

Light Vehicle Inspection Manual

Appendix Q Stationary Noise Test

Appendix Q - Stationary Noise Test

National Stationary Exhaust Noise Test Procedures for In-Service Motor Vehicles – September 2006

Report Prepared by: National Transport Commission on behalf of the Land Transport Environment Committee.



National Transport Commission
ISBN: 1 921168 50 1



FOREWORD

The National Transport Commission (NTC) and the National Environment Protection Council (NEPC) are jointly responsible, through statutory obligations, to develop policy relating to land transport emissions and noise in consultation with each other. This consultation takes place through the Land Transport Environment Committee (LTEC) and this committee includes transport and environmental agencies.

The National Stationary Exhaust Noise Test Procedures (NSENTP) for In-Service Motor Vehicles was first prepared by the Motor Vehicle Environment Committee (MVEC, the precursor to LTEC) in 1999 to introduce a national approach to measuring exhaust noise. Previous to this, some jurisdictions had developed their own approaches and the differences in these approaches could have led to inconsistencies in test results. A nationally uniform approach ensures that vehicle owners will get an accurate assessment of whether their vehicle complies with national noise standards.

The Australian Design Rule (ADR) 83/00 for the external noise of motor vehicles was approved by Ministers in 2003. This new noise emission standard for motor vehicles adopts the UN Economic Commission for Europe (UNECE) Regulations for motor vehicle noise. The UNECE regulations refer to ISO 5130 'Acoustics – Measurement of Sound Pressure Levels Emitted by Stationary Road Vehicles' which provide the noise testing procedures for in-service vehicles. The NSENTP needed to be updated to incorporate elements of ISO 5130.

These test procedures have been approved by the Australian Transport Council and the National Environment Protection Council. They are referred to in the Roadworthiness Guidelines issued under the Australian Vehicle Standard Rules 1999 (Rule 153).

The test procedures should be used by all environment and transport agencies when testing for compliance with Australian Vehicle Standard Rules.

LTEC would like to acknowledge the Environment Protection Authority Victoria for the work in developing this revised draft NSENTP.

1. Definitions

1. 'Diesel Engine' - means an internal combustion engine that operates on the compression-ignition principle.
2. 'Engine Speed at Maximum Power' ('ESMP') - means the speed at which the engine develops maximum power (rpm).
3. 'From Harley-Davidson' - means an engine design or a variant of such a design, of the manufacturer of that name.
4. 'Goods Vehicle' does not include a passenger car or passenger car derivative.
5. 'Motor Cycle' means motorcycle or moped.
6. 'Pre ADR83' vehicle - means a vehicle not originally certified to Australian Design Rule ADR 83/00.
7. 'Spark Ignition' means positive ignition

2. Measuring instruments

1. A sound level meter complying at least with one of the specifications of Standard:
 - a. International Electrotechnical Commission Publication IEC - Category - Class 1 61672-1 Ed. 1.0 (Bilingual 2002) : Electroacoustics - Sound level meters - Part 1: Specifications
 - b. Australian Standard AS IEC 61672.1-2004: Electroacoustics - Category - Class 1 Sound level meters - Specifications
 - c. International Electrotechnical Commission Publication IEC - Category - Type 1 60651 (1979) 'Precision sound level meters'
 - d. Australian Standard AS 1259.1-1990 'Acoustics - Sound level - Category - Type 1 meters Part 1 Non-integrating' shall be used for measurements of noise levels. Measurements must be carried out using frequency weighting 'A' and time weighting 'F'.

Class 2 or Type 2 meters meeting one of the above technical standards may be used for field or conformance purposes however a tolerance of 2dB(A) must be allowed.

2. The sound level meter shall be calibrated against an acoustic calibrator immediately before and after each series of tests of each vehicle tested. If the meter readings obtained from these calibrations differ by more than 1dB(A) the test shall be considered invalid.
3. The rotational speed of the engine shall be measured by either an external tachometer whose accuracy is within 3 percent or where fitted, the vehicle's tachometer.

3. Test Site Ambient Requirements

1. The measurements shall be made in the open air where both the ambient and wind noise levels are at least 10dB(A) below the noise level being measured.

The site may take the form of an open space or beneath a canopy if no part of the canopy or its supports is within 3 metres of the microphone being used in the test.

The test site within 3 metres of the microphone(s) must be substantially flat and may include kerbs, channels, gutter, poles or other objects not providing excessive acoustic reflection provided that no such object is within 1 metre of the microphone.

2. Measurements shall not be made under adverse weather conditions unless the test site is located beneath a canopy meeting the requirements of 3.1 above. Any sound peak that appears to be unrelated to the characteristics of the vehicle shall be ignored in taking the readings. If a windscreen is used, its influence on the sensitivity and the directional characteristics of the microphone shall be taken into account.
3. Whilst testing is in progress no person other than any occupants of the vehicle or, in the case of a motor cycle, the rider, shall be within 1 metre of the microphone in use. No person or object other than the testing officer and an observer or the objects necessary for the performance of the test shall be within 3 metre of the microphone in use.

4. Test method for all vehicles except pre ADR83 in-service goods vehicles and omnibuses.

Microphone position

1. The microphone shall be directed towards the orifice of the exhaust outlet and shall be supported by a tripod or similar device not providing excessive acoustic reflection. The general requirements for positioning microphones are shown in the Appendix.
2. The nominal axis of maximum sensitivity of the microphone shall be substantially parallel to the test site surface and shall make an angle of 45 degrees \pm 10 degrees with the principal direction of gas flow from the exhaust.
3. In selecting the 45 degree alignment from the outlet of a motor vehicle fitted with two or more outlets, only the angle resulting in the microphone being farthest from any other outlet must be used.
4. The height of the microphone above the test site surface shall be equal to that of the orifice of the exhaust outlet \pm 25mm but shall not be less than 200mm above the test site surface.

5. The distance of the microphone from the exhaust outlet orifice shall be $500\text{mm}\pm 25\text{mm}$.
6. In the case of a vehicle fitted with a vertical exhaust, the microphone shall be placed at the height of the exhaust outlet, oriented upwards with its axis vertical. It shall be placed at a distance of $500\text{mm}\pm 25\text{mm}$ from the side of the vehicle nearer to the outlet.
7. For vehicles fitted with one exhaust outlet the microphone shall be placed so that the greatest possible distance is achieved between it and the vehicle.
8. For vehicles fitted with two or more exhaust outlets spaced less than 300mm apart only one microphone position shall be used. That position shall be selected in accordance with the procedure described in the preceding paragraphs in respect of an exhaust outlet that results in the greatest possible distance from the vehicle or where this does not exist, to the outlet that is highest above the ground.
9. For vehicles fitted with two or more exhaust outlets spaced more than 300mm apart, each exhaust outlet shall be treated separately as if it were the only one.
10. Notwithstanding anything to the contrary in the preceding paragraphs if the microphone positioning procedures result in no suitable position due to an obstruction being part of the vehicle or in an obstruction being directly between the microphone and the exhaust outlet, the requirements of paragraphs 4.1.2, 4.1.3 and 4.1.5 may be varied provided the distance from the outlet to the microphone is not less than $500\text{mm}\pm 25\text{mm}$.
11. Despite the preceding paragraphs if the microphone is to be placed so that it is less than 500mm from the engine then the angle between the direction of gas flow and the angle of the nominal maximum sensitivity of the microphone may be altered so that the microphone is more than 500mm from the engine.

Vehicle operation and noise measurement

1. The vehicle shall be stationary with the transmission in “neutral” or, in the case of a vehicle with automatic transmission, with the gear selector in the “park” position if such a position is provided. In the case of a motor cycle, the vehicle shall be held in a substantially vertical position. In the case of a motor cycle having no neutral gear position, measurements shall be carried out with the rear wheel raised off the ground.
2. Before the measurements are begun, the testing officer shall ensure that the engine of the vehicle under test is sufficiently warm to allow the noise testing to be carried out.

3. The engine of the vehicle under test shall be operated in accordance with one of the following procedures:
- i. Where the ESMP for that engine has been determined by the testing authority the engine shall be brought to and stabilised at a speed as close as the testing officer can achieve to:
 - $\frac{1}{2}$ ESMP in the case of a pre ADR83 motor cycle
 - $\frac{1}{2}$ ESMP in the case of any other motor cycle where the ESMP is more than 5000 rpm; or
 - $\frac{3}{4}$ ESMP in the case of any other vehicle.
 - ii. Where the engine speed has been governed by the manufacturer and $\frac{3}{4}$ ESMP cannot be achieved, the test speed shall be 5% below the maximum governed speed.
 - iii. Where the ESMP for that engine has not been determined by the testing authority then the engine shall be brought to and stabilised at a speed as close as the testing officer can achieve to one of the following speeds:

In the case of a passenger car or derivative, if the engine has:

- 5 cylinders or less 4000 rpm
- 6 cylinders and is
 - manufactured before 1995 3200 rpm
 - manufactured in 1995 or later 3600 rpm
- 8 cylinders and is
 - manufactured before 2000 3300 rpm
 - manufactured in 2000 or later 3900 rpm
- more than 8 cylinders 4300 rpm
- If the engine is a rotary engine 4500 rpm

In the case of a motor cycle:

- for a two-stroke engine 3750 rpm
- for a four-stroke engine:
 - from Harley Davidson 2500 rpm
 - from any other manufacturer 3000 rpm

In the case of a goods vehicle or bus, if the engine has:

- 6 cylinders or more 3000rpm
 - 4 cylinders and is
 - manufactured before 1970 - 2500rpm
 - manufactured in 1970 or later - 3500rpm
- iv. Where, in the opinion of the testing officer, the test speed determined by reference to the above is not attainable by the engine then at the maximum speed that the testing officer believes that the engine can be safely tested.
4. A noise level measurement shall then be made. The noise level shall be the maximum level measured between the stabilised test speed and when the throttle is swiftly returned to idle position.
5. The specified procedure shall be repeated until a least three consecutive readings are obtained, each within a range of 1dB(A). For the purposes of this sub-paragraph only, non-integer decibel readings are to be rounded downwards to the nearest whole decibel.

Interpretation of results

1. Where one microphone position is used the noise level of the vehicle shall be the arithmetic mean of the readings specified in paragraph 4.2.4 prior to any rounding process.
2. When the noise level of the vehicle has been calculated, non-integer results shall be conventionally rounded to the nearest whole decibel.
3. Where more than one microphone position is used the noise level at each microphone position shall be determined as if it were the only one as described in 4.3.1. The noise level of the vehicle shall be the higher or highest noise level so calculated.
4. In the case of a pre ADR83 vehicle, if the microphone position is less than 1 metre from the engine compartment of the vehicle the calculated noise level shall be reduced by 2dB(A). Alternately if the mechanical noise of a pre ADR83 vehicle (for example engine or transmission noise) can be shown to increase the measured noise level by 2dB(A) or more, special acoustic shielding may be fitted to mask this source so that the test is carried out on the exhaust noise alone.

5. TEST METHOD FOR PRE ADR83 IN-SERVICE GOODS VEHICLES AND OMNIBUSES

Microphone position

1. The microphone shall be directed towards the orifice of the exhaust outlet and shall be supported by a tripod or similar device not providing excessive acoustic reflection. The general requirements for positioning microphones are shown in the Appendix.
2. The nominal axis of maximum sensitivity of the microphone shall be substantially parallel to the test site surface.
3. The height of the microphone above the test site surface shall be equal to that of the orifice of the exhaust outlet $\pm 25\text{mm}$ but shall not be less than 200mm above the test site surface.
4. The distance of the microphone from the orifice of the exhaust outlet shall be $1050\text{mm} \pm 50\text{mm}$.
5. For vehicles fitted with one exhaust outlet that is at a height above the test site surface of less than 1500mm, the nominal axis of maximum sensitivity of the microphone shall make an angle of 45 degrees ± 10 degrees with the principal direction of the gas flow from the exhaust outlet. In selecting this microphone position the microphone shall be placed so that the greatest possible distance is achieved between it and the vehicle.
6. For vehicles fitted with one exhaust outlet that is at a height above the test site surface of at least 1500mm, the nominal axis of maximum sensitivity of the microphone shall make an angle of 90 degrees ± 10 degrees with the longitudinal centreline of the vehicle. However, if positioning the microphone according to the preceding requirement would result in the microphone being placed in the gas flow from the exhaust outlet then the microphone location may be rotated, in a horizontal plane, no greater than 45 degrees. In selecting this microphone position the microphone shall be placed so that the greatest possible distance is achieved between it and the vehicle.
7. For vehicles fitted with two or more exhaust outlets spaced less than 500mm apart and connected to a single silencer only one microphone position shall be used. That position shall be selected in accordance with the procedure described in the preceding paragraphs in respect of an exhaust outlet that results in the microphone being at the greatest possible distance from the vehicle.
8. For vehicles fitted with two or more exhaust outlets connected to separate silencers or spaced more than 500mm apart, each exhaust outlet shall be treated separately as if it were the only one.
9. Notwithstanding anything to the contrary in the preceding paragraphs if the microphone positioning procedures result in no suitable position due to an obstruction being part of the vehicle or in an obstruction being directly between the microphone and the exhaust outlet, the requirements of paragraphs 5.1.2 and 5.1.3 may be varied.

Vehicle operation and noise measurement

1. The vehicle shall be stationary with the transmission in "neutral" or, in the case of a vehicle with automatic transmission, with the gear selector in the "park" position if such a position is provided.
2. Before the measurements are begun, the testing officer shall ensure that the engine of the vehicle under test is sufficiently warm to allow the noise testing to be carried out.
3. In the case of goods vehicles and omnibuses powered by a diesel engine the engine shall be operated in accordance with the following procedure.
 - a. With the engine at idling speed the accelerator pedal of the vehicle shall be depressed as rapidly as possible and kept fully depressed until the speed of the engine is substantially stable at maximum (or governed) speed. The accelerator pedal shall then be permitted to return to its original position as rapidly as possible and left in that position until the engine has returned to idling speed.
 - b. A noise level measurement shall be made for each microphone position in use by noting the maximum noise level indicated during this procedure.
4. In the case of goods vehicles and omnibuses powered by a spark ignition engine the engine shall be operated in accordance with one of the following procedures.
 - a) Where the ESMP for that engine has been determined by the testing authority, the engine shall be brought to and stabilised at a speed as close to $\frac{3}{4}$ ESMP as the testing officer can achieve;
 - Or**
 - b) Where the ESMP has not been determined for that engine by the testing authority, then the engine shall be brought to and stabilised at as close as the testing officer can achieve to one of the following speeds:

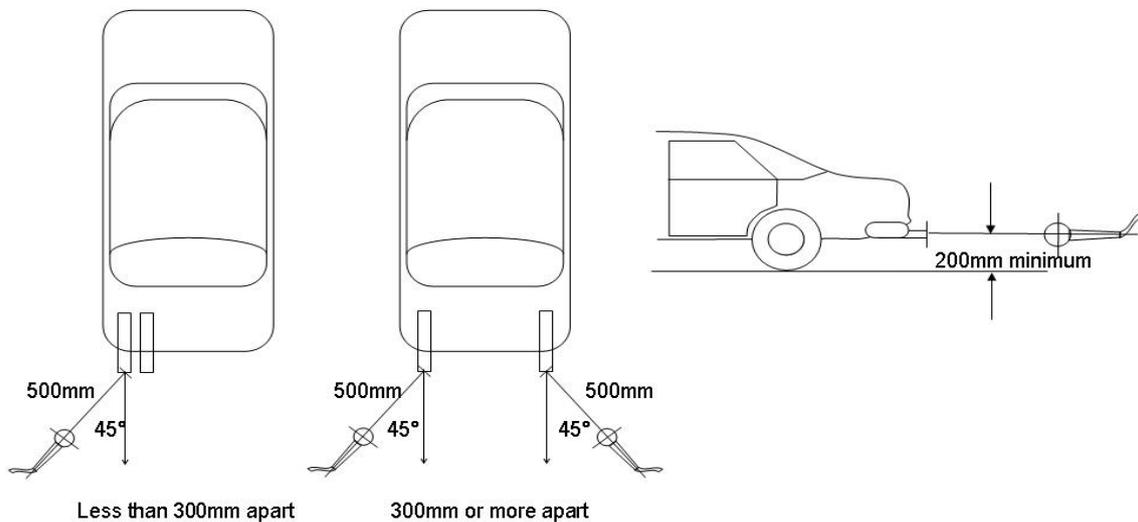
If the engine has:

- I. 6 cylinders or more 3000rpm
 - II. 4 cylinders and is
 - manufactured before 1970 2500rpm
 - manufactured in 1970 or later 3500rpm
 - c) Where, in the opinion of the testing officer, the speed determined by reference to the above is not attainable by the engine then at the maximum speed that the testing officer believes that the engine can be safely tested.
 - d) A noise level measurement shall then be made.
5. The specified procedure shall be repeated until a least three consecutive readings are obtained, each within a range of 1dB(A). For the purposes of this sub-paragraph only, non-integer decibel readings are to be rounded downwards to the nearest whole decibel.

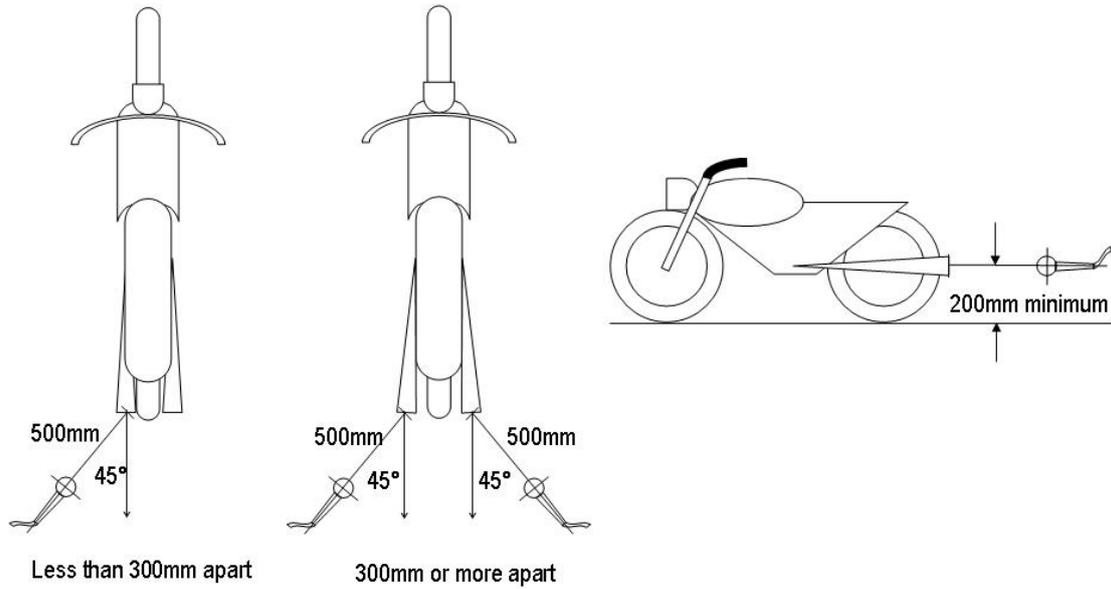
Interpretation of results

1. Where one microphone position is used the noise level of the vehicle shall be the arithmetic mean of the readings specified in paragraph 4.2.4 prior to any rounding process.
2. When the noise level of the vehicle has been calculated, non-integer results shall be conventionally rounded to the nearest whole decibel.
3. Where more than one microphone position is used the noise level at each microphone position shall be determined as if it were the only one as described in 4.3.1. The noise level of the vehicle shall be the higher or highest noise level so calculated.
4. In the case of a pre ADR83 vehicle, if the microphone position is less than 1 metre from the engine compartment of the vehicle the calculated noise level shall be reduced by 2dB(A). Alternately if the mechanical noise of a pre ADR83 vehicle (for example engine or transmission noise) can be shown to increase the measured noise level by 2dB(A) or more, special acoustic shielding may be fitted to mask this source so that the test is carried out on the exhaust noise alone.

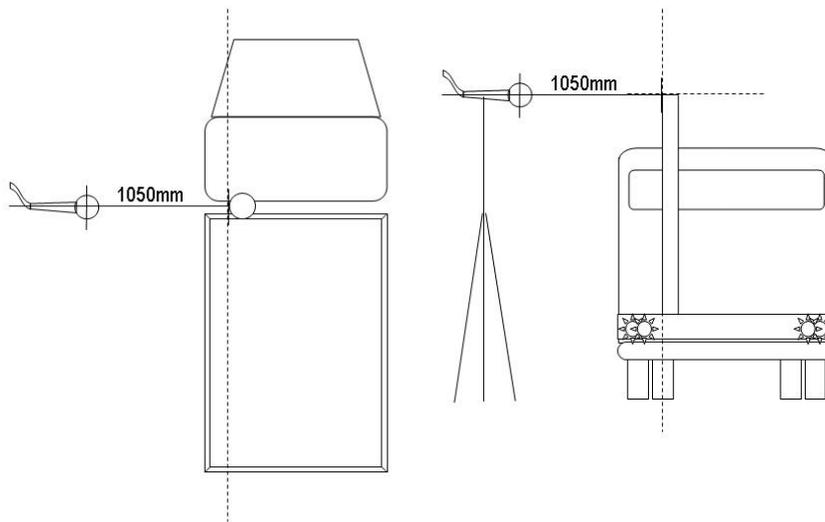
TYPICAL CAR MICROPHONE LOCATIONS



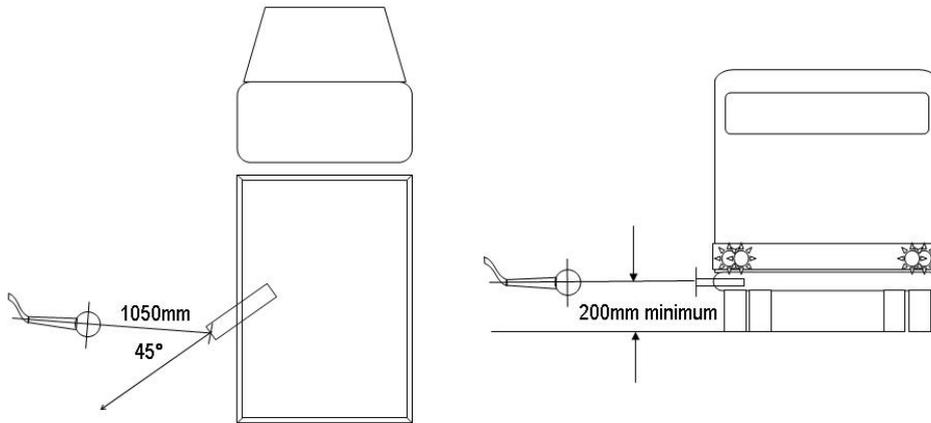
TYPICAL MOTOR CYCLE MICROPHONE LOCATIONS



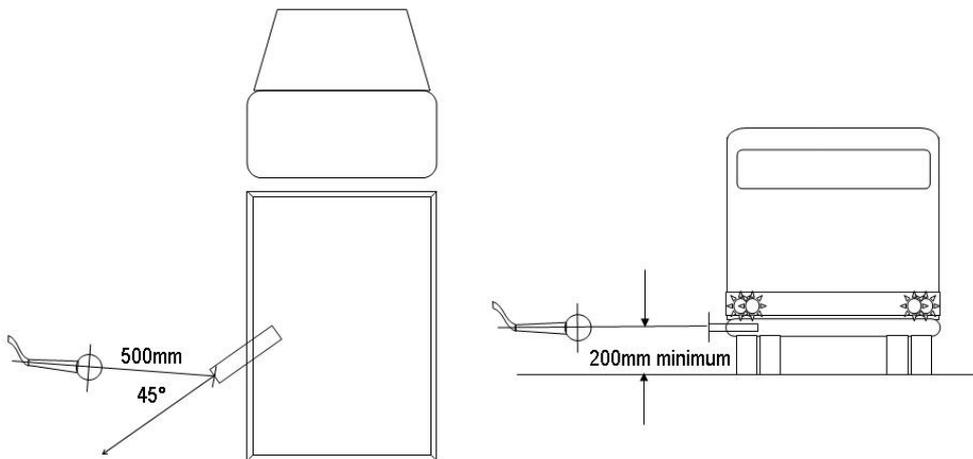
TYPICAL TRUCK MICROPHONE LOCATIONS PRE ADR83 VEHICLES Exhaust height 1500mm or more above surface



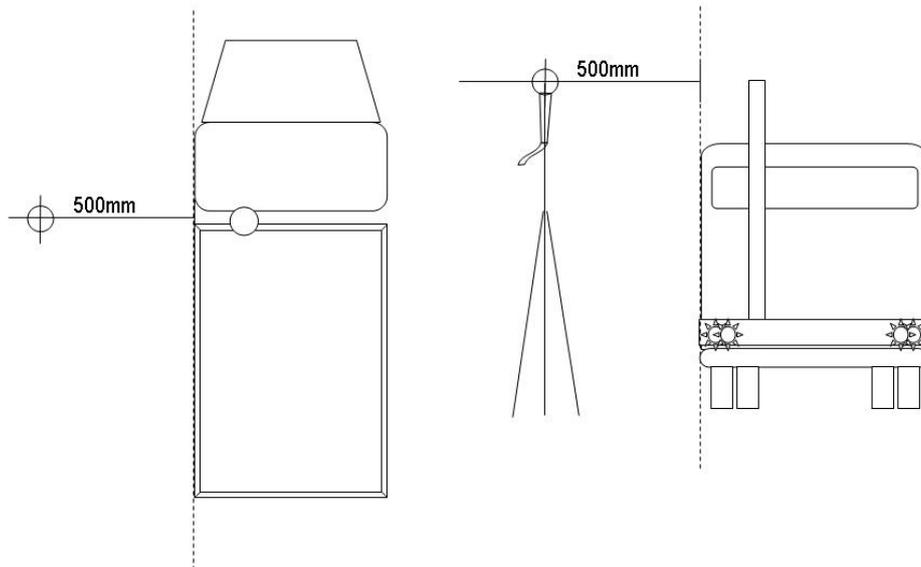
TYPICAL TRUCK MICROPHONE LOCATIONS PRE ADR83 VEHICLES
Exhaust height less than 1500mm above surface



TYPICAL TRUCK MICROPHONE LOCATIONS ADR83 VEHICLES
Side Exiting Exhaust



TYPICAL TRUCK MICROPHONE LOCATIONS ADR83 VEHICLES
Vertical Exhaust



POSSIBLE MICROPHONE POSITION FOR
ALTERNATE EXHAUST CONFIGURATIONS

