

“Capacity Building and Strengthening Institutional Arrangement”

Analysis and sampling of air and air pollution

ENVIRONMENTAL ACUSTIC

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NOISE

Definition of noise

Noise is represented by any sounding emissions that causes undesired, disturbing or dangerous effects on human being or that causes qualitative deterioration of environment (DPCM 1st March 1991).

The noise can have a damaging effect on:

- auditory organ
- nervous organ
- cardiovascular system
- neuropsychical system

NOISE

Basic physical quantities and their units of measure:

- Sound pressure **P** [Pascal= newton * meter⁻²=
meter*kg*s⁻² =]
- Velocity of sound **C** [meter* second⁻¹]
- Sound Intensity **J** [Watt*meter⁻²]
- Density of sound energy **D** [Joule*meter⁻³]

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Sound Pressure p

The sound pressure is the difference between the total pressure $P(x,y,z,t)$ in the presence of the acoustic phenomenon at a specific point of space and of time (t) and the static pressure of propagation means (atmosphere) P_0 .

In first approximation, P_0 can be considered constant and independent of x,y,z,t .

$$p(x,y,z,t) = P(x,y,z,t) - P_0$$

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Velocity of sound C

The velocity of propagation of sound in the air (perfect gas hypothesis), depending on temperature T [°C], is:

$$C = 331.2 + 0.6 T$$

C can be considered a constant (340 m/s) because the parameters are sufficiently invariable.

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Sound Intensity J

The sound intensity is represented by the ratio between the sound power dW that goes through a surface dS in parallel to n (the normal of dS) and the same surface dS .

$$J = dW/dS$$

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Density of sound energy D

Density of sound energy is the energy (dE) associated to the corresponding vibratory phenomenon, localized in the unit of volume (dV) that circumscribes an assigned point in the propagation means.

$$D(x,y,z,t)=dE/dV$$

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Levels

The sound quantities have extensive fields of variability , so it's useful to refer to logarithmic scale.

The levels are used to rappresent the sound quantities in the place of absolute values.

Types of level:

• *Level of sound pressure*
 P_r

$$L_p = 20 \log P_{\text{eff}} /$$

• *Level of sound intensity*

$$L_j = 10 \log J / J_r$$

• *Level of density of sound energy*

$$L_D = 10 \log D / D_r$$

The numerical values of reference quantities are fixed by ANSI and used universally.

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Noise sources

The noise sources are characterized by:

- issued power;
- spectrum emission;
- distribution of issued power in various directions.

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Examples of sources - issued power (dB)

-Take off of a big jet	170
-Take off of a little jet	140
-Pneumatic hammer	120 (threshold of pain)
-Rock Band	110
-Noisy road traffic	80
-Conversation between two people	60
-Whispering	30 (very quiet)
-Rustling of leafs	20
-Normal breathe	10 (barely audible)

NOISE

Effects of noise on human being

The effects of noise on human being depend on characteristics of *average intensity, duration and type of sound pressure* (spectral composition and temporal evolution of the instantaneous sound pressure)

The effects are:

- ***Annoyance***: unsatisfied sense of the human being towards the surrounding sound environment; subjective answer to a sound of modest average intensity, of prolonged or repetitive duration.

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Effects of noise on human being

- ***Disturb***: unsatisfied sense towards the surrounding sound environment is added to any temporary alteration of the conditions of psychophysical system of human being; the subjective answer causes physiopathological effects;
- ***Damage***: any alteration, not or only partially reversible and verifiable in clinical way, of the state of health of a human being; this alteration regards auditory function and can cause deafness. It can involve also extraauditory functions.

ITALIAN REGULATIONS

In the last fifteen years the Italian regulations are developed broaching the problem of the protection of population from noise pollution.

Maximum levels of differential tone (5 dB day, 3 dB night) and maximum levels of sound emission have been inserted.

In particular each commune has to proceed to *acoustic zoning* of its municipal land in conformity with the limits of the following table.

ITALIAN REGULATIONS

DPCM 14th november 1997

Land use	Emission Limit Values dB(A)		Absolute Limit Values for the area dB(A)	
	Day	night	day	night
I – protected areas	45	35	50	40
II- residential areas	50	40	55	45
III – mixed areas	55	45	60	50
IV – areas with high human activity	60	50	65	55
V – mainly industrial areas	65	55	70	60
VI – totally industrial areas	65	65	70	70