

# BASICS OF SOUND

When considering the requirements of a sounder, some basic physics may come in useful. The human ear detects sounds by registering pressure changes from 20µPa (micro Pascals), “the threshold of audibility”, to 60,000,000µPa, the “threshold of pain”. In dealing with such a large dynamic range, measuring sound levels in dB, a log-linear scale is more convenient. The threshold of audibility is defined as 0dB, the threshold of pain around 120dB; on this scale the background sound level in a typical office is 65dB, a pneumatic drill generates around 100dB.

Four factors must be taken into account when deciding how loud a sounder is required.

1. **DIN 33404 defines 10dB as the minimum difference for unequivocal audibility**, so in typical office with a 65dB background noise level, the sounder must produce an output of 75dB at the persons location.
2. **Sound volume falls by 6dB every time the distance doubles.**

Distance	Output(dB)	Level(dB)
1	100	0
2	94	-6
4	88	-12
8	82	-18
16	76	-24
32	70	-30
64	64	-36

These attenuation figures are **worst case** in practice, in a confined area or indoors reflected sound will increase the final sound level.



3. **The human ear does not detect all frequencies equally.**

To allow for this, the dB(A) measure allows for the non-uniform response. All sounder manufacturers will quote figures in dB(A) for the performance of their products, and specifications such as BS 5839 in the UK, define the required frequencies for good audibility.

4. **Each 3dB increase in output is equivalent to a doubling of the volume.**

Output (dB)	Relative Volume
100	1
103	2
106	4
109	8
112	16

# BASICS OF LIGHT

A visual signal (also known as beacon, flash-alarm or strobe) is a luminous source within a coloured transparent enclosure and is used in many applications not least as a reinforcement to an audible signal in the event of danger, warning or machine/system process.

There is a choice of luminous sources,

**Filament bulb** - usually operated in conjunction with an additional circuit, both a steady output and more effective blinking output may be achieved. The filament light bulb gives adequate performance, at a relatively low cost, which may be enhanced with a freznel lens. It does however have quite a short life, and is further shortened when exposed to quite low levels of vibration.

**Xenon (strobe) tube** - operating at high voltage generated by an inverter circuit, the xenon tube is ignited creating an instantaneous brilliant flash of light, which may further be enhanced when viewed though a freznel lens. The energy of the flash is a function of the tube size, the voltage across it and the capacitor discharging into it. The tube life is typically 5 to 8 million flashes with after which erosion of light output is experienced until the tube eventually fails.

**L.E.D (Light Emitting Diode)** - a semiconductor device, which unlike the filament bulb and xenon tube emits only one frequency of light (i.e one colour) dependant on its construction. LED technology is developing and does not as yet offer as bright a solution as the xenon tube, it does however offer an extremely low current and very long life time, giving an effective solution where an indication or status is required.

IEC 73 - Colours of luminous indicators and push buttons, sets out the required colours as shown below in order to conform to the machine directive.

**RED** - Danger Act Now.

Danger of live or unguarded moving machinery or essential equipment in protected area.

**AMBER** - Warning, Proceed with Care.

Temperature or pressure different from normal level

**GREEN** - Safety Precaution: Go Ahead

Checks complete, machine about to start

**BLUE** - Site Specified

Pre-set ready or remote control

**CLEAR** - No Specific Meaning

Could confirm an earlier message

