

## HARMONOISE -IMAGINE road source model



A short overview for GRB September 2008

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# EC Environmental noise directive 2002/49/EC

- Requests noise maps and action plans for
  - Agglomerations (populations > 100 000)
  - Major roads
  - Major railways
  - Major civil airports
- Ready in 2008
- Recommended calculation methods
  - Roads: NMPB-96 (the French method)
  - Railways: RLM2 (the Dutch method)
  - Airports: ECAC 29
  - Industrial sites: ISO 9613
- Future calculation method: EU harmonised



## EU research projects on harmonized methods

- Harmonoise (FP5 2001-2004)
- Imagine (FP6 2004-2007)
- 15 project partners from all over europe (D, F, I, NL, PL, S, UK)
- 4 source models (road, rail, air, industry)
- 1 propagation model
- Validation with measurements

## Harmonoise - IMAGINE traffic noise model

- Prediction of the noise emission of the **average European road vehicle**, based on:
  - vehicle class
  - vehicle speed
- With **optional** calculations for:
  - vehicle acceleration/deceleration
  - road surface type, age, gradient, meteo
  - directivity
  - regional variations

## Model structure

- Separate calculation of rolling and propulsion noise:

- Rolling noise: 
$$L_{WR} = A_R(f) + B_R(f) \cdot \log(v/v_{ref})$$

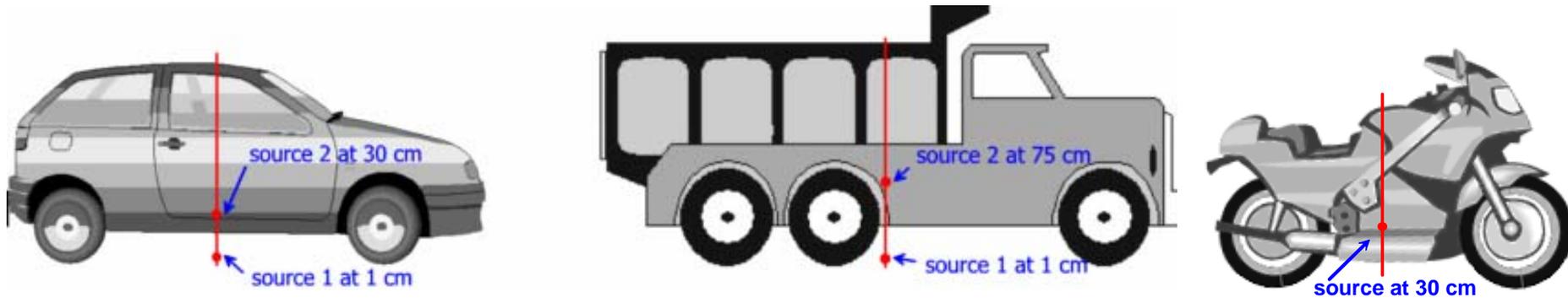
- Propulsion noise: 
$$L_{WP} = A_P(f) + B_P(f) \cdot \frac{v - v_{ref}}{v_{ref}} + C_P \cdot a$$

- Coefficients  $A$ ,  $B$  and  $C$  are known for each vehicle class, per 1/3-octave frequency band

# Vehicle classes

category	name	description	vehicle category in EU/ECE type approval
1	Light motor vehicles	Passenger cars, delivery vans ? 3.5 tons, SUV's, MPV's including trailers and caravans	M1 and N1
2	Medium heavy vehicles	Medium heavy vehicles, delivery vans > 3.5 tons, buses, touring cars, etc. with two axles and twin tyre mounting on rear axle	M2, M3 and N2, N3
3	Heavy vehicles	Heavy duty vehicles, touring cars, buses, with three or more axles	M2- and N2 with trailer, M3 and N3
4	Powered two-wheelers	4a mopeds, tricycles or quads with ? 50 cc	L1, L2, L6
		4b motorcycles, tricycles or quads with > 50 cc	L3, L4, L5, L7

# Source geometry



- Two source heights:
  - Rolling noise : 80% to lower and 20% to higher source
  - Propulsion noise: 20% to lower and 80% to higher source
  - Motor cycle : no rolling noise, 100% to single source

## Corrections factors (1)

- Regional variations
  - engine type (only cat 1) (Otto, Diesel)
  - tyre width (only cat 1) through its relation with weight
  - tyre mounting (summer, winter, studded)
  - age (only cat 1)
  - fraction of IRESS (illegal replacement exhaust silencing systems) (all categories)
  - fraction of VANs in cat 1.
  - distinction between three and multi-axle HDV's.

## Corrections factors (2)

- Meteo conditions
  - Temperature
  - Road surface wetness
- Type of road surface
  - Acoustic classification scheme developed in EU 6th framework project SILVIA fits in this calculation scheme,
    - Reference condition DAC/SMA 0-11
    - Effect of other surface defined for passenger cars and trucks
    - Frequency dependence and speed dependence formulated

# Examples of data acquisition program, trucks



# Examples of data acquisition program cars



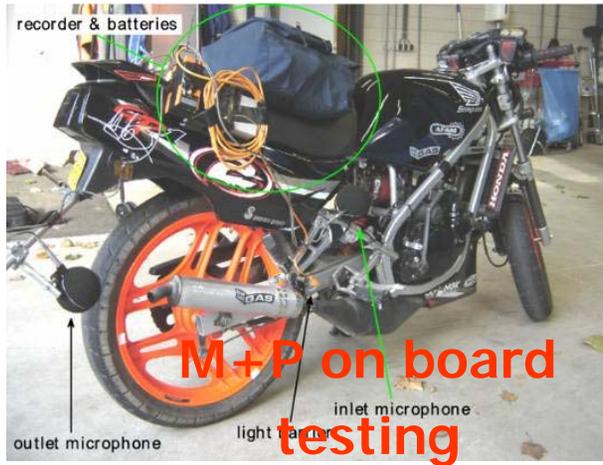
TUG controlled  
single vehicle  
testing



TRL pass-by  
testing UK,

SP pass-by  
testing Sweden

# Examples data acquisition program motorcycles



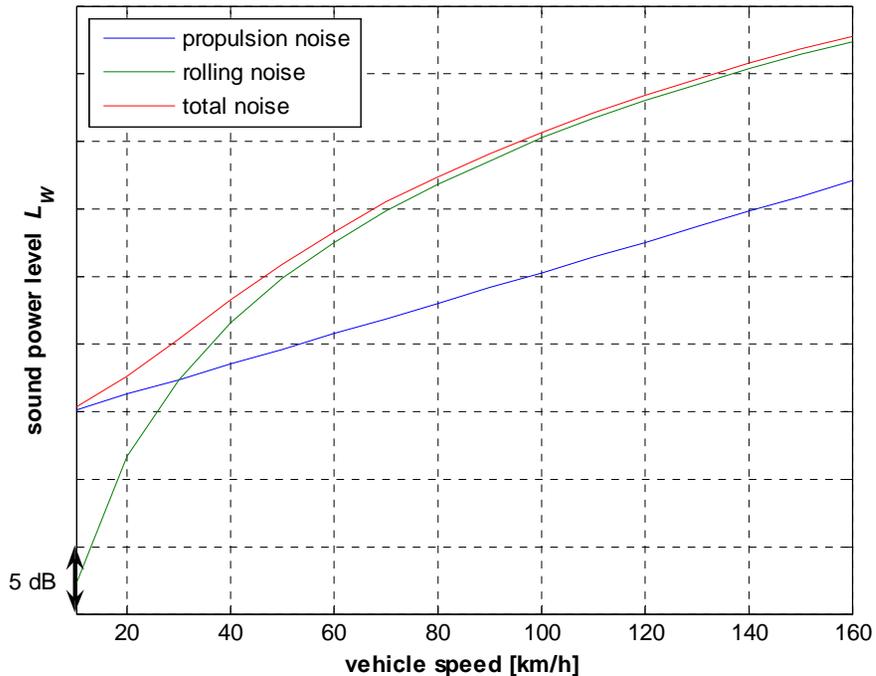
JRC, TUG, Autostrade  
road side testing



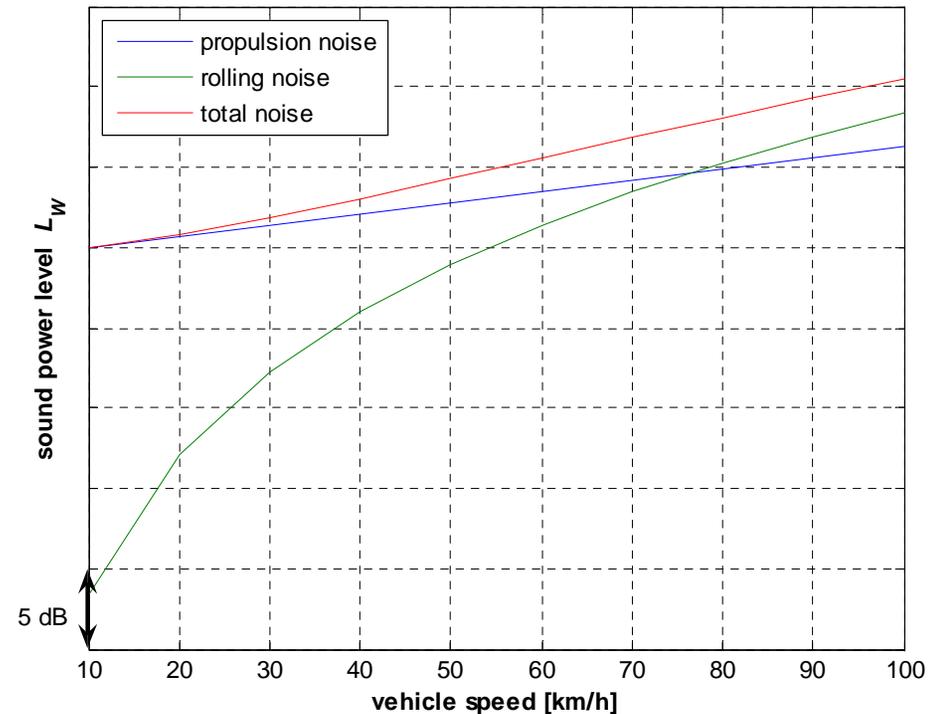
# Fraction rolling noise and propulsion noise

- Depends on speed and vehicle class

category 1 - Light motor vehicles

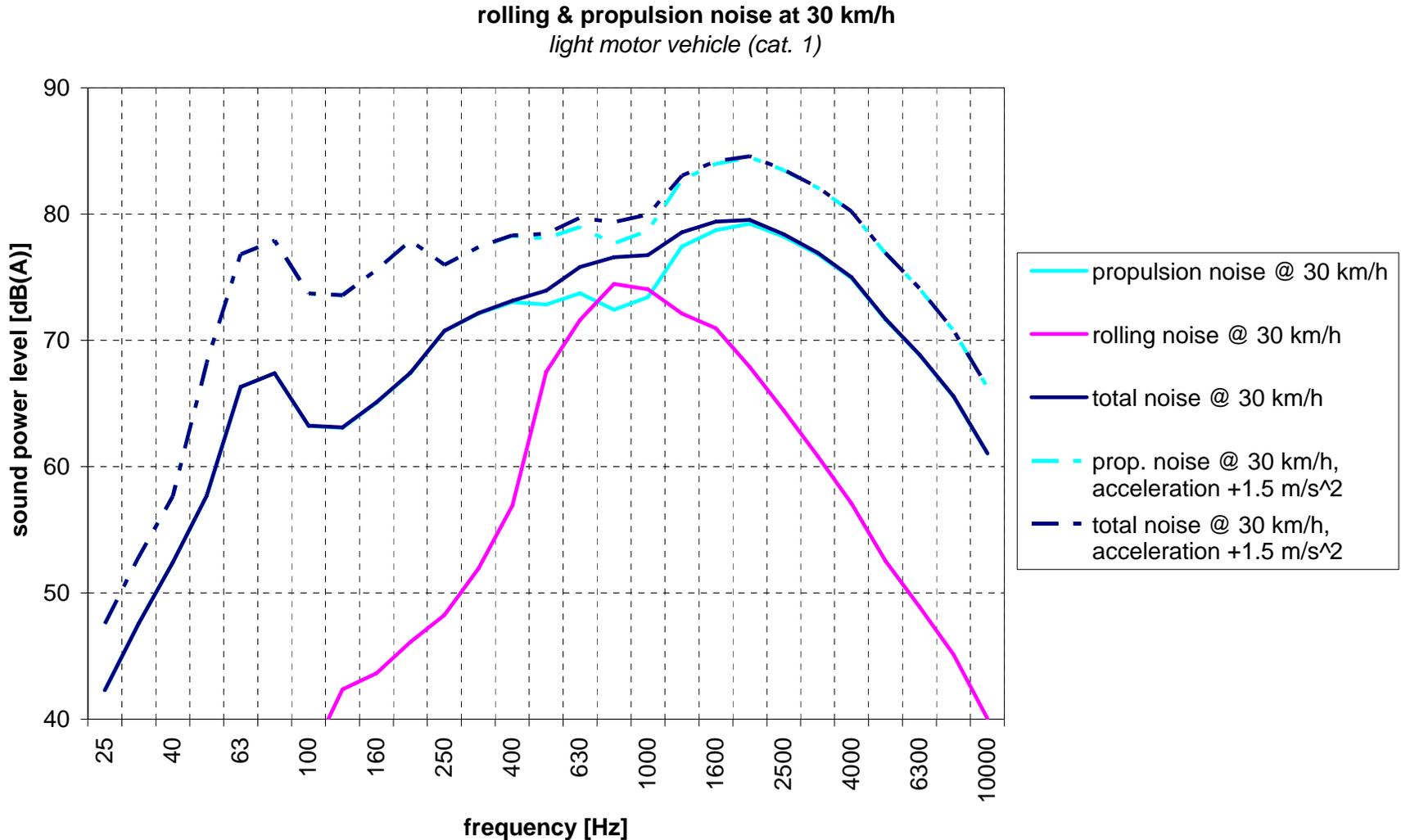


category 3 - Heavy duty vehicles



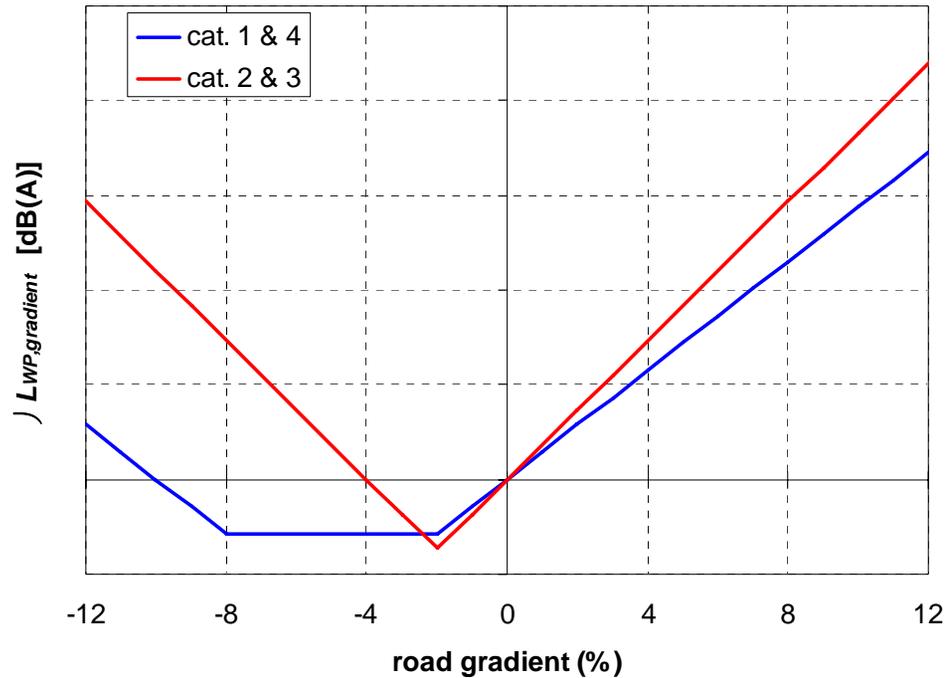
# Vehicle acceleration

- Increase in propulsion noise; not in rolling noise



# Effect of road gradient on propulsion noise

approximate effect on overall LWP level



Effect of illegal silencers on propulsion noise level,  
standard: 1% for cars and trucks, 35% for  
motorcycles.

Effect of an IRESS is 12 dB on propulsion noise

$$\Delta L_{WP,IRESS} = 29 \cdot p_{IRESS} - 24 \cdot p_{IRESS}^2$$

$$p_{IRESS} = \begin{cases} \frac{\% IRESS - 1\%}{100\%} & \text{for category 1, 2 and 3} \\ \frac{\% IRESS - 35\%}{100\%} & \text{for category 4} \end{cases}$$

## conclusion

- A complete and state-of-the-art model for the noise emission of an EU vehicle is developed.
  - Defined in Lw, fits into propagation calculations
  - Easy to use and to implement in computerized noise mapping tools
  - Allows adaptation to local situations and to future developments in vehicle technology (such as hybrid cars)
- Reports available on IMAGINE website:
  - [www.imagine.org](http://www.imagine.org)
- First noise maps show the need for serious action plans
- Depending on action plans, many agglomerations may urge EC/ECE on noise reduction of tyres and vehicles

