

tire technology  
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## Low noise road surfaces : current practices in Europe

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**TYROSAFE** 



**FEHRL** 

TYROSAFE:

Tire and Road Surface Optimisation for Skid Resistance and ***Further Effects***



➤ NOISE

➤ ROLLING RESISTANCE

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## Noise: an environmental problem

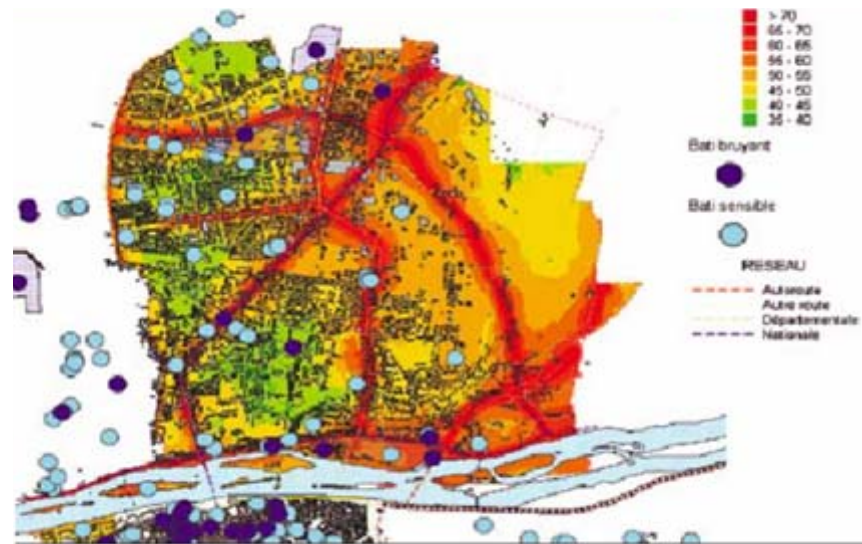
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*EC Green Paper on Future Noise Policy, 1996*

- 20% of EU population (~80 M) exposed to unacceptable noise levels
  - annual costs caused by noise pollution estimated between 0.2% and 2% of GPD
  - Road transport noise is the dominant source (90% of the EC population exposed to noise levels > 65 dB(A)).
  - EC regulations of noise sources since the 1970's
  - Result : limited effect after 25 years :
    - ❖ Traffic growth
    - ❖ Longer periods of high noise emission
    - ❖ More roads and spread of built areas ...etc
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# Noise: an environmental problem

- EC Directive 2002/49/EC :
  - Noise mapping for major cities and large transportation infrastructure >> need relevant noise emission *models*
  - Action plans >> need low noise emission *solutions*
- MS designate competent authorities for drawing up and adopting maps and action plans
- MS set ambient noise limits



Niveaux sonores - Carte ACOUplus Agglomération de Tours

## Noise: a difficult problem

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- National regulations to protect the residents
    - Different noise indicators:  $L_{Aeq}$ ,  $L_{den}$ ,  $L_{Amax}$
    - Different legal thresholds
    - Different application schemes: calculation, check by measurements...
    - Usually based on noise immission (emission + propagation)
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# Road noise emission

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## Scientific

- Road noise emission mainly due to **tire-road interaction**

## Technical

- Different **tools** to reduce road noise emission:
  - improve **vehicle / tire** conception
  - Improve **road surface** conception
  - **Traffic management**: speed limits, reduce traffic volume (re-routing), increase fluidity
  - Build **noise barriers**
  - Improve **façade insulation**



Legislation ?

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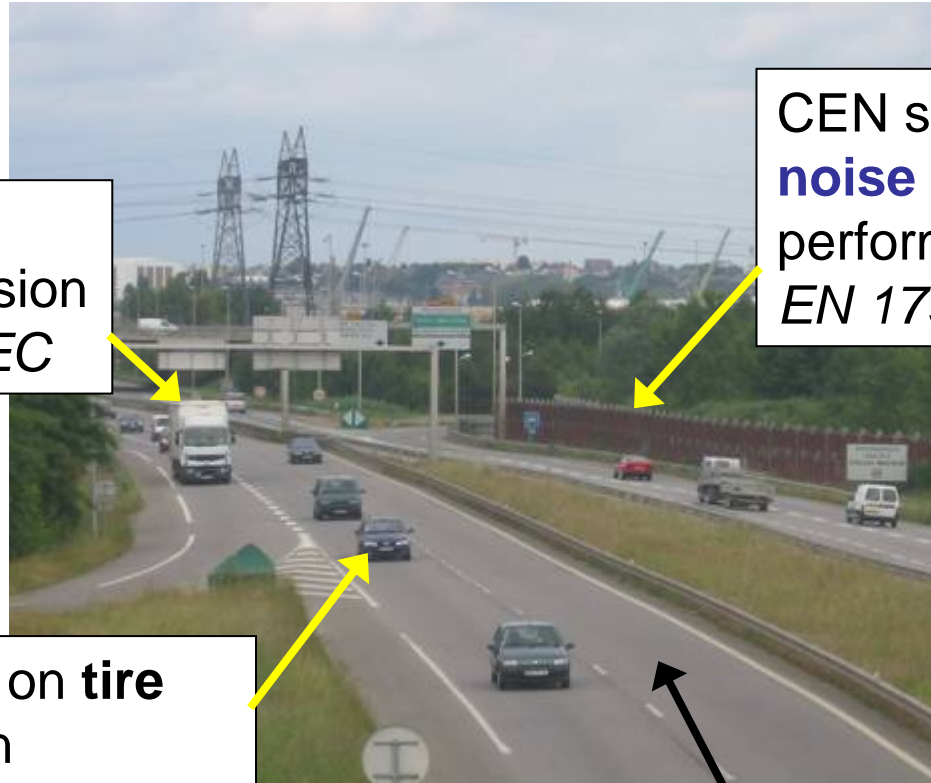
# Legislation on road noise emission

Requirements on **vehicle** noise emission  
*Directive 70/157/EEC*

CEN standards for **noise barrier** intrinsic performances  
*EN 1793 series*

Requirements on **tire** noise emission  
*Directive 2001/43/EC*

No requirement for **road** noise performance



# Road noise performance

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## Advantage of a common classification system

- guidance for decision-makers,
- correction terms in calculations
- contractual specifications

road noise mitigation:  
the current practice in EU...

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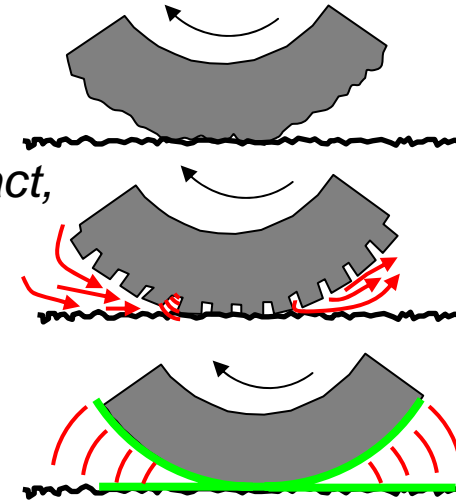


# Tire/Road noise emission



- **Complex mechanisms** depending on tire, pavement and driving speed

- Tire vibrations: *radial and tangential due to impact, running deflection, indentation, adhesion mechanisms*
- Air displacement mechanisms: *air pumping, resonance, turbulence...*
- Amplification: *horn effect, tire belt and cavity resonance...*



- **Several models** developed over the past 10 years:

- FEM : tire-oriented
- statistical or hybrid : pavement-oriented (AOT, SPERoN, HyRoNE...)

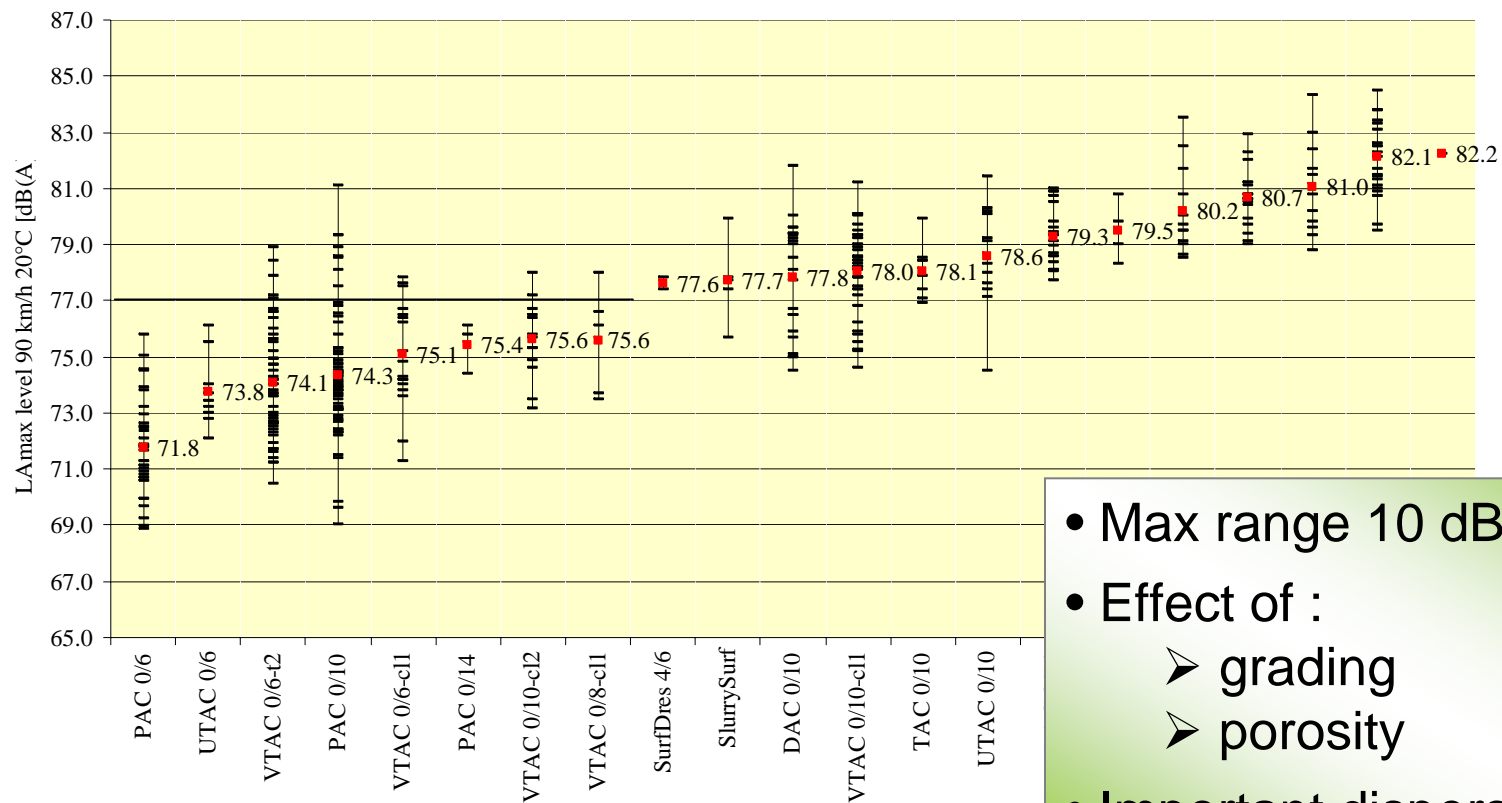
## Tire/Road noise emission

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Road surface relevant parameters for noise emission:

- **Texture:** depends on maximum chipping size and laying technique
    - tire vibration
    - reduces air pumping
  
  - **Porosity:** created by a missing size of aggregates in the material
    - reduces air pumping
    - introduces sound absorption > reduces horn effect and sound propagation
  
  - **Stiffness ?**
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# Low noise road surfaces



- Max range 10 dB(A)
- Effect of :
  - grading
  - porosity
- Important dispersion within a pavement type

SPB French data base, LCPC Strasbourg (Passenger Cars @ 90 km/h and 20°C)

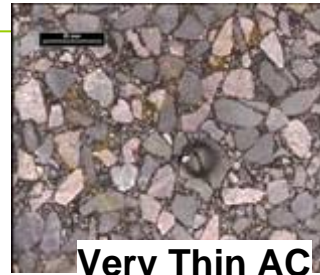
# Low noise road surfaces

Several techniques available:

- **Porous** pavements, **single** or **double layers**
- **Thin semi-porous** layers with small aggregate size
- **Rubber** asphalts
- ...



Dense A.C.



Very Thin AC

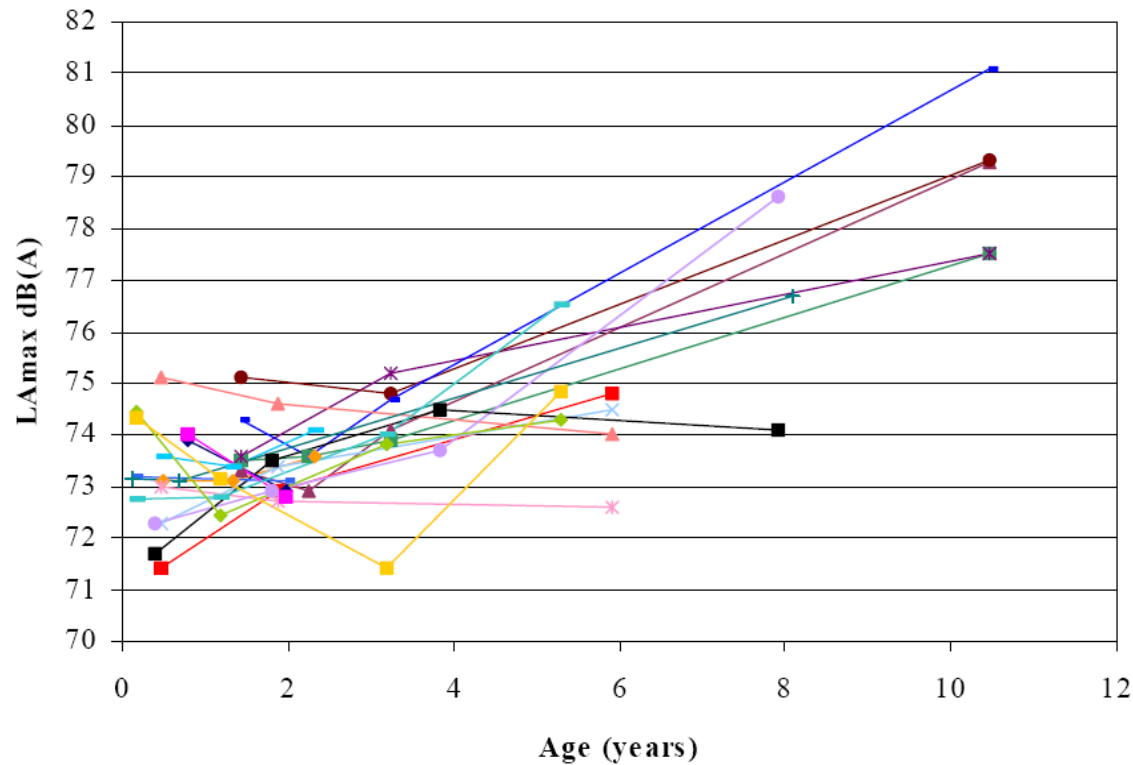


Porous AC

Expected efficiency in practice: 3 – 5 dB(A) average benefit of pavement replacement at initial stage

# Low noise road surfaces

Problem of ageing of acoustic performance of low noise road surfaces



Example of Porous Asphalt Concrete 0/10 (French data base)

# Characterization of low noise pavements

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## Statistical Pass-By (SPB) tire-road noise measurements



International standard  
ISO 11819-1 : 1997  
(currently under revision)

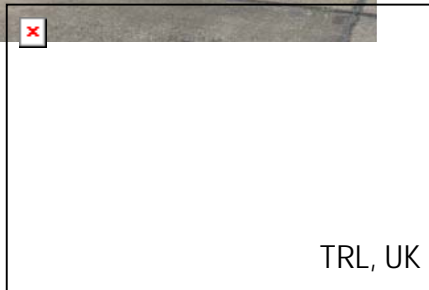
### Limits...

- restrictive site conditions
- spot measurement

# Characterization of low noise pavements



## Close Proximity (CPX) tire-road noise measurements



- Several devices
- International standard Pr ISO 11819-2 under draft
- Need (a) reference tire(s):  
Pr Technical Specification 11819-3



- need further comparison of devices
- **a relationship with SPB should be established**

# Low noise pavements: need for requirements



## Road authority

- to promote the use of low noise surfaces
- to specify requirements in tendering procedure for low noise surfaces (indicator, level of performance..)
- to check requirements (which method ?)
- to monitor the evolution of performances

*Conformity of Production*

*Monitoring procedure*

*Classification procedure*

## Road contractor

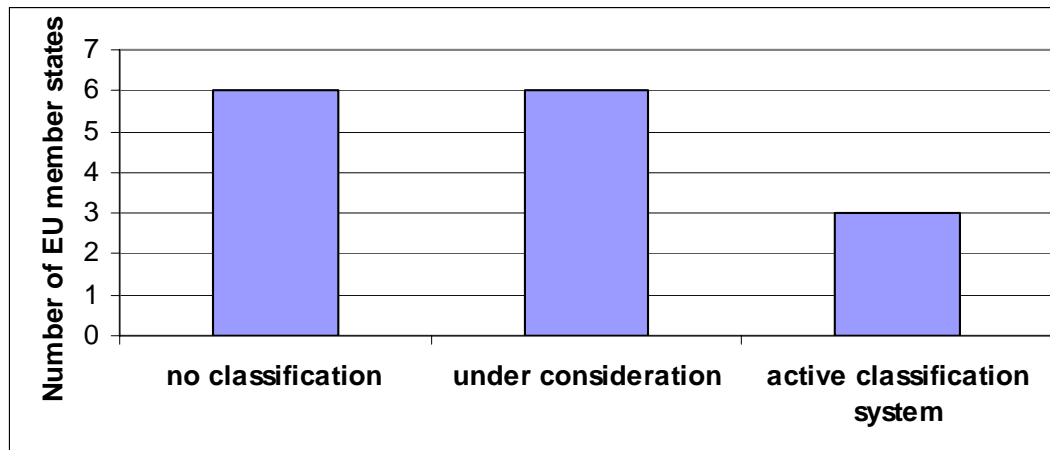
- to select an appropriate surfacing to answer to the contract specifications
- to promote its low noise product (Inland and abroad)



# Classification of low noise surfaces

*It is difficult to compare road surfaces in EU !*

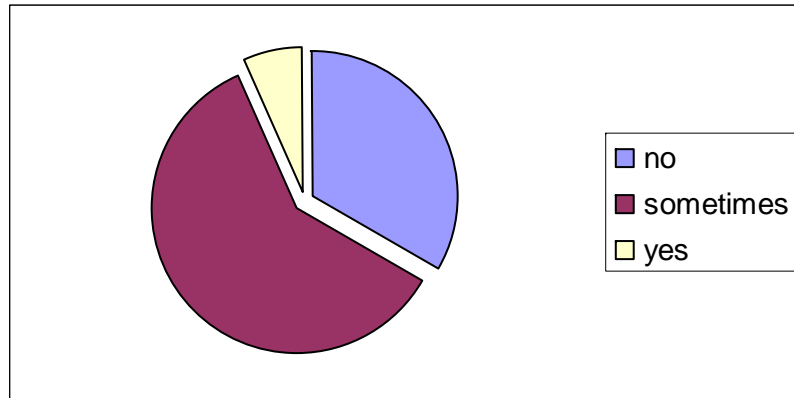
- No common names (definitions) of pavement products
- No common definition of low noise surfaces
  - $\neq$  performance indicator: RSI (*UK*),  $C_{\text{wegdek}}$  (*NL*), Lm25 (*D*),  $L_{\text{CPX}}$  (*DK, Fin*),  $L_{\text{Amax}}$  (*F*), LMA (*A*),  $L_{\text{Aeq}}(24\text{h})$  (*S*)...
  - $\neq$  classification procedures. Existing in 3 (4) countries, under consideration in 6 others



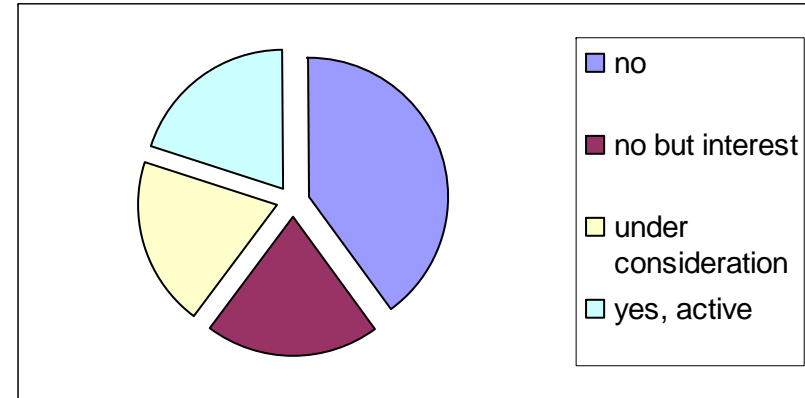
**EU Members with a noise classification system of road pavements (results from a questionnaire in TYROSAFE, set of 15 countries)**

# COP test procedure

**EU-members where noise specifications are introduced in tendering procedures (set of 15)**



**EU-members where a procedure for COP of acoustic properties is active (set of 15)**



- ≠ specifications, limits, requirements
- ≠ indicators
- ≠ methods for checking: *CPX*, *SPB*, *LAeq*
- ≠ periods of guarantee and ≠ penalties

# Conclusion

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- Measurement methods
    - CPX, SBP, but also “proxi” methods need to be further developed and validated
  - Need for a common Classification and COP test procedure
  - Integrate the evolution of performances over time
  - Integrate complementarity with other surface characteristics (skidding resistance, rolling resistance)
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The end

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Thank you !

