



# CityHush

CityHush – Acoustically Green Road Vehicles and City Areas

## About CityHush

The CityHush project supports city administrations with the development and implementation of noise action plans according to the directive EC 2002/49. Noise action plans made with existing technology suffer from major shortcomings: there is a poor correlation between hot spots and annoyance and complaints, most measures lead to increased emissions, and only indoor noise comfort is addressed.

In order to reduce noise in city environments, CityHush develops suitable problem identification and evaluation tools and designs noise reduction solutions for hot spots that show a high correlation with annoyance and complaints. The innovative solutions and tools under development are listed below.

### Urban planning & noise score rating systems

- Q-zones;
- parks embedded in Q-Zones;
- improved indoor noise score rating models integrating low-frequency noise and the occurrence of high noise single events;
- noise score rating models for the outdoors.

### Vehicles, tyres & road surfaces

- objective and psychoacoustic evaluation tool for low noise low emission vehicles;
- mathematical synthesis tool for noise from low noise low emission vehicles;
- general performance noise specifications for low noise low emission vehicles;
- novel concepts for low noise roads based upon dense elastic road surfaces;
- novel concepts for low noise roads based upon grinding of asphalt top layers;
- novel concepts for tyres for low noise vehicles, including heavy vehicles;
- criteria for use of low noise motorcycles;
- active and passive noise attenuation measures within the tyre hood.

### Building design & noise barriers

- solutions for high low-frequency absorption at facades of buildings;
- solutions for high low-frequency isolation in the propagation path.

The CityHush project is co-funded by the European Commission under the 7<sup>th</sup> Framework Programme for RTD.

Duration: January 2010 - December 2012

Budget: appr. 5 m€

13 partners in 7 countries

[www.cityhush.eu](http://www.cityhush.eu)



## Editorial

We are happy to present you the fourth issue of the CityHush newsletter. This issue marks the final phase of the project, when many results will become available. These will also be presented at the CityHush series of events planned until the end of this year. The series kicked off with the CityHush workshop "Acoustically Green Road Vehicles and City Areas" which took place at Euronoise 2012 last month in Prague. Topics of presentations included definitions and impacts of quiet facades and quiet urban areas, noise of electric and combustion powered scooters, measuring and analyzing road traffic noise, noise mapping on a large scale and embedded Parks in Quiet Zones.

In autumn, one seminar and two training workshops will be held. The training workshops target local authorities and will teach participants how the concepts developed by CityHush can assist them in tackling transport issues in their cities and meeting the European Noise Directive requirements. These tools include the concept of quiet zones, noise absorbing facades, road surface and others. The first training workshop will be held within the framework of the annual Polis conference, which will take place in Perugia on 29-30 November 2012.

The seminar, which will target stakeholders from different sectors interested in urban transport noise abatement, and the second training workshop will take place on 10-11 December in Stockholm, in conjunction with the final seminar of the Hosanna project ([www.greener-cities.eu](http://www.greener-cities.eu)), which works towards a toolbox for the reduction of road and rail traffic noise in the outdoor environment.

Go to [www.cityhush.eu](http://www.cityhush.eu) and register to our mailing list to ensure you are kept informed!

The next and final issue of the CityHush newsletter will be published in December 2012.

We wish you a pleasant read and look forward to seeing you at one of our events!

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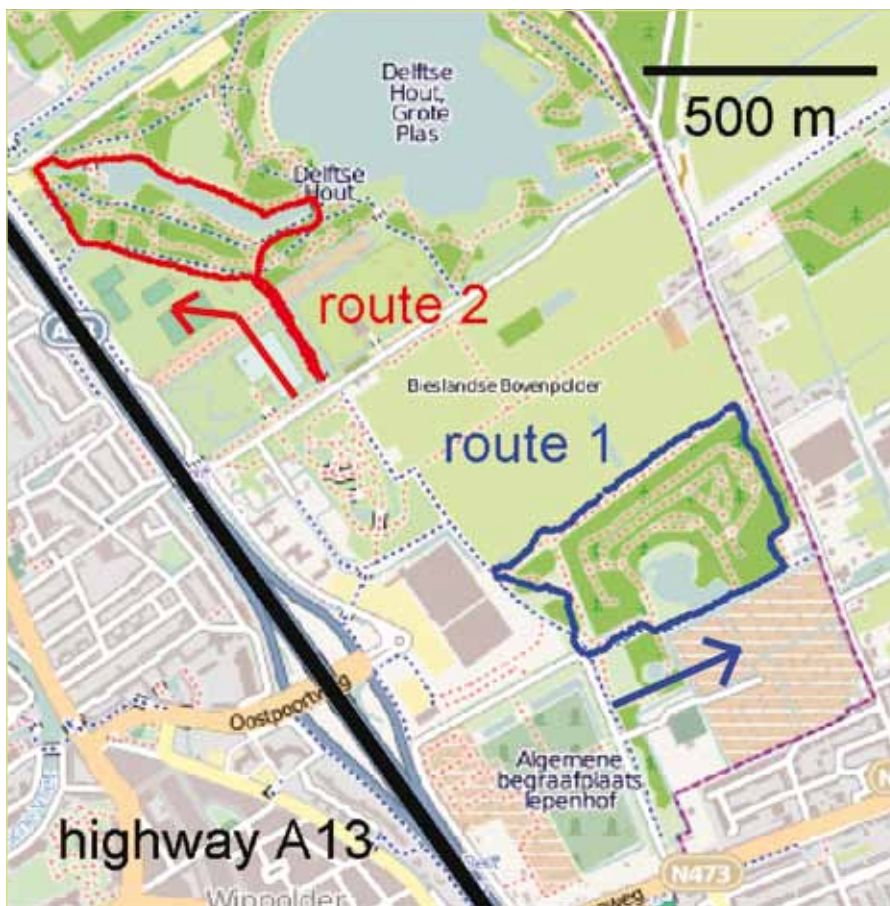
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## Evaluation of outdoor noise in urban recreational areas

*The impact of transport noise on human health has primarily been studied for the home environment, with the facade exposure level as a determinant.*

*However, urban residents may travel, work and recreate outdoors during many hours of the day, and outdoor noise may also affect their health and well-being.*



Test site in the Netherlands (image: TNO)

Previous studies have shown that aircraft noise is perceived as annoying by visitors of natural recreational areas, and that road traffic noise may reduce the perceived quality of the acoustic environment in recreational areas. It is not clear, however, whether this more negative evaluation is associated with a reduction in physiological and mental restoration while visiting a natural

environment. It was hypothesized that outdoor transportation noise may impair the restorative aspects of a natural outdoor environment. This hypothesis was tested in an urban park in the Netherlands, where 52 participants were monitored during a walk either in a relatively noisy area nearby a highway, or in a quieter area further away from the highway. Self-report measures such

as annoyance and mood state were taken into account, while heart rate and blood pressure were monitored to assess possible restorative effects of the environment on physiology. Noise exposure was individually assessed to enable the establishment of relationships between exposure and human response.

Annoyance due to highway noise as well as perceived interference of highway noise with natural quiet were found to be higher in the relatively noisy than in the quiet walking conditions. Furthermore, individual noise exposure correlated with each of the four evaluation measures (perceived quietness and soundscape quality, and annoyance and interference due to highway noise). No effects of walking conditions or individual noise exposure were found on physiology and mood. Effects on the evaluation measures suggest that above an A-weighted sound level of around 50 dB (averaged over the park visit), more than half of the visitors will report annoyance and interference by highway noise, less than half of the visitors will perceive the area as quiet, and less than 70% will perceive the soundscape as good. The results complement earlier findings on outdoor annoyance and may have implications for urban planning, indicating the need for a restriction of transport noise in outdoor urban recreational areas.

In the context of the EU Environmental Noise Directive (END), it is important to be able to assess the impact of environmental noise in the outdoor situation on residents. The END promotes the preservation and creation of quiet areas, both in urban and in rural areas, and stresses the need for supplementary noise indicators for quiet areas. However, measures directed towards a more quiet outdoor situation, in so far as they are not reflected in facade levels, will not show up in health assessment indicators. Based on current knowledge and additional data from the field study, a noise score rating model for pedestrians and visitors of parks was designed. In this rating model, indicators for outdoor noise can be combined with information about the number of people making use of the area to predict the overall annoyance response, i.e. the percentage (or number) of visitors that is expected to be annoyed by noise in a given area. ■■■

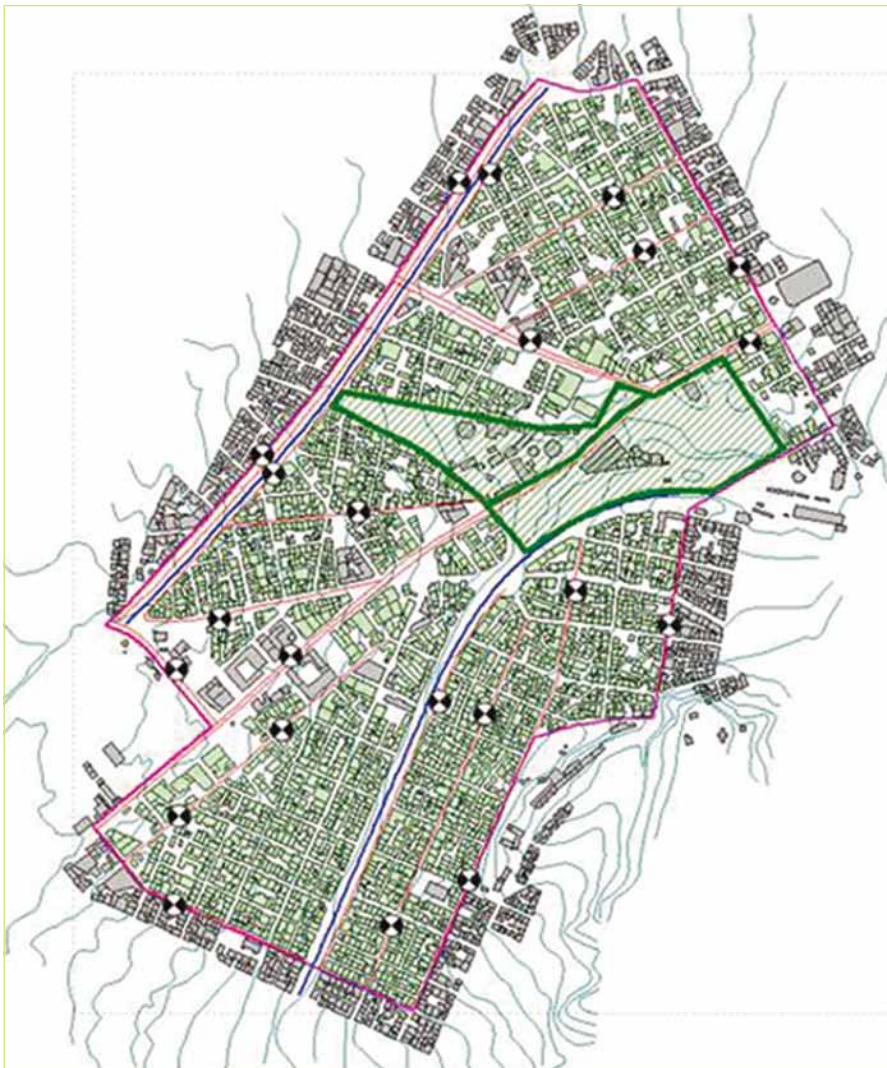


## Validating noise score rating models: The case of Athens

Within the CityHush project, noise score rating models are being validated through a case study in Athens. Chosen locations are the Kerameikos archaeological green area & museum and the Gazi municipal cultural area and park, which allow including Q-Zones and embedded parks. Noise score models for indoor and outdoor noise will be used.

In the coming three months, a detailed analysis with different noise score rating models will identify the actual and perceived benefits of the noise effects and impact of Q-Zones and embedded parks. Also, situations will be analysed with high noise

levels from motorcycles, as well as situations with low frequency noise annoyance. The picture below shows the Athens validation site with Q-zone (red marked) and embedded park (green crosshatched). The surroundings of the Q-zone will not be considered.



The test site in Athens consists of the Kerameikos archaeological green area and museum as well as the Gazi municipal cultural area and park (image: TTE)



The aim of the different noise investigations at the Athens validation site is to apply the evaluation tools (noise score model for residents and park visitors, capacity of embedded park, noise distribution,...) on traffic scenarios with different compositions of the traffic fleet and different background noise levels (caused by rail). The different traffic scenarios, with no influence of the traffic flow outside the Q-zone, are listed in the table below. ■■■

Scenario	Description
S01	Status Quo traffic composition (cars, trucks, scooters, motor bikes) and real background noise caused by rail
S02	S01 + speed reduction at Piräus Avenue (main road through the Q-zone and park) + 50 % electric scooters and motor bikes within the fleet at all road sections within the Q-zone
S03	S02 + 5 dB reduction of background noise from rail
S04	S01 + speed reduction at Piräus Avenue (main road through the Q-zone and park) + 100 % electric scooters and motor bikes within the fleet at all road sections within the Q-zone
S05	S04 + 5 dB reduction of background noise from rail
S06	S04 + 20% electric cars
S07	S06 + 5 dB reduction on railway noise



## Mitigating the 'horn effect'

Horns are great for transmitting sound efficiently. As Figure 1 shows, our ancestors used them to good effect in the days before electronic amplification was possible. Unfortunately, what was good news for music lovers is bad news for the urban populace. The horn-shaped region formed by the tyre belt and road surface (see Figure 2) leads to efficient amplification of the sound created by tyre vibrations: tyre noise. As a result, for a given source, the sound perceived can be increased as much as four times over its level if the tyre were absent. Research within CityHush aims to identify how the basic dimensions of a tyre should be modified to mitigate this 'horn effect'.



Figure 1. Using horns to improve the efficiency of sound transmission.

The horn effect is assessed by calculating the amplification, relative to the tyre-absent case, of a sound source on the tyre belt. This calculation is repeated for all possible belt locations to produce a 'map' of the amplification. Two examples are shown in Figure 3. The horizontal direction represents the distance around the 'unwrapped' tyre belt, and the vertical direction distance across the belt. The colour indicates the level of amplification in decibels (dB). The plots are for a single sound frequency in the audible range. For detailed assessment, different frequencies are considered.

The maps in Figure 3 are for tyres with belt widths equal to one-eighth (upper) and one-half (lower) of their diameter. These geometries are, respectively, significantly narrower and slightly broader than typical current car tyres. The horn amplification of the narrower geometry is clearly much lower than that of the broader. Note also that it applies over a smaller width (the plots are scaled to the same vertical size, but the narrower tyre is one-quarter the width of the broader). Both these observations imply that the narrower tyre would be significantly quieter.

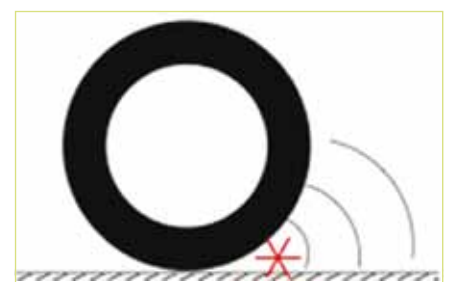
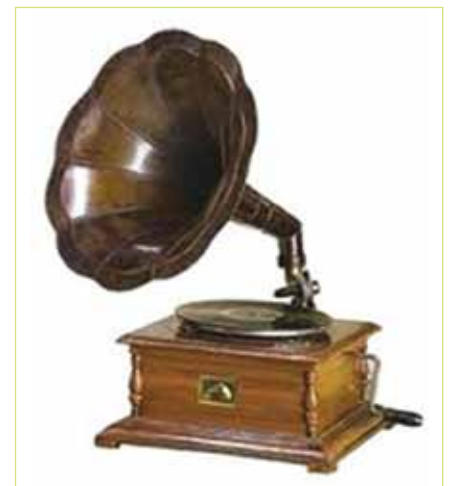


Figure 2. Noise sources in the horn-like region between the road and the tyre belt are preferentially amplified.



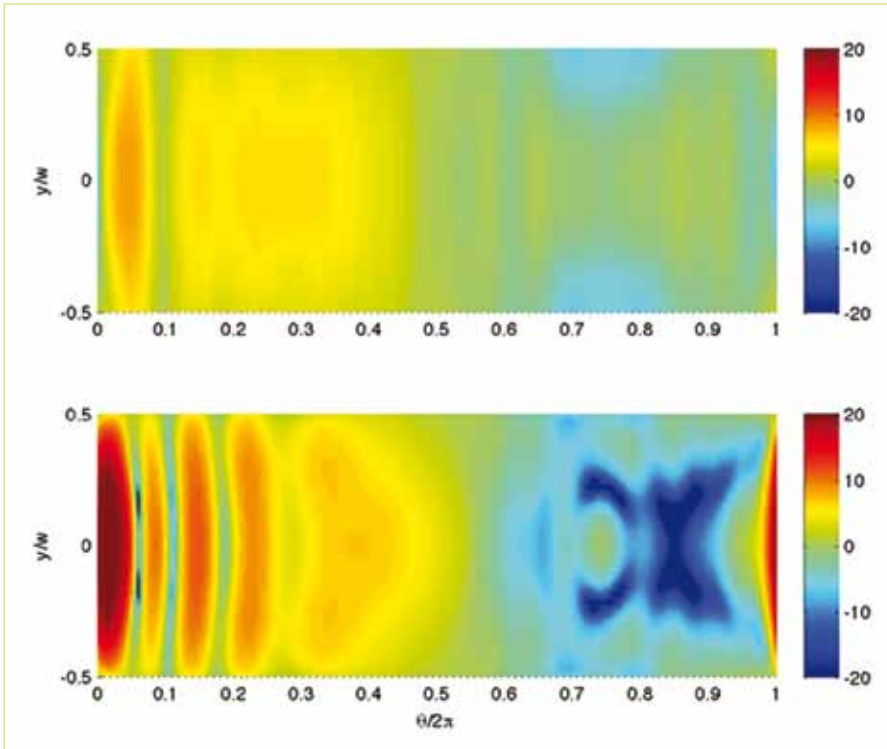


Figure 3. Horn amplification maps (in dB) for a narrow (upper) and wide (lower) tyre. The tyre is unwrapped in the horizontal direction.

In reality, simply making tyres narrower without other alterations may not be practically possible; for example, it might mean that they could no longer support their design load. For this reason, the research has also compared a narrow belt with a large diameter against a wide belt with a smaller diameter, with both geometries having the same product of width and diameter. Figure 4 shows an example of the results, with the narrower tyre again represented by the upper map. Even when its diameter is increased in this way, the narrow tyre has much lower horn amplification than the broader one.

This study suggests that making tyres narrower would be a simple and powerful way to reduce their noise. It applies across the entire range of audible frequencies, and to both truck and car tyre sizes. ■■

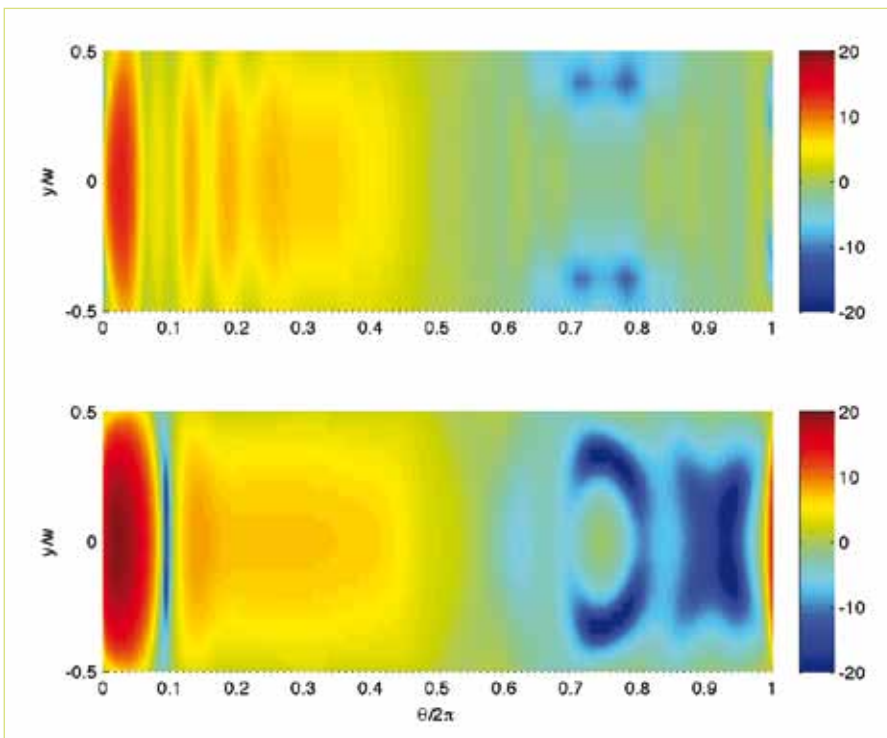


Figure 4. Horn amplification maps for narrow (upper) and wide (lower) tyres with, respectively, greater and smaller diameters.

For a given source, the sound perceived can be increased as much as four times over its level if the tyre were absent. Research within CityHush aims to identify how the basic dimensions of a tyre should be modified to mitigate this 'horn effect'

## Development of a low noise road surface for inner city areas

*In the previous issue of the newsletter, we already reported on the first results of the CityHush study on low noise road surfaces for inner city areas. The 'smooth' dense road surface for inner-city applications was studied. By carefully selecting the size distribution of the stone ballast in the asphalt mix, it was expected that a smooth surface with a high wear rate could be achieved.*

Two questions were to be answered. The first was if it is possible to reproduce the texture in field using ordinary large scale asphalt machines. The second was how much the texture will affect the noise emission.

Three new road surfaces with different prescriptions were tested on Arvid Lindmans Gata in Gothenburg. As reference, one new standard road surface (8mm stone size) and one worn road surface with 11 mm maximum stone size (only for the CPX-measurement) were used. Except for the two recipes from the laboratory, one surface with 4mm maximum stone size was also tested.

The tyre/road noise at "Arvid Lindmans gata" was assessed using the CPX-method. The first measurements were done only one week after the implementation of the pavement because of the upcoming winter. This meant that all pavements were "soft", which also resulted in reduced noise levels for all pavements. Compared to an old standard pavement with 11 mm stone size, all pavements showed a noise reduction of about 5-6 dB(A) units, but the difference between the tested surfaces was small.

In spring 2012, the texture in the wheel tracks was more like the texture in the laboratory. The difference in noise emission for the two test surfaces was almost 2 dB(A)-units and it was the rough texture that gave the lowest noise levels, the major reason for this being the leakage effects in the gaps between the stones.

Despite the fact that the results didn't differ very much on the total noise level for the first CPX measurements, some interesting results were found. In figures 1-2, it can be seen that

for frequencies above 1000 Hz, the smooth dense ABS 4 pavement gives higher noise levels of about 3 dB-units. For frequencies below 1000 Hz, the same pavement gives reduced noise levels of about 3 dB-units. This means that a rough texture leads to a lower noise at high frequencies. This is judged to be due to the leakage through the air gaps between the stones. At lower frequencies, the road surface excitation of the noise is lower due to the smooth surface. The measurements show that the potential reduction of noise only due to

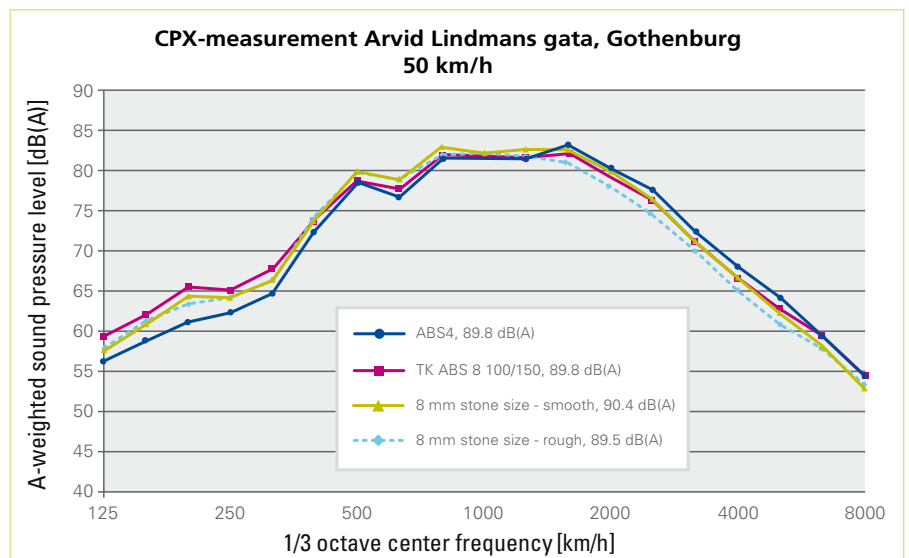


Figure 1. Tire/road noise measured for the new road surfaces on Arvid Lindmans gata. Measurements performed <1 months after production.

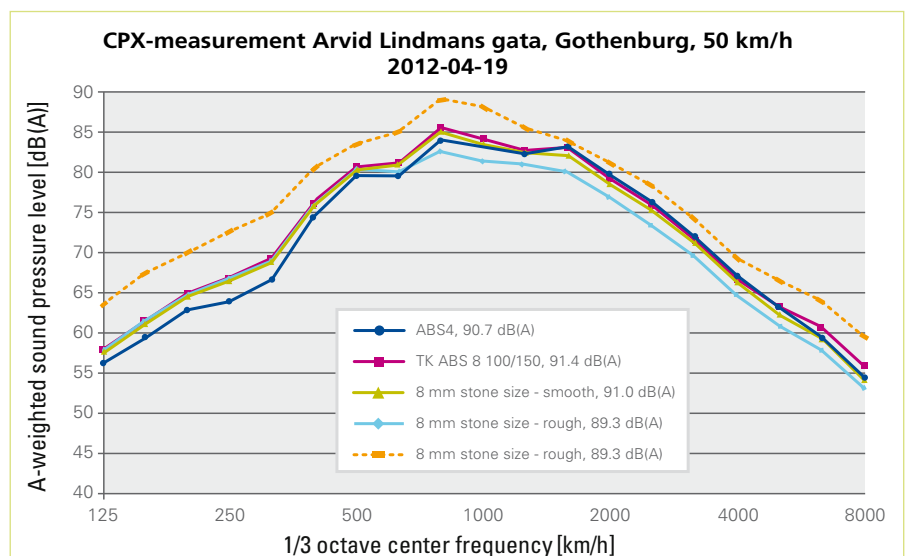
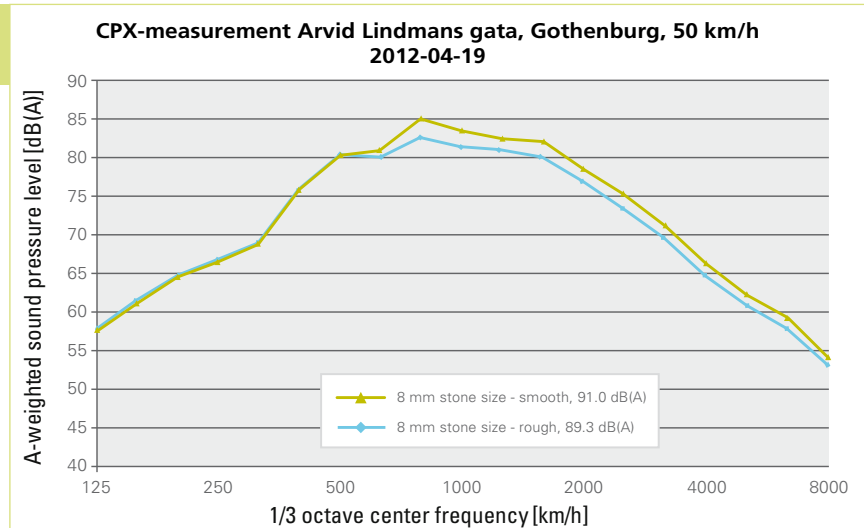


Figure 2. Tire/road noise measured for the new road surfaces on Arvid Lindmans gata. Measurements performed >7 months after production. The 8 mm road surfaces are also compared to a road surface with 4 mm max. stone size and a worn road surface with 11mm max stone size.

**Figure 3.** Measured tyre/road noise for the smooth and rough road surface. Measurements performed >7 months after production.

road texture is around 3 dB(A) for pavements using the same maximum stone size.

The tests carried out this spring (see figures 2-3) show that the rough texture with 8 mm maximum stone size gives around 2 dB(A)-units less noise compared to the smooth texture with the same maximum stone size. From these results, it looks like the optimal texture should be rough but with a maximum stone size of not more than 8 mm. ■■■



## EU Policy Update

*Last December, the European Commission put forward a draft regulation to reduce noise produced by cars, vans, buses, coaches, light and heavy trucks. The proposal is to lower noise limit values in two steps of each 2 dB(A) for passenger cars, vans, buses and coaches. For trucks, the reduction would be 1 dB(A) in the first step and 2 dB(A) in the second step.*

The first step is to apply two years after the publication of the text, once approved by the EP and Member States, and the second step is foreseen three years thereafter. Altogether, these measures will reduce vehicle noise nuisance by some 25%. In addition, the Commission intends to introduce a new and more reliable test method to measure sound emissions. Moreover it is proposed that electric and hybrid electric vehicles can be fitted optionally with sound generating devices which would make these cars safer. Noise emissions limits have not changed since 1996 despite increasing traffic.

The World Health Organisation concluded that traffic related noise may account for 1 million healthy years of life lost per year in Western Europe. Hence, reduction of traffic noise is essential to improve the health and quality of life of Europe's citizens.

### New test method

The proposal on reducing vehicle noise includes passenger cars, vans (light commercial vehicles), buses, light trucks, coaches and heavy trucks. It will ensure that the noise levels of new vehicles will be measured by a new and more reliable test method.

To this end, so-called additional sound emission provisions (ASEP) will be included. These are preventive requirements which will ensure that the sound emissions of a vehicle under street driving conditions will not differ significantly from what can be expected from the type-approval test result for this specific vehicle.

### Electric and hybrid electric vehicles

So-called 'Approaching Vehicle Audible Systems' requirements shall ensure that only adequate sound generating devices are used which will also lead to a harmonisation of the applied technology. The fitting as such would remain an option for the vehicle manufacturer. This will increase road safety and undoubtedly help avoiding road-accident injuries.

### A global benefit

Having the same basic rules throughout the EU makes it easier to buy, sell and use vehicles in any Member State – and ensures equal health, safety and environmental standards across the EU.

With this proposal the current EU rules applicable to noise emissions from vehicles will be updated and further aligned with internationally recognised UN standards. This should enable to improve market access for European car manufacturers in those third countries which are contracting parties to the UNECE Agreement of 1958 and thus boost the competitiveness of European industry.

### Next steps

The proposal, if adopted by the Parliament and Council, will replace the existing Vehicle Noise Directive (70/157/EEC). The proposal is currently being considered in the European Parliament by the Environment Public Health and Food Safety (ENVI) Committee, with opinions being provided by the Transport and Tourism (TRAN) and Internal Market and Consumer Protection (IMCO) Committees. The TRAN and IMCO opinion committees voted in June, while the ENVI Committee vote planned for 10 July has been postponed to 19 September. As a result, The European Parliament vote planned for October will also have to be pushed back, most probably to December or possibly January 2013. The Council has not yet addressed the file. ■■■

### Source:

<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1520&format=HTML>

### More information:

[http://ec.europa.eu/enterprise/sectors/automotive/documents/proposals/index\\_en.htm](http://ec.europa.eu/enterprise/sectors/automotive/documents/proposals/index_en.htm)



# External Events

Date	Event	Place
19-22 August 2012	InterNoise 2012	New York, USA
17-19 September 2012	International conference on Noise and Vibration Engineering (ISMA 2012)	Leuven, Belgium
7 November 2012	Serbian Noise Congress 2012 (Government to Government (G2G) project)	Belgrad, Serbia
29-30 November 2012	CityHush workshop for local authorities at 2012 Annual Polis Conference	Perugia, Italy
10-11 December 2012	Joint Hosanna and CityHush workshop and seminar	Stockholm, Sweden

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