



The National Standard of the People's Republic of China

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Partly Replacing GB16169-1996, GB/T4569-1996, GB16169-2000, GB4569-2000

Limit and Measuring Method of Noise Emitted by Accelerating Motorcycles and Mopeds

(Draft for Approval)

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Preface

This Standard is formulated for carrying out the “Law of the People’s Republic of China on the Prevention and Control of Environmental Noise Pollution”, for preventing motorcycle noise pollution and for promoting the sustainable and technology development in the motorcycle manufacturing industry.

This standard is prepared by adopting and modifying the ECE R9 “Uniform provisions concerning the approval of three-wheeled vehicles with regard to noise”, ECE R41/02 “Uniform provisions concerning the approval of Two-wheeled vehicles with regard to noise”, ECE R63 “Uniform provisions concerning the approval of Mopeds with regard to noise”, 97/24/EC C9 “Supplementary provisions concerning the approval of Motorcycles with regard to noise”.

This standard is partially equivalent with ECE R9 “Uniform provisions concerning the approval of three-wheeled vehicles with regard to noise”, ECE R41 “Uniform provisions concerning the approval of two-wheeled vehicles with regard to noise”, ECE R63 “Uniform provisions concerning the approval of Mopeds with regard to noise”, 97/24/EC C9 “Supplementary provisions concerning the approval of Motorcycles with regard to noise”. The main differences are:

—Two-Wheeled motorcycles, mopeds and three-wheeled motorcycles’ formatting is modified according to Chinese regulations;

—Descriptions that apply to international standards are modified to apply to Chinese standards;

—The “Acoustics--Measurement of noise emitted by stationary road vehicles” section is added to the “Limit and Measurement Method of Noise Emitted by Accelerating Motorcycles and Mopeds” regulation.

This standard replaces the section, “limit of noise emitted by accelerating vehicles” in GB16169-1996 and “the measuring method of noise emitted by vehicles” in GB/T4569-1996.

Compared with GB16169-1996 and GB/T4569-1996, this standard comprises the following changes:

—The sorting method for the Limit of Noise Emitted by Accelerating Motorcycles, i.e., engine displacement, has been adjusted; the Limit of Noise Emitted by Accelerating Mopeds has been sorted into different types according to their highest designed speeds; the Three-Wheeled Vehicles’ Noise Limit has been categorised into an individual provision; the requirements for Product Consistency Inspection has been proposed.

—Modified contents for background noise have been proposed;

—The requirement for acquiring the measuring value has been changed;

—Requirements for the Exhaustion Silencer System with Fibre Sound Absorption Materials has been standardised;

—Requirements for the Road Surface for Testing Noise has been standardised which is equivalent to the provisions in ISO 10844: 1994 “Regulations of Road Surfaces for Acoustic--Measurement of Noise Emitted by Stationary Road Vehicles” which comes into force on 1 July 2005.

Appendices A and B are regulations. Appendix C is for reference.

This standard is provided by the Science and Technology Standard Office of National Environmental Protection Administration.

This standard is drafted by: the China National Motorcycle Quality Inspection and Testing Centre, the Shanghai Motorcycle Quality Inspection and Testing Centre, China Arms and Weapons Equipment Group, and China Jialing Industry Co., Ltd.

This is the fourth revised edition.

The standards replaced by this proposal are:

——GB5467-85、GB4569-84、GB/T4569-1996、GB16169-1996、GB4569-2000、GB16169-2000。

This standard is ratified by the National Environmental Protection Administration on YY MM DD

This standard comes into force on YY MM DD. Standards GB5467-85、GB4569-84、GB/T4569-1996、GB16169-1996、GB4569-2000、GB16169-2000 are terminated simultaneously.

This standard is interpreted by the National Environmental Protection Administration.

Limit and Measuring Method of Noise Emitted by Accelerating Motorcycles and Mopeds

1 Scope

This standard regulates the limit and measuring method of noise emitted by accelerating motorcycles (not including sports motorcycles) and mopeds.

This standard applies to approving motorcycles and moped types in addition to product consistency inspection.

2 Regulation Reference Documents

The provisions in the following documents have passed this standard for reference and have become provisions in this standard. Documents with dates and their later versions (not including their corrigendum) do not apply to this standard. However, all parties concerned are encouraged to discuss whether the new versions should be used. Later versions of documents without dates apply to this standard.

GB/T 3785	The Electrical and Acoustic Functions of A Sound Level Meter and Its Testing Method
GB/T 5378	General Rules for Road Tests for Motorcycles and Mopeds.
GB/T 6003.1	Test Sieves of Metal Wire Cloth
GB/T 15173	Sound Calibrators
ISO 2599: 1983	Iron Ore—Determination of Phosphorus Content—Titrimetric Method
ISO 10534.1: 1996	Acoustics—The Determination of Suction Coefficient and Impedance—Impedance Tube Method
ISO 10844: 1994	Acoustics—“Regulations on Road Surfaces for Acoustics--Measurement of Noise Emitted by Stationary Road Vehicles”

3 Terminology, Definitions and Symbols

3.1 The following terminology and definitions apply to this standard.

3.1.1 Type Approval Testing

Type Approval Testing refers to the testing for approving the types of manufactured motorcycles or mopeds according to the related regulations.

3.1.2 Product Consistency Inspection Test

Product Consistency Inspection Test refers to manufactured motorcycles and mopeds that have passed the Type Approval Testing.

3.1.3 Background Noise

Background Noise refers to the noise in the testing environment (including wind noise) without the presence of the vehicle.

3.1.4 The Exhaust Silencer System

The Exhaust Silencer System refers to the whole set of parts that are needed to control the noise emitted by motorcycle or moped engines.

3.2 Symbols

This standard uses the following symbols.

V_h : Engine displacement;

S: Maximum engine rotational speed;

N_A : The stable engine rotational speed of the vehicles being tested when they are

approaching the Beginning Line of Acceleration (AA' Line);

V_m : The designed maximum speed of the vehicles being tested;

V_A : The stable speed of the vehicles being tested when they are approaching the Beginning Line of Acceleration (AA' Line);

4 The Limit of Noise Emitted by Accelerating Vehicles

4.1 The Limit of Noise in Type Approval Testing

See Diagram 1 for the Limit of Noise Emitted by Accelerating Motorcycles in Type Approval Testing. See Diagram 2 for the Limit of Noise Emitted by Accelerating Mopeds in Type Approval Testing.

Diagram 1 The Limit of Noise Emitted by Accelerating Motorcycles in Type Approval Testing

Engine Displacement (V_h) mL	Noise Limit dB(A)			
	Phase 1		Phase 2	
	Before 1 July 2005		After 1 July 2005	
	Two-Wheeled Motorcycles	Three-Wheeled Motorcycles	Two-Wheeled Motorcycles	Three-Wheeled Motorcycles
> 50 and ≤80	77	82	75	80
> 80 and ≤175	80		77	
> 175	82		80	

Diagram 2 The Limit of Noise Emitted by Accelerating Mopeds in Type Approval Testing

Designed Maximum Speed (V_m) km/h	Noise Limit dB(A)			
	Phase 1		Phase 2	
	Before 1 July 2005		After 1 July 2005	
	Two-Wheeled Mopeds	Three-Wheeled Mopeds	Two-Wheeled Mopeds	Three-Wheeled Mopeds
> 25 and ≤50	73	76	71	76
≤25	70		66	

4.2 The Limit of Noise in Product Consistency Inspection

The dates for Product Consistency Inspection are the same as the dates for Type Approval Testing for motorcycles (including mopeds) in different phases. The limit of noise emitted by accelerating the vehicle in The Product Consistency Inspection (CPE) is 1dB higher than that in the Type Approval Testing (TAT) and tested noise level in CPE should not exceed the level in TAT plus 3dB(A)

4.3 Other Requirements

Motorcycles and Mopeds with The Exhaust Silencer System with Fibre Sound Absorption Materials (ESSFSAM) should meet the requirements in Appendix A (Regulations).

5 Measuring Instruments

5.1 Acoustics Measuring Instruments

5.1.1 The Sound Level Meter (SLM) for noise measuring or equivalent measuring system should meet the accuracy requirements for Type 1 SLM in GB/T3785. Extension rods and extension cables should be used as much as possible. The intervals between reading times should not exceed 30 ms when using A-weighted Sound Pressure Level System that can perform periodic monitoring. SLM or its equivalent measuring systems should be regularly checked according to the state rules governing measuring instruments.

5.1.2 When measuring, use “A Frequency and Fast Time (F)” property on the SLM.

5.1.3 At the beginning and end of every measuring stage, SLM should be properly checked and adjusted according to the manufacturer's manual and the requirements in GB/T15173. If the SLM is not adjusted and the difference between two measurements exceeds 0.5dB (A) in Type 1 SLM, then the first measuring result is considered invalid. The results of each reading should be recorded in the form provided in Appendix C (Reference) according to the Measuring Requirement.

5.1.4 During the measuring procedure, the wind shield may be used properly according to the SLM manual, but its influence on the sound conducting the sensitivity of the apparatus and direction should be taken into consideration.

5.2 Measuring Instruments for Vehicle Speed and Engine Rotational Speed

Special instruments that meet the requirements in GB/T 5378 should be used for testing vehicle speed and engine rotational speed.

5.3 Meteorological Measurement Instruments

Wind Velocity Indicator (WVI), barometer and thermometer should meet the requirements in GB/T 5378.

6 Measuring Method of Noise Emitted by Accelerating Vehicles

6.1 Measuring Environment

6.1 .1 Measuring Field (See Diagram 1)

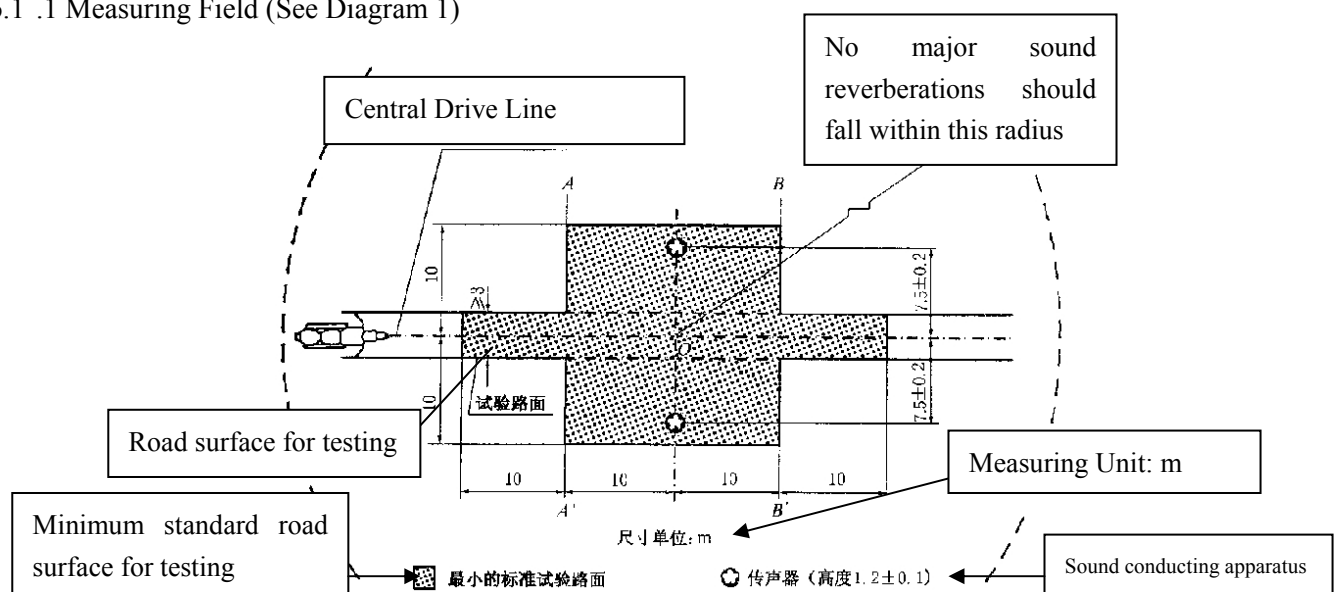


Diagram 1 The Field for Measuring Noises Emitted by Driving;

Testing Area and the Setting of Sound Conducting Apparatus

6.1.1.1 The sound field condition for measuring is: when an omni direction sound source is placed in the centre, point 0, in the testing area, the sound level deviation in all directions from centre 0 should not exceed $\pm 1\text{dB(A)}$. When the following conditions are provided, the testing field meets the requirement:

a) No major sound reverberations on buildings, fences, trees, rocks, bridges and parked vehicles within a 50 m radius from centre 0.

b) The surface of the testing field should consist of strong materials such as concrete cement and asphalt. It should be flat, level and dry. It should not be covered by snow, grass, dust or other sound absorbing materials.

6.1.1.2 The runway that leads to the measuring field should have at least 100 m straight concrete cement or asphalt pavement. The longitudinal slope should not exceed 1%. The vein of the runway should not cause excessive tyre noise. From Phase 2 the road surface should meet the requirements in Appendix B (Regulation).

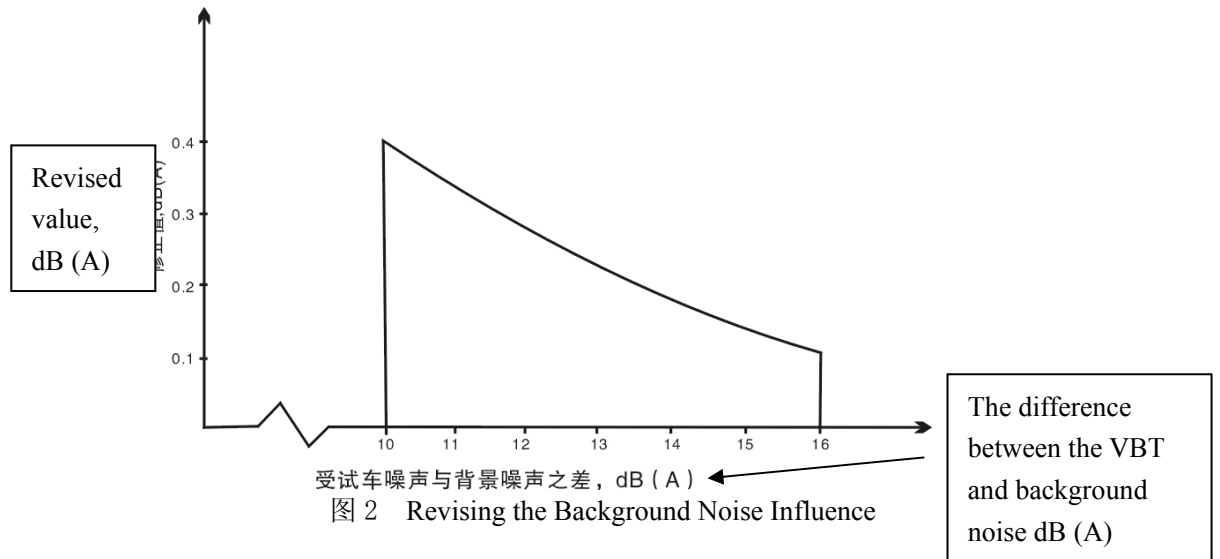
6.1.1.3 Only the testing staff and the driver are permitted to enter the testing area during the test. Testing staff should stay in a position that will not influence the SLM readings.

6.1.2 The Weather

The test should not be carried out if there is any precipitation. The wind velocity must be lower than 3 m/s. The influence of wind on SLM readings should be considered.

6.1.3 Background Noise

During the testing process, the background noise (A-weighted Sound Pressure Level) should be at least 10 dB (A) lower than the motorcycle being tested. If the difference between the background noise and the motor noise is between 10-16 dB (A), the noise reading of the motorcycle being tested should be deducted from the revised value indicated in diagram 2.



6.2 The Requirements for Vehicles Being Tested (VBT)

6.2.1 The VBT should not carry anyone other than the driver or any goods other than necessities such as cooling fluid, lubricant, fuel, the toolbox and a spare tyre. The three-wheeled motorcycles should not be connected to a trailer or semi trailer.

6.2.2 If the VBT is equipped with fans, the system should not be influenced during the testing procedure. If the VBT is equipped with more than one driving wheel, the one used on normal roads is only permitted for use. If the VBT has a sidecar, it should be removed from the motorcycle during the process.

6.2.3 Before the test, the motor engine should be preheated according to the regulations in GB/T 5378 to the normal working temperature.

6.2.4 Other Conditions for the VBT should meet the requirements in GB/T 5378.

6.3 The Testing Area and the Setting of the Sound Conducting Apparatus (SCA)

6.3.1 The noise testing field area is detailed in diagram 1. Point 0 is the centre of the testing field. Line AA' is the beginning of acceleration. Line BB' is the end of acceleration. Line CC' is the centre driveline.

6.3.2 SLM SCA should be positioned at both sides of point 0. The SCA head should be $1.2 \text{ m} \pm 0.1 \text{ m}$ higher than the ground, each $7.5 \text{ m} \pm 0.2 \text{ m}$ away from the centre point (measured by the perpendicular line along the CC' line). The referential axis is parallel to the ground and with a perpendicular point to the CC' line.

6.4 Choosing the Gears of the VBT and Determining the Speed When Approaching AA' Line

6.4.1 Two-Wheeled Mopeds

6.4.1.1 Choosing Gears When Driving

6.4.1.1.1 Two-Wheeled Mopeds using Hand (or Foot) Gearshifts.

The highest gear that meets the condition of $N_A \geq 1/2S$ when approaching AA' should be chosen.

6.4.1.1.2 Two-Wheeled Mopeds with Automatic Shifts.

Two-Wheeled mopeds with automatic shifts should be tested according to the requirement in Provision 6.4.1.2

6.4.1.2 The Speed When Approaching AA'

If $V_m > 30$ km/h, take $V_A = 30$ km/h;

If $V_m \leq 30$ km/h, take $V_A = V_m$;

6.4.2 Two-Wheeled Motorcycles

6.4.2.1 Motorcycles with Hand (Foot) Gearshifts

6.4.2.1.1 Choosing Gears When Driving

- a) Choose the second gear if there are 4 or fewer forward gearshifts in the VBT.
- b) If the VBT has 5 or more forward gearshifts,

When V_h is 175mL or lower, use the third gear for testing.

When V_h is higher than 175mL, use the second and third gears for testing. Take the average value as the test result.

c) When using second gear in a) and b), if the engine rotational speed exceeds S when the VBT reaches BB' then switch to the third gear and use this value as the final result.

6.4.2.1.2 The VBT Speed When Approaching AA'

The V_A of the VBT when it is approaching AA' is:

the speed corresponding to $3/4S$. $V_A = 50$ km/h if the VBT exceeds 50 km/h.

6.4.2.2 Automatic Two-Wheeled Motorcycles without Hand (Foot) Gearshifts.

The VBT speed when it is approaching AA' is:

30 km/h、40 km/h、50 km/h (if the VBT's $3/4V_m$ is lower than 50 km/h, then its speed should be $3/4V_m$) The highest value is the final measuring result.

6.4.2.3 Automatic Two-Wheeled Motorcycles with Hand (Foot) Gearshifts

6.4.2.3.1 Choosing the Gears While Driving

If the VBT has X forward foot (hand) gears, then the highest gears should be chosen (not including the external low shift, for example the emergency low gear shift). If the VBT passes AA' and it automatically shifts to low gears, the test result is invalid. Choose the "highest shift-1" gear to test again. Use "highest shift-2" if necessary. Select the gears until the highest gear is found at which no automatic low gear switching occurs. (Not the manual low gear shifting). The test result at this gear is the final result.

6.4.2.3.2 The VBT Speed When It Is Approaching AA'

The VBT V_A when it is approaching AA' is:

the speed corresponding to $3/4S$. $V_A = 50$ km/h if the VBT speed is over 50 km/h.

If the gear automatically switches to the first gear when the VBT is being tested as $V_A = 50$ km/h, then take $V_A = 60$ km/h so that no automatic shifting will occur.

6.4.3 Three-Wheeled Motorcycles (Including Three-wheeled Mopeds)

6.4.3.1 Three-Wheeled Motorcycles with Hand (Foot) Gearshifts

6.4.3.1.1 Choosing Gears When Driving

a) If the VBT has 4 or fewer forward gears, use the second gear.

b) If the VBT has 5 or more forward gears, use the third gear.

c) When using second and third gears in a) and b), if the engine rotational speed exceeds S when the VBT reaches BB' then switch to the third and fourth gear and use this value as the final result, but do not use the overdrive gear. If the VBT has a driving system with two ratios of transmission gear, choose the gear at which the VBT can reach V_m .

6.4.3.1.2 The VBT Speed When It Is Approaching AA'

The VBT V_A when it is approaching AA' is: :

$N_A = 3/4S$.

$N_A = 3/4$ the maximum engine rotational speed that the speed-limit device allows

$V_A = 50$ km/h

Choose the lowest speed of the three.

6.4.3.2 Three-Wheeled Motorcycles without Gear Boxes

The VBT speed V_A when approaching AA' is determined by the requirements in 6.4.3.1.2.

6.4.3.3 Three-Wheeled Motorcycles with Automatic Gear Boxes

6.4.3.3.1 Choosing the Gear When Driving

Choose the forward gear that gives the highest average acceleration in the VBT. Do not select gears for braking, parking or sliding the car.

6.4.3.3.2 The VBT Speed When It Is Approaching AA'

The speed V_A of VBT when approaching AA' is:

$$V_A = 3/4V_m ,$$

$$V_A = 50 \text{ km/h}$$

Choose the lower gear.

6.5 Accelerating the VBT When Driving

The VBT should go to AA' with its longitudinal surface along CC' at the gear regulated in 6.4 and at a stable speed. The tolerance of the engine rotation speed and the vehicle speed with the stipulated values is $\pm 3\%$. When the front part of the vehicle reaches AA', all the throttles should be open and remain open. When the end of the VBT passes BB', the throttles should be closed and idle.

6.6 Back & Forth Test and the Requirement for Obtaining the Value

6.6.1 The same test however the VBT goes back and forth. Each VBT is tested twice on each side. The highest reading is taken on the SLM every time the VBT is reached. The difference between the two results should not exceed 2dB(A), or the result is invalid.

6.6.2 Each reading should subtract 1dB(A) to be accurate.

6.6.3 Take the average value of all the 4 results of the VBT as its maximum acceleration noise level. The result should be a figure as required in GB/T 5378.

6.7 The Test Record

Complete the form in Appendix C (Reference) with the data, result, condition of VBT and test instrument specifications. If there are other things to state, place them in the "Other Specifications" column.

Appendix A (Regulation)

Requirements for the Exhaust Silencer System with Fibre Sound Absorption Materials

A.1 The fibre sound absorption materials (FSAM) in the exhaust silencer system (ESS) should not contain asbestos.

A.2 During the entire process, the FSAM should remain stable in the exhaust system.

A.3 The ESS must meet one of the requirements in A3.1, A3.2 or A3.3.

A.3.1 When the FSAM is taken apart from ESS; the VBT's maximum acceleration noise should reach the limit in this standard.

A.3.2 The FSAM should not be placed where the air emitted by ESS flows by it and it should meet the following requirements:

a) Place FSAM in a furnace to heat it to $650^{\circ}\text{C}\pm 5^{\circ}\text{C}$. Retain this temperature for 4 hours. The FSAM's length, diameter and density should not decrease.

b) After being heated in a furnace for 1 hour at $650^{\circ}\text{C}\pm 5^{\circ}\text{C}$, test it according to ISO 2599:1983. At least 98% of the materials should stay in the 250 μm sieve as specified in GB/T6003.1.

c) Under $90^{\circ}\text{C}\pm 5^{\circ}\text{C}$, FSAM mass loss should not exceed 10.5% after it has been submerged in the solution containing the following ingredients for 24 hours.

Solution that contains 80.91 g of HBr/L (1 Equivalent Concentration)	10 ml
Solution that contains 49.04 g of H_2SO_4 (1 Equivalent Concentration)	10 ml
Add distilled water up to	1000 ml

Note: before the FSAM is weighed, it must be rinsed with distilled water and allowed to dry at a temperature lower than 105°C for one hour.

A.3.3 Before the Test of Noise Emitted by Acceleration, one of the following methods should be taken in order for the ESS of the VBT to remain under normal working conditions.

A.3.3.1 The Adjustment for Continuous Road Driving.

A.3.3.1.1 The shortest distance for the motorcycle being tested is determined by Form A1. The shortest distance for the moped being tested is determined by Form A2.

Form A1 the Shortest Distance for Motorcycles Driving on Continuous Road

Engine Displacement (V_h), mL		Driving Distance: km
Two-Wheeled Motorcycles	Three-Wheeled Motorcycles	
≤ 80	≤ 250	4000
> 80 and ≤ 175	> 250 and ≤ 500	6000
> 175	> 500	8000

Form A2 The Shortest Distance for Mopeds Driving on Continuous Road

The Vehicles Being Tested	Driving Distance: km
Two Wheeled Mopeds	2000
Three-Wheeled Mopeds	4000

A.3.3.1.2 50%±10% of the continuous road cycles should be carried out in the city. The rest is high speed, long distance driving which can be carried out on a testing runway.

A.3.3.1.3 The two speed mode on the continuous road cycle should alternate at least 6 times.

A.3.3.1.4 Stop the vehicle at least 10 times during the entire test program. Each stop should last for at least 3 hours in order for the engine to cool down.

A.3.3.2 Adjusting the Pulse

A.3.3.2.1 The ESS or other parts should be set on the VBT, which should be set on the chassis power tester. Otherwise the ESS can be set on the engine, which should be set on the frame of the testing bench.

The testing devices are set at the vent of the ESS as shown in Diagram A1. Other equivalent devices can be used.

A.3.3.2.2 The testing devices are adjusted by a quick-action valve that alternatively breaks and resumes the exhausted air flow 2500 times.

A.3.3.2.3 Open the quick-action valve when the Exhaust Back Pressure, tested at least 100 mm away from the air inlet flange in the test device is 0.35~0.40 kPa. If this value cannot be acquired due to the property of the engine, open the valve when the Exhaust Back Pressure reaches 90% of the maximum engine value tested before the engine stops. Close the valve when the difference between the value of the back pressure and the stable value of the valve (when it is open) is less than 10%.

A.3.3.2.4 Calculate the sustaining exhaustion time according to A3.3.2.3

A.3.3.2.5 The engine rpm is 3/4S.

A.3.3.2.6 The power indicated on the power tester should be 50% of the power when the gas valve is completely open and the engine rpm is 3/4S.

A.3.3.2.7 Plug the vent of the ESS during the test.

A.3.3.2.8 The entire test should be completed within 48 hours. The engine should be cooled down every hour if necessary.

A.3.3.3 Adjusting the Testing Bench

A.3.3.3.1 The ESS should be set on the engine that is designed for the VBT. The engine should be set on the testing bench.

A.3.3.3.2 The process of adjustment consists of the regulated bench test cycle index. See Form A3 for the Motorcycle Engine Test Bench Cycle Index. See Form A4 for the Moped Engine Test Bench Cycle Index.

Form A3 The Motorcycle Engine Test Bench Cycle Index

Engine Displacement (V_h), mL		Cycle Index
Two-Wheeled Motorcycle	Three-Wheeled Motorcycle	
≤ 80	≤ 250	6
> 80 and ≤ 175	> 250 and ≤ 500	9
> 175	> 500	12

Form A4 The Moped Engine Test Bench Cycle Index

Vehicle Being Tested	Cycle Index
Two-Wheeled Mopeds	3
Three-Wheeled Mopeds	6

A.3.3.3.3 Each bench should stop for at least 6 hours after every test cycle.

A.3.3.3.4 Each Test Cycle Index consists of 6 phases. See Diagram A5 for the working condition of the motorcycle engine and operation time. See Diagram A6 for the work condition of the moped engine and operation time.

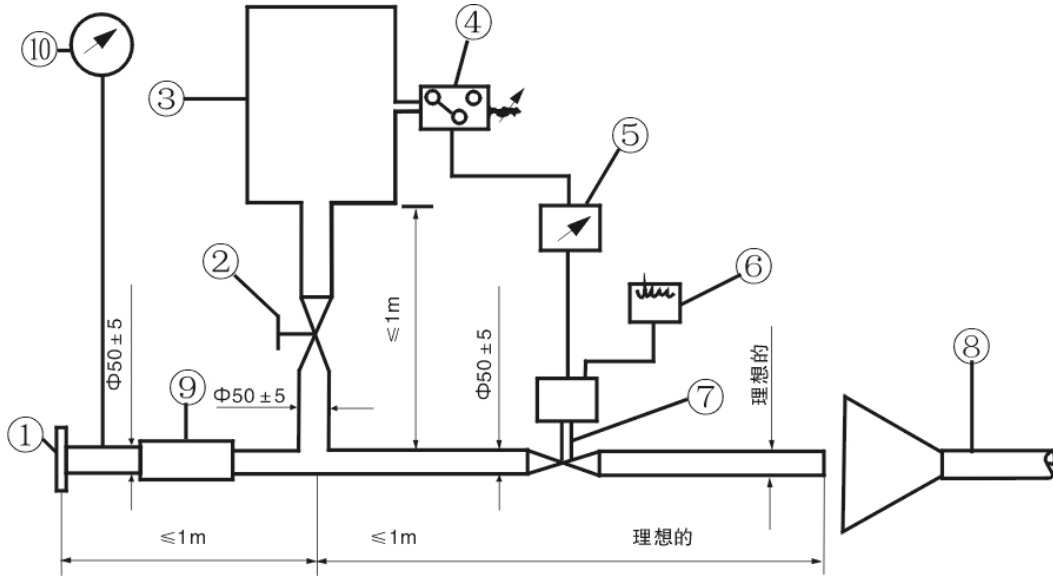
A.3.3.3.5 If the manufacturer requires, the engine and the silencer can be cooled down during the testing procedure so that the temperature can be measured within 100 mm from the exhaust vent. The tested motorcycle temperature should not exceed the normal temperature when the vehicle is running at 110 km/h or when the engine is rotating at 3/4S at the highest gear. The tested moped temperature should not exceed the normal temperature when the engine is rotating at 3/4S at the highest gear. The tolerance of the engine rotational speed and the VBT speed is within $\pm 3\%$.

Form A5 The State of Cyclic Operation on Motorcycle Engine Test Bench

Phase	The Operation state	T			
			Two-Wheeled Motorcycle $V_h \leq 175$ mL	Three-Wheeled Motorcycle $V_h \leq 250$ mL	Two-Wheeled Motorcycle $V_h > 175$ mL
1	Idle	Mi n	6		6
2	at 3/4S 1/4 loaded		40		50
3	at 3/4S 1/2 loaded		40		50
4	at 3/4S Fully loaded		30		10
5	at S 1/2 loaded		12		12
6	at S 1/4 loaded		22		22
Total Time		h	2.5		2.5

Form A6 The State of Cyclic Operation on the Moped Engine Test Bench

Phase	The Operation state	Time	
1	Idle	Minutes	6
2	at 3/4S 1/4 loaded		40
3	at 3/4S 1/2 loaded		40
4	at 3/4S		30
5	at S 1/2 loaded		12
6	at S 1/4 loaded		22
Total Time			2.5



1. Air inlet flange or bushing at the back of the ESS for connecting the VBT; 2. Manual control valve; 3 compensating tank of 40l max volume with a filling time no less than 1 s; 4. Pressure switch at 5-250 kPa working range; 5. Delay switch; 6. Pulsed counter; 7. Snap valve, e.g. a 60 mm diameter exhaust brake valve controlled by a Pneumatic Linear Actuator of 120 N output power at 400 kPa. The unevenness of responding time to on/off should not exceed 0.5 s; 8. Exhaust; 9. Hose; 10. Manometer

Figure A1 Test Device for Pulsating Adjustment

Appendix B
(Regulation)
Road Surface Requirements for Testing Noise

B.0 Introduction

Based on the main content of ISO 10844:1994, this appendix regulates the technical requirements for paving the Road Surface for Testing (RST), its required physical property and the testing method.

B.1 Definitions

This appendix comprises the following definitions:

B.1.1 The Porosity Rate

The porosity rate refers to the proportion of pores between the aggregates in the concrete on the road, known as V_c . These pores may be connected (closed pores) or open to the air (open pores). The porosity rate of the RST is determined by the samples with the following formula:

$$V_c = (1 - \rho_A / \rho_R) \times 100\% \quad \dots\dots\dots (B1)$$

In the formula: ρ_A —the surface density of the sample;

ρ_R —the maximum theoretical density of the sample.

The surface density ρ_A is determined by the following formula:

$$\rho_A = m/V \quad \dots\dots\dots (B2)$$

In the formula: m —the mass of the sample from the RST;

V —The volume of the sample. Not including the air volume.

The maximum theoretical density ρ_R is determined by measuring the mass and volume of the binders and the aggregates in each sample as shown in the following:

$$M_{rf} = \frac{m_B + m_A}{V_B + V_A} \quad (B3)$$

In the formula: m_B —the mass of the binder;

m_A —the mass of the fillings;

V_B —the volume of the binder;

V_A —the volume of the fillings.

B.1.2 Sound-Absorbing Coefficient (SAC)

The SAC refers to the proportion between the intensity of the incidence sound wave (IISW) absorbed by RSAM and the whole IISW, shown as α :

$$\alpha = \text{IISW not reflected} / \text{Total IISW} \quad \dots\dots\dots (B4)$$

The ASC is determined by the frequency of the sound wave and its incidence angle. The sound frequency range corresponding to the SAC in this standard is 400Hz~1600Hz, and it is perpendicular.

B.1.3 The Structural Depth of the Road Surface (SDRS)

The SDRS refers to the average depth of the uneven open pores within a certain area of road surface, shown by MTD (mm). It is the average thickness of special, fine, glass ball sand paved on the road surface

to fill the open pores. This layer of ball sand surface contacts the surface of the mounts on the road surface at a tangent.

B.2 The Required Properties for the Road Surface

If the SDRS and the porosity rate or SAC meet the requirements in the following and in B.3.2, the road surface meets the requirements in this appendix.

B.2.1 The Porosity Rate

The paved RST concrete porosity rate should be $V_c \leq 8\%$. See B.4.1 for the testing method.

B.2.2 The Sound Absorption Coefficient (SAC)

If the road surface meets the requirement of the porosity rate, then the SAC must be $a \leq 0.10$. See B.4.2 for the testing method.

Remark: though the road builders are more familiar with the porosity rate, the most relevant property is SAC. However the SAC is only required when the porosity rate cannot meet the requirement. Depending on the porosity rate it may improperly deny some road surfaces because the measurement and relevancy are uncertain.

B.2.3 The Structural Depth of the Road Surface (SDRS)

The average SDRS acquired by Volumetric Method should be: $MTD \geq 0.4$ mm. See B.4.3 for the measuring method.

B.2.4 The Evenness of the Road

The evenness of the SDRS and porosity rate in the testing area should be guaranteed.

Remark: the SDRS will be different in different sections, so the SDRS will not be even if the road is not evenly rolled.

B.2.5 The Examination Period

The following periodical road surface examinations should be carried out to ensure if the SDRS, the porosity rate and the SAC have been conforming to the requirements in this appendix.

a) About the Porosity Rate or SAC

If the road has been recently paved, check once. No periodic checks are required if the road surface meets the requirement. If the new road surface does not meet the requirement, it can be checked again after a certain time since the pores on the road surface may be filled and become firm after a while.

b) About the Structural Depth of the Road Surface (SDRS)

Check once if the road surface has been recently paved. Check once when the noise test has commenced (notice: the road should be checked four weeks after it has been paved). Check the road every year.

B.3 The Design of the Road Surface for Testing

B.3.1 The Area

The test field is as shown in Diagram 1: the shaded areas are the smallest units paved and rolled with the regulated materials. At least the area for the motorcycle being tested should be paved with the stipulated materials and with the necessary edges for safe driving in the design. The width of the runway should be at least 3 meters. Its length between AA' and BB' should be extended for at least 10 meters.

B.3.2 The Design of the Road Surface and the Equipment

B.3.2.1 Basic Requirement for Designing

The road for testing should meet the following four requirements:

B.3.2.1.1 Thick asphalt concrete should be used;

B.3.2.1.2 the maximum size of gravel is 8 mm (tolerance: 6.3 mm~10 mm);

B.3.2.1.3 The wear down layer thickness should be ≥ 30 mm;

B.3.2.1.4 The asphalt for paving the road surface should be unmodified asphalt with a certain penetration degree.

B.3.2.2 Design Guide

Diagram B1 shows the gravel grading curves in the mixed asphalt materials. These curves give the ideal properties as a guide for designing. Also, Form B1 provides a number of standard values to acquire the ideal structure of road surface and durability. The grading curves are expressed in the following formula:

$$P=100(d/d_{max})^{1/2} \dots\dots\dots(B5)$$

In the formula:

- P—— pass rate, % (m/m);
- d——the square mesh size: mm;
- $d_{max}=8$ mm corresponding to the average curve; ;
- $d_{max}=10$ mm corresponding to the lower limit of tolerance curve
- $d_{max}=6.3$ mm corresponding to the upper limit of tolerance curve.

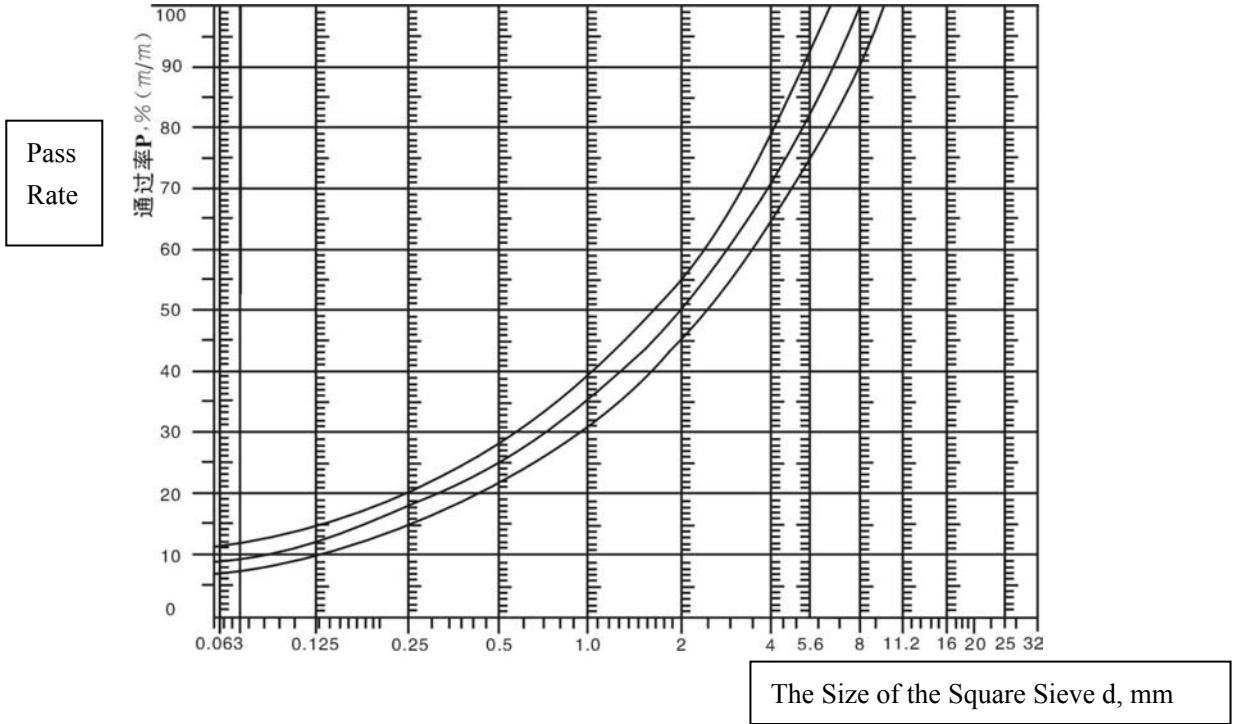


Diagram B1 The Curve of the Gravel Grading in the Mixed Asphalt

Form B1 The Design Standard Value

	Target Value		
	Calculated by the General Asphalt Mass	Calculated by the Gravel Mass	Tolerance
The Gravel Mass (The Size of the Square Mesh Size $d>2$ mm)	47.6%	50.5%	±5%
Sand Mass ($0.063 \text{ mm}<d<2 \text{ mm}$)	38.0%	40.2%	±5%
The Fillings Mass ($d<0.063 \text{ mm}$)	8.8%	9.3%	±2%
The Bitumen Mass	5.8%	—	±0.5%
Maximum Gravel Size: mm	8		6.3~10
The Penetration Degree of Asphalt	See 3.2.2.f		—
Polished Stone Value (PSV)	>50		—

compactness, compared with Marshall Compactness	98%	—
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Besides the requirements above, the following requirements should be met:

a) the ingredients of the sand (the square mesh size should range between 0.063 mm and 2 mm) should include less than 55% of natural sand and at least 45% of crushed sand;

b) according to the requirements in the highest standard for road construction, the base and the sub base layers should be guaranteed with excellent stability and smoothness;

c) the gravel should be crushed (100% crushed surface) and extremely hard;

d) the gravel in the mixed material should be rinsed clean;

e) no extra gravel should be added on the road surface;

f) the Penetration Degree (PEN) of the asphalt should be 40~60, 60~80 or even 80~100, depending on the local weather condition; use the lowest PEN (extremely hard) asphalt under the general requirement.

g) the mixed materials should be at the proper temperature before they are compacted so that the required porosity rate will be acquired during the next compaction. The degree of firmness should be analysed to improve the possibility of meeting the requirements in B.2.1~B.2.4 Both the proper temperature of the materials and the proper compactors and compacting times should be considered.

B.4 The Measuring Method

B.4.1 Measuring the Porosity Rate

At least four samples from the testing area, evenly between AA' and BB', are required for carrying out this measurement. The samples should be taken from around the wheel tracks however not on the wheel tracks in order to retain their evenness and integrity. At least two samples should be taken near the wheel tracks and one between the wheel tracks and each sound conducting apparatus.

Take other samples from the testing area if the evenness is not certain (see B.2.4)

The porosity rate of each sample should be measured and then the average value should be obtained. Compare the result with the requirement in B.2.1. No porosity rate in any sample should exceed 10%. Remind the pavement workers that the pipeline and cable heating areas may have problems caused by sampling work. Those devices have to be designed carefully so that they are away from the sampling areas. It is recommended that an area of 200 mm×300 mm should not be set with pipelines or antennas, or they have to be submerged totally so that they are not ruined during the sampling of the road.

B.4.2 Measuring the Sound Absorption Coefficient (SAC)

SAC (perpendicular incidence) should be measured with impedance tubes according to the regulations in ISO 10534.1:1996.

The requirement for sampling is the same as that for the porosity rate (see B.4.1). The frequency range for SAC is 400Hz~800Hz and 800Hz~1600Hz (at the least, it should be based on the central frequency which is 1/3 of the Sound Interval). Obtain the largest values in these two frequency ranges. Take the average value as the final result.

B.4.3 Measuring the Structural Depth of the Road Surface (SDRS)

There should be 10 positions spread around the wheel tracks on the testing runway. Obtain the average value and compare it with the regulated minimum depth. See Appendix A in ISO 10844:1994 for the measuring method.

B.5 The Stability with Time and the Maintenance

B.5.1 The Influence of Aging

Like any other road surfaces, the tyre/road noise level attained on the testing road surface may

increase during 6 ---12 months after the road is paved. The road should reach the required property four weeks after it is paved. This aging problem has a lower influence upon trucks than that upon vans. The road surface stability with time depends on the firmness of the road being compacted. It should be checked regularly according to the regulations in B.2.5.

B.5.2 Maintaining the Road Surface

The loose gravel and dust that greatly influence the SDRS should be removed from the road. No salt is to spread on the road for preventing ice to form since salt may temporarily or permanently change the road surface property thus causing the noise level to increase.

B.5.3 Repaving the Road for Testing

Repave the testing road if necessary. If the testing area beside the runway (see Diagram 1, the width is 3 m) meets the requirement on porosity and SAC then it is not necessary to repair the road.

B.6 About the Testing Road Surface and the Report on Noise Test

B.6.1 The report on the testing road should include:

B.6.1.1 The location of the Runway for Testing

B.6.1.2 The type, PEN of asphalt, the gravel type, the maximum theoretical density of concrete (D_R , the wearing layer thickness and grading curves determined by the samples from the testing runway.

B.6.1.3 The means of compacting the road, the mass and type of the compactors and compacting times)

B.6.1.4 The temperature of the mixed materials during the road construction, the environment temperature and wind velocity.

B.6.1.5 The dates of road construction and the contractors' names.

B.6.1.6 All or the recent test results, including:

B.6.1.6.1 The porosity rate of each sample;

B.6.1.6.2 The location where the samples were taken;

B.6.1.6.3 The SAC of each sample (if it is acquired). Give specifications of the test results in all the frequency ranges and the average values;

B.6.1.6.4 The locations where the samples for SAC were acquired;

B.6.1.6.5 The SDRS, including the measuring times and standard deviations;

B.6.1.6.6 The institute in charge of the tests in B.6.1.6.1~B.6.1.6.2 and the types & specifications of the instrument & equipment used;

B.6.1.6.7 The dates of the tests and the samplings from the testing runway.

B.6.2 The Report of the Motorcycle Noise Test on This Road Surface

If the road surface meets all the requirements in this appendix in the motorcycle noise test report, this should be specified . The road test report quoted should be specified. The report should meet the requirements in B.6.1 that proves the road surface meets the requirement.

Appendix C

(Reference)

The Record of Measuring Noise Volume Emitted by Acceleration

Date____Year____Month____Day Place_____ Road Condition_____

Weather_____ Temperature (°C)_____ Wind Velocity (m/s) _____

Vehicle Being Tested: Manufacturer_____ Type _____

Frame No. _____ Designed Maximum Speed (km/h)_____ Final Gear Ratio_____

Engine: Type_____ Displacement (mL)_____ Serial No. _____

Max Hp (kW)_____ Max rpm (r/min)_____

Gearbox: Type_____ Number of Forward Gears _____

Exhaust Silencer: Manufacturer ____ Fibre Sound Absorption Material Yes / No Test Method _____

Tyre: Specification Front Tyre _____ Back Tyre _____ Side Tyre _____

Air Pressure (kPa) Front Tyre _____ Back Tyre _____ Side Tyre_____

Sound Level Meter: Model No. _____ Class of Accuracy _____ Instrument Serial No. _____

Adjusted Value Before Measuring____ Adjusted Value After Measuring____ Final Result _____

Sound Regulator: Type _____ Class of Accuracy _____ Instrument Serial No. _____

Vehicle Speed Tester Type_____ Revolution Meter Type _____

Form C1

Gear	Sound Conducting Apparatus Position	Number of Times	Engine Speed (r/min) or Vehicle Speed (km/h)		Measured Value dB(A)	Average Value dB(A)	Background Noise dB(A)	Remarks
			Enter Line	Exit Line				
	Left Side	1						
		2						
	Right Side	1						
		2						
	Left Side	1						
		2						
	Right Side	1						
		2						

Max Acceleration Noise Level_____ dB (A)

Measurer's Name _____ Driver's Name _____

Specifications for the Testing Road Surface _____

Other Specifications _____