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Noise from amplified music played in discotheques, pubs and clubs - A review of some national regulations

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The development of new musical styles (with strong low frequency content) and high-power sound-reinforcement systems induced an appreciable increase in the noise levels inside and in the neighbourhood of public establishments diffusing music, for example discos, pubs, clubs or restaurants. The presence of dwellings contiguous or very near this type of establishments frequently involves significant noise nuisances. In the last years, one could see not only large campaigns of information and prevention relating to these problems but also the appearance, in many countries, of various local or national recommendations, standards, directives or laws to control or limit this type of noise nuisances. The analysis of many regulations in this field shows a great diversity of methodological approaches and limit values. The requirements of these regulations relate in particular either to the immission level of the music (for example in CH, NL, N, and S), or on its emergence compared to the background noise (A, B, I, P, and the UK) or on the values of the required sound insulation (A, CH, F, and D).

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1. INTRODUCTION

In order to compare the international practices with regard to the regulation of noise in the vicinity of the public establishments diffusing music (called PEDM in this paper), this work analyzes some national regulations: Austria (A), France (F), Germany (D), Italy (I), Netherlands (NL), Norway (NR), Portugal (P), Sweden (S), Switzerland (CH) and the United Kingdom (UK).

2. SUMMARY OF SOME NATIONAL REGULATIONS

Austria – The standard ÖNORM S 5012 (2000) details and models the noise sources in the PEDM according to their type and proposes various measures of protection. It gives limit values for the weighted standardized impact sound pressure level: $L'_{nT,w} < 33$ dB (28 dB if open after 22 h) for a background noise $L_{A,Gg} (= L_{p,A,95}) \geq 20$ dB, resp. < 20 dB). It also indicates limit values for the airborne sound insulation according to the foreseeable peaks noise level ($= L_{p,A,01} + 4$) and of the background noise ($L_{A,Gg}$), that is $D_{nT,w} + C_j = (L_{p,A,1} + 4) - (L_{A,Gg} + 10)$. For a discotheque downtown ($C_j = C_{tr}$, $L_{p,A,01} = 110$ dB, $L_{A,Gg} = 20$ dB), there will be thus a minimum insulation of $D_{nT,w} + C_{tr} = (110 + 4) - (20 + 10) = 84$ dB.

According to the recommendation ÖAL Richtlinie Nr. 33 (1990) the minimum weighted standardized level difference $D_{nT,w}$ between a PEDM and a noise sensitive room must ensure that the peak level at the immission ($L_{A,01}$) be 5 dB below the background noise level (L_{gr}) or: $D_{nT,w} > L_{A,01} - L_{gr} + 5$. For a discotheque with average peak levels about 100 dB(A), located in an urban zone, $D_{nT,w} > 85$ dB ($= 110 - 20 + 5$). With regard to outside noise, the limit in a mixed urban zone (dwelling/industry) is 40 dB(A) at night.

France – The decree 98-1143 (15.12.1998) fixes requirements for D_{nT} by octave band according to the level at the emission ($L_f = L_{Aeq} (10-15 \text{ min})$ at the most exposed place) with a severe limitation

at low frequencies (sound insulation of 66 or 75 dB in the 125 or 250 Hz octave bands for a standardized emission sound level of 99 dB in these octaves). The calculation of the immission sound level according to this decree, gives a value of 22 dB(A) for a maximum emission sound level of 105 dB(A). The noise emergences in the standardized octaves of 125 to 4k Hz should not exceed 3 dB.

The Noise National Council had endorsed "recommendations relating to the sound isolation of the residences at vicinity of noises produced inside establishments diffusing music" which recommend an insulation to pink noise $D_{nAT} (= R'_w + C) \geq 68$ dB with respect to sound emitting bars (L_{Aeq} from 85 to 95 dB during the noisiest period). This minimum sound insulation reaches $D_{nAT} \geq 88$ dB for the discotheques (L_{Aeq} from 105 to 115 dB). These recommendations also limit the arithmetic mean of insulations in the octave bands centred on 125 and 250 Hz that must be higher or equal to 75 (discotheques) or 55 (sound emitting bars) and the disturbing sound level alone should not surpass 22 dB(A) (= the value of the residual noise).

Germany – The recommendation VDI 3726 (1991), which relates specifically to the PEDM, fixes the requirements according to their emission sound level L_{AFmax} (≤ 80 ; ≤ 85 ; ≤ 95 ; > 95 dB) and their opening schedules. The recommendation fixes requirements for the insulation to airborne noises ($R'_w > 55, 62, 67$ and 72 dB according with the PEDM) and to the impact noises ($L'_{n,w} < 43, 33, 28, 23, 13$ dB). It also limits the evaluation level (L_r) of the technical installations according to recommendation VDI 2058, that is 35 dB(A) at daytime and 25 dB(A) during the night. The peaks (L_{AF}) should not exceed these values of more than 10 dB. The standard DIN 4109-1989 imposes an insulation $R'_w \geq 72$ dB and $L'_{n,w} \leq 28$ dB with respect to the sound emitting PEDM (maximum level L_{AF} between 85 and 95 dB). Regarding the external noise, various regulations (DIN 18005-1, DIN 45645 and VDI 2058) settle the limit in mixed urban zone from 40 to 45 dB(A) at night with a corrective factor according to the audibility of the tonal and impulsive components going from 0 to 12 dB.

Italy – In the general framework of the law 447 (26.10.1995), the decree limits the noise level in the PEDM ($L_{ASmax} (3 \text{ min}) < 102$ dB, 24 months after the entry into force of the decree, $L_{Aeq} (1 \text{ min}) < 95$ dB). A decree (DPCM 280 of 14.11.1997) gives immission values for the external noises, either at nighttime, 40 dB(A) open window and 25 dB(A) closed window, as well as the maximum acceptable emergence of 3 dB(A) at night. The minimum insulations inside a building, fixed by another decree (DPCM 297 of 5/12/1997), account only for the type of building according to its noise sensitivity (categories A to G) and not for the emitted noise level ($R'_w > 50$ dB, $L_{ASmax} < 35$ dB and $L_{Aeq} < 35$ dB for the dwelling).

Netherlands - The Environment Protection Act (1993) requires that L_{Aeq} coming from the PEDM should not exceed 25 dB between 23 h and 7 h. Since 1998, the Catering Industry Order [1] specifies preventive measures and limits the immission level according to the background noise (L_{A95}) or 10 dB below the limiting values for the road traffic noise (see Table 1). The limits for the maximum sound level (L_{AFmax}) are 20 dB above those fixed for the equivalent sound level. The "12 days exception rule" allows occasional events (festivals, carnival, etc.) to derogate the legal requirement. An acoustic study is necessary for the granting of licence for



large discotheques (> 2000 persons) or for large leisure parks. Such a study is also sometimes required according to the use and the noise level of the music in the establishment (> 80 dB(A)).

Table 1: *Noise limits according with the Catering Industry Order.*

L_{Aeq} (dB)	Daytime 7-19 h	Evening 19-23 h	Night time 23-07 h
Outside/Inside	50/35	45/30	40/25

Norway – The standard NS8175-1997 specifies not only the insulations between buildings but also the acceptable limit of the noise at the immission. The limit ($L_{A,max}$) is between 22 and 37 dB for inside noise, and between 25 and 45 dB for the external noise.

Portugal - The Noise Code (D.L. 292/2000) fixes a maximum noise emergence of 3 or 5 dB(A) (22-7h or 7-22h) with corrections to take into account the T duration of the noise (0 if $T > 8$ h, and up to +4 if $T < 1$ h), the tonal components (penalty of +3 dB if one 1/3 octave is ≥ 5 dB higher than the neighbours bands) and the impulsive components (penalty of +3 dB if $L_{A,Leq} - L_{A,Feq} > 6$ dB). A recent decree [4] fixes that $D_{n,w}$ should not be less than 55 dB between commercial places and dwellings.

Sweden – The directive SOSFS 1996:7 (Nat. Board of Health and Welfare) mentions that "the structure borne transmitted music is perceived as more disturbing when the low frequencies prevail. The recommendations for which the noise can constitute a potential harmful effect should thus be interpreted more severely for this type of noise. The L_{Aeq} as low as 25 dB can be perceived as annoying. The evaluation of the levels to which the noise constitutes an annoyance effect must be made according to the local circumstances".

Switzerland – The directive of the Circle Noise (DEP 10.3.1999), which relates specifically to the PEDM, fixes limiting values for $L_{Aeq(10 s)}$ at the immission according to the noise propagation paths (penalization of 10 dB for inner compared to outer propagation), of the period of the day (5 dB of variation between the following periods: activity, rest, sleep), of the date of entry in exploitation (decrease of 5 dB before 1985), of the tonal and impulsive components (penalization of 6 dB), and of the particular situation (penalization of 5 dB for calm zones). Thus, for a downtown PEDM exploited after 1985, the nighttime level (22 - 7 h) should be $L_{Aeq(10 s)} < 24$ dB for the inner propagations and $L_{Aeq(10 s)} < 34$ dB for the outer propagations.

The standard SIA 181-1988 fixes, for a very high degree of nuisance (for example discotheque) a $D_{nT,w}$ of at least 62 dB (minimum requirement) or of 67 dB (increased requirement) with respect to the residences located in the same building. The Noise Protection Ordinance (OPB) limits the external night noise level downtown (L_{Aeq}) from 33 to 45 dB according the audibility of the tonal and impulsive components considered.

United Kingdom – The recommendation done by the Institute of Acoustics to limit the noise of the pubs [2] (currently still in consultation) must guarantee that "where entertainment takes place on a regular basis, music and associated sources should not be audible inside noise-sensitive property at any time". For less frequent events, this restriction is limited to the night (23-7 h).

Open-air concerts are regulated by another recommendation [3] emanating from the Noise Council, which gives indications on the method of control and fixes the limiting values for the music according to the number and to the category of venue (see Table 2). Between 23 h and 9 h the music should not be audible in any noise-sensitive room with an open window to ensure its ventilation. With regard to the low frequencies, the level in the 63 and 125 Hz octave bands should not exceed 80 dB. For indoor venues (up to 30 per year, finishing no later than 23 h), the sound level of the music should not exceed the background noise by more than 5 dB(A) over a fifteen minute period.

Table 2: *Environmental noise control at concert in UK.*

Number of events per year	Venue Category	Limit L_{Aeq} (15 min) 1 m facade between 9 h and 23 h
1-3	Urban Stadia or Arenas	75 dB
1-3	Other Urban and Rural Venues	65 dB
4-12	All Venues	Background noise (L_{A90}) + 15

3. SYNTHESIS

The majority of the countries which have a regulation on the PEDM fixes requirements on the noise level to be respected in the noise-sensitive rooms in the same building as a PEDM (sound level at the reception) either in the form of an absolute value or in the form of an emergence value. Some regulations give requirements for the sound insulation between the PEDM and the noise-sensitive rooms located in the same or next building.

Table 3: *Limits on the noise level at the reception.*

Country	Text	Descriptor	Requirements dB(A)	
			Inside	Outside
CH*	DEP	L_{Aeq} (10 s)	24	34
D	VDI 2058 B11	L_r	25	40-45
		L_{AFmax}	35	(DIN 18005)
F	Recommendation CNB (1993)	L_{Aeq}	22	-
I	DPCM 14/11/97 No 280	L_{Aeq} (1 min)	25	40 (open window)
N	NS 8175-1997	L_{AFmax}	22-37	25-45
NL	Catering Order (1998)	L_{Aeq} (19-07)	25	40
		L_{AFmax}	45	60
S	SOSFS 1996:7	L_{Aeq}	25	-
UK	Code of Practice Concerts**	L_{Aeq} (15 min)		75 (stadia)
				65 (other)

*Exploitation after 1985, night time (22-7h) downtown; **Max. 3 open air concerts/year

3.1 Limitation on the received sound level

It is difficult to compare among the requirements because the indexes used for the noise levels differ from one country to another. We note (Table 3) nevertheless a relative coherence with regard to the equivalent level (L_{Aeq}) recommended which is about 25 dB inside and 40 dB outside (without taking account the UK regulation concerning occasional concerts). Sometimes this limit does not include penalties for the qualitative components of the sound (tonal, impulsive, informative) or it corresponds to relatively short durations of measurement (from 10 to 600 s).

3.2 Limitation on noise emergence

It is also difficult to compare among the requirements for noise emergences because the descriptors used also vary from one country to another (Table 4). We note nevertheless a relative coherence of allowed emergence for the music compared to the background noise that is on average of 3 dB(A).

Table 4: *Limitation of noise emergence at the reception.*

Country	Text	Descriptor music	Descriptor backgr. noise	Requirement emergence dB(A)
F*	Décret 98-1143	L_{Aeq} (1h)	L_{Aeq}	< 3
I	DPCM 280 14/11/97	L_{Aeq} (1 min)	L_{Aeq} (1 min)	< 3
NL	Catering Order 1998	L_{Aeq} (19-7h)	L_{A95}	< 0
P	Noise Code 2000	L_T (22-7h)**	L_{Aeq}	≤ 3
UK***	Code of Practice Concerts	L_{Aeq} (15 min)	L_{A90} (4 h)	< 5
UK	Code of Practice Pubs & Clubs	Not defined	Not defined	"Inaudible"

*Limit for each octave band 125 to 4k Hz (measurement method: NF S 31-010); ** $L_r = L_{Aeq}(\text{music} + \text{background noise}) + K_{t,i}$ (tonal and impulsive 0, 3 or 6) - K_d (duration, 0 to 4); ***Maximum 30 indoor venues /year

3.3 Sound insulation requirements

Certain countries fix requirements on the minimum sound insulation (for the airborne noise and sometimes for the impact noise) to be ensured between the PEDM and the noise-sensitive rooms located in the same building. The sound insulation requirements are always given according to the type of establishment either by the use of classes (in CH and D) or by taking into account the noise level in the PEDM (A and F).

It is however difficult to compare among the recommended sound insulations because the descriptors used for the noise levels and the sound insulations vary from one country to another. Table 5 gives a summary of the descriptors and the sound insulation requirements for the maximum sound level at the emission and for a typical example of a PEDM, a discotheque with the following assumptions:

- 1) Same inside sound level expressed in different ways according to the descriptor and to the method of measurement specific to each country (France: $L_f = L_{Aeq}$ (10-15 min most exposed) = 105 dB, Austria: $L_{A,01} = 105$ dB (that is $L_{Aeq} = 95$ dB), Switzerland: L_{Aeq} (1h) = 95 dB, $L_{Aeq}(10\text{ s}) = 100$ dB).
- 2) Urban situation with a background noise of $L_{A95} = 20$ dB (standardized in Austria).

The requirements for the sound insulation largely vary from one country to another. The countries (P and I) that specifically do not take into account the type of establishment, recommend a very weak insulation. The Switzerland and, to a lesser extent, Germany recommend relatively weak airborne noise sound insulations (respectively 62 and 72 dB) compared to France and Austria, where the required insulation exceed 80 dB.

Table 5: Sound insulation requirements.

Country	Requirement	Descriptor	Requirements	Maximum*	Example**
A	ÖNORM S 5012	$D_{nT,w} + C_{tr}$	$L_r - L_{A,Gg}$ $L_{pA,01} - (L_{A,Gg} + 6)$ $L'_{nT,w}$ 33, 28	99	79
A	ÖAL 33	$D_{nT,w}$	$L_{A,01} - L_{Gr} + 5$	85	90
F	Décret 98-1143	$D_{nT}(L_f)$, $L_f = \text{emission}$	$D_{nt}(99) + (L_r - 99)$, $D_{nT,w} + C_{tr} \approx L_f - 22$	83	83
F	Recommend. CNB (1993)	D_{nAT}	68, 78, 88	88	88
D	DIN 4109	R'_w $L'_{nT,w}$	62, 67, 72 43, 33, 28	72 28	72 28
CH	SIA 181-1988 (ex. minimums)	$D_{nT,w}$ $L'_{nT,w}$	62, 67 45, 40	62, 67 45, 40	62, 67 45, 40
P	Noise Code 2000***	$D_{n,w}$	55	55	55
I	DPCM 297 5/12/97***	R'_w	55	50	50

* Highest sound insulation required (for the highest emission value), ** Sound insulation required for the considered example (discotheque); *** Values for all commercial buildings (not only for discos).

4. CONCLUSIONS

The analysis of the regulations at the international level showed that many countries fix limits of noise level at the immission (noise-sensitive rooms located in the same building) either by a maximum sound level not to be exceeded (on average $L_{Aeq(short)} = 25$ dB inside and 40 dB outside), or by a maximum noise emergence (on average 3 dB(A)) of the noise resulting from the public establishment diffusing music - PEDM - compared to the background noise). The countries that specifically require a minimum sound insulation value between a PEDM and a noise-sensitive room, ask for relatively high qualities of insulation (about $D_{nT,w} + C_{tr} = 80$ dB between a discotheque and a dwelling).

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