Methods of measurement for peak noise during loading and unloading (2015 update)

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Foreword

These are the 2015 Piek-Keur methods of measurement for peak noise during loading and unloading, published by Stichting Piek-Keur. These methods of measurement are an update to the TNO report 'Methods of measurement for peak noise during loading and unloading' of 2010. The methods of measurement were agreed within the Piek-Keur panel of experts.

Any modifications to the methods of measurement for engine noise (Section 4) are not included in this publication. These methods of measurement are currently still being evaluated, among others, with the suppliers involved.

These methods of measurement are intended for everyone involved in producing and marketing new equipment and materials used in loading and unloading goods in the retail trade.

A measurement and report in accordance with the 2015 Piek-Keur methods of measurement for peak noise during loading and unloading make it possible for participants of Stichting Piek-Keur to have their component certified under Piek-Keur.

Summary

In this report measurement methods are described for determining the peak noise level of various noise sources occurring during goods delivery. The methods provide noise levels at 7.5 m distance for individual noise sources under controlled conditions. The measurement methods have been designed to provide both representative and reproducible results that are as similar as possible to noise levels occurring in practice.

The methods have been designed in such a way as to be able to quantify the effect of noise reduction measures. The measured peak noise levels can be used to get an indication whether the product concerned will satisfy Dutch legal peak noise reception limits in most situations. The methods can also be used to make a comparison between different products.

Measurement methods are included for the following:

- Constant speed, acceleration and braking at low speed for trucks and vans
- Doors, hatches, hinged and sliding doors of trailers, bodies and cabs
- Tail lifts, body floors and walls of trucks and vans
- Shopping trolleys, goods carts, 'rollies', dollies and hand pallet trucks
- Forklift trucks and mobile forklift trucks
- Transport cooling units

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1. Introduction

The 2014 Piek-Keur test protocol complies with the Decree on Environmental Management in Craft and Retail Trades (the Decree), which was incorporated in the Decree on General Rules for Environmental Management in 1998.
This report describes methods of measurement that are suitable for determining the peak noise levels of relevant sources of noise during loading and unloading. The methods of measurement determine peak noise levels for single sources under controlled conditions at a distance of 7.5 metres from the source. The methods of measurement are set up to yield both representative and reproducible results, which approach the practical conditions as closely as possible. Furthermore, the methods of measurement are set up in such a way that the noise-reducing measures are clearly expressed in the measurement results.

Technology develops at lightning speed; Piek-Keur is no exception to this. This protocol incorporates the relevant innovations. Furthermore, the experiences of the past 12 years regarding Piek-Keur were incorporated in the 2014 Piek-Keur test protocol. In terms of technical content, the protocol has been significantly updated.

In addition, a clear structure was chosen, with a subdivision into the following subjects:
- measuring conditions and measuring equipment,
- methods of measurement,
- reports

This subdivision improves the protocol's accessibility for certification
The protocol was extensively discussed with our partners. A large number of our partners provided their expertise free of charge, and we thank them for this.
The result of all the efforts is an up-to-date and accessible protocol, safeguarding the validity and reliability of the measurement results as much as possible.

2. Objective and scope of the methods of measurement

The methods of measurement described in this report are used for determining the peak noise levels of various sources of noise during loading and unloading.

The methods of measurement provide peak noise levels for single sources under controlled conditions at a distance of 7.5 metres from the source. Dutch law on peak noise during loading and unloading (the Decree) applies to the peak noise level at the outer wall in practical conditions.

The measured peak levels can be used to obtain an indication of whether the product in question will meet the legal limit values in most practical situations. It may be, however, that a product complies with the limit value at 7.5 metres, but that the distance from the source to the outer wall is less in a particular practical situation, so that it does not comply with the legal limit value in that specific situation.

Furthermore, the methods of measurement are used to compare the peak noise emissions of products with each other.

The methods of measurement are intended to evaluate partial sources in their practical conditions, where there is interaction with other components. In cases where artificial collision is used, this is done to ensure that the measurements are reproducible.

The methods are not suitable for determining the noise capacity level.

3. Measuring equipment, general measuring conditions and procedure

ISO standard 362 [3] and Directive 92/97/EEC [4] were (largely) used in relation to the requirements to be set for the equipment, the acoustic environment, the meteorological conditions and the background level.

3.1 Measuring equipment

The following equipment is required to measure peak levels:

- Sound level meter, type 1 (in accordance with IEC publication 651:1979, Sound Level Meters), equipped with an A filter, “Fast” adjustable integration time and read option set to “Max. Hold”
- Windsock for microphone
- Acoustic source (in accordance with IEC publication 942:1988, Sound calibrator) to calibrate the sound level meter
- Tripod to attach the microphone or sound level meter. If not otherwise stated, height to be set at 1.2m +/- 0.1m above local ground level
- Speedometer, accuracy +/- 3%

The sound level meter and the acoustic source must be calibrated by a certified institution at least once every two years.

3.2 Measuring conditions

One should aim for a background noise level (LpA) of less than 50 dB(A) during measurement, or a noise level that is at least 10 dB(A) lower than the noise level of the source/activity to be evaluated. If this requirement is not fulfilled, a decision may be made to measure closer to the source (minimum distance 5m) and to determine the noise level at the 7.5m measuring distance by calculation, by correcting for the geometric expansion of the sound, using the following formula:

$L_{pA(7.5m)} = L_{pA(5m)} + 20 \times \lg(5/7.5)$ [dB(A)]

There should not be any reflecting outer walls or objects within a radius of at least 25m from the object to be measured. There should not be any objects or people between the measured object and the microphone. The ground surface between the measured object and the microphone must be flat and ‘acoustically’ hard. The average wind speed (at the measurement height) must not be more than approx. 5 m/s. The noise measurements must be taken in dry weather and on a dry surface.

If the background noise level during the measurement is not lower than 50 dB(A), or a noise level that is at least 10 dB(A) lower than the noise level of the source/activity to be evaluated, or if any outer walls or objects are located within a radius of 25m from the object to be measured, no correction will be applied to the measurement result. An exception applies if it turns out that the measured value obtained is lower due to this condition not being met.

3.3 Measurements

For stationary tests, the microphone is aimed at the measured object, parallel to the ground. For moving objects, the microphone is also aimed perpendicular to the direction of movement. The standard measuring distance for moving test objects is 7.5m from the driving line, and for stationary settings 7.5m from the axis of the object to be measured, on the side of the noise source. For lorries and vans, measurements are also taken at 7.5m from the rear of the vehicle for stationary settings. A short distance may be chosen only in situations where there is too much disruptive noise; the minimum distance is 5m. Complete working cycles are always measured at least 3 times.

In general, measurements are for unloaded vehicles, except in the case of lorries and vans or if the noise level increases by 3 dB or more as a result of loading. In that case, 50% of the maximum load must be taken. Readings of non-representative, interrupted or erroneous measurements must be removed. If only one microphone (sound level meter) is available, the prescribed number of actions will have to be carried out for each measuring point. The highest value of multiple readings taken using a sound level meter in dB(A) 'Fast' or 'F' is rounded to a whole number in dB(A), see Table 3.1.

Table 3.1: Example of highest value reading rounded to a whole number

1st reading	2nd reading	3rd reading	4th reading	Highest value
86.3	87.6	86.8	84.5	88

The following sections indicate how the noise level is determined for each type of source. In multiple test settings, an energetic average noise level is determined. The energetic average of a series of *n* measured values L_1, L_2, L_3,….L_n is defined in accordance with:

$$L_{gem} = 10\lg((10^{L_1/10} + 10^{L_2/10} + \ldots + 10^{L_n/10})/n)$$

For energetic averaging over multiple measurements, only the average value is rounded to a whole number in dB(A), see Table 3.2.

Table 3.2: Example of energetic averaging with rounding to a whole number.

1st reading	2nd reading	3rd reading	4th reading	Energetic average value
86.3	87.4	86.8	84.5	86

The number of averages varies depending on the type of measurement. The number of averages may be increased, which may result in a more stable average value. The mathematical results are presented to one decimal place. The evaluation result is then presented in whole dB. Rounding to a whole number is done in accordance with NEN 1047, which states that, if the number to be rounded ends in 5 after the decimal point, it is rounded to the nearest whole even number. For example, 40.5 is rounded to 40 and 45.5 to 46.

3.4 Directionality

Many noise sources have directional noise radiation, which means that noise levels vary depending on the direction in which noise radiates. As noise can be observed in all possible directions in terms of the noise source in inner-city situations (both around and above the noise source), the measured level should be the maximum noise level from all possible radiation directions. This type of measurement may require disproportionate measurement efforts in practice, especially in the case of highly variable noises. For practical reasons, the aim therefore was to prescribe as few measuring points as possible. The radiation directions that are expected to be most critical, however, were taken into account. For some noise sources, such as moving vehicles, it is difficult to measure in all

radiation directions. Here it was decided, in accordance with international rules, to measure to the left and right of the vehicle only. Conversely, the method of measurement must not result in noise-limiting measures being designed so that the maximum effects are achieved only in the direction of the measuring points indicated in this report. A good example of less than optimal design (for inner-city use) is transport refrigeration systems installed at the front end of a cargo body. The insulating enclosure is often designed in such a way that an effect is achieved horizontally, but little effect upwards. The top of the enclosure is usually left open.

3.5 PEAK mode

For various parts/machines present on a vehicle, the speed of functioning may affect the noise level produced by the part. Examples of this are the RPM of a refrigeration unit's motor or a lorry's engine. If the part has two speeds and the part/machine is tested at the low speed setting, this is called PEAK mode. If the part or the machine has a PEAK mode, it must operate driver-independently. For lorry engines, PEAK mode does not have to operate driver-independently for the time being.

PEAK mode must ensure that the part/machine meets the legal noise requirements within a distance of 300 metres from the loading/unloading location.

There are several types of driver-independent PEAK modes.
The basic principle of a PEAK mode is that it is driver-independent and that, outside of the PEAK-specified time frames and outside of the so-called PEAK locations, the machine can be set to maximum power with technical tools. In other words, PEAK mode is the normal operating setting of the machine.
In case of a defect in the technical tool or other faults relating to the functioning of PEAK mode, the part/machine must operate in PEAK mode. The functioning of PEAK mode must be guaranteed. The functioning of PEAK mode must also be demonstrated and described in the report

4. Method of measurement for moving van and lorry noise, and for warning systems

Background

The following driving conditions are indicated in [2] as important for the evaluation of the engine noise of vans and lorries during deliveries to shops:

- Driving at a constant speed
- Braking
- Reversing
- Accelerating
- Warning system

Based on the experience of the TNO Institute of Road Transport, it appears that 20 kph is a good estimate for the average speed of distribution vehicles usually driving along the route between the inner-city roads and the unloading location at the shops.

The '**driving past at a constant speed**' test is therefore conducted at a speed of 20 kph. The transmission drive closest to 20 kph is selected. The engine speed is 30% of n_{rated} [1] but never less than 1000 revolutions per minute, or at $n_{max\ reduced}$ [2] if that is the highest engine speed.

For the '**braking**' test, the noise production of the braking system including blowing is evaluated.

The '**reversing**' test focuses on the engine noise, so the reversing signal is switched off (the signal is generally switched off when unloading outside normal daylight hours).

In the '**accelerating**' test, the noise is determined particularly by the engine, exhaust and intake. The transmission and gear changing may also play a part. Tyre noise is not a factor. The noise level of the engine noise is closely associated with the level of engine speed at which gear changing occurs. Other variables are the driver's behaviour, the available engine capacity and the degree of loading.

The degree of loading for lorries is determined on the basis of available engine capacity. The figure used for this is 50 kg/kW, so that the load on the engine of each vehicle is the same. The load on vans is up to their empty weight plus 50% of the load weight.

The lorry is stationary for the '**warning systems**' test, and the warning systems for reversing and turning right (blind spot) are measured. The warning systems should be operating separately for this.

[1]) Definition of n_{rated}: The highest speed at which 90% of the maximum output is still achieved.

[2]) Definition of $n_{max\ reduced}$ is: The maximum speed in the event of a reduced mode in engine management.

4.1 Measuring course, measuring conditions

The measuring course must be part of a straight section of road approx. 100m long. A microphone is placed halfway along the course at 7.5m ± 0.2m from the axis of the road (see Figure 4.1). The noise measurements can be performed with a single microphone (sound level meter), in which case the measuring course must be driven from right to left and from left to right to measure both sides of the vehicle. If two microphones (sound level meters) are available, one direction will suffice, as the radiation directions from the vehicle can be evaluated simultaneously.

The speed of the van or lorry is measured with a speedometer. If the speed deviates from the agreed speed by more than 10%, the measurement will be taken again. The following measuring conditions apply:

- The vehicle to be measured must be brought up to normal condition, ready for use
- If a revolution limiter or speed limiter is present, it must be switched on
- If the vehicle is equipped with a PEAK mode function, the tests can be performed with PEAK mode activated. This is on the condition that the driver has access to the PEAK mode switch from within the cabin.
- Loaden vehicles with a load of 50kg/kW are measured. The load on vans is up to their empty weight plus 50% of the load weight
- Measurements are taken of:
  the van
  tractor, possibly with trailer
  lorry, possibly with trailer
- At least three measurements are taken on both sides of the vehicle.

4.2 Accelerating

The following procedure must be completed (see Figure 4.1):

1st series of measurements: accelerating without changing gears

- The loaded van or lorry is stationary, with the engine running at the start of the course.
- The length of the measuring course is 10m.
- The throttle is then opened fully in first gear and acceleration then takes place to $n_{stationary}$ + 0.5 x ($n_{,rated}$ – $n_{stationary}$)[3], or $n_{max\ reduced}$, or full power if there is a revolution limiter and the test is performed in PEAK mode. Acceleration continues until the front of the vehicle reaches the end of the course or the maximum RPM is achieved. If the engine's maximum RPM is reached within 10m, the accelerator pedal is then released and the engine disengaged. Driving then continues with the engine disengaged until the end of the course.

[3] RPM at maximum power – RPM for idling engine

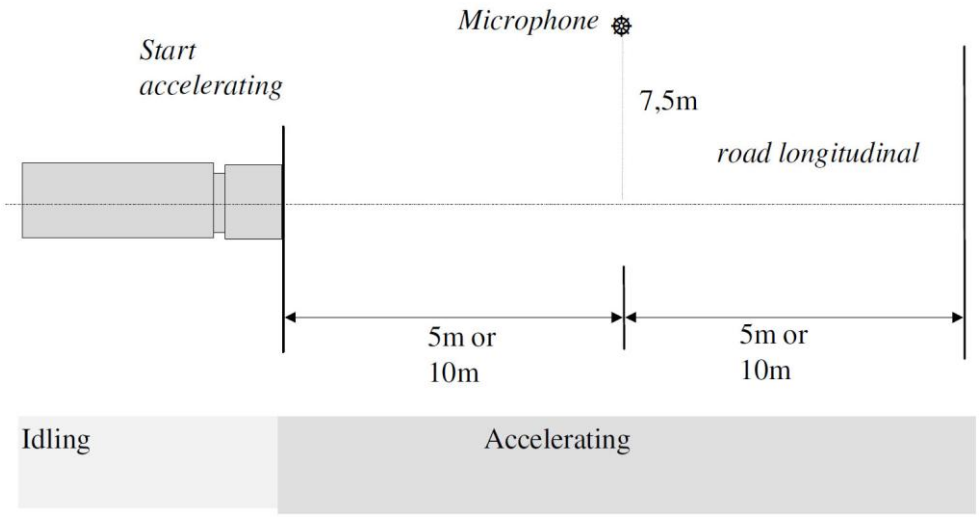

Figure 4.1: Measuring course for the acceleration test.

2nd series of measurements: acceleration with gear changes or automatic gearbox
The length of the measuring course is 20m. The method of measurement is repeated, but now with full-throttle acceleration in first gear or automatic drive from a stationary position with the engine running. After reaching 70% of n_{rated} with a manual gearbox or an engine speed of 2200 RPM, the next gear is selected and driving continues full-throttle to the end of the course. After the front end of the vehicle passes the 20m line, the accelerator pedal is released.

The measurement result is determined as follows:
The highest value from both measuring points of the 1st series of measurements is taken. The highest value from both measuring points of the 2nd series of measurements is taken. The lowest of the values for manual and automatic is rounded to a whole number in accordance with Section 3.3. This is the measurement result and is entered for the lorry under a "PEAK mode" button. If manual and automatic gearboxes give the same results, the automatic result is entered under a "PEAK mode" button.

4.3 Braking

The following procedure must be completed (see Figure 4.2):

1st series of measurements: braking
The van or lorry drives up at a constant speed of approx. 20 kph. For a manual gearbox, the gear is selected in which the stipulated engine RPM is as close as possible to 20 kph, which must be 30% of n_{rated}, but never less than 1000 RPM, or in the case of a special stipulation, the value $n_{max\ reduced}$.

- The vehicle drives up along the axis of the road
- The length of the measuring course is 20m
- When the front end of the van or lorry is approx. 5m inside the measuring course, the brakes are applied normally and an attempt is made to come to a halt within the measuring course

2nd series of measurements: releasing the brake (releasing pressure from brake air reservoir)

- The measurement is performed at a distance of 7.5m when the pressure regulator is released and when air is released after use of both the foot brake and the hand brake. The sound of the pressure regulator is measured with the engine at idling RPM. Before the measurement, the air pressure unit must be set at the highest admissible operating pressure.

The measurement result is determined as follows:
The highest value from both measuring points of the 1st series of measurements is taken. The highest value from both measuring points of the 2nd series of measurements is taken. The maximum of these two values is rounded to a whole number in accordance with Section 3.3. This is the measurement result.

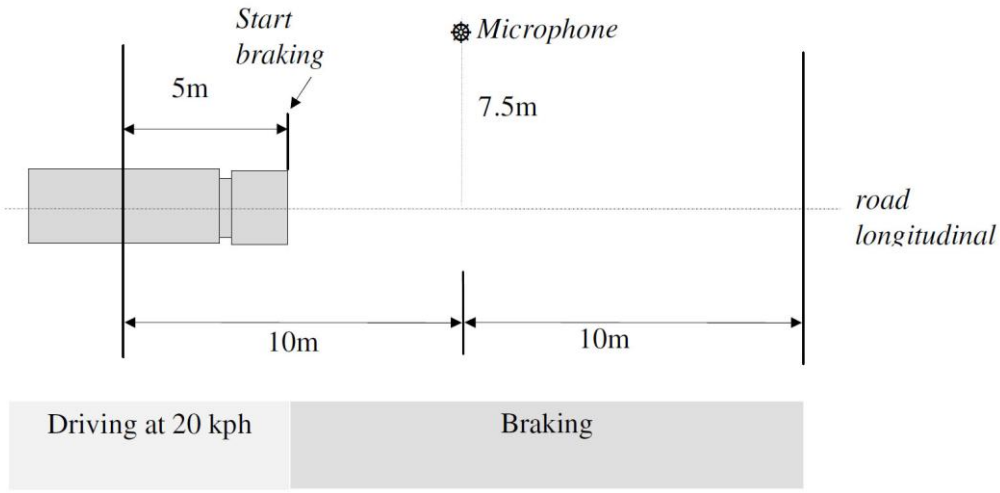

Figure 4.2: Measuring course for the braking test.

4.4 Driving past at a constant speed

The following procedure must be completed:

- The length of the measuring course is 20m, see Figure 4.3.
- The vehicle drives along the axis of the road.
- The vehicle is driven at a constant speed of 20 kph. For a manual gearbox, the gear is selected in which the stipulated engine RPM is as close as possible to 20 kph, which must be 30% of n_{rated}, but never less than 1000 RPM, or in the case of a special quiet stipulation, the value $n_{max\ reduced}$.

The measurement result is determined as follows: The highest value from both measuring points is determined and rounded to a whole number in accordance with Section 3.3. This is the measurement result.

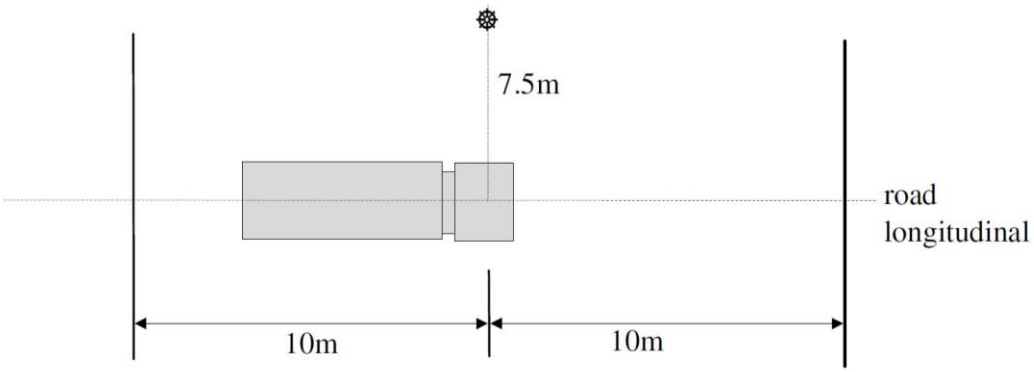

Figure 4.3: Measuring course for the drive-by test.

4.5 Reversing

The following procedure must be completed:

- The length of the measuring course is 20m, see Figure 4.3
- Reverse gear must be engaged
- The vehicle is driven at a speed of 3 kph or at $n_{max\ reduced}$ at the corresponding speed, in reverse along the axis of the test course, with the reversing signal disengaged

The measurement result is determined as follows: The highest value from both measuring points is determined and rounded to a whole number in accordance with Section 3.3. This is the measurement result.

4.6 Reverse warning system and blind spot warning

Pedestrians and cyclists are warned of a lorry reversing or taking a right-hand turn by an audible signal. The following procedure must be completed for measuring the audible signal:

- Reversing: the noise from the reverse warning system is measured three times at a distance of 7.5m from the rear of the lorry (duration of signal about 30 seconds).
- Turning right: the noise is measured three times at a distance of 7.5m from the side of the lorry, directly opposite the blind spot warning system (signal duration about 30 seconds)

See Figure 4.4 for the measuring arrangement.

The highest value from each measurement point is determined separately and rounded to a whole number in accordance with Section 3.3; these are the measurement results.

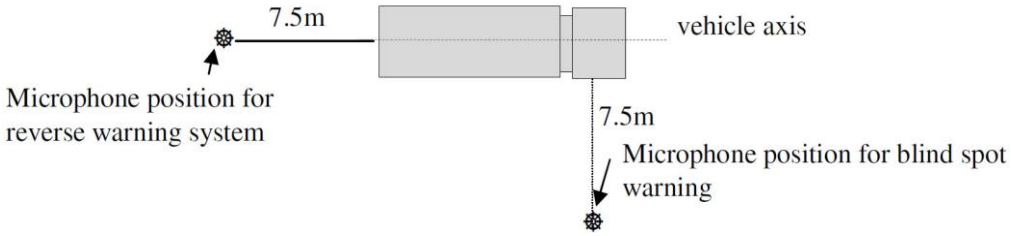

Figure 4.4: Microphone positions for measurements of reverse and blind spot warning sounds

5. Method of measurement for opening and closing doors of cargo bodies and cabins and air curtains for cargo bodies

5.1 Vehicle doors, hatches, hinged and sliding doors and air curtains for cargo bodies

The following situation is used for this method of measurement (see Figure 5.1):

- The engine and any other sources of noise from the vehicle are switched off
- The measuring microphone is at a distance of 7.5m opposite the centre of the vehicle door to be measured (hatch or door). The microphone is 1.2m above the paved surface

The following procedure must be completed:

- The vehicle door (hatch or hinged door) is opened and closed by standing at arm's length from the vehicle door (hatch or hinged door) and grasping the door handle with an outstretched arm. A raised platform may be necessary to be able to operate the vehicle door (hatch or hinged door). The door is then opened until the handle is next to one's shoulder. If a door holder is present, the door must be fully opened and secured with the door holder. The vehicle door (hatch or hinged door) is then closed with a single even motion
- For hinged doors to the cargo body, both doors are opened and closed.
- For a sliding door, the tester walks along in the direction of the door so that the complete motion of unlocking and sliding and relocking can be carried out
- The opening and closing of the vehicle door (hatch or hinged door) is repeated at least 5 times, waiting approx. 5 seconds after closing each time before reading the noise level
- For air curtains, the doors of the cargo body are fully opened and the air curtain fans are turned to maximum power. Measurements are taken three times at a distance of 7.5m from the rear of the lorry (at least 10 seconds between the measurements)

The energetic average value of the measured levels is rounded to a whole number in accordance with Section 3.3. The rounded number is the measured value.

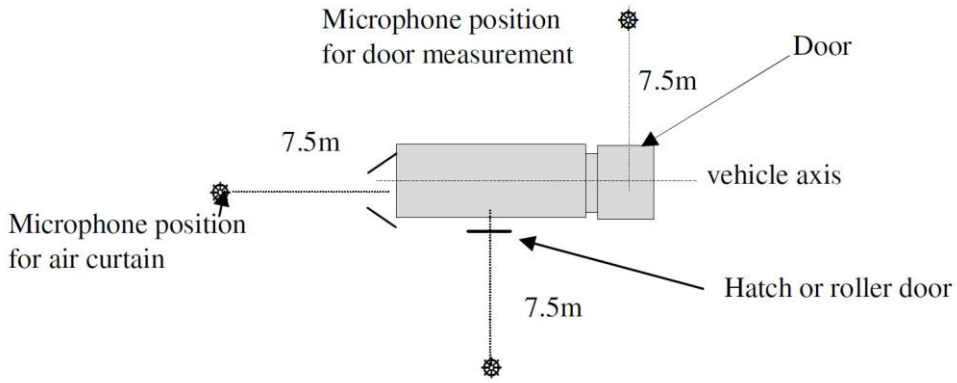

Figure 5.1: Microphone positions for measuring the noise of vehicle doors, hinged and sliding doors and air curtains for cargo bodies.

5.2 Roll-up doors and curtain sides

In addition to hinged doors and hatches, the cargo body may also be closed by means of roll-up doors and curtain sides. If there are several roll-up doors or curtain sides, these must be tested separately. Noise during opening and closing is evaluated as follows:

- The roll-up door or curtain side panel is unlocked, opened fully, secured and then closed and locked again as quickly as reasonably possible.
- Curtain sides are slid completely open and then closed as quickly as reasonably possible.

See Figure 5.2 for the microphone positions. If the roll-up door or curtain side is mounted to the side of the vehicle, microphone 2 is located on that side of the vehicle where the actions take place. If the roll-up door or curtain side is mounted to the rear, microphone 2 is located on the side where the drive system is located. The cycle is repeated and measured at least 5 times.

The measurement result is the energetic average value of the readings (minimum of 5 per measuring point) at both measuring points, rounded to a whole number in accordance with Section 3.3.

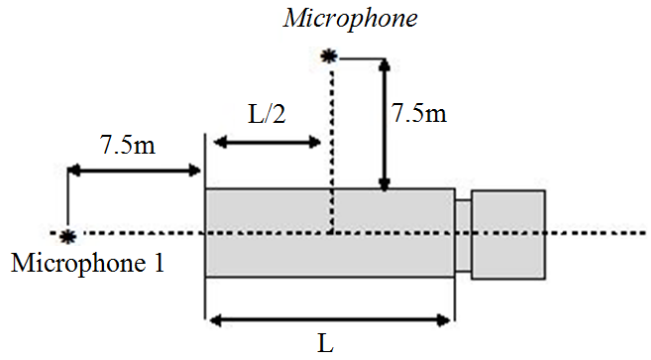

Figure 5.2

5.3 Sliding partition

A sliding partition may be present in the cargo body. This kind of partition allows the cargo body to be divided into two sections, so that cargo can be transported at two different temperatures.

The noise produced while moving it is measured as follows:

- At the start of the cycle, the partition is located against the ceiling at the rear opening of the cargo body without being locked. After putting the partition into the correct position, it is moved to the front of the vehicle at a speed of 3 kph. At the front, the partition is moved towards the ceiling without locking it to the ceiling. Here the tester waits for a few seconds, after which the partition is moved back to the rear of the vehicle and then moved towards the ceiling without locking it to the ceiling
- The partition is slid against the stops both at the start of the rail and at the end of the rail.
- The cycle of moving the partition to the front and back is performed 3 times

- The measurement result is the energetic average value of the readings (minimum of 3 per measuring point) at both measuring points, rounded to a whole number in accordance with Section 3.3

See Figure 5.3 for the measurement setup

The noise produced during unlocking and locking is measured as follows:

- The following cycle is performed: The sliding partition is locked to the ceiling, then unlocked, and the partition is then moved to the position on the floor and locked in place. The partition is then unlocked again and moved towards the ceiling, where it is locked.
- For each locking point, the cycle is performed at least 3 times
- The unlocking and locking of the partition on the floor is performed at a distance of 1/4L, 1/2L and 3/4L from the rear opening of the cargo body. If the rail in the vehicle is shorter, as a result of which these distances cannot be reached, the points closest to these must be used
- The measurement result is determined as follows: the energetic average of 3 readings is calculated for each measuring point and collision point. The measurement result is the highest of the 6 energetic average values of the readings, rounded to a whole number in accordance with Section 3.3

See Figure 5.3 for the measurement setup

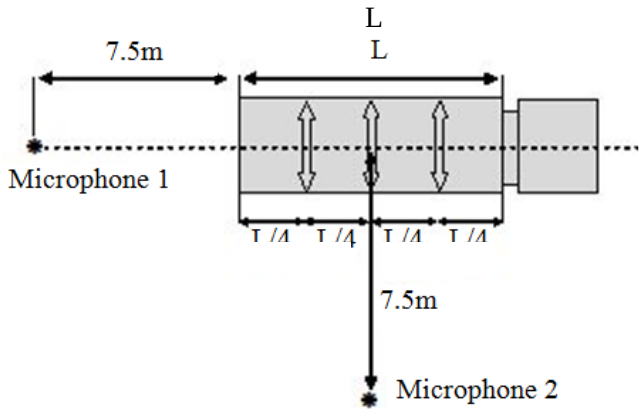

Figure 5.3

5.4 Steps

In order to enter the cargo body, certain vehicles are equipped with steps.

The noise produced while lowering and lifting the steps is measured as follows:

- The steps are in the transport position and are used in the usage position in accordance with the manufacturer's instructions. The steps are then returned to the transport position
- The above cycle is performed at least 5 times. Between the measurements, a pause of about 5 seconds must be added to read the noise level
- The measuring microphone is at a distance of 7.5m opposite the centre of the steps to be measured. The microphone is 1.2m above the paved surface. See Figure 5.1
- The energetic average value of the measured levels is rounded to a whole number in accordance with Section 3.3. The rounded number is the measured value

5.5 Strip curtain

Apart from having an air curtain, a cargo body can also be closed off by a strip curtain.

This can be a sliding strip curtain (perpendicular to the direction of travel) or a fixed curtain. In case of a sliding curtain, the sliding should be measured as follows:

- The doors to the cargo body in front of the strip curtain are fully open
- During the measurement, the strip curtain must be moved from being fully closed to being fully open and back, and locked in place if possible. If the curtain consists of several sections, all the sections must be tested
- If various types of strip curtains are present in the vehicle (opening to the right, opening to the left, opening in the middle, etc.), these must be tested separately
- The above cycle is performed at least 5 times. Between the measurements, a pause of about 5 seconds must be added to read the noise level
- The energetic average value of the measured levels is rounded to a whole number in accordance with Section 3.3. The rounded number is the measured value

The noise produced while moving it in the direction of travel is measured as follows:

- At the start of the cycle, the strip curtain is located at the furthest position at the rear opening of the cargo body and locked in place. The strip curtain is moved as far as possible into the vehicle at a speed of 3 kph. At the front, the strip curtain is locked in place. Following this, the tester waits a few seconds, after which the curtain is moved back to the rear of the vehicle and locked
- The curtain is slid against the stops both at the start of the rail and at the end of the rail
- The cycle of moving the curtain to the front and back is performed 3 times
- The measurement result is the energetic average value of the readings (minimum of 3 per measuring point) at both measuring points, rounded to a whole number in accordance with Section 3.3

See Figure 5.4 for the measurement setup

Moving the strips of the strip curtain

- The doors to the cargo body in front of the strip curtain are fully open
- A roll container with a steel superstructure (comparable to Figure 5.6) with a minimum height of 1.5m is positioned on the centre line of the vehicle in the cargo body against the strip curtain
- The centre strip is grabbed at a height of 1.5m, pulled back 50cm and then released, see Figure 5.5
- The tester waits a few seconds between the strip movements to read the noise level
- The above cycle is repeated at least 3 times

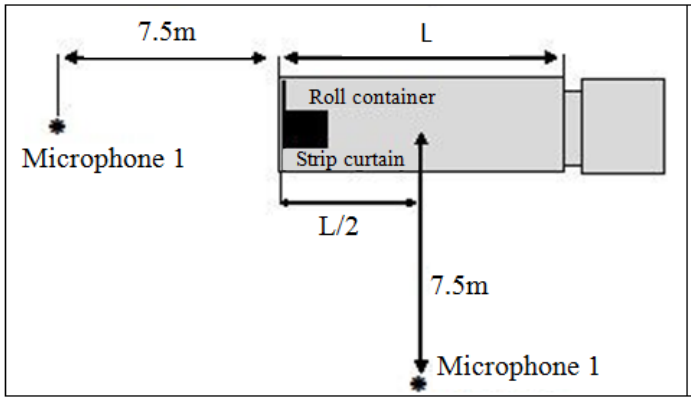

Figure 5.4

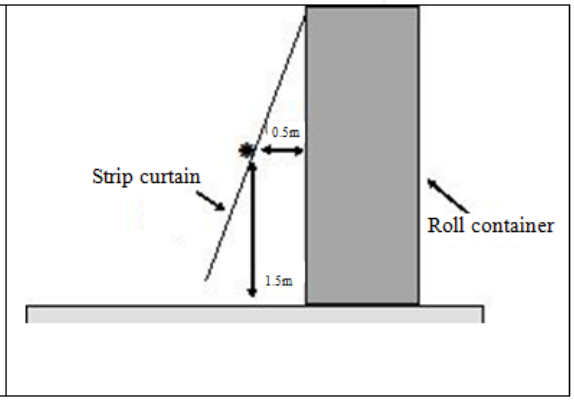

Figure 5.5

Figure 5.6

6. Methods of measurement for tailboards and walls of vans and lorries, and fasteners

This section deals with the methods of measurement regarding the use of the tailboard, fastening the load and moving transport equipment over the tailboard, floor and walls of the cargo body. All tests described in this section are conducted with an empty cargo body.

6.1 Measuring arrangement

Two microphones are placed around the van or lorry, with its engine switched off (see Figure 6.1):

- One at 7.5m from the rear, on the axis of the vehicle
- One at the side of the vehicle (tailboard operation side), 7.5m from the axis and at the halfway point of the cargo body length (L/2)
- The microphones are 1.2m above the paved surface
- If the drive system is located on the other side of the vehicle from the controls, a measuring point is selected on that side as well and a measurement taken

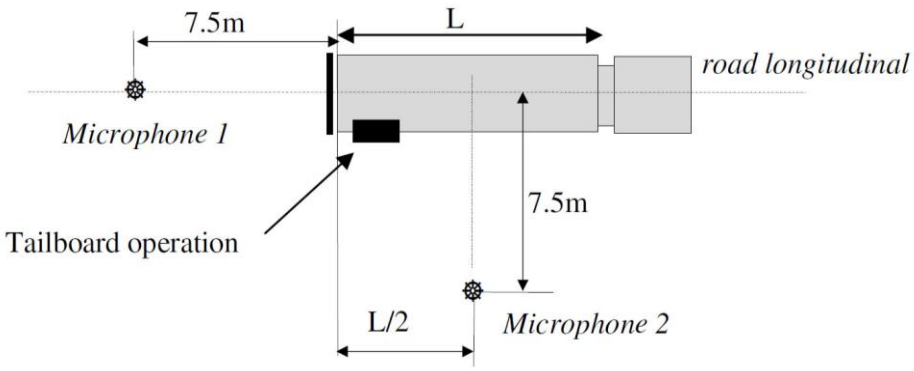

Figure 6.1 Microphone positions for measurements near the tailboard, cargo body and fasteners

6.2 Tailboard

The tailboard is a platform at the rear of the lorry that can be raised. It is used to load and unload goods in roll containers or pallet trucks from the cargo body floor level to street level and vice versa. The tailboard is hydraulically driven. The hydraulic pump is electrically powered. This section describes the method of measurement for the power source of the tailboard and the roll-off stops.

6.2.1 Opening and closing

The method of measurement for opening and closing the tailboard is as follows:

- The noise measurement is taken during a complete cycle of opening and closing the tailboard
- See Figure 6.1 for the measuring points. Microphone 2 is at the side of the tailboard drive system.
- The cycle is repeated and measured three times
- The noise measurement begins as soon as the tailboard (in the closed position) is activated, followed by the complete lowering cycle, including any folding out, until the tailboard touches the ground. The tailboard must lie on the ground so that a roll container can be rolled onto the tailboard. The folding-up cycle then follows until the tailboard is fully folded up. The measurement is stopped

- The measurement result is the higher of the two energetic average values of the readings (minimum of 3 per measuring point) at both measuring points, rounded to a whole number in accordance with Section 3.3

6.2.2 Roll-off stop

The roll-off stop is a small folding barrier built into the tailboard near the rear edge of the tailboard. In its raised position, this barrier prevents a roll container from rolling off the tailboard.

The method of measurement for the roll-off stop is as follows:

- The tailboard is in its lowest position
- See Figure 6.1 for the measuring points
- The roll-off stop is folded down and raised at least five times using one's foot. A pause of several seconds is added between folding down and raising. If there are several ways to lock the stop in place, all the methods must be tested
- The measurement result is the higher of the two energetic average values of the readings (minimum of 5 times raising and pushing down) at both measuring points, rounded to a whole number in accordance with Section 3.3

6.3 Rolling noise

When rolling transportation equipment over a tailboard, through the cargo body or over a plate bridging a difference in height, both the transportation equipment and the plate or lift can create noise. This section describes a method of measurement for evaluating only the noise radiated by the plate or lift. To obtain a collision comparable with practical conditions, a modified 'quiet' roll container is used as shown in Figure 6.2. The modified roll container must be fitted with four hard (shore 100) standard plastic wheels (no rubber tyres) with a diameter of 100 mm. The roll container is loaded with a sandbag weighing 25 kg.

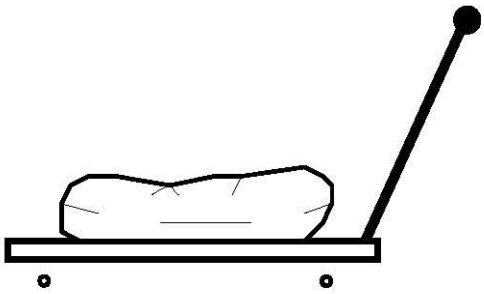

Figure 6.2: Schematic representation of a 'quiet' roll container with hard standard plastic wheels (no rubber tyres) with a diameter of 100 mm and a 25 kg sandbag as load.

6.3.1 Rolling over the tailboard

The method used to evaluate the noise produced in rolling over the tailboard is as follows:

- The tailboard is horizontal in its highest position, extending from the floor of the van or lorry
- The rolling speed must be approx. 3 kph
- See Figure 6.1 for the measuring points

- The ‘quiet’ roll container (see Figure 6.2) is rolled at least three times from left to right and back (perpendicular to the driving direction) and at least three times from front to rear and back (in the driving direction) without rolling over the gap between the tailboard and the cargo body. (back and forth is 1 cycle). If the platform of the tailboard consists of several components, all the components must be measured.
- The measurement result is the energetic average value of the readings (minimum of 6 per measuring point) at both measuring points, rounded to a whole number in accordance with Section 3.3

6.3.2 Rolling over the floor of the cargo body

The method used to evaluate noise production while rolling over the floor of the cargo body of the van or lorry is as follows:

- The tailboard is horizontal in its highest position, extending from the floor of the van or lorry
- The rolling speed must be approx. 3 kph
- See Figure 6.1 for the measuring points
- The doors are open as wide as possible
- The ‘quiet’ roll container (see Figure 6.2) is rolled into the cargo body, starting at the entrance to the cargo body, to the rear panel and back
- If the floor consists of several components, all the components must be measured
- There must be no collisions with the wall while rolling
- The measurement cycle is carried out and measured at least three times (back and forth is 1 cycle)
- The measurement result is the energetic average value of the readings (minimum of 3 per measuring point) at both measuring points, rounded to a whole number in accordance with Section 3.3

6.3.3 Rolling over transitions (e.g. from tailboard to cargo body floor)

The method used to evaluate the noise occurring while rolling over the gap between the tailboard and the cargo body floor is as follows:

- The ‘quiet’ roll container (see Figure 6.2) is rolled onto and off the tailboard from the cargo body, in the driving direction of the vehicle.
- The rolling speed must be approx. 3 kph
- See Figure 6.1 for the measuring points
- The measurement cycle is carried out and measured at least three times (back and forth is 1 cycle)
- The measurement result is the energetic average value of the readings (minimum of 3 per measuring point) at both measuring points, rounded to a whole number in accordance with Section 3.3

6.4 Noise of collision with walls of the cargo body

6.4.1 Wall

The noise radiated by the wall of the cargo body as a result of colliding roll containers, for example, is evaluated as follows:

- The collision is simulated using a ball on a cord, which is released at a distance from the side wall and then collides with the wall (see Figure 6.3). By using a ball (that radiates little noise) instead of a roll container, for example, only the noise radiated from the wall is measured, in analogy with the rolling noise measurement (see Section 6.4). In principle, measurements are taken on one side of the vehicle only
- A steel ball weighing 1 kg hangs on a cord. The distance from the centre of the ball to the fastening point (directly above the collision point) of the cord is 1m. The ball is released at a distance of 10cm from the wall (see Figure 6.3). The ball is caught after the collision. The noise level is read
- If there are wheel housings in the cargo body, a single collision point on the vertical wall of the wheel housing is chosen. The fastening point of the cord is kept directly above the collision point on the wheel housing. The collision is equivalent to the collision with the wall
- The collision points are 15cm above the floor and at a distance of 1/4L, 1/2L and 3/4L from the rear opening of the cargo body
- If any parts protrude in relation to the collision points located 15cm above the floor, these must also be measured. Only the highest point of these protruding parts should be measured

See Figure 6.4 for the measuring points.

A pause of a few seconds is added between the collisions to read the noise level.

6.4.2 Front end

- A steel ball weighing 1 kg hangs on a cord. The distance from the centre of the ball to the fastening point (directly above the collision point) of the cord is 1m. The ball is released at a distance of 10cm from the front end (see Figure 6.3). The ball is caught after the collision. The noise level is read
- The collision points are 15cm above the floor and at a distance of 1/3L from the side walls of the cargo body
- If any parts protrude in relation to the collision points located 15cm above the floor, these must also be measured. Only the highest point should be measured

See Figure 6.5 for the measuring points.

A pause of a few seconds is added between the collisions to read the noise level.

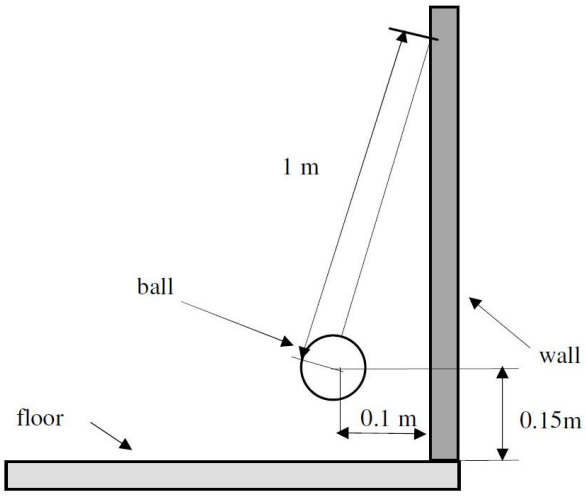

Figure 6.3

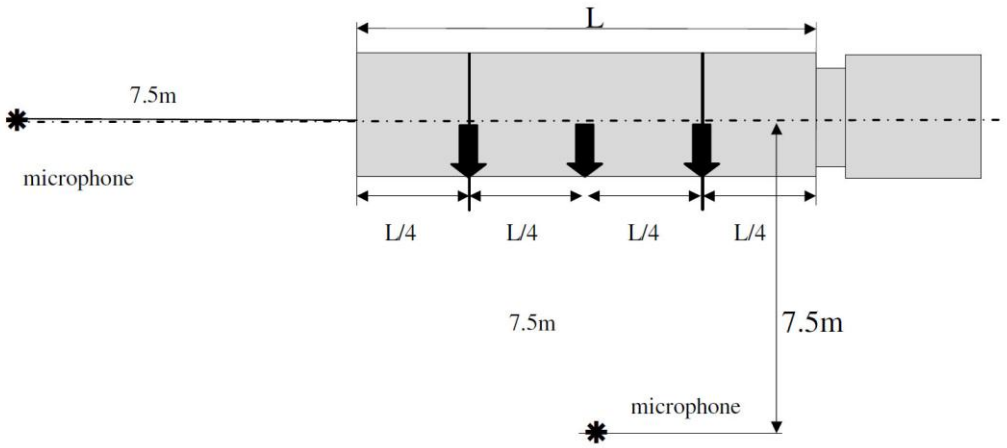

Figure 6.4

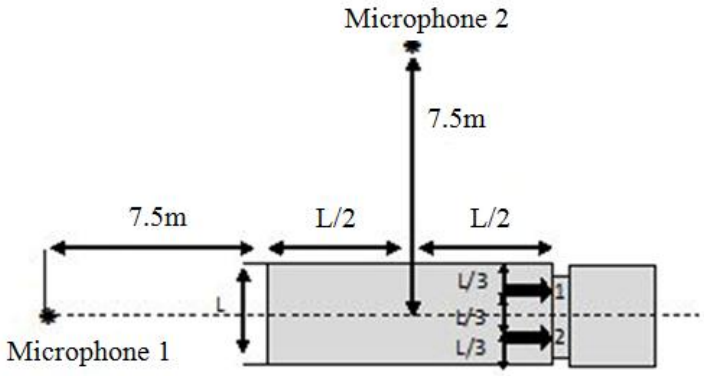

Figure 6.5

The measurement is performed at least three times per point.

- The measurement result is determined as follows: the energetic average of 3 readings is calculated for each measuring point and collision point. The measurement result is the highest of the 6 energetic average values of the readings, rounded to a whole number in accordance with Section 3.3

6.5 Load fastening

Straps and clamping blocks are used to secure the load in the cargo body. Setting and releasing the load fasteners creates noise in the fastener itself and the wall, floor or ceiling of the cargo body. The following methods are intended to determine the noise resulting from securing, strapping down and collisions.

6.5.1 Straps

The method of measurement is as follows:

- Attach the hooks of the straps to both fastening rails of the cargo body.
- Pull the strap tight. It is then released again
- This cycle is carried out at least 3 times for each point (3 times in the front, 3 in the middle and 3 in the back)
- See Figure 6.1 for the measuring points
- The measurement result is determined as follows: the energetic average of 3 readings is calculated for each measuring point and fastening point. The measurement result is the highest of the 6 energetic average values of the readings at both measuring points, rounded to a whole number in accordance with Section 3.3

6.5.2 Clamping blocks

The method of measurement is as follows:

- Place the clamping block in both fastening rails in the cargo body
- Click the clamping block into place. It is then released again
- This cycle is carried out at least 3 times for each point (3 times in the front, 3 in the middle and 3 in the back)
- See Figure 6.1 for the measuring points
- The measurement result is determined as follows: the energetic average of 3 readings is calculated for each measuring point and fastening point. The measurement result is the highest of the 6 energetic average values of the readings at both measuring points, rounded to a whole number in accordance with Section 3.3

7. Method of measurement for shopping trolleys and pallet trucks

7.1 Rolling noise

In order to evaluate the noise of shopping trolleys, manually and electrically operated pallet trucks while rolling, a smooth surface is used with standardised irregularities applied to it. The surface itself must not radiate noise.

The irregularities consist of steel strips, preferably glued to the surface, in accordance with Figure 7.1. A different attachment method may be used, possibly combined with glue. The transport equipment is measured unloaded.

Measuring course

The measuring course for these three types of transport equipment is as follows (see Figure 7.1):

- The surface must consist of smooth asphalt or concrete
- The irregularities consist of four rectangular metal strips 30mm wide and 5mm high, as indicated in Figure 7.1
- The strips are at least 1.5 times the width of the transport equipment in length
- The strips are preferably glued or attached over the entire length of the surface
- The four strips are applied to the measuring course in parallel at a distance of 2m from each other
- The test course is at least 1.5 times as wide as the transport equipment being evaluated
- The length of the measuring course is 12m

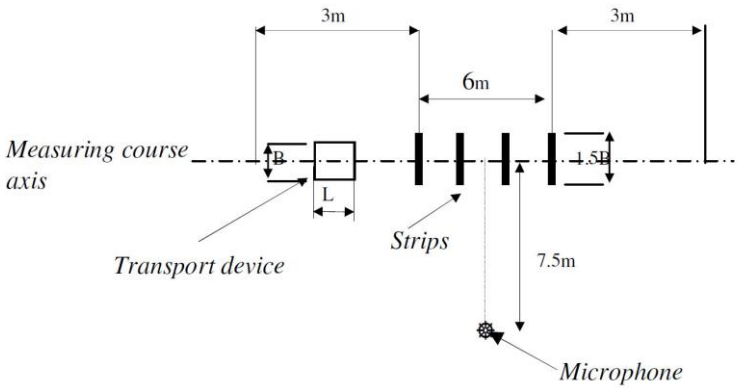

Figure 7.1: Situation for measuring the rolling noise of roll containers, pallet trucks and shopping trolleys.

Measurement procedure

The measurement procedure is as follows:

- The transport equipment is rolled over the course at a walking speed of approximately 3 kph
- The rolling direction is perpendicular to the irregularities, in both directions
- All wheels must pass over the irregularities
- The transport equipment is unloaded
- When measuring the pallet truck, the fork is in its lowest position
- The measuring course is covered at least 3 times
- See Figure 7.1 for the measuring point

- The measurement result is the energetic average value of the readings (minimum of 3) at the measuring point, rounded to a whole number in accordance with Section 3.3

7.2 Lowering and raising electrically and manually operated pallet trucks

The method of measurement applied to lowering and raising electrically and manually operated pallet trucks is the one used for evaluating the lowering and raising of a forklift truck. See Section 9.2 for this.

8. Method of measurement for roll containers, 'rollies' and dollies

The roll container is a transporter for a large range of products. The roll container has a folding base and sides that can be hinged, so that the empty roll containers can be nested together for moving. The 'rolly' (half Europallet) and the dolly (quarter Europallet) are wheeled pallets for transporting crates and boxes, and are used, among other things, for direct positioning. The empty 'rollies' and dollies are stacked for moving around.

8.1 Rolling noise

8.1.1 Loaded

The method of measurement for rolling noise is identical to that used for shopping trolleys and pallet trucks described in

Section 7.1, with the difference that the strips are 3mm high. The roll container and the 'rolly' are loaded with a weight of 100kg; the dolly is loaded with a weight of 50kg.

If several loading shelves can be placed in a roll container, 'rolly' or dolly, the test must be performed without additional loading shelves and with 75% of the maximum number of loading shelves (number must be rounded up). When using several loading shelves, the load must be evenly distributed with a minimum of 10kg.

8.1.2 Rolling nested roll containers

The method of measurement involves rolling three nested roll containers in accordance with the method of measurement described in Section 8.1.1, but unloaded.

8.1.3 Rolling empty roll containers that cannot be nested

The method of measurement for rolling noise is identical to that used for shopping trolleys and pallet trucks described in

Section 7.1, with the difference that the strips are 3mm high. If several loading shelves can be placed in a roll container, the test must be performed without additional loading shelves and with 75% of the maximum number of loading shelves (number must be rounded up).

8.1.4 Rolling stacked 'rollies' and dollies

The 'rollies' and dollies are rolled along the measuring course in accordance with the method of measurement described in Section 8.1.1, with 5 stacked but unloaded 'rollies' or dollies.

8.2 Colliding/nesting roll containers

For the collision noise, the method of measurement involves nesting the roll containers. One roll container is rolled into two already nested roll containers, as is customary with nesting.

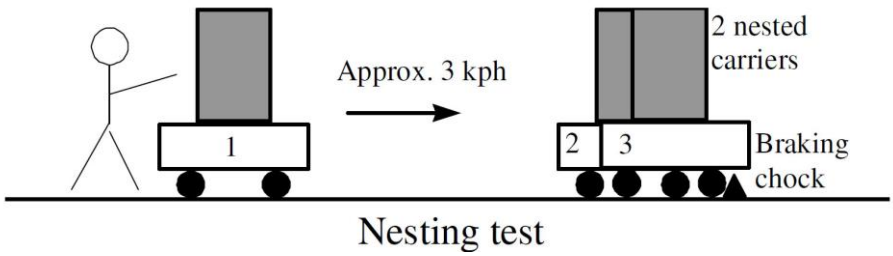

Figure 8.1: Test. Figure 8.1 shows the measuring arrangement. The floor surface should consist of smooth asphalt or concrete. The two nested roll containers should be stopped by a braking chock or a similar obstacle.

Measurement procedure

The measurement procedure is as follows:

- Roll container 1 is pushed against the nested roll containers 2 and 3, at a speed of approximately 3 kph, as is customary with nesting
- The transport equipment is unloaded and of the same type
- The microphone is at 7.5m from the collision point on a line perpendicular to the rolling direction
- The test is repeated at least three times
- The measurement result is the energetic average value of the readings (minimum of 3) at the measuring point, rounded to a whole number in accordance with Section 3.3

8.3 Placing and removing additional loading shelves

- No additional loading shelves are present in a roll container
- During the measurement, an additional loading shelf is placed; after placing it, the tester waits for a few seconds, after which the additional loading shelf is removed
- The cycle is repeated at least 3 times
- The microphone is at 7.5m from the centre point of the roll container
- The measurement result is the energetic average value of the readings (minimum of 3) at the measuring point, rounded to a whole number in accordance with Section 3.3

8.4 Stacking 'rollies' and dollies

The empty 'rollies' and dollies are stacked for moving around.

Measurement procedure

The measurement procedure is as follows:

- The transport equipment is unloaded and of the same type
- The microphone is placed at 7.5m from the stacking point
- An empty 'rolly' or dolly is lifted up and placed on a stationary 'rolly' or dolly from standing height, while measuring the noise level. The next 'rolly' or dolly is then lifted up and placed on the two stacked 'rollies' or dollies from standing height and the noise level is measured. Finally, one more 'rolly' or dolly is placed on the stacked 'rollies' or dollies and the noise level is measured
- The measurement result is the energetic average value of the 3 measurements, rounded to a whole number in accordance with Section 3.3

9. Method of measurement for forklift trucks and mobile forklift trucks

A mobile forklift truck differs from other forklift trucks in that it is connected to the rear of the lorry during transport. There are versions for which the operating personnel are not seated on the forklift but walk behind it. There are no functional differences. Like a forklift truck, a mobile forklift truck has its own drive system. Forklift trucks and mobile forklift trucks are evaluated in the same manner in terms of noise production during driving and lifting. Because of peak noise, collisions are important when driving over irregularities. A driving test is therefore proposed in which forklifts are driven over several standardised irregularities, see Figure 7.1. For a mobile forklift truck, the (collision) noise that occurs when connecting it to the lorry is also measured.

9.1 Driving

- The requirements for the measuring course and the forklift to be measured are:
- See Figure 7.1 for the layout of the measuring course
- At least another 10m of smooth surface must be available before and after the measuring course with irregularities
- The forklift is unloaded
- The forks are in their lowest position, so that the scoops of the pallet truck do not touch the strips
- The forklift is tested in its standard version as described by the manufacturer
- The engine and hydraulic system (see 8.2) of the forklift truck must be within the limits of the operating temperature indicated by the manufacturer

Measurement procedure

The measurement procedure is as follows:

- The forklift truck is driven over the measuring course at a constant speed of 13 ± 2 kph or, if this is not possible, the maximum speed indicated by the supplier
- For a forklift truck with a manual gearbox, the highest gear is selected
- For mobile forklift trucks that are operated while walking, the driving speed is approx. 3 kph
- Each side of the forklift truck (left and right) is measured at least 3 times
- The measurement result is the energetic average value of the readings (minimum of 6) at both measuring points, rounded to a whole number in accordance with Section 3.3

9.2 Evaluation of lifting

Measurements are taken at 4 measuring points (front, side (2), rear) around the stationary forklift. The evaluation distance of 7.5m to the microphone is from the vertical projection of the geometric centre of the forklift to the reflecting surface.

The following measurement procedure for evaluating the lifting noise must be completed:

- The forklift lifts a load equal to 70% of the actual capacity (permitted by the manufacturer) from minimum to maximum height at maximum acceleration
- Each side of the forklift truck is measured at least 2 times
- The measurement result is the energetic average value of the readings (minimum of 8) at the measuring points, rounded to a whole number in accordance with Section 3.3

9.3 Evaluation of connecting mobile forklift truck

This test uses an unloaded lorry. The doors and panels of the vehicle are closed. Measurements are taken in two directions (see Figure 9.1).

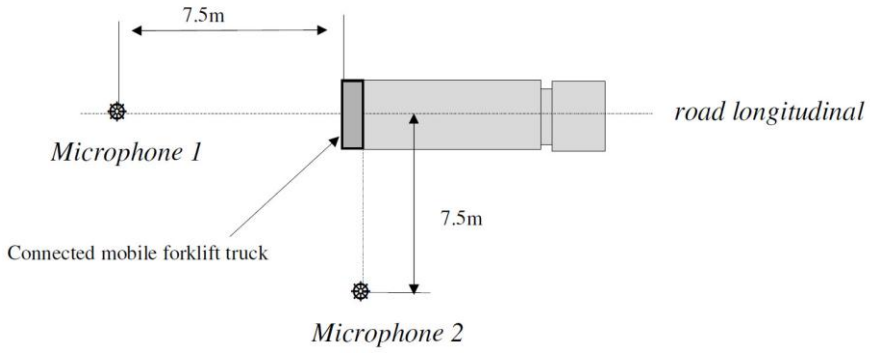

Figure 9.1: Test for mobile forklift truck

The following measurement procedure must be completed to evaluate the noise when connecting and disconnecting the mobile forklift truck:

- The lorry is placed in the measuring position and its engine is switched off
- The measurement begins before the engine of the mobile forklift truck is started, on the lorry
- The mobile forklift truck is unloaded and placed on the ground, after which it is reversed until the forklift is clear of the lorry
- The mobile forklift truck is then driven back into the lorry clamp
- The truck is put in the transport position and locked
- The engine is switched off and the measurement stops
- Measurements are taken at least three times. The measurement result is the energetic average value of the readings (minimum of 6) at both measuring points, rounded to a whole number in accordance with Section 3.3

10. Method of measurement for transport refrigeration

Refrigeration is used to keep perishable goods at the correct temperature during transport [6]. The following systems are distinguished:

10.1 Types of transport refrigeration

10.1.1 Refrigeration system with integrated combustion engine

A refrigeration system with a compressor, one or more evaporators, a control valve, a condenser and an integrated combustion engine that provides the power. The unit, possibly excluding the evaporator(s), is placed in an enclosure that is attached against the front end of the cargo body or underneath the floor. An electric motor may also be present within the enclosure to power the compressor when the lorry's engine is switched off. The electric motor is then connected to the public mains.

10.1.2 Refrigeration system without separate combustion engine

A refrigeration system with a compressor, one or more evaporators (possibly in the cargo body), a control valve, a condenser. The unit is powered by the lorry's engine or by a separate diesel engine mounted underneath the loading body, or the unit is connected directly to the vehicle's battery. The following are distinguished:

10.1.2.1 Electrical systems in which a generator is powered directly or indirectly by the lorry's engine. For a direct drive system, the generator is powered by the lorry's engine without any other components. One example of an indirect drive system is having a hydraulic transmission mounted between the lorry's engine and the generator.

10.1.2.2 Systems in which the mechanical compressor of the refrigeration unit is powered directly by the lorry's engine.

10.1.2.3 Electrical systems stated under 10.1.2.1 with additional support by a (quickly exchangeable) powerpack ((diesel) generator set). The latter consists of a (diesel) engine with a generator that can power the refrigeration system when the lorry's engine is switched off.

10.1.2.4 Systems in which the original integrated diesel engine has been removed and mounted in a separate diesel engine enclosure underneath the cargo body.

10.1.2.5 Systems in which the unit is connected directly to the vehicle's battery.

10.1.3 Refrigeration system based on an "open" gas system

A cooling system with a control valve in which gas (e.g. nitrogen or carbon dioxide) evaporates directly in the cargo body or indirectly in one or more evaporators.

10.1.4 Refrigeration system with eutectic mass

In this system, a eutectic mass is installed in the body instead of the evaporator. The eutectic refrigerant is usually frozen when the vehicle is stationary (at night). The cooling occurs because the cooled air is heavier and floats down in the cargo body. It is also possible to use a fan in the cargo body to lead air along the eutectic mass and cool it.
This system is expected to be sufficiently quiet in terms of the peak noise issue and will not be discussed any further.

If the vehicle is equipped with a PEAK mode switch, the tests can also be performed with PEAK mode activated. PEAK mode must be driver-independent. The driver must not be able to influence PEAK mode either, see also 10.4.

10.2 Measuring arrangements

The lorry with transport refrigeration is placed in the middle of the measuring surface.

10.2.1 Measuring points for refrigeration unit at front end

If the refrigeration unit is mounted to the front end of the vehicle, measurements are taken in 2 directions (angular width is 90^{o}) at the front of the transport refrigeration unit in the horizontal plane at a height of 3m and at 1 measuring point above the transport refrigeration unit (see Figure 10.1). The distance from the 2 measuring points in the horizontal plane to the geometric centre of the refrigeration unit is 7.5m. By way of exception, measurements may be taken at a distance of 2m above the refrigeration unit instead of 7.5m, converting the level to 7.5m as follows:
$L_{p,\ 7.5m\ calculated} = L_{p,\ 2m\ measured} - 11\ dB(A)$, to a noise level at a distance of 7.5m. If measurements can be taken at 7.5m above the vehicle, this will be preferable.

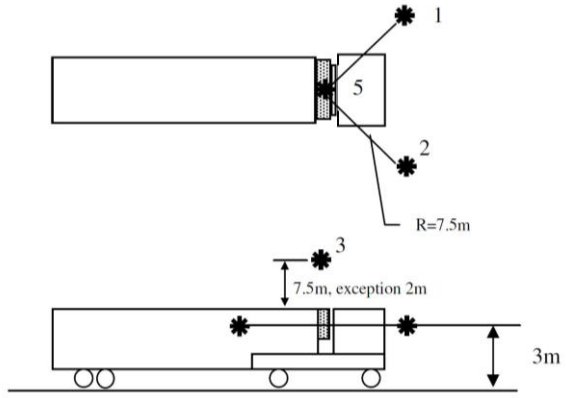

Figure 10.1 Measuring points around the transport refrigeration unit mounted to the front end

10.2.2 Measuring points for refrigeration unit underneath cargo body

If the refrigeration unit is not mounted to the front end, but underneath the cargo body, the measuring points indicated in Figure 10.2 will be used rather than the measuring points indicated in Figure 10.1.

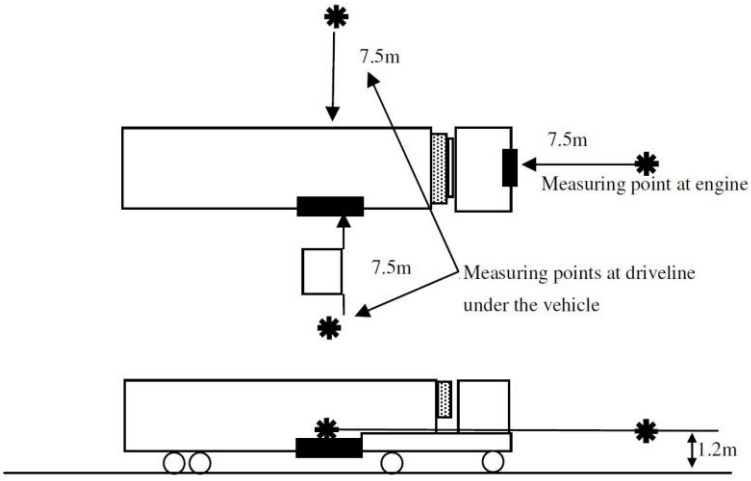

Figure 10.2 Measuring points if the refrigeration unit is mounted underneath the vehicle.

10.2.3 Additional measuring point for unit powered by lorry's engine

If the lorry's engine is used to power the refrigeration unit, a measuring point at a distance of 7.5m from the front of the engine compartment and at a height of 1.2m will be chosen in addition to the measuring points stated in Figure 10.1 or 10.2, see Figure 10.3. The entire installation must be operational during the measurements.

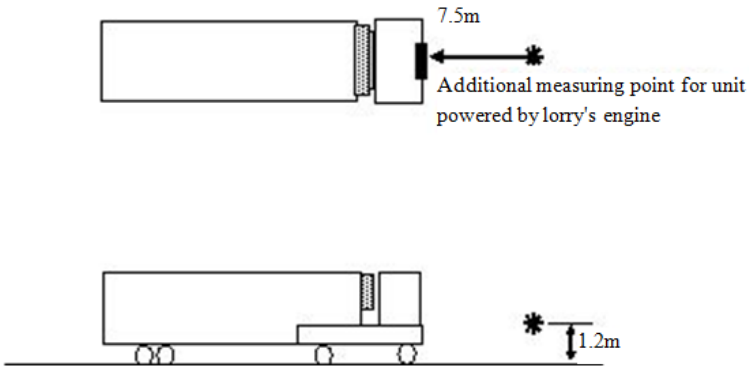

Figure 10.3: Additional measuring point for unit powered by lorry's engine

10.2.4 Additional measuring points for drive system underneath cargo body

If the drive system for the refrigeration unit is mounted underneath the vehicle (10.3.4 and 10.3.5), measuring points will be selected at 7.5m from the sides of the vehicle, positioned parallel to the centre of the drive unit (e.g. diesel engine, compressor, hydromotor, etc.) at a height of 1.2m in accordance with Figure 10.4, in addition to the measuring points indicated in Figure 10.1 or 10.2. The entire installation must be operational during the measurements.

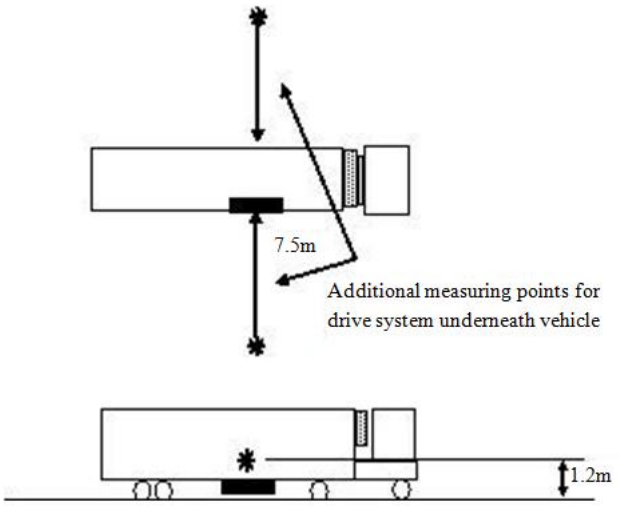

Figure 10.4 Additional measuring points for drive system underneath the cargo body.

10.3 Measurement procedures

There are different measurement procedures for the refrigeration systems described in 10.1. These measurement procedures are described in 10.3.

It may be possible to drive a refrigeration system in various ways, for example, using an integrated combustion engine and through a power connection with the public mains. If a refrigeration system can be driven in various ways, all the possible methods must be tested.

Only a full system can be evaluated; individual parts such as a (quickly exchangeable) powerpack cannot be evaluated separately.

10.3.1 Evaluation of refrigeration system with integrated combustion engine (see 10.1.1 Refrigeration system with integrated combustion engine)

The following measurement procedure must be completed:

- Position lorry in measuring location, switch off engine.
- To guarantee that the refrigeration system to be measured operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the 'set' temperature at -/- 20°C. If the refrigeration system cannot be set to a 'set' temperature of -/- 20°C, the refrigeration system must be set to the lowest possible 'set' temperature
- Start the diesel engine of the refrigeration unit, turn the refrigeration unit on and set it to the 'diesel-high' operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions)
- Main evaporator/evaporator with greatest capacity is operational
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings)
- The measurement result is the highest value read from the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3

For the 'diesel-low' operating condition, the noise level is lower than for the 'diesel-high' operating condition. As the diesel engine runs at reduced RPM in the 'low' setting, this situation will therefore not be evaluated.

If the compressor can be powered by an additional electric motor (connection to the public mains), the refrigeration system will also be measured in accordance with 10.3.6.

10.3.2 Evaluation of refrigeration system without separate combustion engine (see 10.1.2.1 Refrigeration system without separate combustion engine)

The following measurement procedure must be completed:

- Position lorry in measuring location, leave lorry engine running.
- To guarantee that the refrigeration system to be measured operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the 'set' temperature at -/- 20°C. If the refrigeration system cannot be set to a 'set' temperature of -/- 20°C, the refrigeration system must be set to the lowest possible 'set' temperature.
- Turn on refrigeration unit and set it to the 'fast' or 'high' operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions).
- Main evaporator/evaporator with greatest capacity is operational.
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings).
- The measurement result is the highest value read from the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3.

At the current state of the art, the noise level of the lorry engine will be higher than the noise level produced by the refrigeration system when performing the above measurement procedure. Until vehicles are introduced that can be used to perform the above test, the refrigeration unit may be measured using a connection to the public mains in accordance with measurement procedure 10.3.6. If the system has an "overnight cooling system" using a power connection and an electric drive system, this system must also be tested as stated under 10.3.6.

10.3.3 Evaluation of refrigeration system without separate combustion engine (see 10.1.2.2 Refrigeration system without separate combustion engine, with a compressor directly connected to the lorry's engine)

The following measurement procedure must be completed:

- Position lorry in measuring location, leave lorry engine running and bring it to its operating temperature.
- To guarantee that the refrigeration system to be measured operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the 'set' temperature at -/- 20°C. If the refrigeration system cannot be set to a 'set' temperature of -/- 20°C, the refrigeration system must be set to the lowest possible 'set' temperature.
- Turn on refrigeration unit and set it to the 'fast' or 'high' operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions).
- Main evaporator/evaporator with greatest capacity is operational.
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings).
- The measurement result is the highest value read from the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3.

At the current state of the art, the noise level of the lorry engine will be higher than the noise level produced by the refrigeration system when performing the above measurement procedure. Until vehicles are introduced that can be used to perform the above test, the refrigeration unit may be measured using a connection to the public mains in accordance with the measurement procedure below.
If the system has an "overnight cooling system" using a power connection and an electric drive system, this system must also be tested *as stated under 10.3.6*

10.3.4 Evaluation of refrigeration system without separate combustion engine (see 10.1.2.3 Refrigeration system without separate combustion engine, with additional support by a (quickly exchangeable) powerpack)

The following measurement procedure must be completed if the system can operate without a functioning powerpack ((diesel) generator set):

- Position lorry in measuring location, switch off engine.
- Electrically connect refrigeration system to the public mains.
- To guarantee that the refrigeration system to be measured operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the 'set' temperature at -/- 20°C. If the refrigeration system cannot be set to a 'set' temperature of -/- 20°C, the refrigeration system must be set to the lowest possible 'set' temperature.
- Turn on refrigeration unit and set it to the 'fast' or 'high' operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions).
- Main evaporator/evaporator with greatest capacity is operational.
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings).
- The measurement result is the highest value read from the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3.

The following measurement procedure must also be followed if the system has a functioning powerpack ((diesel) generator set):

- Position lorry in measuring location, switch off engine.
- Start powerpack and set it to the 'fast' or 'high' operating condition (unit settings in accordance with the manufacturer's instructions). Run the engine until it reaches its operating temperature.
- To guarantee that the refrigeration system to be measured operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the 'set' temperature at -/- 20°C. If the refrigeration system cannot be set to a 'set' temperature of -/- 20°C, the refrigeration system must be set to the lowest possible 'set' temperature.
- Turn on refrigeration unit and set it to the 'fast' or 'high' operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions).
- Main evaporator/evaporator with greatest capacity is operational.
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings).
- The measurement result is the highest value read from the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3.

For the '**slow**' or '**low**' operating condition, the noise level is lower than for the '**diesel-high**' operating condition. As the diesel engine runs at reduced RPM in the 'low' setting, this situation will therefore not be evaluated.

10.3.5 Evaluation of refrigeration system with external combustion engine (see 10.1.2.4 Systems with the original integrated diesel engine installed externally)

The following measurement procedure must be completed:

- Position lorry in measuring location, switch off lorry engine
- Start diesel engine of refrigeration unit and leave it running until it reaches its operating temperature. Turn on refrigeration unit and set it to the 'fast' or 'high' operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions).
- To guarantee that the refrigeration system to be measured operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the 'set' temperature at -/- 20°C. If the refrigeration system cannot be set to a 'set' temperature of -/- 20°C, the refrigeration system must be set to the lowest possible 'set' temperature.
- Main evaporator/evaporator with greatest capacity is operational.
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings).
- Read the maximum noise levels per measuring point during the entire cycle.

The measurement result is the highest value of the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3.

If the compressor can be powered by an additional electric motor (connection to the public mains), the refrigeration system will also be measured in accordance with 10.3.6.

10.3.6 Evaluation of electrically powered refrigeration system with a connection to the public mains and refrigeration system based on an “open” gas system with a connection to the public mains

The following measurement procedure must be completed:

- Position lorry in measuring location, switch off lorry engine or other combustion engine.
- Electrically connect refrigeration system to the public mains.
- To guarantee that the refrigeration system to be certified operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the ‘set’ temperature at -/- 20°C. If the refrigeration system cannot be set to a ‘set’ temperature of -/- 20°C, the refrigeration system must be set to the lowest possible ‘set’ temperature.
- Turn on refrigeration unit and set it to the ‘fast’ or ’high’ operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions).
- Main evaporator/evaporator with greatest capacity is operational.
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings).
- The measurement result is the highest value read from the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3.

10.3.7 Evaluation of electrically powered refrigeration system with a connection to the vehicle's battery and refrigeration system based on an “open” gas system with a connection to the vehicle's battery

The following measurement procedure must be completed:

- Position lorry in measuring location, switch off engine.
- To guarantee that the refrigeration system to be measured operates under full load, the noise measurement will have to be taken at a cargo body temperature of between +15°C and +5°C, with the ‘set’ temperature at -/- 20°C. If the refrigeration system cannot be set to a ‘set’ temperature of -/- 20°C, the refrigeration system must be set to the lowest possible ‘set’ temperature
- Turn on refrigeration system and set it to the ‘fast’ or ’high’ operating condition or to PEAK mode (unit settings in accordance with the manufacturer's instructions)
- Main evaporator/evaporator with greatest capacity is operational
- Read the maximum noise levels every 10 seconds for about 30 seconds (at least 3 readings)
- The measurement result is the highest value read from the measuring points and any value corrected to a distance of 7.5m, rounded to a whole number in accordance with Section 3.3

If the compressor can be powered by an additional electric motor (connection to the public mains), the refrigeration system will also be measured in accordance with 10.3.6.

10.4 Refrigeration system with PEAK mode

For a refrigeration unit that is fitted with a driver-independent PEAK mode control system, it must be demonstrated that PEAK mode functions in addition to the above methods of measurement.
PEAK mode must ensure that the refrigeration unit meets the legal noise requirements within a distance of 300 metres from the loading/unloading location.

There are several types of driver-independent PEAK modes.
The basic principle of a PEAK mode is that it is driver-independent and that, outside of the PEAK-specified time frames and outside of the so-called PEAK locations, the machine can be set to maximum power with technical tools. In other words, PEAK mode is the normal operating setting of the machine.
In case of a defect in the technical tool or other faults relating to the functioning of PEAK mode, the machine must operate in PEAK mode.
The functioning of PEAK mode must be guaranteed. The functioning of PEAK mode must also be demonstrated and described in the report.

11. Reports

The report must state all relevant matters that are required for the certification of a product.
Details that must always be included in the measurement report are:

Product details in accordance with the form below:

*** Vehicle doors, hatches, hinged and sliding doors**

Description of vehicle doors, hatches, hinged and sliding doors:

Manufacturer	
Make	
Type	
Hinge	
Make	
Type	
Number	
Picture	Place picture here
Locking system	
Make	
Type	
Number	
Picture	Place picture here
Door grip	
Make	
Type	
Number	
Picture	Place picture here
Door catch	
Make	
Type	
Number	
Picture	Place picture here
Rubber	
Make	
Type	
Number	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Air curtain**

Description of air curtain:

Manufacturer	
Make	
Type	
Fan	
Make	
Type	
Number	
RPM	
Picture	Place picture here
Enclosure	
Material	
Material thickness	
Picture	
Insulation material	
Insulation material	
Insulation material thickness	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Roll-up door**

Description of roll-up door:

Manufacturer	
Make	
Type	
Wheels	
Make	
Type	
Number	
Picture	Place picture here
Wheel bearing	
Make	
Type	
Number	

Picture	Place picture here
Locking system	
Make	
Type	
Number	
Picture	Place picture here
Rubber	
Make	
Type	
Number	
Picture	Place picture here
Stop	
Type	
Material	
Picture	Place picture here
If electric	
Electric motor	
Make	
Type	
RPM	
Picture	Place picture here
If pneumatic	
Cylinder	
Make	
Type	
Picture	Place picture here
Opening speed	
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Curtain side**

Description of curtain side:

Manufacturer	
Make	
Type	
Wheels	
Make	

Type	
Number	
Picture	Place picture here
Wheel bearing	
Make	
Type	
Number	
Picture	Place picture here
Locking system	
Make	
Type	
Number	
Picture	Place picture here
Stop	
Type	
Material	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Sliding partition**

Description of sliding partition

Manufacturer	
Make	
Type	
Wheels	
Make	
Type	
Number	
Picture	Place picture here
Wheel bearing	
Make	
Type	
Number	
Picture	Place picture here
Locking system	
Make	

Type	
Number	
Picture	Place picture here
Locking system	
Make	
Type	
Number	
Picture	Place picture here
Rubber	
Make	
Type	
Picture	Place picture here
Stop	
Type	
Material	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Steps**

Description of steps

Manufacturer	
Make	
Type	
Material	
Type	
Thickness	
Picture	Place picture here
Rubber	
Make	
Type	
Picture	Place picture here
Stop	
Type	
Material	
Picture	Place picture here
Other	
Part name	

Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Strip curtain**

Description of curtain

Manufacturer	
Make	
Type	
Wheels	
Make	
Type	
Number	
Picture	Place picture here
Wheel bearing	
Make	
Type	
Number	
Picture	Place picture here
Stop	
Type	
Material	
Picture	Place picture here
Strips	
Number	
Material	
Thickness	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Tailboard**

Description of tailboard

Manufacturer	
Make	
Type	
Version	rear-closing tailboard / slides underneath vehicle / internal vertical tailboard
Engine	
Make	
Type	
RPM	
Picture	Place picture here
Pump	
Make	
Type	
RPM	
Picture	Place picture here
Roll-off stop type	
Roll-off stop modifications	
Picture	Place picture here
Rollers	
Make	
Type	
Number	
Picture	Place picture here
Rubber possibly present on rear frame	
Make	
Type	
Thickness	
Number	
Picture	Place picture here
Rubber possibly present at bottom of cargo body	
Make	
Type	
Thickness	
Number	
Picture	Place picture here
Platform	
Material	
Coating material	
Coating thickness	
Picture	Place picture here

Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Floor**

Description of floor:

Manufacturer	
Make	
Type	
Floor	
Make	
Type	
Structure	
Thickness	
Picture	Place picture here
If coating present	
Make	
Type	
Thickness	
Picture	Place picture here
Anti-skid	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Wall**

Description of wall:

Manufacturer	
Make	
Type	
Wall	
Make	
Type	
Material	
Structure	
Thickness	
Picture	Place picture here
If impact plate present	
Make	
Type	
Dimensions	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Load fastening system**

Description of load fastening system

Locking system	
Manufacturer	
Make	
Type	
Locking system type	
Material	
Picture	Place picture here
Rail	
Manufacturer	
Make	
Type	
Material	
Picture	Place picture here
Other	
Part name	
Make	

Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

Refrigeration unit

Description of refrigeration unit:

Manufacturer	
Make	
Model	
Type	
Where applicable: Variation on standard type:	
PEAK mode: Operating method	
Drive system type:	Powered by vehicle engine / Powered by separate diesel engine Electrically powered / Diesel-electrically powered Nitrogen unit / Carbon dioxide unit
Diesel engine	
Make	
Type	
RPM	
Picture	
Compressor	
Make	
Type	
RPM	
Picture	Place picture here
Generator frequency (where applicable)	
RPM of condenser fan(s)	
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Noise insulation method:	
Enclosure material	
Material thickness	

Picture	
Where applicable for separate drive system	
Enclosure material	
Material thickness	
Picture	
Insulation	
Insulation material	
Insulation material thickness	
Insulation material type	
Picture	Place picture here
Damping fitted inside enclosure	yes/no
Where applicable: water- or air-cooled generator	
Exhaust damper	
Make	
Type	
Dimensions of exhaust damper	
Location of exhaust damper	
Release location of exhaust gases	
Picture	Place picture here
Other	
Part name	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Drive noise**

Description of vehicle

Manufacturer	
Make	

Type	
Engine	
Type	
RPM	
Picture	Place picture here
Tyres	
Make	
Type	
PEAK mode	
Operating method	
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Noise insulation method:	
Enclosure material	
Material thickness	
Picture	Place picture here
Insulation	
Insulation material	
Insulation material thickness	
Insulation material type	
Picture	Place picture here
Damping fitted inside enclosure	yes/no
Exhaust damper	
Make	
Type	
Dimensions of exhaust damper	
Location of exhaust damper	
Release location of exhaust gases	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

*** Reverse warning system and blind spot warning**

Description of warning system

Make	
Type	
Picture	Place picture here
Other	
Part name	
Make	
Type	
Number	
Picture	Place picture here
Peak-specific modification	
Part name	
Make	
Type	
Number	
Picture	Place picture here

Method of measurement

Title, reference to section of peak methods of measurement report and description of the test used: (where applicable, indicate any deviations from the method and the reason for doing so).

Only one method of measurement has to be performed to certify various products. Several methods have to be used for a number of different products.

To certify a QuietTruck, it must pass the following measurements:

4.2 Accelerating

4.3 Braking

4.4 Driving past at a constant speed

4.5 Reversing

4.6 Reverse warning system and/or blind spot warning

To certify a tailboard, it must pass the following measurements:

6.2.1 Opening and closing

6.2.2 Roll-off stop

6.3.1 Rolling over the tailboard

6.3.3 Rolling over transitions

To certify a pallet truck, it must pass the following measurements:

7.1 Rolling noise

7.3 Lowering and raising

To certify a roll container, it must pass the following measurements:

8.1.1 Loaded

8.1.2 Rolling nested roll containers or

8.1.3 Rolling empty roll containers that cannot be nested
8.2 Colliding/nesting roll containers
8.3 Placing and removing additional loading shelves

To certify a 'rolly' or dolly, it must pass the following measurements:
8.1.1 Loaded
8.1.4 Rolling stacked 'rollies' and dollies
8.4 Stacking 'rollies' and dollies

To certify a forklift truck, it must pass the following measurements:
9.1 Driving
9.2 Evaluation of lifting

To certify a mobile forklift truck, it must pass the following measurements:
9.1 Driving
9.2 Evaluation of lifting
9.3 Evaluation of connecting mobile forklift truck

Measuring environment
Description of the measuring location:
- Date and time of the measurements
- Description of the weather conditions: temperature, wind speed, rainfall:
- Distance to reflecting objects (walls, etc.):
- If indoors, dimensions and furnishings of the space:
- Description of the road surface:
- Background level ($L_{pAmax,Fast)}$ in dB(A):

Pictures of the measured object with immediate surroundings.

Measuring equipment
List of measuring equipment used, indicating the type, type number, serial number and last calibration date. Measuring quantity: $L_{pAmax,Fast}$

Load and operating condition
If laden, describe the load. Operation method, driving speeds, pictures of the load:

Measuring points
Distance to the source and height of the measuring microphone for each measuring point. Pictures of the measuring points in relation to the measured object.

Measured levels and processing
Levels read for each measuring condition and each measuring point. Number of averaging operations and type of averaging:

Measurement results by type of source and condition

12. References

[1] ‘Proposals for methods of measurement for peak noise during loading and unloading’, TNO report HAG-RPT-980088, November 1998

[2] ‘Feasibility study on reducing peak noise during loading and unloading’, TNO report HAG-RPT-970095, 30 September 1997

[3] ‘Acoustics -Measurement of noise emitted by accelerating road vehicles Engineering method’ International Standard ISO R 362, First Edition - 1981-10-01

[4] ‘EEC approval of a type of motor vehicle in terms of the noise level’. Official Journal of the European Communities 19.12.92, No. L371/1 Council Directive 92/97/EEC of 10 November 1992 amending Directive 70/157/EEC on the harmonisation of the laws of the Member States relating to the permissible noise level and the exhaust system of motor vehicles

[5] ‘Method to determine the noise capacity level in dB(A) radiated by a forklift’, Vamil publication series number 3.1, October 1997, Ministry of Housing, Spatial Planning and the Environment

[6] ‘Feasibility study on quiet transport refrigeration’, Environmental technology publication series, number 1990/3, Ministry of Housing, Spatial Planning and the Environment

[7] ‘Methods of measurement for peak noise during loading and unloading (2010 update)’ TNO report MON-RPT-2010-00466, 18 February 2010

13. Signatures

Leidschendam,

A NOVEM memo, 4 July 2002

To	:	Mrs de Gooijer, Mr Niehoff, MrVisser
From	:	R. Goevaers
Copy to	:	Hielke Zandberg
Subject	:	Motivation for evaluation method for peak noise in road vehicles
Reference	:	Noise measurement vs 0

Introduction

These notes briefly discuss the specific noise measurements regarding the Retail Trade Decree and the PIEK programme.

General

The following measurement and calculation methods are used in the Netherlands:

1 Type testing:
Based on EU rules for devices used outside an establishment: Noise Abatement Act, chapter II (devices) and road traffic legislation. These devices are indicated for each Decree. Examples include vehicles, construction equipment, lawnmowers and similar.

2 Traffic noise (under the Noise Abatement Act, chapter VI, sec. 102 +103):
All traffic noise in terms of equivalent noise levels on the outer walls of homes. This therefore includes traffic noise caused by urban distribution, combined with passenger vehicles, motorcycles, etc. The legally established method is indicated in the Calculation and Measurement Directive. The rules are applied to all public roads. The legal basis is presented in the Decree by the Minister of Health and Environmental Protection of 22 May 1981, Government Gazette no. 107, most recently amended by a Decree of the Minister of Spatial Planning, Housing and the Environment of 28 March 2002, Government Gazette no. 62.

3 Industrial noise, Noise Abatement Act + Environmental Management Act:
Under chapter V of the Noise Act, sec. 73, for each specific Decree of the Environmental Management Act and for each permit directive (+ existing jurisprudence), refer to the 'Industrial Noise Measurement and Calculation Guide'. This guide describes measurement and calculation methods for transferring noise from noise sources in and related to facilities to recipients of the noise. The results of measurements and calculations are equated within the limits of the guide. The legal basis of the Guide is given in the ministerial orders of 20 August 1982, Government Gazette no. 161, and 31 May 2001, Government Gazette no. 117.

Retail Trade Decree

The Industrial Noise Circular (1979), fully supported by existing jurisprudence, states that for establishments, therefore including retail trade, peak levels must be included in permit directives along with limits in terms of equivalent noise levels. In the 1980s, this policy was also included in the general rules on the basis of the Abatement Act. The Decrees contain limits for both phenomena. This policy was continued in 1998 in the 'Retail Trade and Craft Businesses Environmental

Management' Decree (hereinafter referred to as the Retail Trade Decree), although the hard limits of the Abatement Act Decree were changed to targets.
In addition to the familiar series for the equivalent noise level during the day, evening and night periods of 50, 45 and 40 dB(A), it was established that deliveries to shops in the evening and night was permitted, provided the peak levels (Lmax) complied with the following values:
Day : 7.00 am – 7.00 pm: No restrictions in terms of L_{max}.
Evening : 7.00 pm – 11.00 pm: 65 dB(A) maximum.
Night : 11.00 pm – 07.00 am: 60 dB(A) maximum.

The competent authority may deviate from these guidelines, independently or on request, in a positive or negative sense, by setting a further requirement. This allows for optimal balancing of the interests of the entrepreneur and of the area.
To determine whether loading and unloading occurs within these limits in practice, the noise level must be measured or calculated on location at the outer wall of the nearest home.

PIEK multi-annual plan
The PIEK programme has been initiated to support business in finding logistical solutions so that loading and unloading can occur within these noise limits.
To measure and compare the quiet solutions developed within this programme in terms of noise performance, TNO has designed **a proprietary special method of measurement** for the **PIEK** programme whereby the results of tested objects are comparable with each other.
The Retail Trade Decree indicates immission values for homes. The PIEK method of measurement is a resource for producers to determine whether their equipment complies with these values in principle. The method is therefore not automatically applicable for determining immission levels on the outer walls of homes as incorporated in the Decree. To determine such noise levels, the results of a 'PIEK measurement' can be translated using the 'Industrial Noise Measurement and Calculation Guide' and possibly the 'traffic noise measurement and calculation method'. The rule of thumb is that the noise level decreases by 6 dB(A) every time the distance is doubled. These measurement and calculation methods must be applied in addition to the PIEK
method of measurement to relate to practical conditions..

The basis for compiling this protocol for PIEK in addition to that of the guide was:

- The Retail Trade Decree.
- As much relevance to the practical situation as possible.
- 'Worst case' approach to measurement conditions.
- The method of measurement must be repeatable and provide the same results.
- Simple and pragmatic evaluation method.

The basis is that the methods of measurement must provide representative values that can be translated to problem situations, possibly by means of calculation.
The choice was therefore made to compare noise levels (L_{max}) at a distance of 7.5 metres at a height of 1.2m above a hard surface.

L_{max} versus $L_{A,eq}$

Another decision involved the choice of the L_{max} versus the $L_{A,eq}$ ($L_{A,equivalent}$ or in the Decree: the L_{Aeq}). L_{max} measures the maximum noise peak occurring in a short time at the standardised meter setting 'F'.

$L_{A,eq}$ measures the noise level of a constant noise source over a longer time at the standardised meter setting 'S'.

The purpose of the Decree is to prevent sleep disturbances and startled reactions, which are measured by the L_{max}. People are generally more easily startled awake by a short noise occurring suddenly – a noise peak – than by a noise that builds slowly. For example, compare a blow with a hammer and a passing car. The first example can be more of a nuisance than the second, even though they may reach the same maximum level at the location of the observer. After all, the observer is given some warning in the second case. Therefore, L_{max} was selected in addition to $L_{A,eq}$.

The following notes may be made:

- The application of the L_{max} and the $L_{A,eq}$ is consistent for all establishments in the Netherlands and is legally established in all Decrees and permit directives.
- $L_{A,eq}$ is used in many (but not all) European countries; L_{max} only if sudden percussive noises may occur. Measuring noise sources using $L_{A,eq}$ provides lower values, as the time window of the 'S' setting is larger than for the 'F' setting and a peak is simply the maximum of a very short noise burst, whereas the equivalent noise level is evaluated as the energetic average over 12, 4 and 8 hours during the day, evening and night respectively. The results of $L_{A,eq}$ and L_{max} measurements must be determined using the method of measurement of the 'Industrial Noise Measurement and Calculation Guide'. The results of the PIEK method of measurement may only be converted to the noise load on the outer walls of homes using the guide. The values of the PIEK method of measurement and those of the Decrees therefore cannot be used in combination, or compared with each other.
- The spread of PIEK at the European level will require L_{max} to be clearly explained to prevent debate.

Choice of the 7.5 metre distance in the PIEK programme.

To make the measurement results comparable, the following aspects were involved in the choice of distance:

- a set distance between the noise source and the microphone;
- an environment free of obstacles;
- a comparable (hard) surface between the source and receiver;
- a calm environment with few sources of disruption (avoid large measuring distances because of the potential for measuring other noise sources);
- staying out of the proximity field of the noise source;
- assuming narrow streets in a city centre, with a width of approx. 15 metres, and halving that;
- the measurement distances must always be equal to be able to compare results.

The distance from the source to homes may vary in practice from 2m (very close) to several hundred metres.

When measuring, **two issues** must be avoided:

- The influence of background noise. When measuring at greater distances, background noises on the measuring microphone may influence the results of the measurement, so that the results cannot be reproduced.
- The measuring distance should not be too small. When measuring close to the source, the measurement result is not reliable as one may end up in the proximity field, such that measurement deviations may occur.

Additional arguments for a 7.5 metre distance

- At a distance of 7.5 metres, the probability that background noise levels will affect the measurement is relatively low, as the noise source will produce a much higher level than at greater distances.
- The 7.5 metre distance of the method of measurement is consistent with a measuring distance indicated in several noise methods of measurement, such as Industrial Noise, Noise Abatement Act + Environmental Management Act and ISO 362 – a measuring distance also applied in international standards.
- The pragmatic choice of a distance of 7.5 metres is justified by the inner-city situation in which homes are close to a loading/unloading location.
- The measuring height is prescribed in the Guide and must be maintained to make it possible to determine or maintain limits at a later stage.

PIEK method of measurement and method to determine noise immission.

The PIEK method of measurement serves to determine reproduceable measurement results quickly and easily so that products are **comparable** with each other. The PIEK method of measurement is not intended to determine noise capacity.

A separate method will have to be developed to measuring the **noise capacity level** of each noise source that does justice to the operating conditions of the device in question. For example, the EU has developed and established such specific methods for vehicles, building equipment and so on. The noise capacity determined using these methods can be converted to immission levels near homes using the 'Industrial Noise Measurement and Calculation Guide'.

The PIEK method of measurement is a **proximity measurement**. The immission thus measured at 7.5m may be extrapolated to greater distances using the methods in the Guide. This takes into account factors such as geometric expansion of noise, ground attenuation, shielding, reflection, molecular attenuation, meteorological conditions, etc. All municipalities, provinces and acoustic consulting firms have the Guide.

Collective disturbance in an urban environment may be calculated by combining the legally established 'Industrial Noise Measurement and Calculation Guide' with the 'traffic noise measurement and calculation method', also established by law.

For an indication of the extent of the influence of traffic, industry, etc., in relation to the annual average noise level, the site www.xs4all.nl/~rigolett provides an indication of L_{den} if the individual contributions of the various noise sources are known.

Evaluating the PIEK method of measurement.
The PIEK method of measurement is currently being evaluated by TNO. TNO has been instructed to adjust several shortcomings observed in practice. This includes a more detailed description to prevent inaccuracies in measuring.

Conclusion
The Retail Trade Decree indicates immission values for homes. The PIEK method of measurement is a resource for producers to determine whether their equipment complies with these values in principle.

The question of whether the PIEK method of measurement is compatible with practical conditions is difficult to answer, as these are highly variable in terms of distance and the composition of noise sources.
However, the 'Industrial Noise Measurement and Calculation Guide' allows the PIEK value to be extrapolated to the immission value near a home with relative ease.
The additional method in the 'Industrial Noise Measurement and Calculation Guide', possibly complemented by the 'traffic noise measurement and calculation method', may therefore be applied so that the PIEK method of measurement is in line with practical conditions.

The PIEK method of measurement has been selected precisely to be able to reproduce measurement results so that noise sources can be evaluated and compared. The measurement conditions have, after all, been set out in the PIEK method of measurement, i.e., the measuring distance, operating condition, situation and measuring environment, for optimal and comparable evaluation.
In relation to practical conditions, however, the selected distances are always open to discussion as practical conditions will deviate from the principles of the method of measurement. After all, there is almost never an area free of obstacles in practice, and distances other than 7.5 metres must be taken into consideration along with the presence of obstacles, which can give rise to shielding or reflection.

It can be concluded that the selected distances have been carefully chosen for the PIEK method of measurement based on several considerations, with 'optimum' as the basic principle.

TNO will be adjusting the method of measurement soon, based on the conclusions of the evaluation of the PIEK method of measurement.