Acoustic Project
Knowledge Database

An acoustic project defines the arrangement of acoustic elements in a warning system (such as electronic sirens, horns, loudspeakers, etc.) in an endangered area. It is the first step in the design of any warning system. In the arrangement of sirens, the following is mainly taken into account:

- Sufficient acoustic coverage of the whole endangered area
- Feasibility of their installation
- Availability of electric power supply
- Communications infrastructure possibilities (wired and wireless links) for siren control
- Accessibility for technicians to carry out regular maintenance and/or service

Endangered Area

An endangered area is a territory where, in an emergency situation, life, health or property of the population may be put in danger. This area must be covered by a warning signal.

Background Noise

There is always some level of noise in every environment under normal conditions. This noise level is called a background noise level, and it is measured in decibels [dB]. It has a direct effect on the audibility and intelligibility of warning signals generated by sirens and other acoustic elements of a warning system. Background noise levels can vary in the course of a day. Commonly, it is influenced mainly by road traffic, industry and various local outdoor noise sources. Their measurements should be made in the noisiest times of a working day, for example, in the rush hour.

Sound Attenuation

Building Intensity Effect

The attenuation of sound distribution caused by the environment depends, amongst other factors, on building intensity, i.e. the height of buildings and density of area development. This building intensity effect is significant influences the acoustic range of a warning device. It is virtually impossible to determine the exact influence of this building density, regarding the diversity of area development. Therefore, the parameter value is estimated based on statistical measurements and practical experience. It is recommended to set an attenuation parameter value up to 1.4 dB / 100m for low area building density, a value up to 2.4 dB / 100m for medium area building density, and a value higher than 2.5 dB / 100m for high-density development of an area.

Other Effects

The attenuation of sound distribution caused by the environment depends on climatic and weather conditions. The distribution of sound in coastal areas with high winds and humidity is somewhat different than in desert areas with typically dry and hot air.

Minimum Acoustic Pressure Required According to Background Noise

The relation between the minimum required level of acoustic pressure of a warning signal and the level of background noise can be directly stipulated by the national legislations of individual countries. Generally, it is recommended that the following relation between the background noise level and the required minimum level of acoustic pressure of a warning signal is obeyed:

Background Noise Level	Minimum Required Acoustic Pressure
< 60 dB	**55 dB**
60 - 75 dB	**equal to the background noise level**
> 75 dB	**5 dB above the background noise level**

Acoustic coverage

Acoustic coverage illustrates an area where the acoustic pressure of a warning signal can reach at least a minimum required level of acoustic pressure. Acusticus Professional automatically displays the acoustic coverage of each siren where the level of acoustic pressure is still compliant with the project requirements.

Horn Arrangement

Sound distribution in the environment also depends on the arrangement of siren horns. It is possible to vary sound emission diagrams by horns arrangement. The emission diagram graphically illustrates the distribution of an acoustic signal of the required acoustic pressure in specific directions.

The most common horn arrangements are as follows:

- O – Omnidirectional, circular diagram
- 8 – Bidirectional, elliptical diagram
- F – Unidirectional diagram with a preferred direction

By the appropriate utilisation of these emission diagrams, it is possible to optimise the number of sirens used in the project.

Horn Azimuth

A horn azimuth is an angle expressing a declination of horn direction from the north in the clockwise direction, and it is measured in degrees.
By the proper direction of siren horn sets, it is possible to optimise the arrangement and number of sirens in an acoustic project.

Power Output

A power output of a siren is stated as the sum of electric power outputs of all siren amplifiers. Various types of power output measured according to various standards are provided for various purposes:

- Sinusoidal (DIN)
- Music
- Peak
- Nominal (RMS)

The parameter of the power output of a siren is rather informative; the essential parameter is its acoustic pressure. **In general, it is advisable to use sirens with a maximum output of 1200 W in warning systems**, as more powerful sirens may impair the hearing of people in their vicinity. Moreover, the acoustic coverage of a siren is not increased proportionally to its increased power output. Therefore, regarding the area coverage, it is more effective, for example, to use two 1200 W sirens rather than one 2400 W siren. More powerful sirens are used only exceptionally in extremely noisy environments or if a single central source of the acoustic signal is required.

Acoustic pressure of a warning signal

The power output of a siren has a direct effect on its fundamental acoustic parameter, i.e. the acoustic pressure of a warning signal. The acoustic pressure of a warning signal is expressed in decibels (dB). Besides the electric output of amplifiers, it is also influenced by other parameters, particularly by the design of electro-acoustic transducers and horns (an acoustic system). The acoustic pressure of a warning signal can also be affected by the adaptation of the spectrum of a warning signal in the acoustic system used. Most manufacturers indicate it for the signal simulating the wailing of a typical motor siren at the so-called steady tone, measured at a distance of 30 m (or at a distance of 1 m for devices for less powerful devices intended for the interior). By the modification of warning signal parameters for a specific acoustic system (its frequency and amplitude), it is possible to increase the acoustic pressure of electronic sirens and thereby increase the acoustic coverage of a warning signal. However, the coverage of spoken word remains unchanged.