power not greater than 225 kW, take n=2. For vehicles with a rated power greater than 225 kW, take n=3. If X/n is not an integer, the gear corresponding to the higher integer shall be selected. The upshift measurement is started from the X/n gear until the engine speed is first lower than the rated speed when the tail passes Line BB' at the end of the gear.

NOTE: If the main transmission has eight speed ratios and the auxiliary transmission has two speed ratios, the drive train has 16 gear positions. If the rated power of the engine is 230 kW, then $(X/n)=(8\times2)/3=16/3=5\frac{1}{3}$. Then the gear that starts to measure is the sixth gear (that is, the sixth gear of the 16 gears obtained by the main and auxiliary transmission combination), the next measurement gear is the seventh gear, and so on.

##### A.3.2.1.2 Determination of approach speed

30, 40, 50 km/h (if the maximum speed of the lane is less than 50 km/h, the maximum speed is 3/4) to Line AA'.

**A.3.3 Accelerated driving operation**

**A.3.3.1** The vehicle shall approach Line AA' at the gear position and steady speed specified above, and its speed change shall be controlled within ±1 km/h. If the engine speed is controlled, the speed change shall be controlled within ±2% or ±50 r/min (whichever is greater).

**A.3.3.2** When the front end of the vehicle reaches Line AA', the accelerator pedal must be stepped as quickly as possible (i.e., the throttle or accelerator is fully open) and remain unchanged until the rear end of the vehicle passes Line BB' and then the pedal is released as quickly as possible (that is, the throttle or accelerator is closed).

**A.3.3.3** The vehicle shall accelerate in a straight line through the measuring area, and its longitudinal center plane shall be as close as possible to the center Line CC'.

**A.3.3.4** If the vehicle is composed of a tractor and a trailer that is not easily separated, it is determined that the tail end does not consider the trailer when passing Line BB'.

**A.3.4 Sound level measurement**

**A.3.4.1** At least four measurements shall be performed on each side of the vehicle.

**A.3.4.2** The maximum sound level of the vehicle that accelerates through the measurement area shall be measured. The measured value of each measurement shall be subtracted by 1 dB(A) as the measurement result.

**A.3.4.3** If the difference between four consecutive measurements on the same side of the vehicle is not more than 2 dB (A), the measurement is considered valid.

**A.3.4.4** Take arithmetic average of four measurements on each side under each gear (or near speed) condition. Then take the larger of the averages on two sides as the intermediate result.

**A.3.5 Determination of maximum noise level of vehicle**

**A.3.5.1** Corresponding to the gear condition of a) in A.3.2.1.1, directly take the intermediate result as the maximum noise level.

**A.3.5.2** Corresponding to the gear condition of b) in A.3.2.1.1, if the second and third gears are used, the arithmetic mean of the intermediate results of the two

# Annex AA

## Requirements for noise measurement test road

### AA1 Introduction

This Annex, based on the main content of ISO 10844:1994 “Acoustics -- Specification of test tracks for the purpose of measuring noise emitted by road vehicles”, specifies technical requirements for test road construction and physical properties to be achieved and their measurement methods.

### AA2 Terms

This Annex adopts the following terms.

### AA2.1 Void ratio

Void ratio refers to the percentage of pore volume between aggregates in road concrete to the total volume of concrete, expressed as $V_e$. These pores are either interconnected (closed pores) or open to the surrounding atmosphere (open pores). The void ratio of the test road is determined by the following formula based on the obtained core sample:

$$(1-\rho_A/\rho_R)\times 100\%$$

Where,

$\rho_A$ - Apparent density of core sample;

$\rho_R$ - Maximum theoretical density of core sample.

The apparent density $\rho_A$ is determined by the following formula:

$\rho_A = m/V$

Where,

m - Mass of the core sample obtained by test road;

V - Volume of this core sample, excluding air volume of the opening gap of the road surface.

The density is determined according to the mass and volume of the binder contained in each core sample, the mass and volume of the aggregate, given by:

If the road surface does not meet the void ratio requirements, its sound absorption coefficient must meet: α≤0.10. See AA3.5.2 for its measurement method.

NOTE: Although road builders are more familiar with void ratio, the most relevant characteristic is the sound absorption coefficient. However, the sound absorption coefficient is measured only when the void ratio cannot meet the requirements. Because the measurement and correlation of void ratio have large uncertainties, it is possible to erroneously negate certain roads based solely on the measurement of void ratio.

### AA3.3 Road surface construction depth

The average road surface construction depth measured by volume method shall meet: MTD≥0.4mm, the measurement method can be found in AA3.5.3.

### AA3.4 Road uniformity

It is necessary to ensure that the road surface depth and void ratio of the road surface in the test area are as uniform as possible.

NOTE: It shall be noted that if the rolling effect is different in some areas, the road surface construction shall be different and shall be uneven.

### AA3.5 Inspection cycle

In order to check whether the road has consistently met the requirements of the road surface construction depth, void ratio or sound absorption coefficient specified in this Annex, periodic road inspection shall be carried out at the following intervals:

a) For void ratio or sound absorption coefficient

When the road is newly paved, check once. If the new road meets the requirements, there is no need to perform periodic inspections. If the new road surface does not meet the requirements, it can be checked after a period of time, because the road space shall be blocked and become dense over time.

b) For road surface construction depth

When the road is newly paved, check once. When starting the noise test (NOTE: it shall be done 4 weeks after paving). Check once a year after that.

## AA4 Design of test road

### AA4.1 Area

| | | |
|---|---|---|
| Compaction, relative to Marshall compaction | 98% | |

g) The appropriate mix temperature shall be selected prior to rolling so that the next void can be achieved to achieve the desired void ratio. In order to improve the possibility of meeting the technical requirements of AA3.1 to AA3.4, the degree of compaction shall be studied. Not only to study the right mix temperature, but also to study the appropriate number of passes and to choose the right rolling machine.

## AA5 Measurement methods

### AA5.1 Measurement of void ratio

In order to perform this measurement, it is necessary to obtain the paved core at least 4 locations in the test area between Line AA' line and Line BB' line (see Figure AA1). In order to avoid causing unevenness or unevenness on the rim, the core sample shall be taken from the vicinity of the rim and shall not be taken on it. At least two core samples shall be taken near the rim. One core shall be taken between the rim and the two microphones.

If the conditions for the homogeneity are not met (see AA3.4), they shall be taken elsewhere in the test area.

The void ratio of each core sample shall be determined. Then calculate the average of all core samples. Compare with the requirements of A.3.1. In addition, there must no core sample with a void ratio greater than 10%. It is necessary to remind the paver of the test road that problems may arise due to sampling in the test area where the pipeline or wire is heated. Installation of these devices must be carefully designed to avoid future sampling locations. It is recommended to leave some areas of approximately 200 × 300mm without tubes or wires, or to make them deeper so that they shall not be damaged when sampling from the road.

### AA5.2 Measurement of sound absorption coefficient

Sound absorption coefficient (normal incidence) is measured by impedance tube, the method is in accordance with ISO 10534-1.

The requirements for sampling are the same as for the measurement of void ratio (see AA5.1). The sound absorption coefficient is measured in the frequency range of 400 to 800 Hz and 800 to 1600 Hz (at least at the center frequency of the octave). The maximum of these two frequency ranges shall be measured. Then, calculate the average the measurements of all core samples, using the average as the final result.

### AA5.3 Measurement of road surface construction

Depth measurement of road surface construction shall be carried out at 10 locations on the rim of the test runway. After averaging, compare with the specified minimum depth. The measurement method is detailed in Annex A of ISO 10844.

**AA6 Stability and maintenance over time**

**AA6.1 Aging effect**

As with any other road surface, the tire/road noise level measured on the test surface may increase slightly during the 6~12 months' period after the paving is completed. The road shall reach the required characteristics after four weeks of paving. The effect of this aging on the noise of trucks is generally less than the impact on passenger cars. The stability of the road surface over time depends mainly on the degree of calendaring and compaction of the vehicle on the road. Periodic inspection shall be carried out in accordance with the provisions of AA3.

**AA6.2 Road maintenance**

Loose gravel or dust that significantly reduces the depth of the effective road surface construction shall be removed. In the winter when it is frozen, no salt shall be used to prevent freezing. Salt may temporarily or permanently change the characteristics of the road surface and cause noise increase.

**AA6.3 Resurfacing road in test area**

Resurface the road area if necessary. If the test area other than the test track (width as 3 m shown in Figure AA1) meets the requirements for void ratio or sound absorption coefficient, there is no need to resurfacing it.

**AA7 Report on test road and noise test**

**AA7.1 Report on road check**

**AA7.1.1** Test runway position

**AA7.1.2** The type of bitumen, the penetration, the type of stone, and the maximum theoretical density ($D_R$) of concrete are taken from the thickness of the wear layer and the grading curve determined by core sample of test runway.

**AA7.1.3** Compaction method (type of roller compactor, weight of mill and number of crushing).

**AA7.1.4** Mixture temperature, ambient temperature and wind speed during paving.

**AA7.1.5** Pavement paving date and contractor