



YOUR HEARING

Human hearing has an incredible dynamic range.

The difference between the quietest sounds perceptible sounds and the loudest tolerable noises is 120 dB or 1,000,000 times. Because of this wide dynamic range, rather than use large numbers of zeros to describe sounds a compressed or logarithmic scale of sound ratios is used. The common unit is the Decibel or dB. 20 dB corresponds to an increase of 10 times, 40 dB corresponds to 100 times and so on. This scale also handles decreases in sound levels. -20 dB corresponds to a ten-fold decrease and so on.

Our hearing ability varies with frequency. In order to allow for this, meters are used that have the approximate response of the human ear in-built. These filters are referred to as frequency weightings as the contributions from the various frequencies are given differing importance in the reading. Most commonly, the A weighting curve is used. This attenuates the low and high frequencies to follow human reception.

How do these scales relate to the every-day sounds we hear? The following table shows approximate sound levels we would measure for every-day noises. Note that these are all effectively continuous sounds.

TABLE 1

Noise	dB _A	Description
Jet plane take-off	140	
Grand Prix audience	130	Pain threshold
Chain saw	120	
Concert/rock group Or earbuds	110	
Police siren	100	
Truck engine	90	Damage threshold
Vacuum cleaner	80	
Busy restaurant	70	
Busy office	60	
Back street	50	
Library	40	
Quiet night outdoors	30	
Sound studio	20	
Testing room	10	
Quietest audible sound	0	



You will also see indications of a pain threshold and a hearing damage threshold. These need a bit more explanation.

The pain threshold is just that. It does not mean that the sound is unpleasant to listen to. It means that the sensation in the ears changes from that of hearing sound to bursts of physical pain somewhat like that occasionally experienced with airplane decompression. This is not good.

The damage threshold is different. It does not mean that your hearing will be immediately damaged by experiencing these sound levels.

Hearing can be affected by long duration exposure to low level sound. The damage threshold is intended to give a guide to the exposure levels and their duration that would avoid any permanent damage if the listener were exposed to these levels every day.

This does not mean that we must totally avoid attendance to noisy tasks – that is what earplugs and hearing protection is for!

From the exposure dose table, we will not experience any hearing ill effects from continuous exposure to 80dBa sound levels. We may not like this level of noise but we will not risk damage. Comparing this to Table 1 we should try to avoid vacuum cleaning continuously all day and night!

If we go to a rock concert we should have some hearing protection or we will need to rest and recover if the entertainment goes longer than 1 or 2 minutes. Many people report ringing in the ears the day after attending a pop concert. This is symptomatic of initial damage. The ringing can disappear after a day or two and permanent damage may not have occurred.

If we attend the Grand Prix we risk damage to our hearing after approximately 1 second of listening on pit lane. This usually does not happen as we experience pain at this sound level and take action to reduce the level. Earplugs are provided to attendees for a reason¹.

At the extreme end of the table listening close-up to a jet plane at take-off without hearing protection will cause damage immediately. It is also way into the pain region.

TABLE 2 - Safe exposure doses

Sound level dB _A	Duration
80	Continuous exposure
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 minutes
100	15 minutes
103	8 minutes
106	4 minutes
109	2 minutes

¹ As their hearing cannot be reliably protected, new-born babies and infants should never be taken to the Grand Prix.



112	1 minute
115	30 seconds
118	15 seconds
121	8 seconds
124	4 seconds
127	2 seconds
130	1 second
133	Instant permanent damage possible

As human hearing has reduced sensitivity to low and high frequencies, higher levels of safe exposure will apply. The A weighting curve takes this into account. Typically, 20 dB should be added to the exposure limits or all safe exposure times should be increased by a factor of 100 if all frequencies are below 100 Hz. If the loud sounds are at even lower frequencies the limits can be further extended.

As we experience many varied sound levels and durations during the day we need the concept of a sound budget or daily dose to tally up the net exposure. Sound dose meters are available that will monitor and add up your daily exposure. These are advisable if you are in a high risk category, but common sense is also a useful help in most situations.

Sound is just pressure waves in the air. It is interesting to note that atmospheric pressure can also be considered as a sound wave, albeit at very low frequencies. A pressure swing of atmospheric pressure corresponds to a sound pressure level of approximately 195 dB yet we experience no damage. It is a good thing that our hearing sensitivity does not extend to low frequencies!

If we are exposed to high levels of sound we should then rest our hearing to allow recovery to occur. The human body has amazing powers of recovery – but only to a limit.

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