

Appendix A

The Basic Physics of Siren Acoustics

### THE BASIC PHYSICS OF SIREN ACOUSTICS

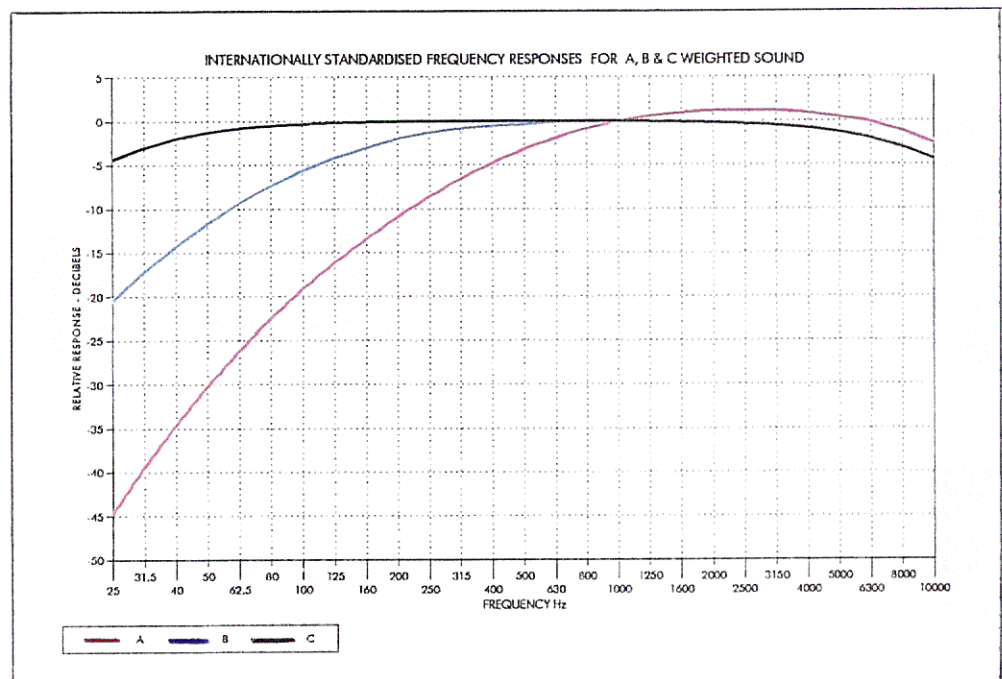
DECIBEL - The Sound Pressure Level (SPL) or the output of a siren is measured in decibels (dB).

#### SOUND LEVEL WEIGHTING

dB(C) - dB(C) relates to a weighting applied to the SPL by a sound level meter. There are three main international weighting standards A, B & C which selectively discriminate against low and high frequencies. The C-weighting when compared with A-weighting will indicate higher sound levels in the frequency range below 800Hz. The C weighting was originally intended for measurements above 85dB. It is used by siren manufacturers in accordance with ISO 13474-1 (and in this report) for quoting the rated output of sirens at 30 metres (100 feet).

dB(A) - dB(A) was originally intended for measuring sound levels below 55dB, but it is now almost universally used for standards and regulations. In this report A-weighted noise measurements and siren overall coverage calculations have been used.

Please refer to the chart below which shows the frequency-response characteristics for each of these weightings.



**FREE FIELD** - The siren dB levels at 30m stated in this report are Free Field measurements. Free Field indicates an unobstructed measurement taken on a calm day over a low reflective surface, where all possible extraneous factors which could affect a true measurement are minimised. Free Field measurements are normally taken on axis at 30 metres from the sound source.

**INVERSE SQUARE LAW** - The nominal coverage area achieved by a siren in Free Field conditions is calculated using Inverse Square Law.

Each time the distance from the sound source is doubled in a free field, the sound column increases in size, this results in a 6dB loss (attenuation) in the sound pressure level. For instance a siren producing 119dB @ 30 m will have a measurement at 60m of 113dB and at 120m - 107dB etc.

However Free Field conditions are hardly ever experienced for siren applications (across water on a calm day is one of the few occasions when -6dB per distance doubled will be seen) and as mentioned earlier in this report there are many factors which affect the coverage that can be achieved. In our calculations we have included an average building density in the Process Areas of 3 and Middle East (Neutral) climatic conditions, this results in an average attenuation to a 80dB(A) minimum of -9.75dB per distance doubled.

**dB GAIN & NETWORKS** - Optimising the coverage of sirens is achieved by placing them, as practicably as possible, in a square network. The advantage of this type of placement is that the combination of the SPL's from each siren results in a gain at the point where they meet. Where equal SPL's meet the gain is 3dB. This gain enables us to place them at the maximum distance possible between each other, to achieve the minimum desired dB level.

The chart below shows the effect of combined dB levels.

