Note

Project	Develop and implement harmonised noise assessment methods		
Concerns	Source Modules Roads – Architecture		
Ref.number	V2012.0816.00.N001	Version	2
Date	27 April 2014	Handled by	-|-
Contact	Th.J.B. (Theo) Verheij	E-mail	ve@dgmr.nl

1. Introduction

This report gives the architecture for the implementation of the source model for road traffic noise as described in Chapter III of the JRC Reference Report "Stylianos Kephalopoulos, Marco Paviotti, Fabienne Anfosso-Lédée (2012), Common Noise Assessment Methods in Europe (CNOSSOS-EU), EUR 25379 EN".

The source model calculates the source power of a road segment for an hourly traffic flow and under given conditions. Typically calculations are performed for day, evening and night period. Values like ambient temperature could differ for these periods, but they might also differ on a seasonal basis. This however is outside the scope of the source model. The source model will only describe the calculation of the source power for a given hour, under given geographical conditions (e.g. slope) and given meteorological conditions (e.g. ambient temperature).

Chapter 2 gives some definitions and chapter 3 will give a breakdown of the formulas.
It starts with a definition of the vehicles. As an open category is described, the chosen structure makes it possible to define new vehicles. This resulted in breaking up formulas into parts which can then also be described for new vehicles types. An example is the calculation of the correction for road gradients.

Chapter 4 gives an overview of the contents of the look-up tables.

2. Definitions

2.1 Static values

These static values are not mentioned in the following chapters anymore, as it is assumed that these values are globally accessible.

- V_{ref} Reference speed [km/h], default is value 70 km/h [1)];
- H_{src} Source height [m], default value is 0.05 m [1)];
- τ_{ref} Reference temperature [°C], default value is 20 °C;
- T_S Period in which vehicles are equipped with studded tyres [months per year];
- τ Ambient temperature in °C.
- IgnoreAcc Ignore correction for the speed variations [Y/N].
  The standard indicates that for noise mapping purposes this could be omitted.

[1)] Although currently not the case, it is possible that these values depend on the vehicle definition. In this case these values should be added to the look-up table with the vehicle definitions and "$_{,m}$" should be added to the respective formulas.

2.2 Definition vehicles

Table 1
Look-up table: Definition vehicles

Category "m"	Description	Has rolling source	Has propulsion source
1	Light motor vehicles	Y	Y
2	Medium heavy vehicles	Y	Y
3	Heavy vehicles	Y	Y
4a	Powered two-wheelers (≤ 50 cc)	N	Y
4b	Powered two-wheelers (> 50 cc)	N	Y
5	*Open category*	*Y/N*	*Y/N*

If a new vehicle type (category 5) is added, all category dependant look-up tables should be extended with relevant values for this new category.

2.3 Frequency

Supported 1/1 octave values [Hz]:

63 125 250 500 1000 2000 4000 8000

3. Breakdown formulas

3.1 Traffic flow (III-1)

Input values:
• m Category
• Q_m Traffic flow per hour for category m
• V_m Average speed category m [km/h]
• $L_{W,i,m}$ Sound power of a single vehicle → §3.2
Output values:
• $L_{W',eq,line,i,m}$

3.2 Individual vehicle (III-3)

Input values:
• m Category
• V_m Average speed category m [km/h]
• $L_{WR,i,m}$ Sound power level for rolling noise → §3.3
• $L_{WP,i,m}$ Sound power level for propulsion noise → §3.7
Output values:
• $L_{W,i,m}$

3.3 Rolling noise (III-5)

Input values:
• m Category
• V_m Average speed category m [km/h]
• V_{ref} Reference speed → §2.1
• $\Delta L_{WR,i,m}$ Corrections for rolling noise emission → §3.4
Look-up tables:
• $A_{R,i,m}$ Coefficients taken from look-up table "EmissionAB", reference="m"
• $B_{R,i,m}$ Coefficients taken from look-up table "EmissionAB", reference="m"
Output values:
• $L_{WR,i,m}$

3.4 Rolling noise corrections (III-6)

Input values:	
• m	Category
• V_m	Average speed category m [km/h]
• $\Delta L_{WR,road,i,m}$	Correction for the road surface → §3.11
• $\Delta L_{studded,i,m}$	Correction for studded tyres → §3.5
• $\Delta L_{WR,acc,i,m}$	Correction for the speed variations → §3.10
• $\Delta L_{W,temp}$	Correction for effect of temperature → §3.6
Output values:	
• $\Delta L_{WR,i,m}$	

3.5 Correction for studded tyres (III-7, III-8, III-9)

Input values:	
• m	Category
• V_m	Average speed (km/h)
• p_m	percentage of cars with studded tyres
• T_s	number of months in a year that cars are equipped with studded tyres
Look-up tables:	
• $a_{i,m}$	Coefficients taken from look-up table "VehicleDefinition", reference="m"
• $b_{i,m}$	Coefficients taken from look-up table "VehicleDefinition", reference="m"
Output values:	
• $\Delta L_{studded,i,m}$	

3.6 Correction for effect of temperature (III-10)

Input values:	
• m	Category
• τ_{ref}	Reference temperature → §2.1
Look-up tables:	
• $K_{surface,m}$	Generic coefficient from look-up table "VehicleDefinition", reference="m" defaults: 0.08 dB/°C for category 1 / 0.04 dB/°C for category 2 and 3
Output values:	
• $\Delta L_{W,temp}$	

3.7 Propulsion noise (III-11)

Input values:	
• m	Category
• V_m	Average speed category *m* [km/h]
• V_{ref}	Reference speed → §2.1
• $\Delta L_{WP,i,m}$	Corrections for propulsion noise emission → §3.8
Look-up tables:	
• $A_{P,i,m}$	Coefficients taken from look-up table "EmissionAB", reference="*m*"
• $B_{P,i,m}$	Coefficients taken from look-up table "EmissionAB", reference="*m*"
Output values:	
• $L_{WP,i,m}$	

3.8 Corrections for propulsion noise (III-12)

Input values:	
• m	Category
• V_m	Average speed category *m* [km/h]
• $\Delta L_{WP,road,i,m}$	Correction for the road surface → §3.11
• $\Delta L_{WP,acc,i,m}$	Correction for the speed variations → §3.10
• $\Delta L_{WP,grad,i,m}$	Correction for road gradients → §3.9
Output values:	
• $\Delta L_{WP,i,m}$	

3.9 Correction for road gradients (III-13 thru III-16)

Input values:

- m Category
- grad Gradient [%]

Look-up tables "GradientCalculation":

Table 3

Propulsion noise – gradient

Category "m"	Correction for gradient	Low gradient [%]	High gradient [%]	Speed correction [km/h]	Denominator 1 [%]	Denominator 2 [%]
1	Y	-6	6	0	1.0	1.5
2	Y	-4	0	20	0.7	1.0
3	Y	-4	0	10	0.5	0.8
4a	N	-10	10	0	0	0
4b	N	-10	10	0	0	0
5	*Y/N*	*-9 .. 0*	*0 .. 9*	*0 .. 100*	*-9.9 .. 9.9*	*-9.9 .. 9.9*

Output values:

- $\Delta L_{WP,grad,i,m}$

3.10 Correction for the speed variations (III-17, III-18)

Input values:	
• m	Category
• x	Distance to the nearest intersection
• k	Kind of junction (1=crossing, 2=roundabout, ...)
Look-up tables:	
• $C_{R,m,k}$	Coefficient taken from look-up table "SpeedVariations", reference="*m*" and "*k*"
• $C_{P,m,k}$	Coefficient taken from look-up table "SpeedVariations", reference="*m*" and "*k*"
Output values:	
• $\Delta L_{WR,acc,i,m}$	
• $\Delta L_{WP,acc,i,m}$	

3.11 Correction for the road surface (III-19)

Input values:	
• m	Category
• V_m	Average speed category *m* [km/h]
• V_{ref}	Reference speed → §2.1
• Surface	Reference to the road surface
Look-up tables:	
• $\alpha_{i,m}$	Coefficients taken from look-up table "RoadSurfaces", reference="*m*" and "*surface*"
• β_m	Coefficient taken from look-up table "RoadSurfaces", reference="*m*" and "*surface*"
Output values:	
• $\Delta L_{WR,road,i,m}$	
• $\Delta L_{WP,road,i,m}$	

4. Lookup table structure

4.1 Static data

- Vref → Reference speed, default is 70 km/h
- Tref → Reference temperature, default is 20 °C
- Hsrc → Source height, default is 0.5m

4.2 Vehicle definition

- ID → Text = unique record identifier
- Description → Text (Vehicle type)
- RollingNoise → Calculation of rolling noise: `true` or `false`
- PropulsionNoise → Calculation of propulsion noise: `true` or `false`
- Studded → Calculation of studded tyres correction: `true` or `false`
- Astudded → Coefficients for studded tyres correction octave
- Bstudded → Coefficients for studded tyres correction octave
- Ksurface → Coefficients for effect of temperature correction octave

4.3 Gradient correction

- Ref → Reference to vehicle type
- Calc → Calculation of gradient correction: `true` or `false`
- Low → Low value for gradient s
- High → High value for gradient s
- Section Low → Values for calculating gradients smaller than "Low"
- Section High → Values for calculating gradients larger than "High"

4.4 EmissionAB

- Ref → Reference to vehicle type
- Ar → Values for rolling noise
- Br → Values for rolling noise
- Ap → Values for propulsion noise
- Bp → Values for propulsion noise

4.5 Speed variations

- Ref → Reference to vehicle type
- K → Type: 1=Crossing, 2= Roundabout
- Cr → Value for rolling noise
- Cp → Value for propulsion noise

4.6 Road surfaces

- ID → Text = unique record identifier
- Description → Text (Road surface)
- Vmin → Minimum valid speed (informative)
- Vmax → Maximum valid speed (informative)
- Ref → Reference to vehicle type
- A → Values per octave ($\alpha_{i,m}$)
- B → Value (β_m)