



## Measurement methods for road traffic noise emission

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# Sources of noise annoyance

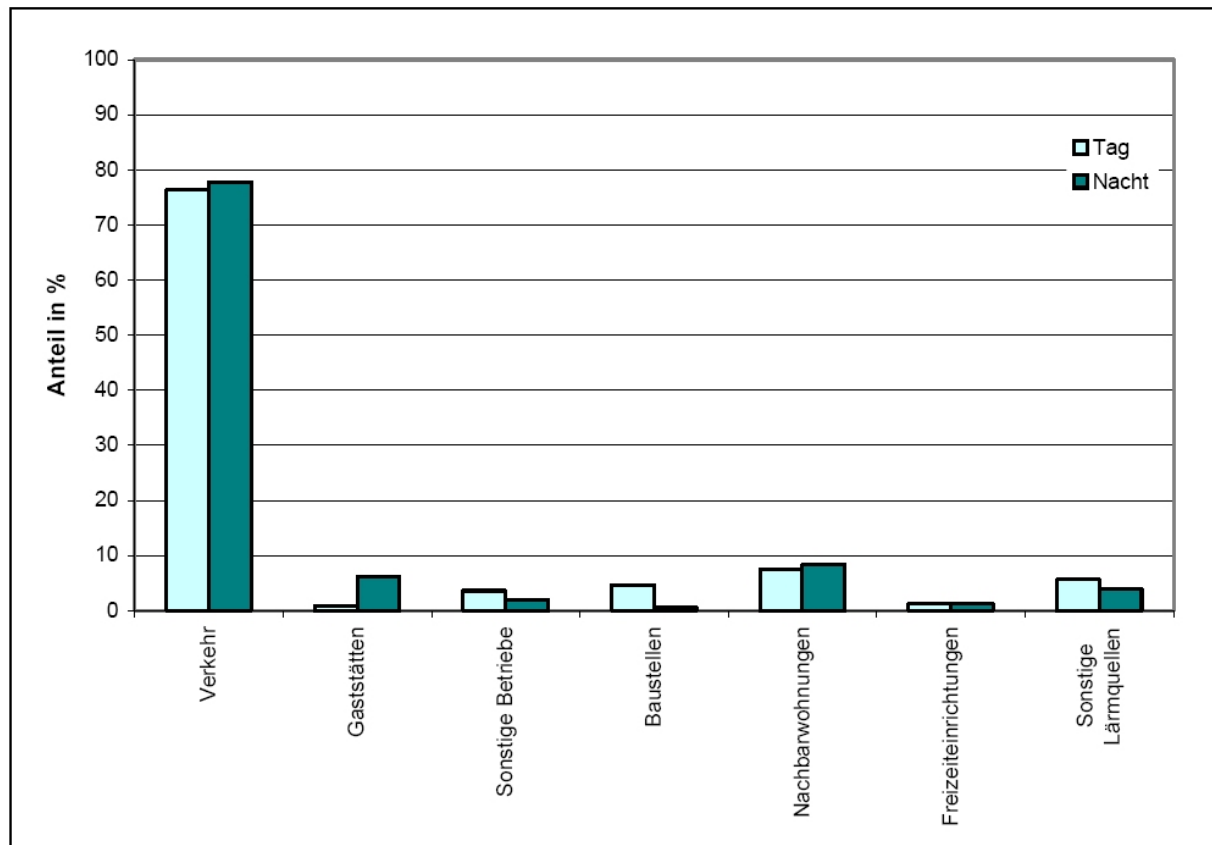


Abb. 2: Aufteilung der Lärmstörung nach Verursacherguppen.

Source: Austrian Environmental Agency,  
Umweltkontrollbericht 2004

# Road traffic noise - a public concern

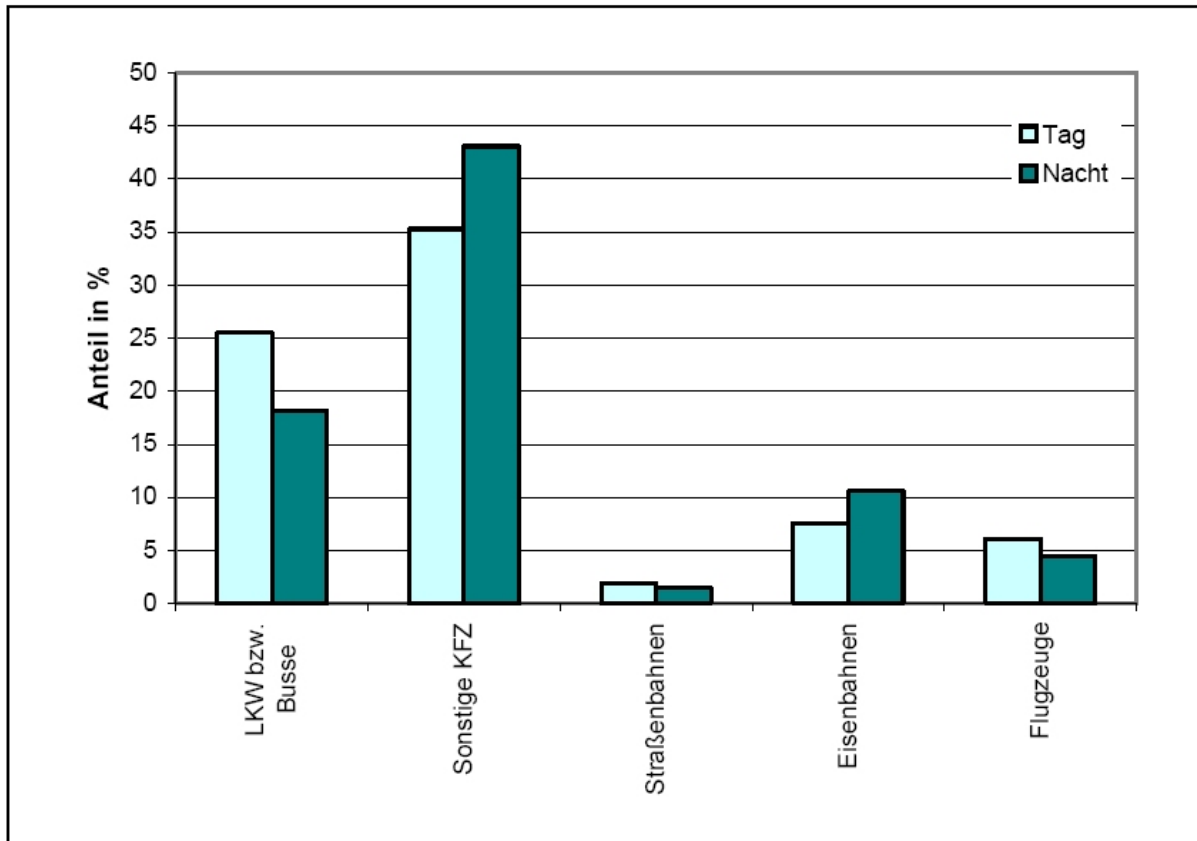


Abb. 3: Anteil der einzelnen Verkehrsmittel an der Lärmstörung.

Quelle: DÖRFLER (2000)

Source: Austrian Environmental Agency,  
Umweltkontrollbericht 2004

# Noise sources of a single road vehicle

Engine/powertrain noise

Tyre/road noise

Aerodynamic noise

dominant  
> 50 km/h

high speed

important  
< 50 km/h



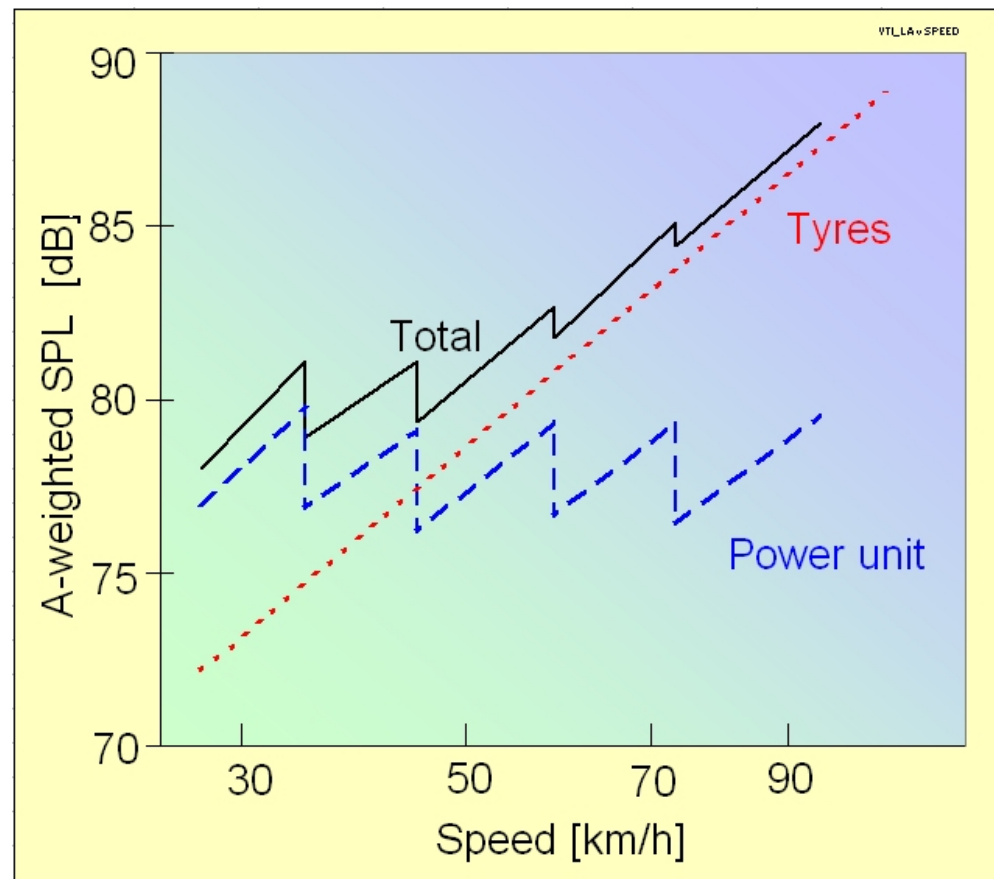
# Dominance of tyre/road noise

Tyre/road noise is speed dependent

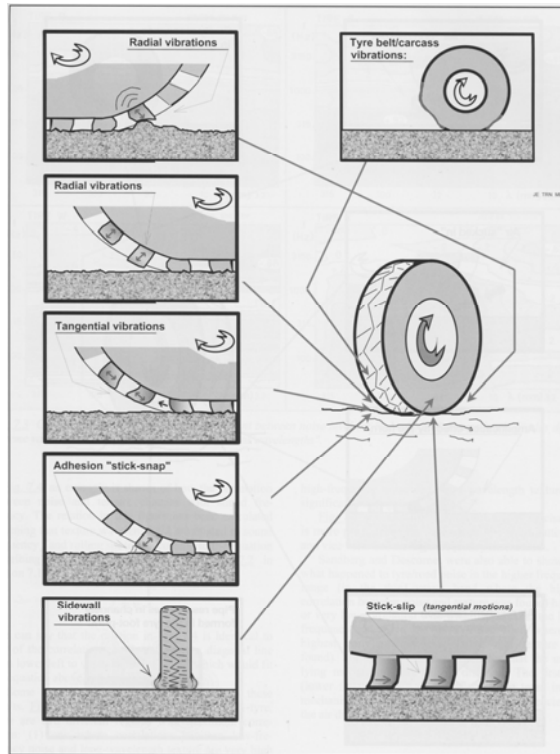
Dominates noise emission above 30 km/h for passenger cars

Above 50 km/h for heavy vehicles

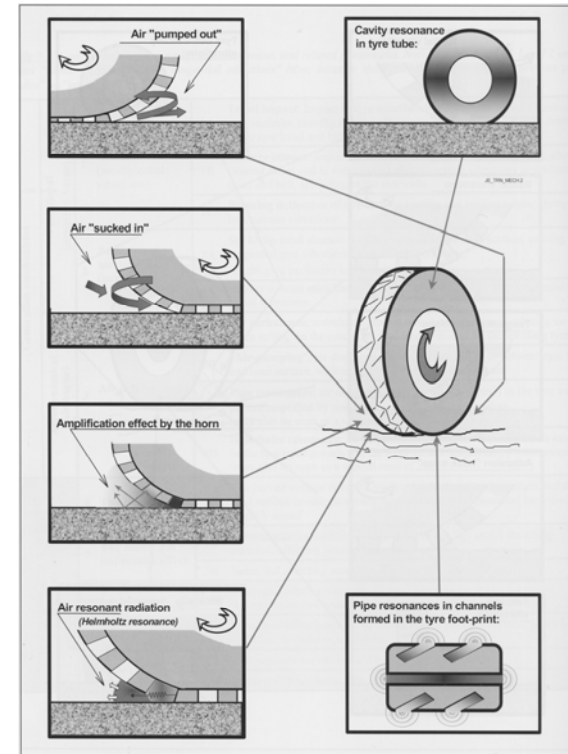
Source:  
Sandberg/Ejsmont,  
Tyre/Road Noise  
Reference Book  
([www.informex.info](http://www.informex.info))



# Tyre/road noise generation mechanisms



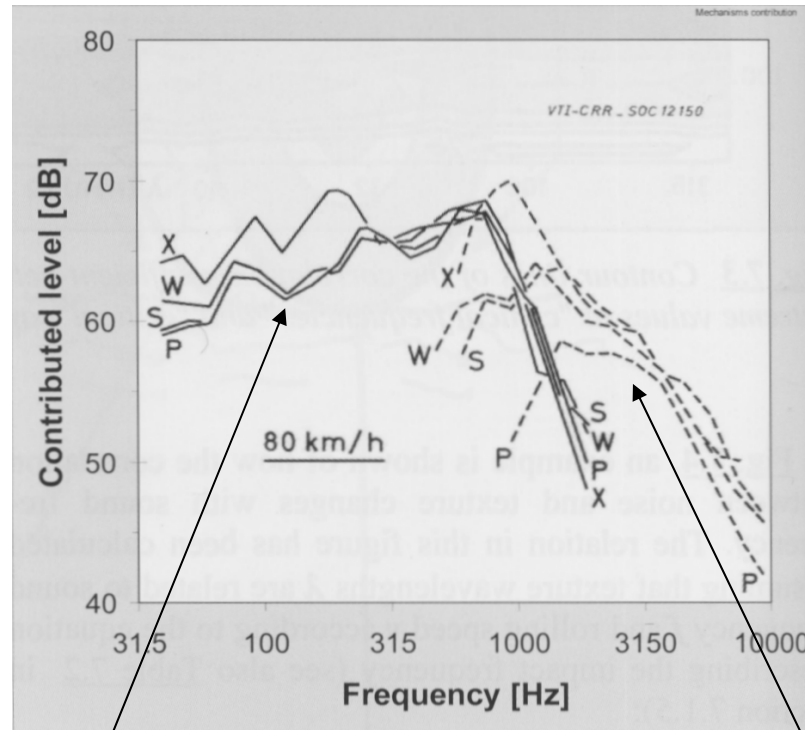
Tyre vibrations



Air pumping

Source:  
Sandberg/Ejsmont,  
Tyre/Road Noise  
Reference Book  
([www.informex.info](http://www.informex.info))

# Spectral contributions



Tyre vibrations

Air pumping

Source:  
Sandberg/Ejsmont,  
Tyre/Road Noise  
Reference Book  
([www.informex.info](http://www.informex.info))



# Measurement methods





# Pass-By methods

## Basic principle:

Measurement of the A-weighted maximum sound pressure level of individual pass-by events together with the traveling speed in a predefined geometrical setup

## Subtypes:

- **ISO 11819-2:** Statistical pass-by, SPB, road surface noise emission testing
  - Vehicle pass-bys are taken from normal traffic flow and standardized using statistics (min. 180 pass-bys)
- **CPB:** Controlled Pass-By
  - Small number of representative test vehicles on open road or test track
- **ISO 362:** Vehicle approval testing
  - Specified road surface (ISO 10844) on a test track
  - Accelerated pass-by
- **EU tyre noise directive (2001/43/EC):** Tyre approval testing
  - Specified road surface (ISO 10844) on a test track
  - Specified vehicle and tyre properties

# Pass-By methods

## Requirements:

- Straight dry homogeneous road section, no strong wind or precipitation
- No obstacles or reflectors in the measurement area (e.g. guard rails, noise barriers)
- Major part of propagation path covered with road pavement
- Measurement of isolated pass-bys must be possible
- Minimum number of measured pass-bys
- Exact knowledge or definition of road surface

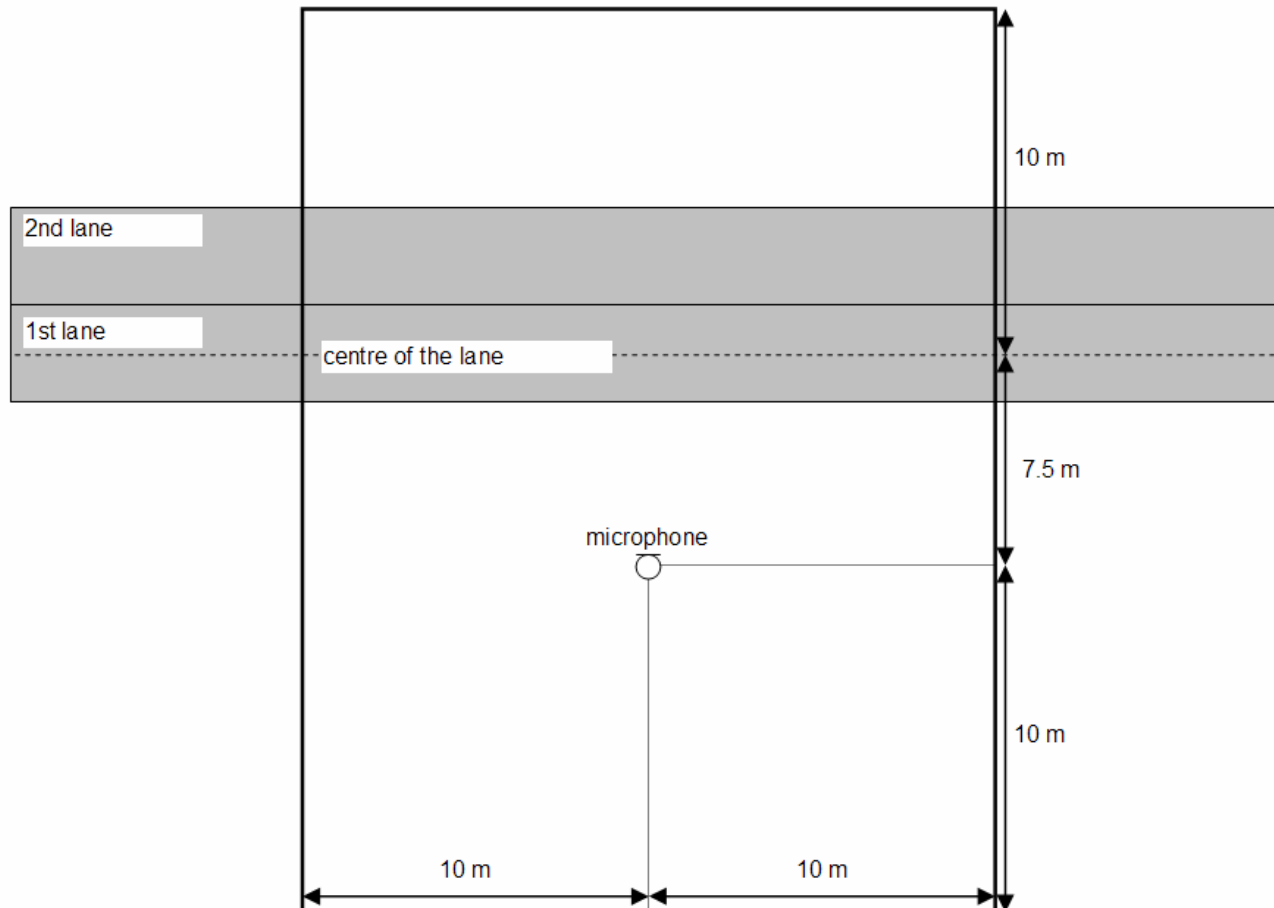
## Possibilities:

**A) test track**

**B) selected site**

# Requirements of ISO 11819-1

Area without obstacles or reflectors according to ISO 11819-1

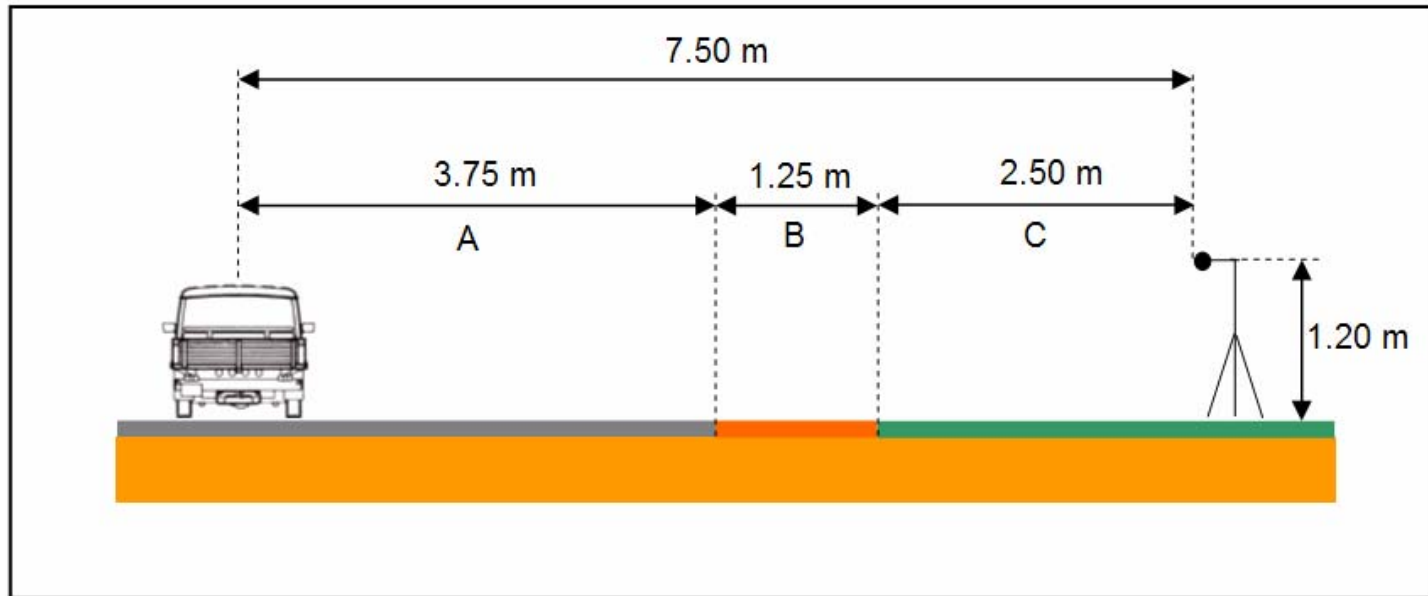


## The Backing Board Variant



Source: BRRC,  
M. Luc Goubert

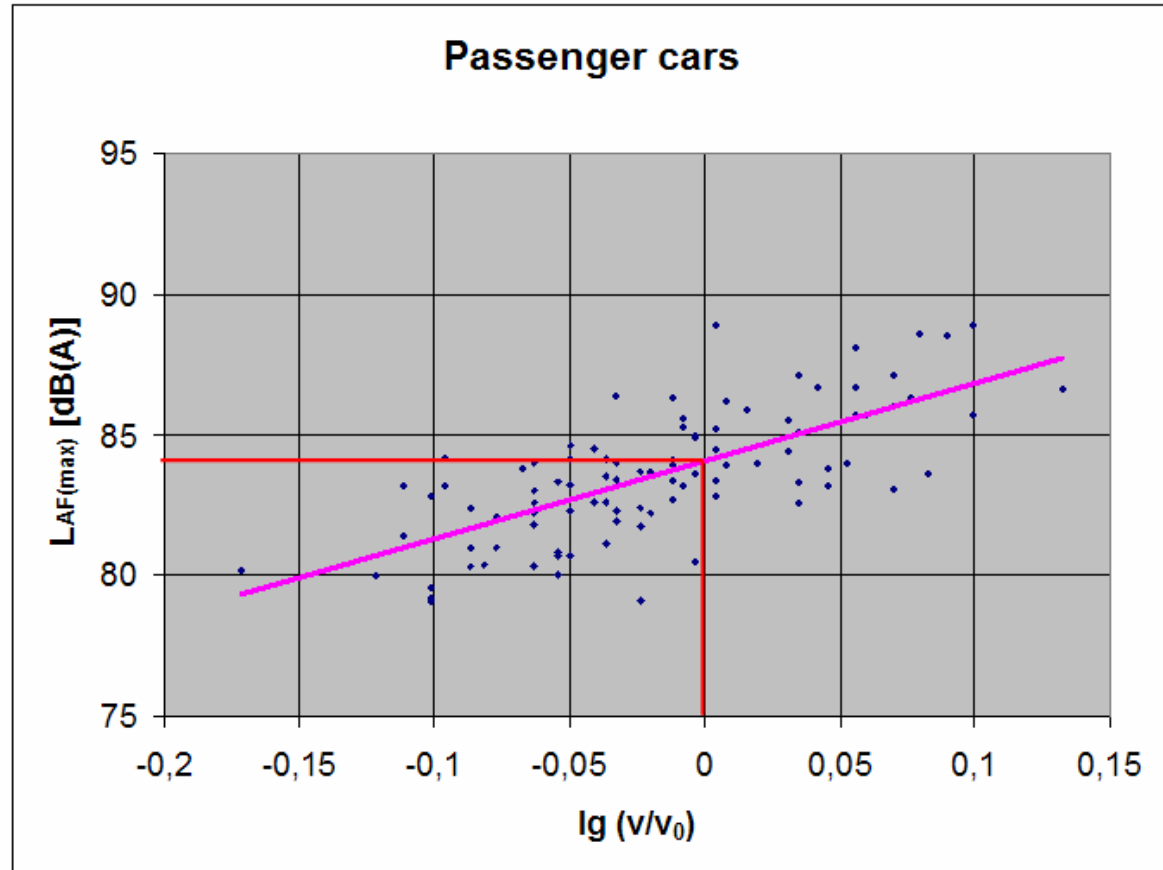
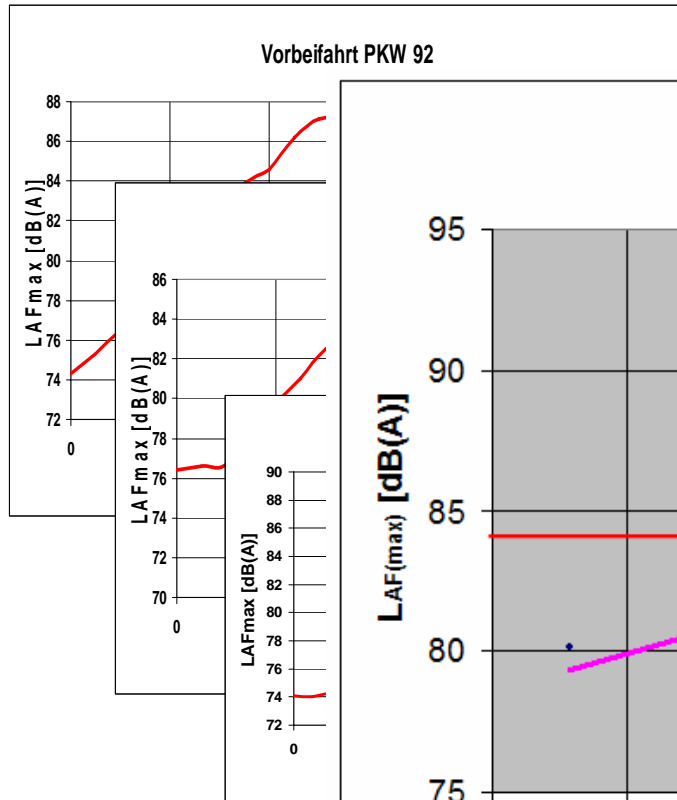
# Requirements of ISO 11819-1



Propagation path surface zones according to ISO 11819-1:

Zone	Distance from lane centre	Requirements
A	0.00 – 3.75 m	Same level and similar acoustic properties as road surface
B	3.75 – 5.00 m	No substantial level differences, only low vegetation
C	5.00 – 7.50 m	None

# Regression analysis



## Pass-By methods

### Result:

- Averaged sound pressure level for a reference speed
- Optionally: weighted index combining passenger cars & trucks
- Comparison with reference or limit values
- Approval
- Classification

### Limitations:

- Spot method
- Restrictive requirements, time-consuming



# Mobile methods

## Basic principle:

Measurement of the A-weighted sound pressure/intensity level close to one or several specified test tyres rolling on the road surface under test in a sufficiently insulated environment

## Subtypes:

- **ISO/CD 11819-2:** Close-Proximity method (CPX), road surface noise emission testing
  - Measurement of sound pressure level
  - Trailer with or without insulation hood or vehicle with shielded tyre
  - Use of 2-4 representative test tyres
  - 2 microphones
- **CPX-Intensity:**
  - Very similar, but sound intensity is measured

# Mobile methods

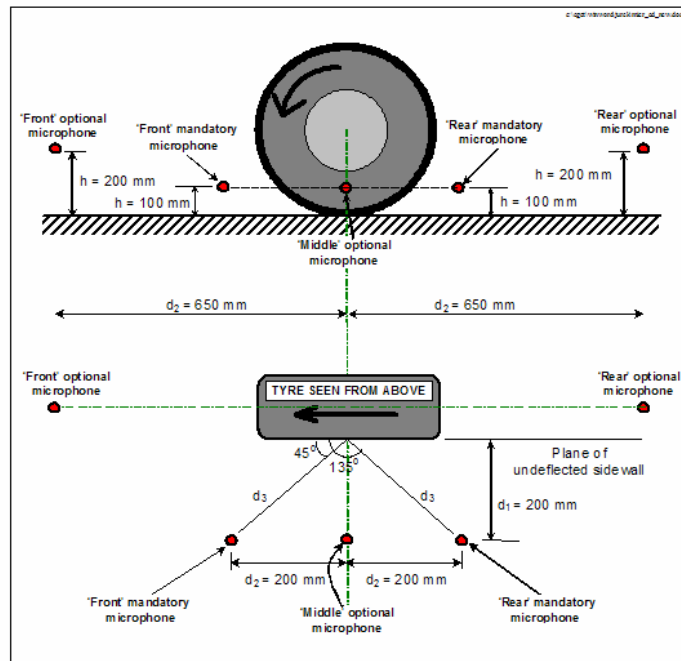
## Requirements:

- Straight dry homogeneous road section, no strong wind or precipitation
- Suitable equipment
- Representative and stable test tyres
- Suitable reference speed



# ISO/CD 11819-2 (CPX)

## CPX method microphone positions (ISO/CD 11819-2)





# Mobile methods

## Result:

- Averaged sound pressure level for a reference speed
- Optionally: weighted index combining passenger cars & trucks (proxy)
- Long-distance measurements
- Comparison with reference or limit values
- Approval testing, monitoring
- Classification

## Limitations:

- Only tyre/road noise
- Heavy vehicles represented by proxy tyre

# Applications

## Applications of road traffic noise emission testing:

- Noise emission classification of
  - road surfaces
  - tyres and
  - vehicles
- Acceptance testing of road surfaces
- Monitoring and Acoustic Pavement Management
- Comparison with reference or limit values
- Basis for noise emission calculations





# Standardization

## Standardization efforts:

- ISO TC43/SC1/WG33 and CEN TC 227/WG5
- EU Projects: SILVIA, SILENCE, ...
- EU legislation, UNECE regulations

# Research

## Fields of research:

- Elastic surfaces
- Acoustic Pavement Monitoring
- Link to immission levels (noise mapping, HARMONOISE)
- Calibration and certification procedures
- Reference tyres and reference surfaces





**Thank you for your attention!**

**To the members of PIARC TC 4.2 WG B:**

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Manfred Haider  
Working Group leader