

Transmitted by the expert from the World Road Association (PIARC)

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(45th GRB, 20-22 February 2007
agenda item 7.)

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EXCHANGE
KNOWLEDGE AND TECHNIQUES
ON ROADS AND ROAD TRANSPORTATION



**WORLD ROAD
ASSOCIATION**

www.piarc.org

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arsenal research

WG leader of
PIARC TC 4.2 WG B
Road Traffic Noise

21.02.2007, Geneva
Presentation to
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World Road Association (PIARC)

- Established in 1909
- Non-political, non-profit organization
- Development of global road community



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Mission

- Lead international forum
- Disseminate best practice
- Promote efficient tools for decision making
- Special emphasis for Developing Countries and Countries in Transition



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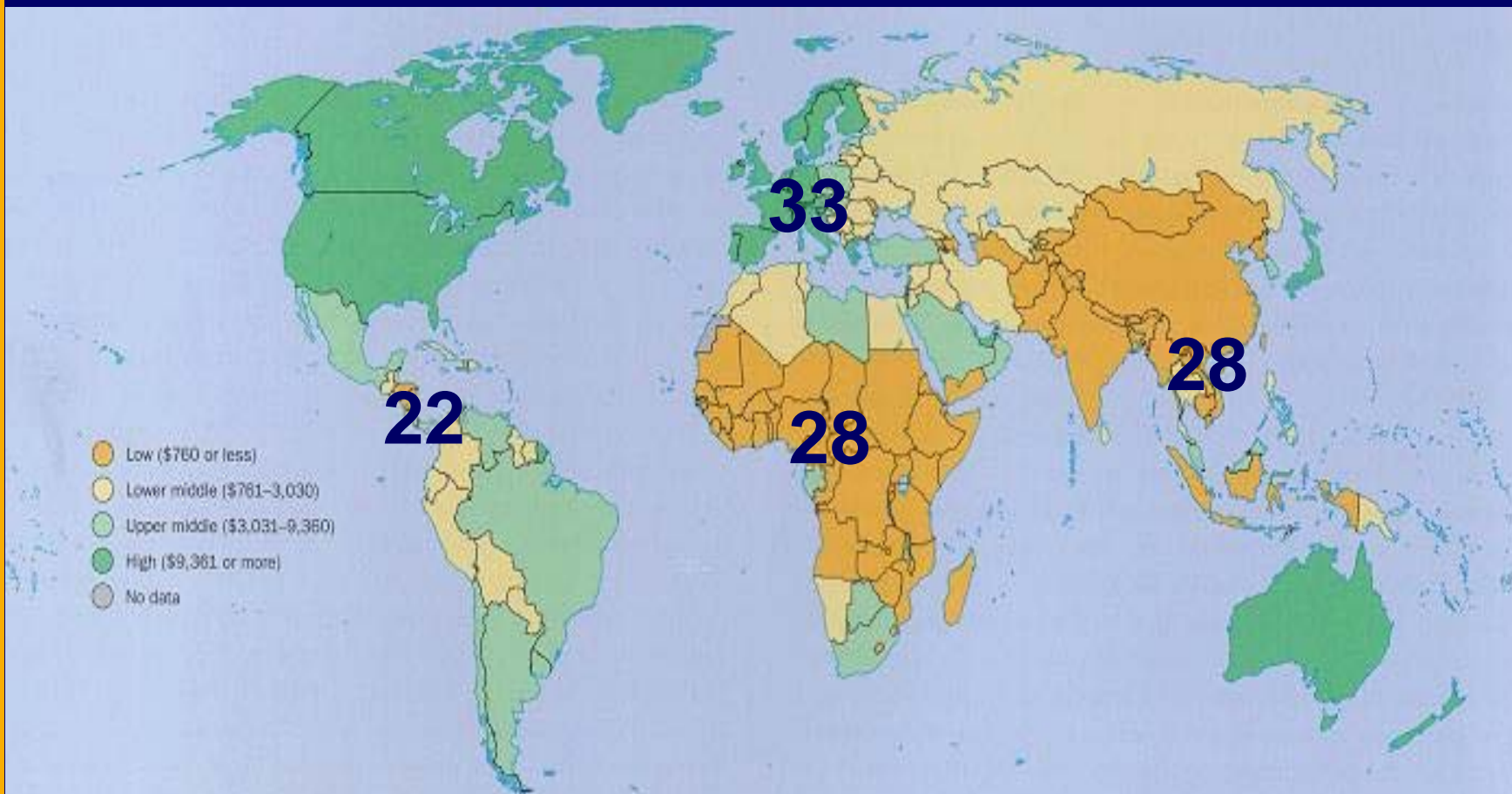
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111 Member Governments



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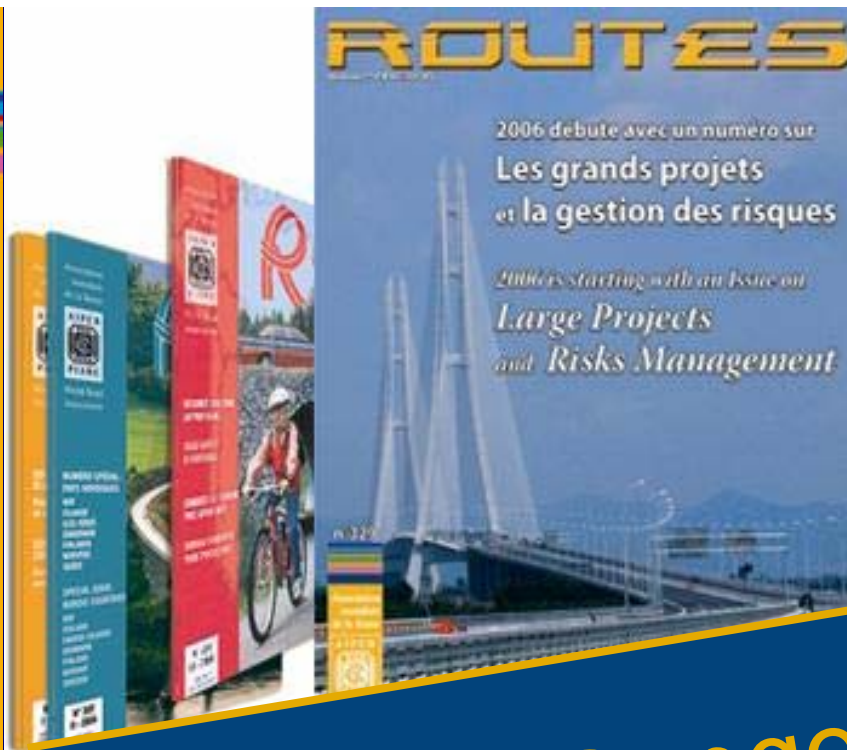


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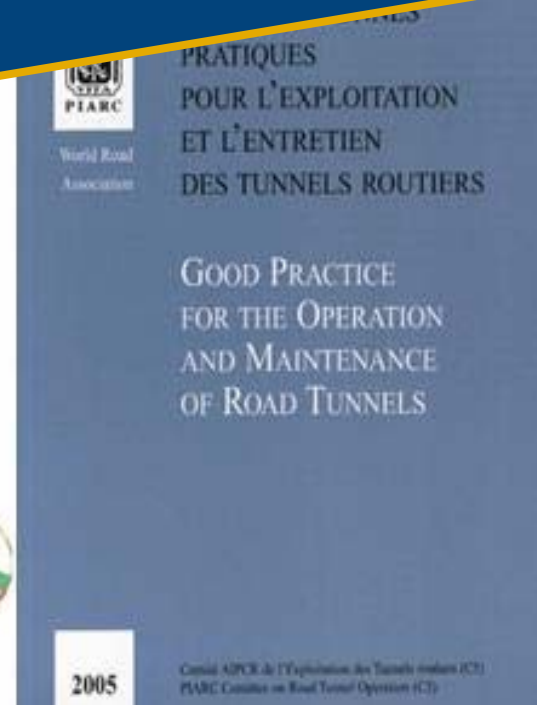
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A Large Range of Publications



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23rd World Road Congress

- 17 - 21 September 2007, Paris, France
- The Centenary Congress
- www.paris2007-route.fr



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Strategic Themes

ST1: Governance and Management of the Road System

ST2: Sustainable Mobility

ST3: Safety and Road Operations

ST4: Quality of Road Infrastructure



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Technical Committees

- 18 Technical Committees + Terminology
- 800 experts and decision-makers
- Various topics of road and road transport
- Outputs assist decision-makers



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ST4: Quality of Road Infrastructures

4.1 Management of Road Infrastructure Assets

4.2 Road/Vehicle Interaction

4.3 Road Pavements

4.4 Bridges and Related Structures

4.5 Earthworks, Drainage and Subgrade

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TC 4.2: Road/Vehicle Interaction

WG A: Trends in vehicle-road interaction monitoring

WG B: Road Traffic Noise

WG C: Texture, Skid resistance and Evenness

WG D: Cracks and road distresses

WG E: Advanced road works acceptance methods and criteria

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WG B: Work Programme

Issue : **4.2.2 - Reducing road noise**

**Description of
the selected
strategies**

- 1) *Review the recent developments and future prospects in vehicles, tyres and pavements influencing road traffic noise emission. Establishing a state of the art of traffic noise reduction technologies at the source, identifying research needs, as well as identifying and recommending new promising global noise reduction strategies.*
- 2) *Review the current noise measurement methods, recommend on strategies for their harmonisation (if necessary) and support the integration of methods to achieve a standardised set of tools to characterize road traffic noise.*

**Working group
leader**

Manfred HAIDER, Austria

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WG B: Links

Type	Organisation
Internal to PIARC	TC 4.1 Road Management
Internal to PIARC	TC 4.2 WG A Future Developments
Internal to PIARC	TC 4.2 WG C Road Surface Characteristics
Internal to PIARC	TC 4.3 Road Pavements
ISO WG	ISO/TC 43/SC 1/WG 33 SPB, CPX
ISO WG	ISO/TC 43/SC 1/WG 42 reference surfaces
CEN WG	CEN/TC 227/WG 5 – road surface characteristics
EU WG	EU WG 8 - Tyre noise policy
UN	UN/ECE/GRB Geneva
EU Project	SILVIA
EU Project	HARMONOISE
EU Project	SILENCE
National Project	IPG (NL)
National Project	Leiser Verkehr (Germany)
National Project	BUWAL/ASTRA project (CH)
National Project	Low noise tyre project (SE, FI, PL, GB)
National Project	Quiet Pavement programme (US)

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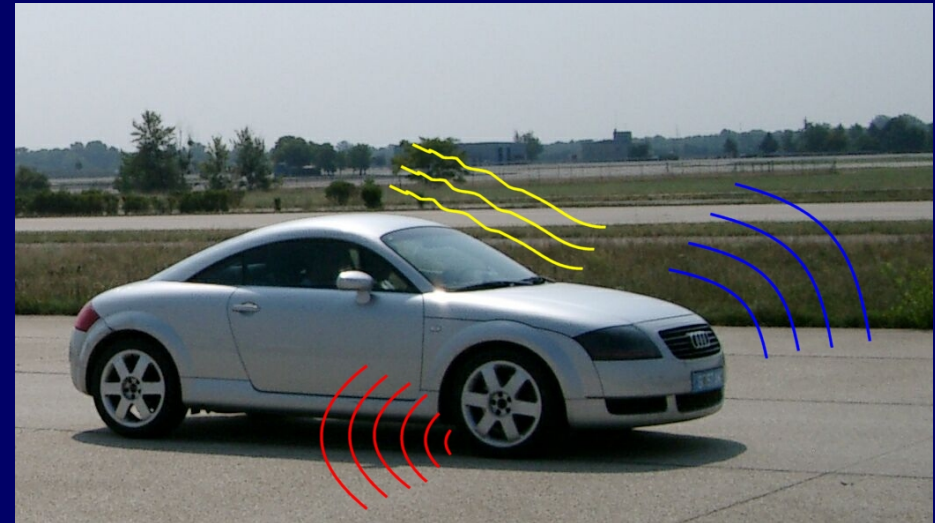
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Noise emission of road vehicles

- Engine/powertrain noise
- Tyre/road noise (rolling noise)
- Aerodynamic noise



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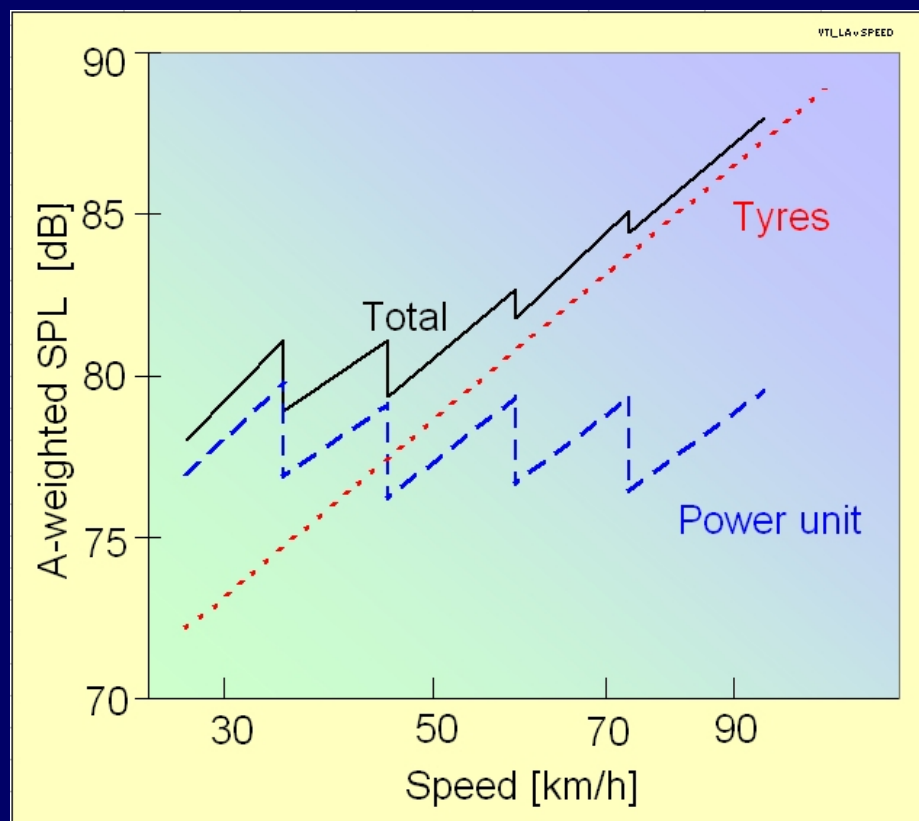
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Dominance of tyre/road noise

Tyre/road noise typically dominates the noise emission starting from 30 km/h (passenger cars) respectively 50 km/h (heavy vehicles)



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

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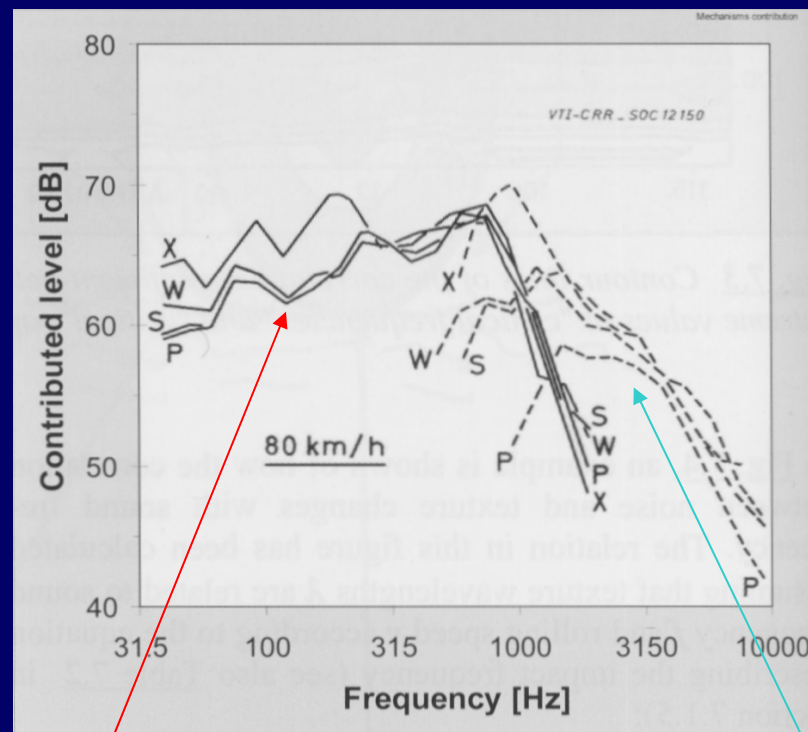
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Generation of tyre/road noise



tyre vibrations

air pumping

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

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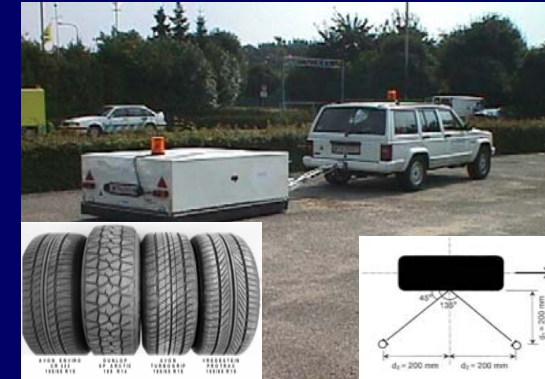
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Measurement methods



- Spot method
- 180 vehicle pass-bys
- Strict conditions, time-consuming
- Representative of total road traffic noise emission
- All vehicle types
- Includes engine noise and propagation effects
- Long-distance measurements
- 4 reference tyres
- Fast, inexpensive, flexible
- Low representativity for truck tyre noise
- only accounts for tyre/road noise

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Tyre/road noise reduction strategies

Tyre/road noise is an highly interactive phenomenon.

Strictly speaking there are only

low-noise tyre/pavement combinations.

Reduction of tyre vibrations:

- Smooth road surface (minimized megatexture, optimized macrotexture)
- Elastic road surfaces
- Optimized (randomized) tyre tread pattern, rubber compounds (especially hardness), sidewall stiffness, tyre width

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Tyre/road noise reduction strategies

Tyre/road noise is an highly interactive phenomenon.

Strictly speaking there are only

low-noise tyre/pavement combinations.

Reduction of air pumping:

- Open-graded or porous road surface (void content >20%)
- Connected road surface pores introduce sound absorption
- Tread pattern without sealed-off cavities in the contact patch
- Porous treads?

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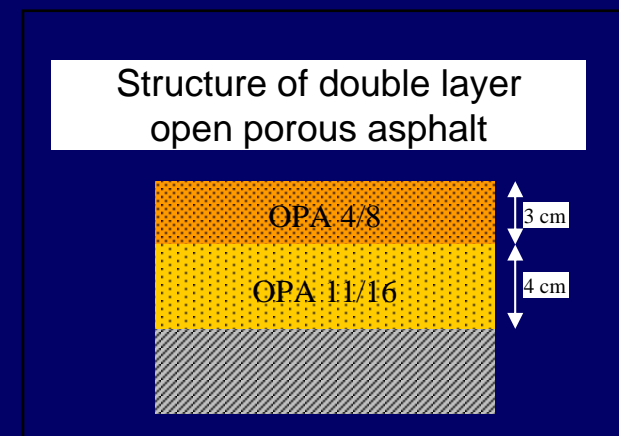
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Example: Porous Asphalt

Latest trend: Double-layer porous asphalt

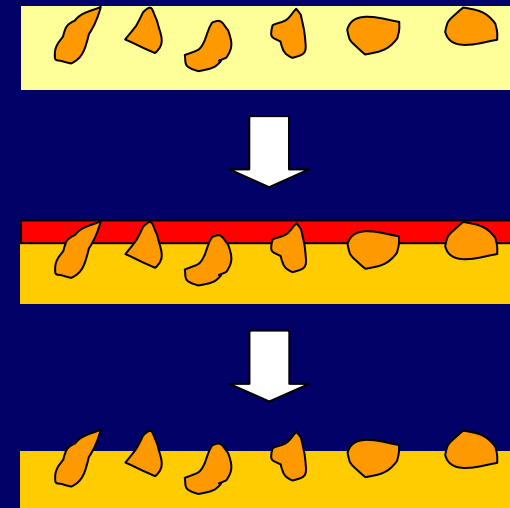
- Top layer with small chipping size, bottom layer with larger chippings
- High void content (20-30%) reduces air pumping
- Sound absorption with 2 absorption peak frequencies (tunable)
- Top layer with small openings reduces clogging
- Noise reduction potential approx. 3 – 9 dB (ref. AC), durability unclear



Example: EACC

Exposed aggregate cement concrete

- High quality gap-graded aggregates (e.g. 0/8 or 0/11)
- Tips are exposed by applying a retarding agent to the surface and removing the remaining mortar after some time
- Texture depth can be controlled by choosing the time delay
- Reduces air pumping - tyre is riding on the tips
- Noise reduction potential approx. up to 3 dB (ref. standard concrete)



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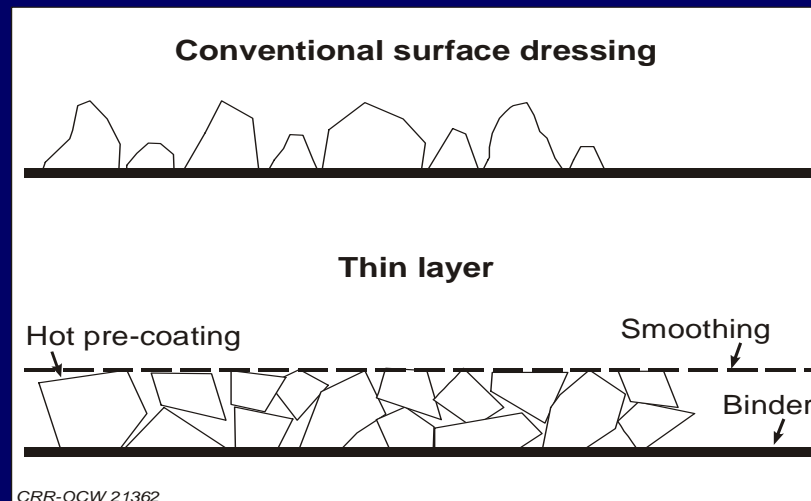
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Example: Thin layers

Thin layers

- Developed from surface dressings
- Thin gap-graded (0/10) bituminous layer with pre-coated chippings
- Surface texture similar to porous asphalt
- smooth due to roller compaction, Reduces tyre vibrations
- Noise reduction potential somewhat less than porous asphalt



Source:

G. Descornet, BRRC

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Future trends in low-noise pavements

- Improved double-layer porous asphalt (frequency tuning, durability)
- Poro-elastic road surfaces
- Improved open-graded surfaces for urban applications
- Texture optimisation for different tasks (e.g. truck versus passenger car tyres)
- New reference surfaces and tyres
- Durable low-noise pavements

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Road pavement classification

- Noise reduction by choice of pavement type require a reliable acoustic classification
- Pavement type designation varies widely in different countries
- The EU Project SILVIA laid the foundation for a common labelling procedure, follow-up research is carried out in the SILENCE project
- The procedures rely on SPB values complemented with CPX or other surfaces parameters

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Road pavement classification

- The LABELLING procedure yields a first-time acoustic classification of a precisely defined pavement type as installed in new optimal condition
- Labelling can be carried out on dedicated sites
- The CONFORMITY OF PRODUCTION (CoP) testing checks the performance of an actual installation against the labelling values
- Requirements of flexibility, applicability at arbitrary locations and easy handling make CPX the preferred method

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The SILVIA procedure

Source:

G. Descornet et. al.

EU Projects SILVIA
and SILENCE

<i>Labelling</i>		
<i>Grading:</i>	Dense	Open
<i>Stiffness:</i>	Rigid	
	Elastic	
	SPB	
	CPX	
	SPB	
	Texture	
	Sound Absorption	
	Mech. Impedance	

<i>COP Testing</i>		
<i>Grading:</i>	Dense	Open
<i>Stiffness:</i>	Rigid	
	Elastic	
	CPX	
	Texture	
	Sound Absorption	
	Mech. Impedance	

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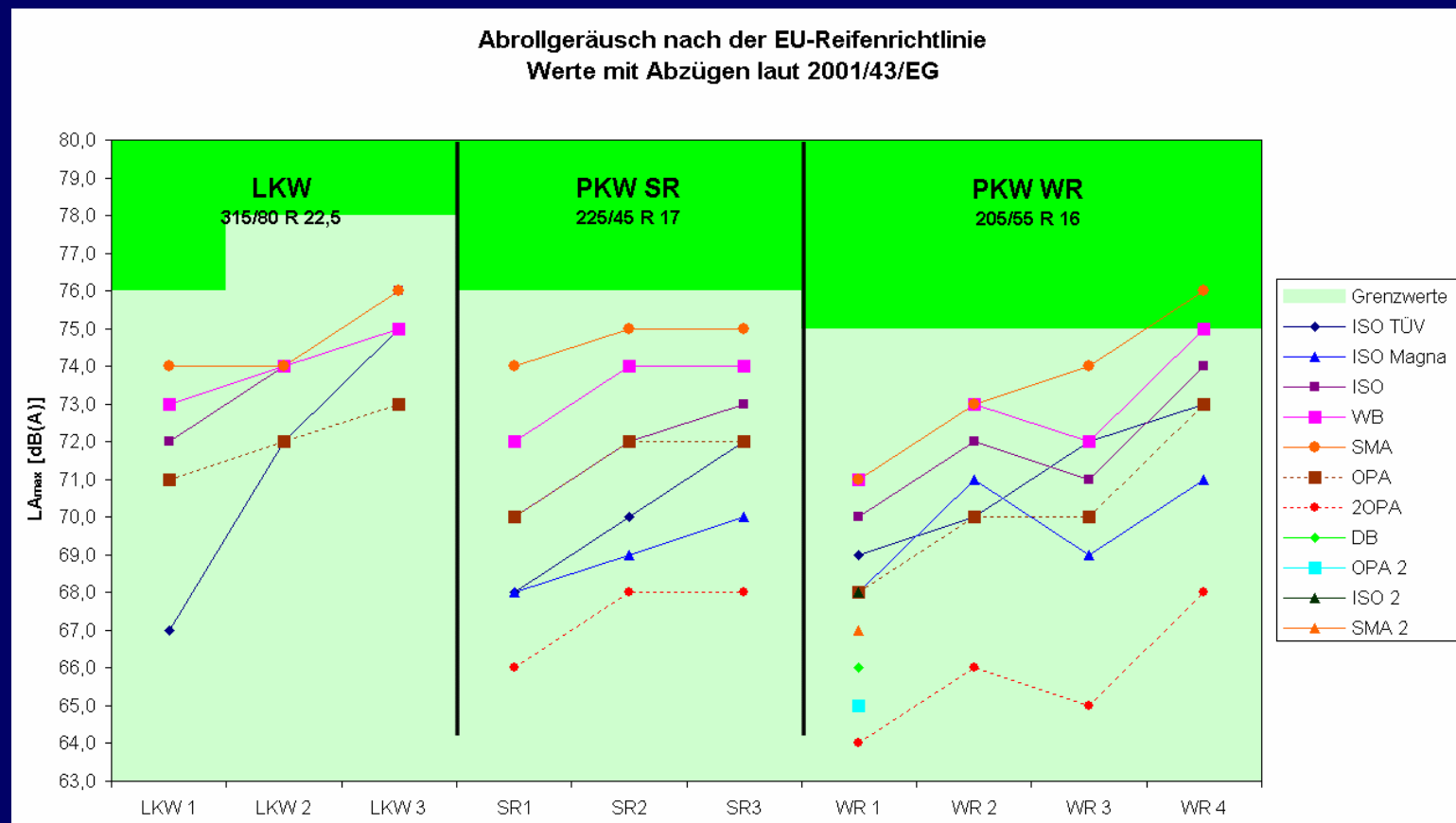
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Noise reduction potentials

Source: Haider et al.,
Low-Noise Tyres

Research Project for
the Austrian BMVIT
2003

Investigation of combined tyre and pavement noise reduction potentials
Following EU Directive 2001/43/EC, using new market tyres & test tracks



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Noise reduction potentials

Source: Haider et al.,
Low-Noise Tyres

Research Project for
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2003

Choice of pavement:

- 7-9 dB for passenger car tyres, 3-6 dB excluding porous surfaces
- 2-3 dB for truck tyres

Choice of tyre:

- 2-5 dB for passenger car tyres
- 2-3 dB for truck tyres
- ISO 10844 surface not always representative
- Most market tyres below limit values
- Comparable potential of tyre and pavement especially for truck tyres
- Values for used tyres and worn pavements: research on acoustic durability needed

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Research & Development needs

- Realistic modelling of tyre/pavement interaction and noise emission using real tyre and road surface data
- Long-term development of the noise emission properties of both tyres and road surfaces
- Representative reference tyres and reference surfaces for both tyre and pavement testing

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Research & Development needs

- Improvement of the standardized labelling, approval testing and performance monitoring methods for pavements and tyres
- Noise classification catalogues of currently used pavements and tyres
- Optimization tools treating driver behaviour, vehicles, tyres and pavement as a system

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