

# Implementation of (EU) 2015/996 *CNOSSOS-EU* in Austria

Christian Kirisits, Günter Dinhobl

# Methods

Software used:

- CNOSSOS-EU Source model software (V1.10)
- TestCnossos – Propagation software (12-05-2014)
- Programming the transmission algorithms in Matlab (The MathWorks)

with conditions for sound propagation:

- Air temperature 10°C
- Humidity 70%
- Favorable propagation conditions  
*(negligible at short distance)*

# Methods

## basic parameters for reference track:

- ballast track
- Mono- block (concrete) sleeper on medium stiffness rail pad (250 to 800 MN/m; -acoustic- railpad stiffness)
- CNOSSOS default for superstructure transfer (empty)
- average network roughness (“normally maintained”)
- no impact noise (no rail joints)
- no bridge
- no curve squeal

# Methods

Reference passenger train: 7 coaches plus 1 electric locomotive

Coach:            disc brakes, 920 mm wheel diameters, 4 axles  
                     contact filter for a wheel load of 100 kN  
                     aerodynamic noise was assumed for speed > 200 km/h

Locomotive:    one vehicle with 4 axles, disc brakes, 1200 mm wheel  
                     diameter,  
                     100 kN wheel load,  
                     default traction for electric locomotive (CNOSSOS-EU Rail  
                     Input Database)

## 2 Reisezugwagen, scheiben- oder kombiniert mit K- oder L-Bremsklotz

Geschwindigkeit: 110km/h

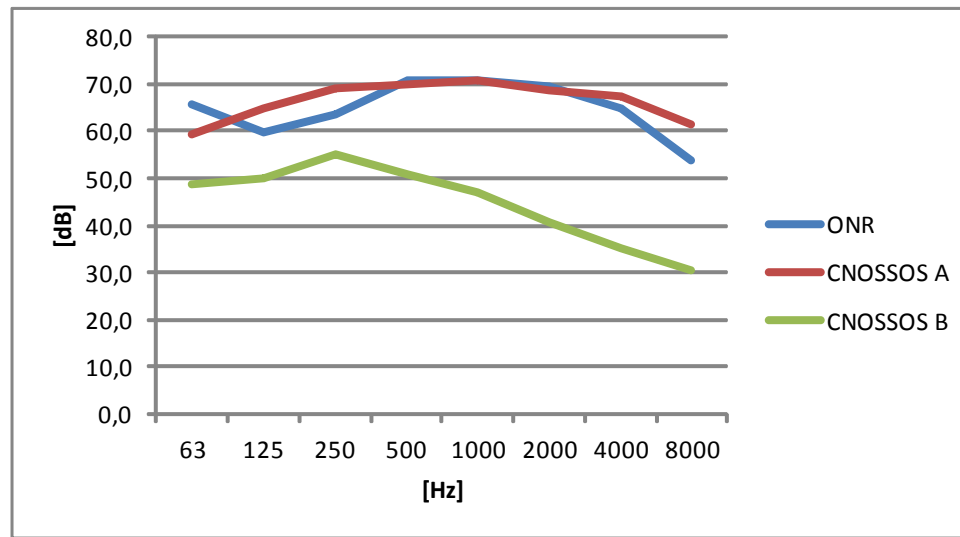
Länge: 205,4 m

**passenger coaches**  
**110 km/h**

Längenbezogener Schallleistungspegel  $L_w$  unbewertet in dB

	63	125	250	500	1000	2000	4000	8000	A-bew.
ONR	65,7	59,7	63,7	70,7	70,7	69,7	64,7	53,7	75,3
CNOSSOS A	59,2	64,8	69,1	69,8	71,0	68,7	67,4	61,6	75,6
CNOSSOS B	48,8	50,2	55,3	50,9	46,8	40,8	35,3	30,5	52,5

**Cnossos A: source height 0.5 m above rail**  
**Cnossos B: source height 4.0 m above rail**



Immissionspegel  $L_p$  A-bewertet in dB

	7,5 m	25 m	100 m	300 m
ONR	57,0	50,9	43,2	36,0
CNOSSOS	58,0	52,6	44,5	38,6
Differenz	1,0	1,6	1,3	2,6

**Comparison with ONR305011:**  
**same type + 1...2dB more loud**

## 2 Reisezugwagen, scheiben- oder kombiniert mit K- oder L-Bremsklotz

Geschwindigkeit: 160km/h

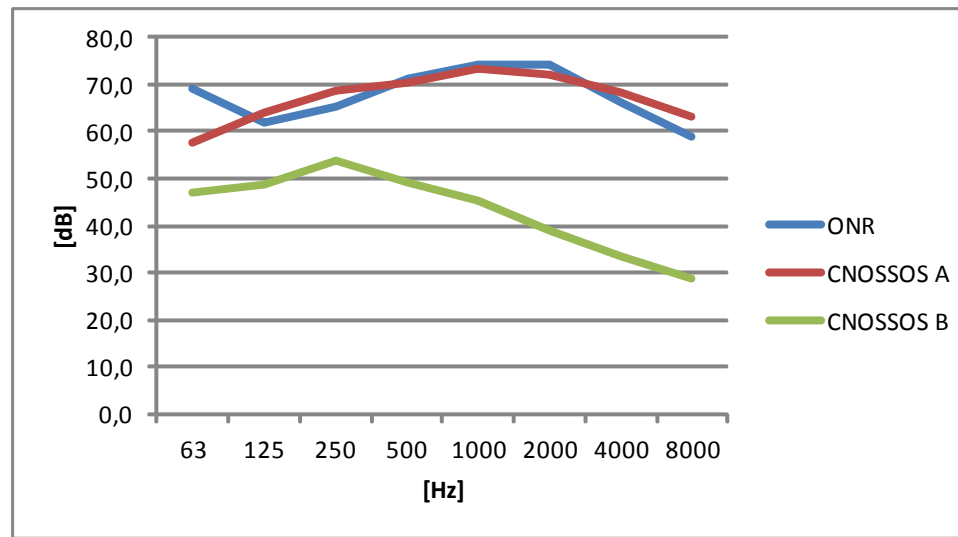
Länge: 205,4 m

**passenger coaches**  
**160 km/h**

Längenbezogener Schallleistungspegel  $L_w$  unbewertet in dB

	63	125	250	500	1000	2000	4000	8000	A-bew.
ONR	69,1	62,1	65,1	71,1	74,1	74,1	66,1	59,1	78,6
CNOSSOS A	57,7	64,0	68,8	70,4	73,5	72,1	68,3	63,3	77,8
CNOSSOS B	47,2	48,6	53,7	49,3	45,2	39,2	33,7	28,8	50,9

**Cnossos A: source height 0.5 m above rail**  
**Cnossos B: source height 4.0 m above rail**



Immissionspegel  $L_p$  A-bewertet in dB

	7,5 m	25 m	100 m	300 m
ONR	60,5	54,6	47,0	39,9
CNOSSOS	60,3	54,9	46,8	41,0
Differenz	-0,2	0,3	-0,2	1,1

**Comparison with ONR:**  
**same type + 0...1dB more loud**

## 2 Reisezugwagen, scheiben- oder kombiniert mit K- oder L-Bremsklotz

Geschwindigkeit: 230km/h

Länge: 205,4 m

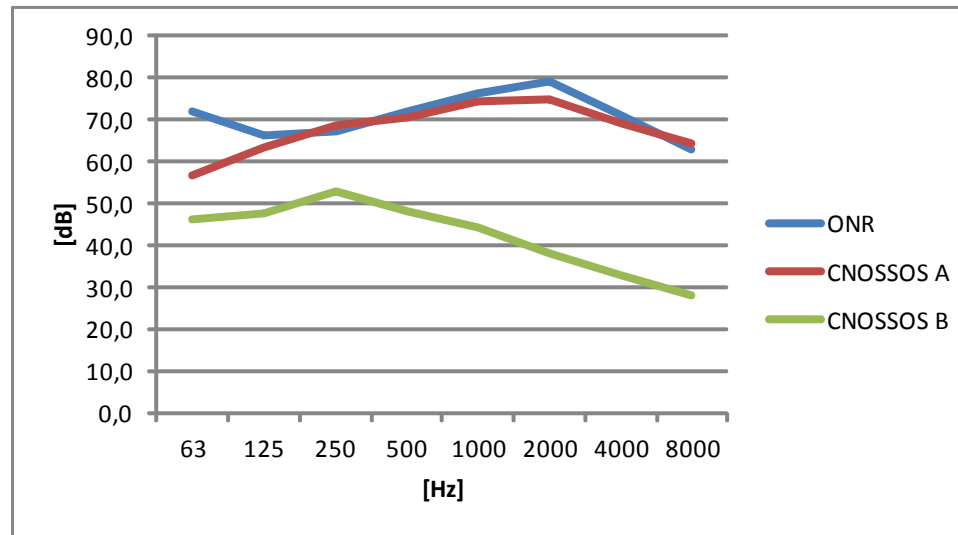
**passenger coaches**  
**230 km/h**

Längenbezogener Schallleistungspegel L<sub>w</sub> unbewertet in dB

	63	125	250	500	1000	2000	4000	8000	A-bew.
ONR	73,0	67,0	68,0	73,0	77,0	80,0	72,0	64,0	83,3
CNOSSOS A	68,7	71,2	72,4	73,4	76,2	77,1	72,1	67,9	81,7
CNOSSOS B	45,6	47,0	52,1	47,7	43,6	63,6	55,3	27,3	65,5

**Cnossos A: source height 0.5 m above rail**

**Cnossos B: source height 4.0 m above rail**



Immissionspegel L<sub>p</sub> A-bewertet in dB

	7,5 m	25 m	100 m	300 m
ONR	65,5	59,7	52,3	45,1
CNOSSOS	64,2	58,8	50,9	44,7
Differenz	-1,3	-0,9	-1,4	-0,4

**Comparison with ONR:**  
**same type + 0...1dB more quiet**

# Methods

## Freight wagons

Wagon: Composite block breaks, 4 axles per vehicle,  
wheel diameters of 920 mm (large)  
contact filter for a wheel load of 100 kN

**Axle per meter (average value): 0.21**



# Güterwagen mit K-Sohle

Geschwindigkeit: 100km/h

Länge: 381 m

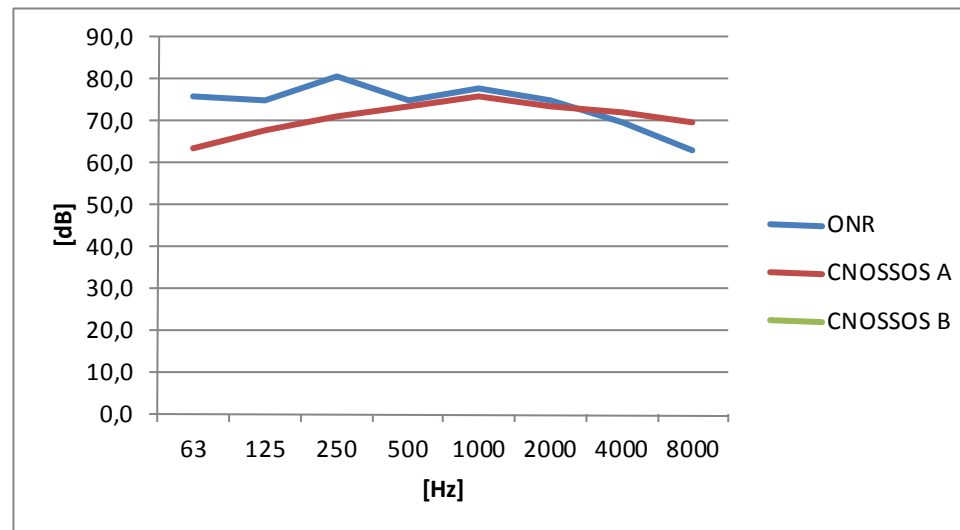
**freight wagons,  
composite-brake, 100 km/h**

Längenbezogener Schallleistungspegel Lw unbewertet in dB

	63	125	250	500	1000	2000	4000	8000	A-bew.
ONR	75,8	74,8	80,8	74,8	77,8	74,8	69,8	62,8	81,6
CNOSSOS A	63,3	67,7	71,3	73,5	75,9	73,3	72,1	69,5	80,3
CNOSSOS B	-29,2	-29,2	-29,2	-29,2	-29,2	-29,2	-29,2	-29,2	-22,2

**Cnossos A: source height 0.5 m above rail**

**Cnossos B: source height 4.0 m above rail**



Immissionspegel Lp A-bewertet in dB

	7,5 m	25 m	100 m	300 m
ONR	63,2	57,0	49,0	42,1
CNOSSOS	62,7	57,2	49,0	43,2
Differenz	-0,5	0,3	0,0	1,1

**Comparison with ONR:  
same type + 0...1dB more loud**

## 6 Güterwagen mit Grauguss-Bremsklotzsohlen

Geschwindigkeit: 100km/h

Länge: 381 m

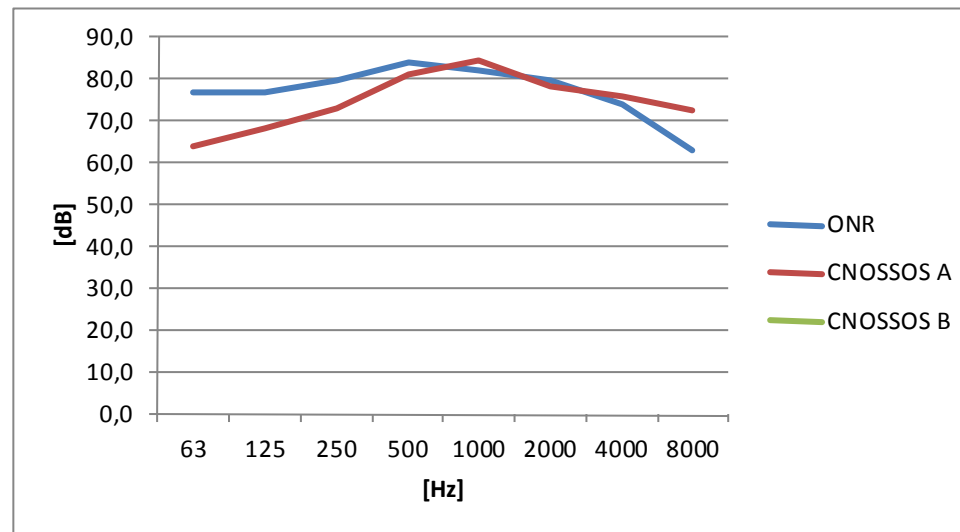
**freight wagons,  
Cast-iron-brake, 100 km/h**

Längenbezogener Schallleistungspegel L<sub>w</sub> unbewertet in dB

	63	125	250	500	1000	2000	4000	8000	A-bew.
ONR	76,8	76,8	79,8	83,8	81,8	79,8	73,8	62,8	86,4
CNOSSOS A	63,7	68,4	72,9	81,3	84,6	78,3	76,0	72,6	87,0
CNOSSOS B	-29,2	-29,2	-29,2	-29,2	-29,2	-29,2	-29,2	-29,2	-22,2

**Cnossos A: source height 0.5 m above rail**

**Cnossos B: source height 4.0 m above rail**



Immissionspegel L<sub>p</sub> A-bewertet in dB

	7,5 m	25 m	100 m	300 m
ONR	67,8	61,6	53,6	46,6
CNOSSOS	69,5	64,1	55,8	50,8
Differenz	1,7	2,6	2,2	4,2

**Comparison with ONR:  
same type + 2...4dB more loud**

#### 4 Triebwagengarnitur BR 4023/4024/4124 (Nahverkehr)

**EMU**  
**100 km/h**

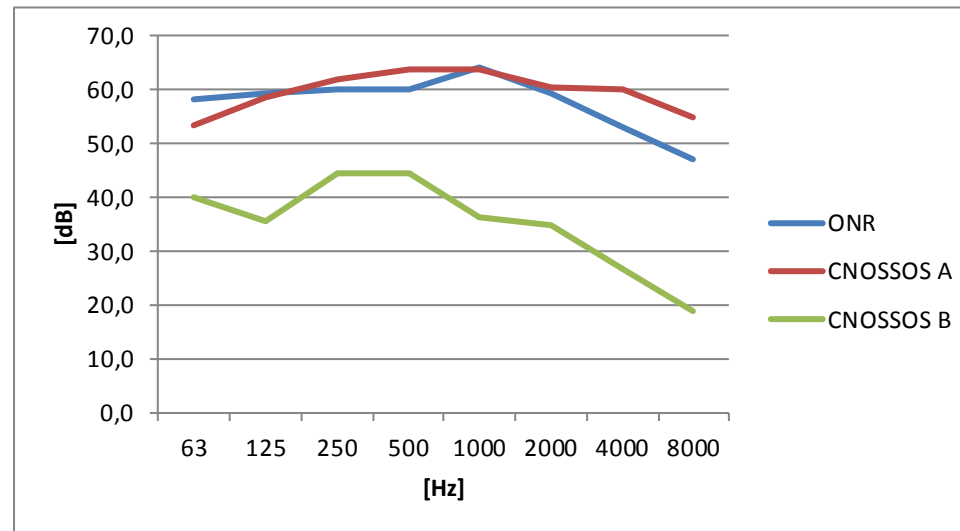
Geschwindigkeit: 100km/h      Länge: 52 m

Längenbezogener Schallleistungspegel L<sub>w</sub> unbewertet in dB

	63	125	250	500	1000	2000	4000	8000	A-bew.
ONR	58,2	59,2	60,2	60,2	64,2	59,2	53,2	47,2	66,7
CNOSSOS A	53,3	58,5	62,0	63,7	63,7	60,6	60,2	54,8	68,3
CNOSSOS B	40,0	35,7	44,6	44,6	36,4	34,7	26,7	18,8	44,3

**Cnossos A: source height 0.5 m above rail**

**Cnossos B: source height 4.0 m above rail**



Immissionspegel L<sub>p</sub> A-bewertet in dB

	7,5 m	25 m	100 m	300 m
ONR	48,3	42,1	34,1	27,3
CNOSSOS	50,7	45,3	37,2	31,3
Differenz	2,5	3,3	3,1	4,0

**Comparison with ONR:**  
**same type + 2...4dB more loud**

**→ Open point: same or similar result in other countries with same EMU-type ?**

# Problems

general:

similar results, but to be careful

identified problems:

- ‘railpad stiffness’: acoustic – not ‘conventional’ railpad stiffness
- not clear distinction between axle load and wheel load Tab.G-2: only 25-50-100 kN “axle load” available)
- curve squeal: seems to be only valid for ‘silent wagons’, in AT not measured at this average level for wagons with cast-iron brake blocks (50000 + 46000 + 37000 freight wagon axles sound measured at different sites /radii)
- noise (@7.5/1.2) depending on axle load could not be proved with noise measuring sites in AT (analysis of >10000 wagon axles, at straight line)
- national calculation standard (ONR305011) often more detailed (e.g. shunting yards)
- guarantee that noise parameters for same railway vehicles (type) are the same in different countries!

# Discussion