TCVN VIETNAM NATIONAL STANDARD

TCVN 7882:2008

(Second edition)

Road vehicles - Noise emitted from mopeds Requirements and test methods in type approval

HANOI - 2008

Forewords

TCVN 7882:2008 is completed basing on technical regulations ECE 63-01/C1, ECE 63-01/C2 and ECE 09-06S1.

TCVN 7882: 2008 replaces TCVN 6597:2000 and requirements for mopeds stated in TCVN 5948:1999, TCVN 6435:1998 and TCVN 6552:1999;

TCVN 7982:2008 was prepared by Technology Committee TCVN/TC22 Road Vehicles, proposed by Directorate for Standards, Metrology and Quality (STAMEQ), and approved by Ministry of Science and Technology.

Second edition

Road Vehicles - Noise emitted from mopeds - Requirements and test methods in type approval

1. Scope

This standard specifies requirements and test methods for noise in type approval for two-wheeled and three-wheeled vehicles which are defined in TCVN 6211 (moped is hereby referred as vehicle).

2. Normative documents

Following normative documents are very necessary for application of the standard. For normative documents stated with issuing year, stated version is applied. For normative documents not stated with issuing year, latest version (including changes/amendments) is applied.

TCVN 6211 (ISO 3833) - Road Vehicles – Types –Terms and Conditions

TCVN 7803 (ISO 2599) - Iron ores. Determination of phosphorus content. Titri-metric method

ISO 3310-1 Test sieves -- Technical requirements and testing -- Component 1: Test sieves of metal wire cloth

ISO 10534-1 -Acoustics -- Determination of sound absorption coefficient and impedance in impedance tubes -- Component 1: Method using standing wave ratio

ISO 10534-2 -Acoustics -- Determination of sound absorption coefficient and impedance in impedance tubes – Component 2: Transfer-function method

ISO 10844 - Acoustics – Test surface for road vehicle noise measurements.

3. Terms and definitions

Terms used in this standard are defined as follows:

3.1. Approval of a moped

Approval of a moped type in term of noise and original exhaust system as an independent technical component of the moped;

3.2. Moped type

One type of vehicles of which typical characteristics are the same related to noise and exhaust system as follows:

3.2.1. Engine type (two-stroke or four-stroke, transitive piston or rotating piston…; number and capacity of cylinders; number of carburetor or fuel injection system; arrangement of valves; maximum output and relevant engine speed (r/min)…

For rotating piston, cylinder capacity should be measured as twice as volume of combustion chamber.

3.2.2. Power transmission system, especially number and transmission ratio of gears.

3.2.3. Number, type and arrangement of exhaust system.

3.2.4. Besides, three-wheeled vehicles should have following characteristics:

3.2.4.1. Shape and material for vehicle body (especially for engine chamber and its noise-insulation material)

3.2.4.2. Length and width of vehicle.

3.3. Exhaust or silencing system

An adequate group of indispensable components for restraining noise caused by vehicle and vehicle's exhausted gas.

3.3.1. Original exhaust system or silencing system

System of a type installed for vehicle when approving type or expanding type approval. It can be original system or substitute system.

3.3.2. Non-original exhaust system or silencing system

System of a type which is not installed for vehicle when approving type for expanding type approval. It can only be substitute system.

3.4. Exhaust or silencing systems of different types

Exhaust or silencing systems differ from each other in following typical characteristics:

3.4.1. Components having different commercial name or brand.

3.4.2. Properties of material forming a component are different or components differ in shapes or dimensions.

3.4.3. Operation theory of at least one component is different.

3.4.4. Their components are differently installed.

3.5. Exhaust system component

Individual components of which installation forms an exhaust system (such as exhaust pipe, silencing set, for three-wheeled vehicle this can be injection contributor pipe, expansion chamber and injection system (air filter), if any.

If engine should be equipped with injection system (air filter and/or absorber for noise caused by injected air) to be suitable to regulations on noise limitation, then the filter and/or the absorber should be considered to be essential components as exhaust system.

4. Technical documents and test sample

4.1. Technical documents

4.1.1. Document describes vehicle type with characteristics stated in 3.2. Number and/or symbol for recognizing engine type and vehicle type should be stated.

4.1.2. List of components of silencing system. These components should be identifiable.

4.1.3. Installation chart of silencing system which states its position on the vehicle.

4.1.4. Detail chart of each component for easy positioning and recognizing components and material used.

4.2. Sample test

4.2.1. A vehicle representing for that type.

4.2.2. An additional sample of exhaust system or silencing system (not including the sample on the vehicle).

5. Technical requirements

5.1. General requirement

5.1.1. Vehicle, engine and exhaust system or silencing system should be designed, manufactured and installed in such a way that the vehicle meets all requirements in this standard in normal working condition even though it can be influenced by vibration.

5.1.2. Exhaust system or silencing system should be designed, manufactured and installed to be able to bear erosive influence during working procedure.

5.2. Measuring method

5.2.1. Noise of vehicle should be measured by two methods, both in moving and parking condition [1)] of vehicle, which are stated in Annex A of this standard, Part I for two-wheeled vehicle and Part II for three-wheeled vehicle.

5.2.2. Two measured values under regulations in **5.2.1** should be stated in test report under following presentation mode:

Noise:

Moving vehicle……dB(A) at constant velocity

Before acceleration……km/h, engine speed……..r/min

Parked vehicle ……dB(A) with engine speed of…….r/min

5.3. Acceptable noise limitation

Noise of moving vehicle measured by methods stated in A.1 for two-wheeled vehicle and in A.3 for three-wheeled vehicle in Annex A should not be greater than noise limitation specified for types of vehicle and silencing systems stated in Table 1.

Table 1 – Noise limitation values

Two-wheeled vehicle		**Three-wheeled vehicle**
Maximum design velocity (km/h)	Noise limitation value (dB(A))	
≤ 25	66	76
>25	71	

5.4. Additional requirements for silencing system or components containing fiber material

If vehicles are installed equipments which are designed for reducing the noise of exhausted air (silencing system), it is required to apply requirements in Annex B. If inlet of engine is equipped with air filter and/or noise absorption equipment of which the noise absorption equipment is needed for ensuring compliance with allowable noise, then the air filter and/or the noise absorption equipment should be considered as components of the silencing system and also meet requirements in Annex B.

[1)] Testing method when vehicle does not move to provide referenced value for authority using this method to test noise for circulating vehicles.

6. Compliance of production

6.1. Any vehicle belonging to the type which has been approved and produced in compliance with the type approved by this standard should be equipped with silencing system of the type approved together with the vehicle and should meet all requirements in Article 5.

6.2. To check out the compliance with above requirement, it is required to randomly select one vehicle sample from the production lot of the type approved. The final product is considered to be in compliance with this standard if its noise measured by method in Annex A is not greater than value measured in type approval over 3 dB (A) or not greater than limited values stated in Table 1 over 1dB(A).

Annex A

(Regulated)

Method and equipment for noise measurement

Part I. Two-wheeled vehicle

A.1. Noise measurement of moving vehicle

A.1.1. Measurement device

A.1.1.1. Sound level measurement

Sound level meter should have high accuracy as stated in IEC 651.

Measurements should be implemented in "quick" time response and frequency property "A". These requirements are also stated in above regulation.

When starting and finishing a sound level measurement series, measuring device should be calibrated under instruction of manufacturer by applying a suitable sound source (e.g. acoustic piston)

If deviation of sound level meter from this calibration is over 1dB in a measurement series, then the noise measurement procedure is considered to be inaccurate.

A.1.1.2. Vehicle velocity and engine speed measurement

Rotating speed of engine and velocity of vehicle on testing road should be measured with deviation of ±3%

A.1.2. Measurement condition

A.1.2.1. Test area

It is required to have a flat and smooth road for accelerating speed at the middle of test area. Road length for accelerating speed should be horizontal located, dry and be designed in such a way that rolling movement of wheel causes low noise.

On test area and in free acoustic field, change in sound source at the middle portion of road and microphone should be remain within 1dB. This requirement can be met if there are not any sound reflection objects such as fence, bridge or building within area far from center line of test road not over 50m. Microphone should not be barred at any directions which can affect the acoustic field. Nobody is allowed to stand between microphone and sound source. Measurement controller should not stand at any place affecting readings on the meter. Road surface on test area should meet requirement in Annex C.

A.1.2.2. Other requirements

It is not allowed to implement the measurement in bad weather condition. It is required to ensure that result of the measurement is not affected by gust wind.

For measuring, noise (at frequency A) from sound source other than vehicle and wind should be less than vehicle's noise at least 10dB (A). It is able to install on wind-proof ball (one kind of windproof shield) under condition that its influence on sensitivity and direction characteristic of microphone is considered.

For noise measurement, if difference between surrounding noise and measured noise is within 10dB(A) to 16dB(A), then measured noise should be deducted a suitable adjusted value as in chart in Figure A.1.

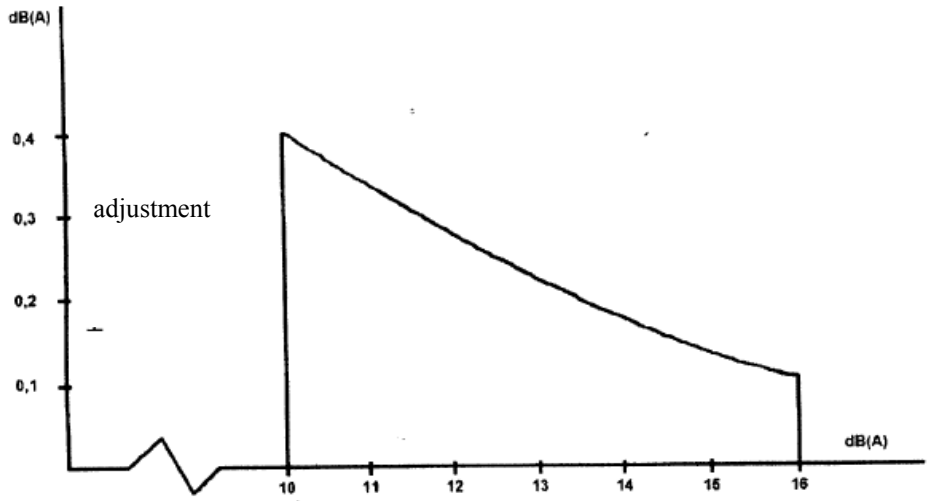


Figure A.1 - Adjustment of noise difference

A.1.2.3. Vehicle condition

A.1.2.3.1. Total weight of driver and test equipment on vehicle should be within 70kg to 90kg. If total weight is not equal to 70kg, it is required to add more weight to have adequate value.

During measurement, the vehicle should be equipped as in normal working condition on road (such as cooling liquid, lubricating oil, fuel, tool set, spare wheel and driver).

A.1.2.3.2. Vehicle tyre should be of right size and pumped to pressure level stated for moped in unload condition.

A.1.2.3.3. Before measurement, vehicle's engine should be in normal working condition in term of temperature, control parameters, sparking plug, carburetor and other components.

A.1.2.3.4. If vehicle contains equipments not necessary for its pulling power but required to use on road, those equipments should be in working condition in compliance with regulations of manufacturer.

A.1.3. Test method

A.1.3.1. Noise measurement for moving vehicle

A.1.3.1.1. General condition of measurement

A.1.3.1.1.1. It is required to carry out two measurements at each side of vehicle. It is allowed to have preliminary measurement for adjusting vehicle but the results will not be used.

A.1.3.1.1.2. Microphone should be placed far from standard line CC' a distance of 7.5m± 0.2m along line PP' (See Figure A.2) at a height of 1.2m±0.1m compared with test surface. Microphone should be pointed to line CC' and perpendicular to that line.

A.1.3.1.1.3. It is required to mark on test road two line of AA' and BB' which are far from line PP' about 10m from AA' forward and from BB' backward. The vehicle should access to line AA' at a constant velocity which is initially stated in following. When the vehicle reaches the line AA', throttle should be opened as quickly as possible and remained at that state until the vehicle's end touches line BB', then the throttle should be closed to the position corresponding with minimum unload speed of engine.

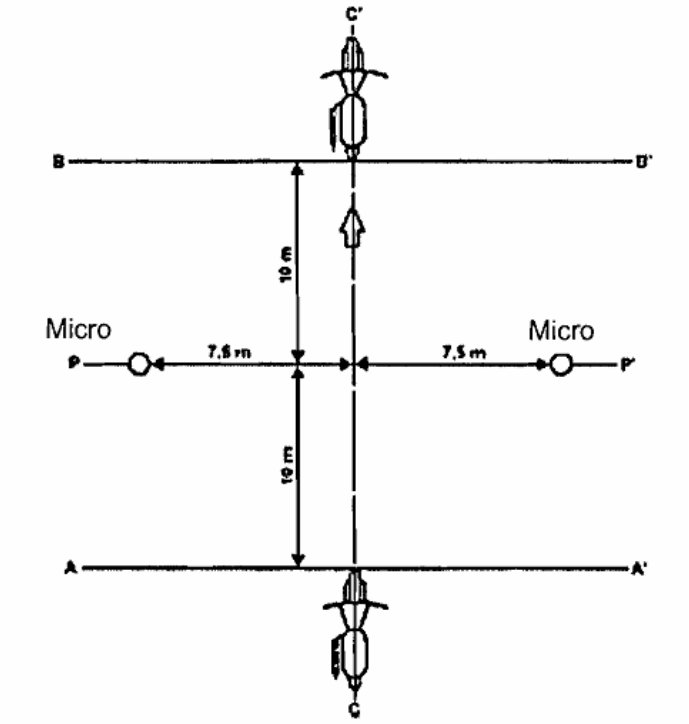


Figure A.2 – Noise measurement of moving vehicle - Measurement positions of microphone

For all measurements, vehicle should run on a straight track on the whole accelerating road, at the mean time the median plane along vehicle should be as close to CC' line as possible.

A.1.3.1.1.4. Maximum noise value of each measurement should be used for calculating measurement result. Results obtained from two consecutive measurements at the same vehicle side with difference not over 2dB(A) will be considered to be valid value for test report.

A.1.3.1.2. Accessing velocity determination

A.1.3.1.2.1. Accessing velocity

Vehicle should access line AA' at a constant velocity equivalent to maximum vehicle velocity if this value does not exceed 30km/h. If vehicle velocity does exceed 30km/h, the vehicle should access line AA' at a constant velocity of 30km/h.

A.1.3.1.2.2. For vehicle equipped with manual gearbox, it is required to select maximum gear when vehicle runs on AA' line with an engine speed not lower than ½ velocity equivalent with maximum engine speed.

A.1.3.1.2.3. For vehicle equipped with automatic gearbox, vehicle should run at velocity stated in A.3.1.2.1.

A.2. Noise measurement for parked vehicle

For convenience when measuring noise of circulating vehicle, the noise should be measured in surrounding area of exhaust pipe according to following requirements. Result obtained should be recorded in test report as in 5.2.1.2.

Sound level meter should be equipment stated in A.1.1.1.

A.2.1. Test area – Surrounding condition (see Figure A.3)

A.2.1.1. Measurement should be carried out when vehicle is parked at a site with inconsiderable acoustic interference.

A**.2.1.2**. Each space with flat surface, covered with concrete, asphalt concrete or other solid material with high acoustic reflection, except for compacted ground surface, can be considered to be test area. Test area should be in rectangular shape of which each side will be far from external edge of vehicle (excluding steering wheel) at least 3m. There should be no considerable acoustic reflection object within this rectangular area, except driver and tester. Especially, vehicle should locate inside this area so that microphone for noise measurement is far from edges of this area at least 1m.

A.2.1.3. There should not be anyone within test area except for driver and tester of which appearances do not affect readings on the meter.

A.2.2. Requirements for surrounding noise and wind

Measured noise (at frequency A) of surrounding acoustic sources and wind should be lower than vehicle noise at least 10 dB(A).

A.2.3. Measurement method

A.2.3.1. Nature and number of measurements

Maximum noise dB(A) should be measured in vehicle's operation mode as in A.2.3.3.2.1. There should be at least three measurements at each test position.

A.2.3.2. Position and vehicle preparation

Before measurement, vehicle engine should be initiated and vehicle reaches normal working temperature. For vehicle equipped with automatic fan system, that system should not be adjusted during noise measurement.

Before measurement, gearbox should be at intermediated gear (gear 0). If it can not cut power transmission, driving wheel of vehicle should be freely rotated, i.e. by leaning vehicle on middle support.

A.2.3.3. Noise **measurement near exhaust pipe**

A.2.3.3.1. Microphone position (see Figure A.3)

A.2.3.3.1.1. Microphone should be placed at a position equal to exhaust pipe, but in all cases should not be greater 0.2m from vehicle parking ground.

A.2.3.3.1.2. Microphone should be pointed to exhaust mouth and far from it about 0.5m.

A.2.3.3.1.3. Microphone axle with highest sensitivity should be placed in parallel with vehicle parking surface and form with vertical plane of direction of exhaust air an angle of $45^{o}\pm$ 10'. Relating to this vertical plane, microphone should be placed at the greatest distance from median plane along vehicle or if not certain, from outer edge of vehicle.

A.2.3.3.1.4. If exhaust system contains more than one exhaust pipe mouth of which center lines are far from each other under 0.3m, then microphone should be faced to the mouth nearest vehicle (except for handle of steering wheel) or toward the mouth at highest position from vehicle parking surface.

A.2.3.3.1.5. If center lines of exhaust mouth are far from each other over 0.3m, there should be independent measurement for each exhaust mouth; the highest value will be valid result.

A.2.3.3.2. Vehicle operation condition

A.2.3.3.2.1. Engine speed should be stable within one of two following values:

+ S/2, if S is greater than 5000 r/min.

+ 3S/4, if S is not greater than 5000 r/min.

Where S is engine speed corresponding with maximum output of engine.

A.2.3.3.2.2. When reaching constant engine speed, throttle should immediately be turned back to original position where engine operates at minimum unload rotating condition. Noise measurement should be implemented in both operation conditions including a short time when engine speed is constant and in above decelerating operation, the highest value will be the test result.

A.2.3.3.2.3. Measurement results should be rounded to nearest integral value dB and should be read out from measurement instrument. If the first decimal number is from 1 to 4, reading value will be rounded down, if it is from 5 to 9, the reading value will be rounded up.

Only results obtained from three consecutive measurements with difference not over 2dB are considered valid result.

Highest value in above measurement values is result of noise test.

A.2.3.3.2.4. Processing measurement result of moving vehicle

Measurement results should be rounded to nearest integral value dB. If the first decimal number is from 1 to 4, reading value will be rounded down, if it is from 5 to 9, the reading value will be rounded up.

Only results obtained from two consecutive measurements at each side of vehicle with difference not over 2dB are considered valid result.

In considering inaccuracy of measurement instrument, above measurement results should be subtracted 1dB(A).

If average value of four results obtained is not greater than maximum acceptable noise for vehicle equivalent to test vehicle, this value will be considered to meet requirements of this standard stated in Table 1. This average value will be test noise result.

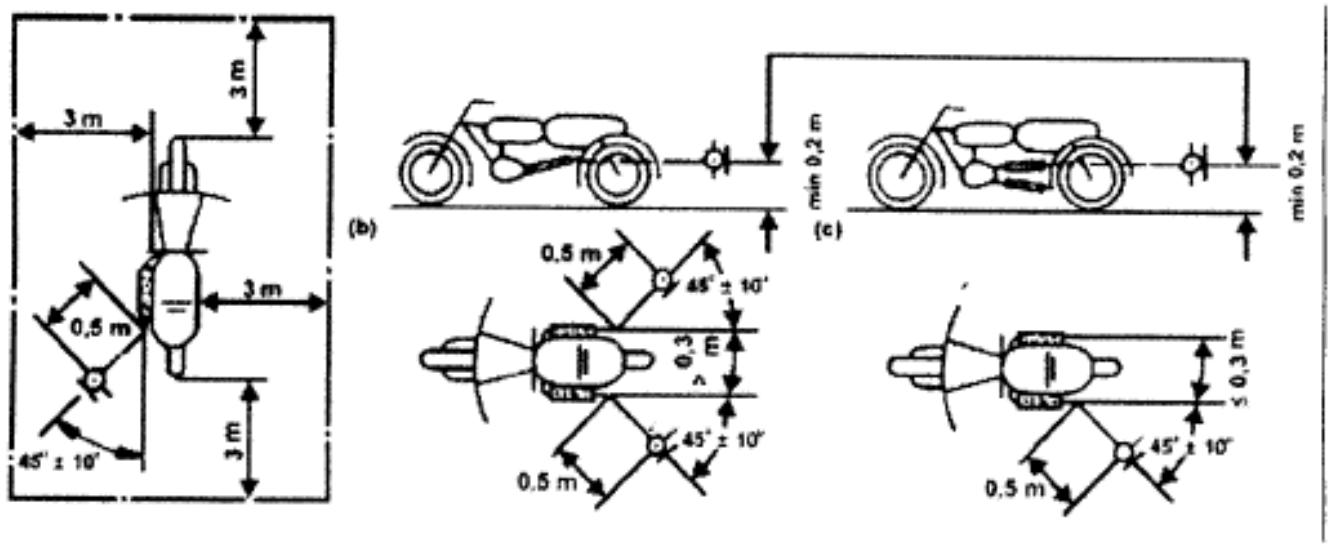


Figure A.3 – Test area and position of microphone for measuring noise of parked two-wheeled vehicle

Part II. For three-wheeled vehicle

A.3. Instrument and condition for measurement

Instrument and condition for measurement are the same as in A.1.1 and A.1.2.

Besides, three –wheeled vehicle taking the noise measurement should be unloaded and have not trailer or semi-trailer.

A.4. Measurement method

A.4.1. Noise measurement for moving vehicle

A.4.1.1. **Nature and number of measurements**:

Maximum noise dB(A) should be measured when vehicle is running between line AA' and BB' (Figure A.2). Measurement will be invalid if abnormal difference between top value and general noise level is recorded

There should be two noise measurements for each side of vehicle.

A.4.1.2. Microphone location: as in A.1.3.1.1.2.

A.4.1.3. Vehicle operation condition

Vehicle should access line AA' at originally constant velocity stated in following presentation. When the vehicle reaches the line AA', throttle should be opened as quickly as possible and remained at that state until the vehicle's end touches line BB', then the throttle should be closed to the position corresponding with minimum unload speed of engine.

For vehicle having semi-trailer permanently connected to form an integral group, vehicle's tail to reach BB' line should not be tail of semi-trailer, but real tail of the vehicle.

A.4.1.4. Measurement values should be rounded to nearest integral value dB and should be read out from measurement instrument. If the first decimal number is from 1 to 4, reading value will be rounded down, if it is from 5 to 9, the reading value will be rounded up.

Only results obtained from three consecutive measurements with difference not over 2dB are considered valid result.

Measurement result should be determined as regulated in A.5.

A.4.1.5. Determination of constant velocity

A.4.1.5.1. For vehicle without gearbox

Vehicle should access line AA' at a constant velocity corresponding with minimum value among following velocity values:

1) Vehicle velocity when engine speed equal to 75% maximum engine output.

2) Vehicle velocity when engine speed equal to 75% maximum engine speed allowed by transmission governor.

3) Vehicle velocity equal to 50km/h.

A.4.1.5.2. Vehicle with manual gearbox

For vehicle having manual gearbox with 2 to 4 gears, it is required to use the second gear. For vehicle

having gearbox with over 4 gears, it is required to use the third gear. If this application of gear lead to situation that engine speed exceeds maximum acceptable speed, then it is required to use the adjacent higher gear than the second or third gear, which should ensure to have this speed situation not longer than the time the vehicle run through line BB' of test area. It is not able to use auxiliary gear with accelerating transmission ratio (accelerating gear). For vehicle having difference with two transmission ratios, then ratio selected should be the one allowing the vehicle to run at greatest velocity.

A.4.1.5.3. Vehicle with automatic gearbox

Vehicle should access line AA' at constant velocity equivalent to minimum value among following velocity values:

1) Vehicle velocity equal to 75% of maximum velocity

2) Vehicle velocity equal to 50km/h.

If there is any position of forward gear, that gear should be selected and lead to maximum average acceleration of vehicle between line AA' and line BB'. Location of gear at which it is only used to brake, to park or run slowly should not be used.

A.4.2. Noise measurement of parked vehicle

A.4.2.1. Noise when measuring near vehicle

To be convenient for measuring noise of circulating vehicles, it is required to measure noise at surrounding area of exhaust pipe (silencing system) under following requirements. Result should be noted in test report.

A.4.2.2. Measurement condition

A.4.2.2.1. Vehicle condition

Before measurement procedure, vehicle's engine should be ignited and vehicle reaches normal working temperature. If vehicle is equipped with automated fan system, this system should not cause any influence during the measurement.

During the measurement, it is required to place gearbox at intermediate gear (gear 0).

If it is not able to stop force transmission, driving wheel of vehicle should freely rotate, i.e. by leaning vehicle on middle support or rollers.

A.4.2.2.2. Test area

Any area without considerable sound interfering object can be used as test area. Surface of test area should be flat, covered with concrete, asphalt concrete or other solid material with high sound reflection. It is not allowed to use compacted ground surface. Test area should be in rectangular shape of which each side will be far from external edge of vehicle (excluding steering wheel) at least 3m. There should be no considerable sound reflection object within this rectangular area, except driver and tester. Vehicle should locate inside this area so that microphone for noise measurement is far from edges of this area at least 1m.

A.4.2.2.3. Other requirements

Noise measured (at frequency A) from surrounding sound source and wind source should be less than vehicle's noise at least 10dB (A). It is able to install on wind-proof ball (one kind of windproof shield) under condition that its influence on sensitivity and direction characteristic of microphone is considered.

A.4.2.3. Measurement method

A.4.2.3.1. Number of measurements

Measurement should be implemented at least three times at each position. Maximum noise (dB(A)) should be measured during operation of vehicle stated in A.4.2.3.3.

Only result of three consecutive measurement at the same side of vehicle with difference not over 2dB(A) is considered to be valid. Maximum value in this measurement procedure will be accepted.

A.4.2.3.2. Microphone position

As stated in A.3.2.3.3.1 (see Figure A.4).

A.4.2.3.3. Operation condition

As stated in A.3.2.3.3.2.

Measurement results should be rounded to the nearest dB value and should be read out from the measurement instrument. If the first decimal number is from 1 to 4, then result will be rounded down, if this number is from 5 to 9, the result will be rounded up.

Only result of three consecutive measurement at the same side of vehicle with difference not over 2dB(A) is considered to be valid. Highest value in this measurement procedure will be test result.

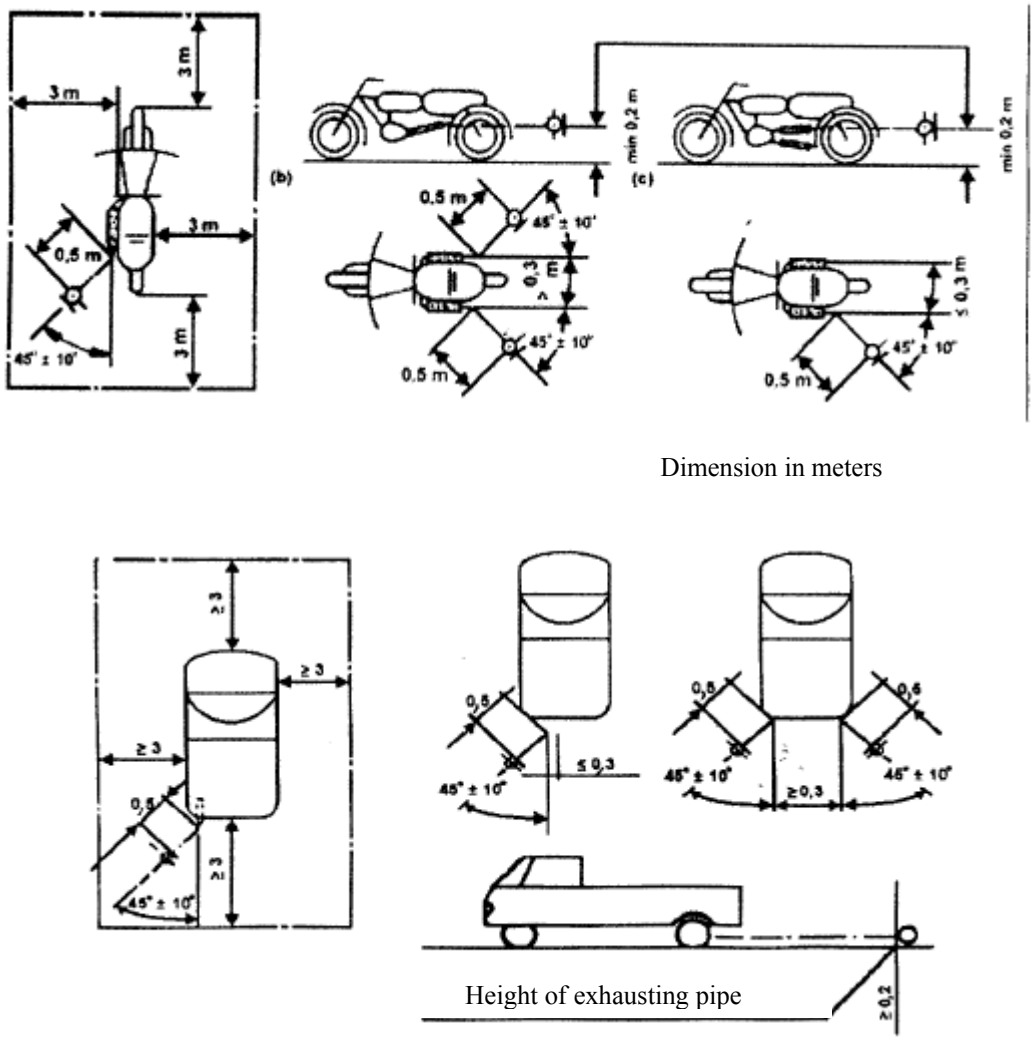


Figure A.4- Microphone positions for noise measurement of parked vehicle

Height equal to exhausting pipe center line.

A.5. Processing measurement results for moving vehicle

A.5.1. Test report should present all environmental factors which can affect the result.

A.5.2. Measurement results should be rounded to the nearest dB value. If the first decimal number is from 1 to 4, then result will be rounded down, if this number is from 5 to 9, the result will be rounded up.

Result of two consecutive measurements at the same side of vehicle with difference not over 2dB(A) is considered to be valid and should be presented in test report.

A.5.3. To estimate inaccuracy in measurement, result of each measurement should be equal to result obtained in A.5.2 subtracted to 1dB (A).

A.5.4. If average value of four measurements (each vehicle side providing two results) which are obtained in A.5.3 does not exceed noise limitation value for vehicle type corresponding with tested vehicle, then this value is considered to meet requirement of this standard stated in Table 1. This average value will be result of noise test measurement.

ANNEX B

(Regulated)

Exhaust system (silencing system) containing fiber material

B.1. Fiber absorption material should not be asbestine and should be used to manufacture silencing system only when there is suitable component ensuring that fiber material is remained in its position during the whole time using silencing system. This type of material should also meet requirements in B.1.1, B.1.2 and B.1.3.

B.1.1. After removing fiber material out of silencing system, noise should meet requirements in Annex A and noise limitation stated in Table 1.

B.1.2. Fiber absorption material can be excluded in components of silencing system which has exhaust pipe running through and should be in compliance with following requirements:

B.1.2.1. Material should be heated to a temperature of 650^{o}C±5^{o}C in four hours in oven without being reduced in length, diameter and fiber bulk density.

B.1.2.2. After heating at temperature of 650^{o}C±5^{o}C in one hour in oven, at least 98% of material still remaining in the sieve with nominal mesh dimension of 250µm in compliance with TCVN ISO 3310/1: 1990 when testing in accordance with ISO 2599.

B.1.2.3. Loss in material mass should not exceed 10.5% after soaking this material in a temperature of 90^{o}C± 5^{o}C in about 24 hours in a condensation mixture of following components:

1N hydrobromic acid (HBr): 10ml

1N sulphuric acid (H_2SO_4): 10ml

Distilled water for mixing: up to 1000ml.

NOTE: Material should be washed in distilled water and dried at a temperature of 105^{o}C in one hour before weighting.

B.1.3. Before system is tested in accordance with Annex A, it should be brought into normal working condition on road by one of following normalization methods:

B.1.3.1. **Normalization by continuous running on road**

B.1.3.1.1. Minimum road length for a vehicle to run in normalization is:

Table B.1 – Running road of vehicle

Two-wheeled vehicle	Three-wheeled vehicle
2000 km	4000 km

B.1.3.1.2. Stage equal to 50% ±10% of this normalization includes two runs in city and the rest is long-distance running at high speed; running on continuous road can be replaced by running on equivalent test road.

B.1.3.1.3. These two velocity conditions should be alternated at least in six times.

B.1.3.1.4. An adequate testing program should consist of minimum 10 resting times in at least three hours to reproduce influence of cooling and condensation.

B.1.3.2. Normalization by vibration

B.1.3.2.1. Exhaust system or its components should be connected to vehicle or vehicle engine. In first condition, vehicle should be place on rolling test panel. Test instrument having detail diagram in Figure

B.1 should be installed at output of exhaust system. It is able to use other instruments if providing equivalent results.

B.1.3.2.2. Test instruments should be adjusted so that alternating exhaust air is cut and reproduced by a quick-action valve in 2500 times.

B.1.3.2.3. The valve should be opened when exhaust back pressure has value within 0.35bar and 0.40 bar when measured at a position from rear end of input flange (Figure C.1) a minimum distance of 100mm. If it is unable to obtain this value due to engine characteristic, valve should be opened when back pressure reaches an equivalent value of 90% the maximum value measured before engine stops. Valve should be closed when this pressure does not differ over 10% of its stable value before valve opening.

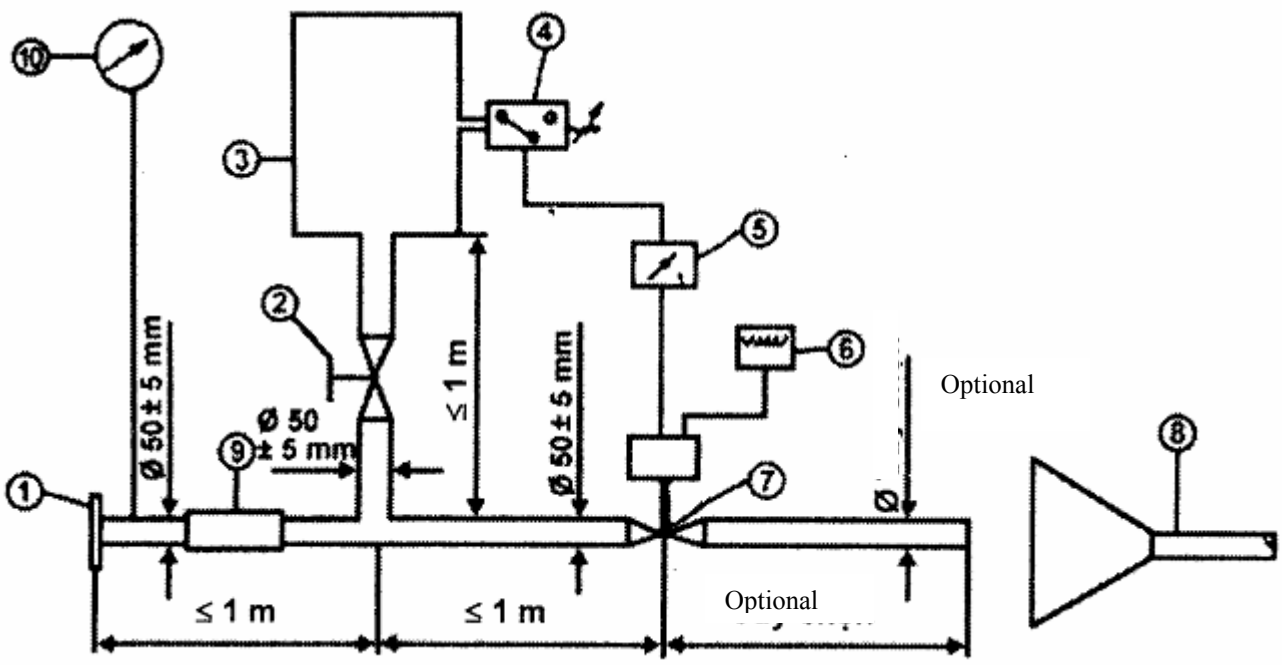
B.1.3.2.4. Time delay switch should be set for time existing of exhaust air calculated basing on requirements in C.1.3.2.3.

B.1.3.2.5. Engine speed should equal to 75% of S speed corresponding with maximum engine output.

B.1.3.2.6. Indicated power on test panel should equal to 50% of throttle full open power measured at a speed of 75% of S speed.

B.1.3.2.7. All drain opening should be closed during the test.

B.1.3.2.8. All tests should be finished within 48 hours. If necessary, there should be one cooling state after each hour.



1. Input flange or ferrule to join with rear of test exhaust system.
2. Manual control valve.
3. Additional container with maximum capacity of 40l.
4. Pressure switch with working range from 0.05bar to 2.5bar.
5. Time delay switch
6. Pulse counter

7. Quick-action value, such as exhaust break valve with diameter of 60mm, activated by a compressed air container with active force of 120N at a pressure of 4 bar. Responding time including in opening and closing should not be greater than 0.5s.

8. Bringing exhaust air out.

9. Flexible pipe.

10. Pressure gauge.

Figure B.1 – Test instrument for normalization by vibration

B.1.3.3. Normalization by running on test panel

B.1.3.3.1. Exhaust system should be installed on engine represented for engine type used for vehicle having designed exhaust system, then engine/vehicle will be placed on test panel.

B.1.3.3.2. Normalization process includes a running on test panel stated in C.1.3.3.4 for each vehicle type having designed exhaust system. Number of running cycles on test panel for each vehicle type is presented in Table B.2.

Table B.2 – Number of running cycles for two-wheeled and three-wheeled vehicle

Two-wheeled vehicle	Three-wheeled vehicle
3	6

B.1.3.3.3. After each running cycle, there should be a resting stage in at least six hours to reproduce influence of cooling and condensation.

B.1.3.3.4. Each running cycle on test panel has six phases. Conditions for engine and time of each phase are presented in Table C.3.

Table B.3 – Conditions for engines and time of each phase

Phase	Condition for engine	Time of each phase (minute)
1	Minimum unload	6
2	25% load at 75% S	40
3	50% load at 75%S	40
4	100% load at 75%S	30
5	50% load at 100%S	12
6	25% load at 100% S	22
Total time		**150**

B1.3.3.5. During this normalization, under requirements of manufacturer, engine and silencing system can be cooled so that temperature at position from exhaust mouth not over 100mm does not exceed measured value when vehicle operates at highest gear with velocity of 110km/h or engine speed of 75% S. Engine speed and/or vehicle is determined with error of ± 3%.

B.2. Silencing system in input

If it is required to install an air filter and/or silencing system in engine input to be in compliance with noise limitation, that air filter and/or silencing system should be considered to be one component of vehicle silencing and therefore should meet requirements in B.1.

ANNEX C

(Regulated)

Requirements for test area

C.1. Introduction

This Annex presents requirements related to physical characteristics and arrangement of test lines. These requirements base on special standard [2)] which describes essentially physical characteristic as well as test methods for these characteristics.

C.2. Surface characteristics

Surface is considered to be in compliance with this standard if its structure and void or sound absorption coefficient are proved to meet all requirements from C.2.1 to C.2.4 and meet designing requirements (C.3.2).

C.2.1. Residual void ratio

Residual void ratio, Vc, of material compound for paving test line should not be greater than 8%. For measurement procedure, see C.4.1.

C.2.2. Sound absorption coefficient

If surface does not meet requirement for residual void ratio, that surface will only be accepted when sound absorption coefficient $\alpha \leq 0.10$.

NOTE: The most related characteristic is sound absorption coefficient despite that residual void ratio is more popular for road builder. However, it is required to measure sound absorption coefficient only when the surface is not compliant with requirement for residual void ratio. That is because void ratio relates to many uncertainties in time manner of the two measurements, then some surfaces can be wrongly dismissed when basing only on void measurement.

C.2.3. Structure depth

Structure depth (TD) measured by volume method (see C.4.3) should $\geq$ 0.4mm

C.2.4. Uniformity

Practically, it is required to ensure test surface in test area as uniform as possible. This includes uniformity in structure and void ratio, but it is also required to check out the surface to find whether the rolling compaction gives different impact at different positions then the structure can be different and unevenness causing hard shock for vehicle can also happen.

C.2.5. Periodical examination

To check whether the surface still meet requirement for structure and residual void ratio or sound absorption coefficient stated in this standard or not, it is required to implement periodical examinations at following periods:

a) For residual void ratio or sound absorption coefficient:

+ When the surface is newly formed

+ If the surface does meet requirements when it is new, it is not required to have periodical examination. Otherwise, it is able to check later because surface tends to be close and compacted over time.

b) For structure depth (TD)

+ When the surface is new.

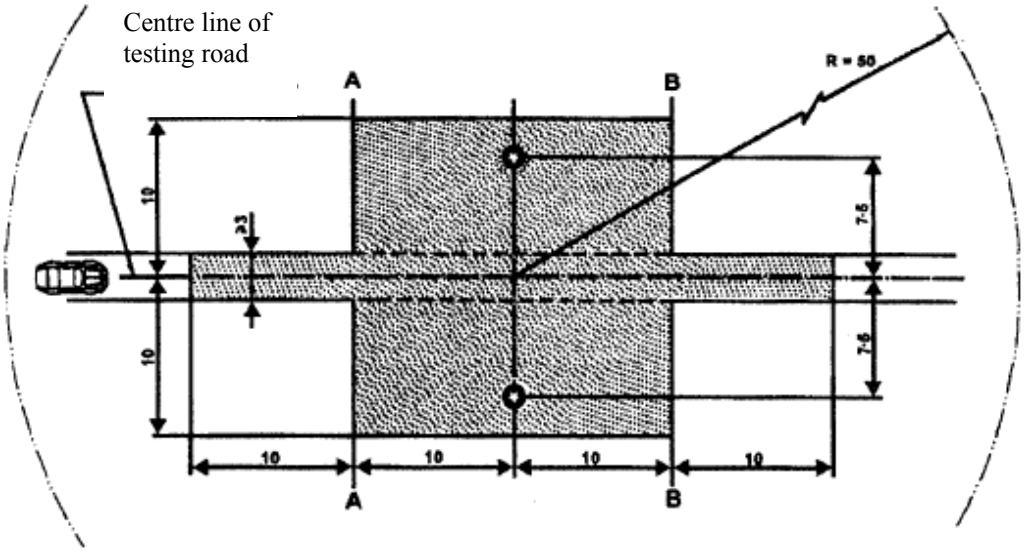
+ When starting noise test (not less than four weeks after covering the surface)

+ The next period for examination is 12 months.

C.3. Test surface design

C.3.1. Area

For generally designing test lines, the important point is to ensure that area passed by vehicle on test line is covered by test material regulated for road for safe driving and practically. This requires a width of test line of at least 3m and a length exceeding line AA' and BB' at least 10m at each end. Figure B.1 presents a chart of a suitable test side and indicates the minimum area for being built by road paving machine and compacting machine with regulated test material. According to A.1.3.1.1.1, measurements should be carried out at each side of vehicle. This can be implemented by measuring with two microphones (each one at a side of test line) and driving the vehicle in one direction or by measuring with a microphone but driving vehicle in both directions. For later situation, it is not required to apply surface requirement for the test line without microphone.



Note: Minimum area with testing line (testing area)

Positions of microphone (height of 1.2m)

NOTE: It is not allowed to have big-size noise reacting objects within radius of this area

Figure C.1 - Minimum requirements for area of test surface

Dark portion is called "test area"

C.3.2. Surface design and preparation

C.3.2.1. Basic design requirements

Test surface should meet four design requirements:

C.3.2.1.1. Solid asphalt concrete

C.3.2.1.2. Maximum dimension of stone covering surface should be 8mm (allowable deviation from 6.3mm to 10mm).

C.3.2.1.3. Thickness of road cover should not be less than 30mm.

C.3.2.1.4. Binding material should be directly penetrated asphalt without property changeability.

C.3.2.2. Design instruction

For instructing builder of test surface, aggregate characteristic line in Figure B.2 will provide desire characteristics. Besides, Table B.1 will provide some instructions to obtain required structure and strength. Aggregate characteristic line is compliant with following formula:

$$P(\%\ \text{sieving}) = 100x\ (d/d_{max})^{1/2}$$

Where:

d: dimension of side of square sieve mesh, in millimeter.

d_{max}: 8mm for middle curve

d_{max}: 10mm for lower deviation curve

d_{max}: 6.3mm for upper deviation curve.

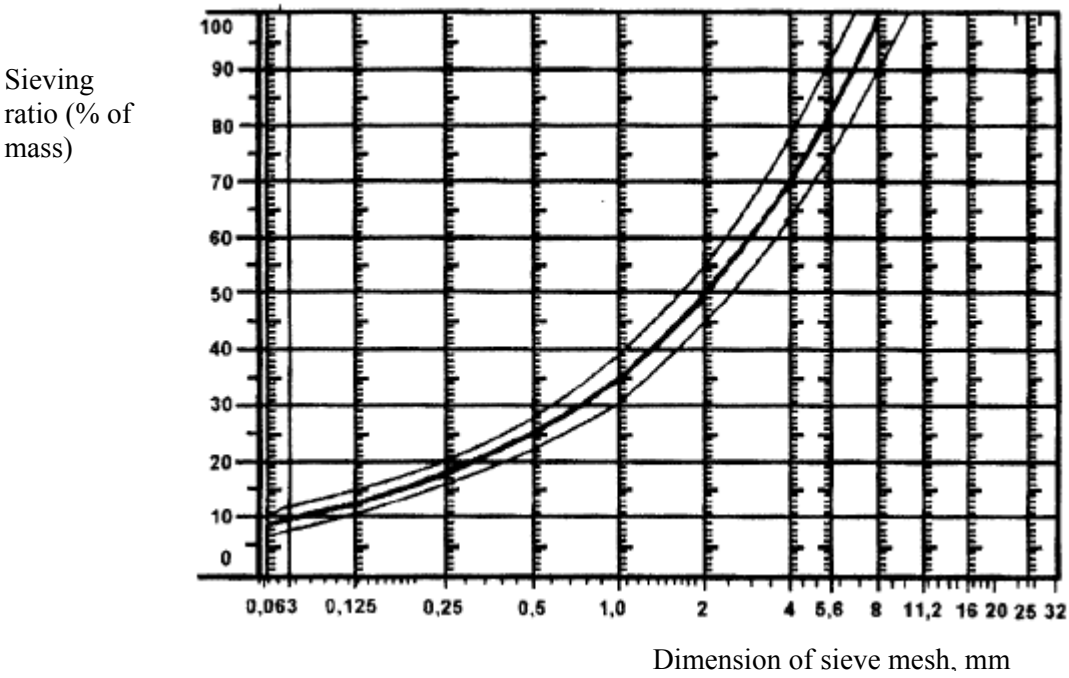


Figure C.2 – Aggregate characteristic line (with deviation) in asphalt concrete compound

In addition to above requirements, it is recommended that:

a) Sand fragmentation (0.063mm < (dimension of side of square sieve mesh, SM) <2mm) should include at least 45% fined sand and not greater than 55% of natural sand.

b) Ground and bedding should be ensured to have stability and good evenness, meeting requirement for the best road structure.

c) Road metal should be crushed (100% crushed for surface) and be made of material with high crushability;

d) Road metal using in compound should be cleaned.

e) It is not allowed to add road metal on surface;

f) Solidness of binding material (unit of PEN) should be equal to 40-60, 60-80 or even 80-100, depending on climate condition. Binding material is more solid is better but still in compliance with general regulation;

g) Compound temperature before rolling should be selected to obtain residual void ratio at the next rolling. To increase ability to meet requirement in B.2.1 to B.2.4, compactness should be

examined not only by selection of proper compound temperature but also by suitable number of sieving granular and selection of rolling machine.

Table C.1 – Instruction for designing

	Target values		Tolerance
	According to total mass of compound	According to aggregate mass	
Mass of stone going through square sieve mesh (SM)>2mm	47.6%	50.5%	±5
Sand mass, 0.063<SM<2mm	38.0%	40.3%	±5
Filer mass, SM >0.063mm	8.8%	9.3%	±5
Binding material mass (asphalt)	5.8%	-	±5
Maximum dimension of road metal	8mm		6.3 – 10
Solidness of binding material	(See B.3.2.2(f))		-
Polished stone value (PSV)	> 50		-
Compactness, compared with Marshall compactness	98%		-

C.4. Test method

C.4.1. Residual void ratio measurement

According to this measurement aim, samples (cylindrical shaped, pear-shaped…) should be taken from test line at minimum four positions of even distance among test area between AA' and BB' (see Figure C.1). To avoid non-uniformity and unevenness of vehicle wheel treads, samples should not be taken directly from wheel treads but adjacent to them. At least two samples will be taken adjacently to wheel treads and at least one sample should be taken near the middle line of wheel tread and microphone positions.

If arising any doubt that uniformity requirement is not satisfied (see C.2.4), it is required to take samples at more positions in test area.

Residual void ratio should be determined for each sample then an average value will be determined and compared with requirements in C.2.1. Besides, there should be no sample having void ratio over 10%. Builder of test surface should take into account possible problems when test area has heat application from pipes and electrical wires and samples should be taken from this area. For such arrangement, it is required to have careful planning relating to future sampling positions. It is suggested to leave some positions with dimension equivalent to 200mm x 300mm of which there should not be any wire/pipe or pipes should be installed deeply enough to prevent any damage caused by surface sampling.

C.4.2. Sound absorption coefficient

Sound absorption coefficient (perpendicular incidence) should be measured by impedance tube as regulated in ISO 10534.

It is required to follow all regulations related to samples the same as to satisfy all requirements related to residual void ratio (see C.4.1). Sound absorption coefficient should be measured in frequency band of 400Hz to 800Hz and frequency band from 800 Hz to 1600Hz (at least at frequency values among eighth frequency domain) and maximum value should be determined for both these frequency bands. Then these values for all samples should be averaged to have final result.

C.4.3. Measurement for great structure by volume

According to this standard's aim, measurement for surface structure depth should be implemented at minimum ten positions of even distance along wheel tread of test line. Values of these measurements then should be averaged to compare with regulated minimum surface structure depth. See ISO 10844 for detail of measurement procedure.

C.5. Chronological stability and maintenance

C.5.1. Life influence

Similar to other surfaces, tyre /road noise can be increased a little after construction in a time period of the first 6 to 12 moths. At least in four weeks, surface will satisfy all requirements after construction.

Chronological stability is mainly determined by smoothness and compactness when vehicle running on surface. It should be periodically examined as in C.2.5.

C.5.2. Surface maintenance

Fragments or dust which can reduce considerably structure depth should be removed from surface. In areas with cold climate, sometimes people use salt to defrost but this should be restricted because salt can temporarily or permanently change surface structure causing noise increase.

C.5.3. Repaving surface of test area

For requirement of repaving surface of test area, generally it is not required to repave a surface greater than test track (about 3m in width as in Figure C.1) if test area outside that track still meet requirements for residual void ratio or sound absorption coefficient when measurement.

C.6. Documents for test surface and test methods on this surface

C.6.1. Documents for test surface

Following data should be presented in document describing test surface:

C.6.1.1. Position of test road

C.6.1.2. Type of binding material, solidness of binding material, type of aggregate, maximum theoretical density of concrete (DR), thickness of hardwearing layer and aggregate supply curve determined from samples taken from test road.

C.6.1.3. Compaction method (type of roller wheel, weight of roller wheel, time of rolling)

C.6.1.4. Mixture temperature, surrounding climate and wind velocity during surface pavement.

C.6.1.5. Date of surface pavement and bidder.

C.6.1.5.1. Residual void ratio of each sample.

C.6.1.6.2. Positions of test area where samples are taken for residual void ratio measurement.

C.6.1.6.3. Sound absorption coefficient of each sample (if measurement). Result determination for each sample, each frequency band as well as average value.

C.6.1.6.5. Structure depth, including number of tests and standard error.

C.6.1.6.6. Authority for testing in B.6.1.6.1 and B.6.1.6.2 and type of applied instrument.

C.6.1.6.7. Date of test and date of sampling for test track.

C.6.2. Document of noise test implementation on surface

It is required to present whether all requirements of this standard are met or not. Refer document to C.6.1 to describe all result confirming this information.