

Adaptation and Fatigue

Based on Hood (1972):

- Adaptation
 - The apparent loudness reduction, with time, of a continuous sound, followed by a period of steady loudness.
 - Hearing response to a continuous sound declines as a function of time until it reaches a steady value, for which the energy expended by the ear is balanced by the available metabolic energy.
 - Adaptation occurs in the perception of all sound signals. Exposure to prolonged, intense signals may lead to fatigue and, possibly, damage.

- Fatigue
 - Results from exposure to sounds at levels and durations that considerably exceed those required to sustain normal hearing response.
 - Measured after exposure has ended and described in terms of Temporary Threshold Shift (TTS).
- Temporary Threshold Shift (TTS)

Temporary reduction in sensitivity (*i.e.* increase in the minimum audible level), following exposure to fatiguing sounds.

Factors that affect TTS

- Intensity of the fatiguing stimulus

Higher intensities -> Larger TTS
- Duration of the stimulus

Longer durations -> Larger TTS
- Frequency of the stimulus

Higher frequencies -> Larger TTS
- Exposure frequency

More frequent exposure -> Larger TTS
- Time gap between the end of the exposure and TTS measurement (recovery interval or RI)

Longer RIs -> smaller TTS

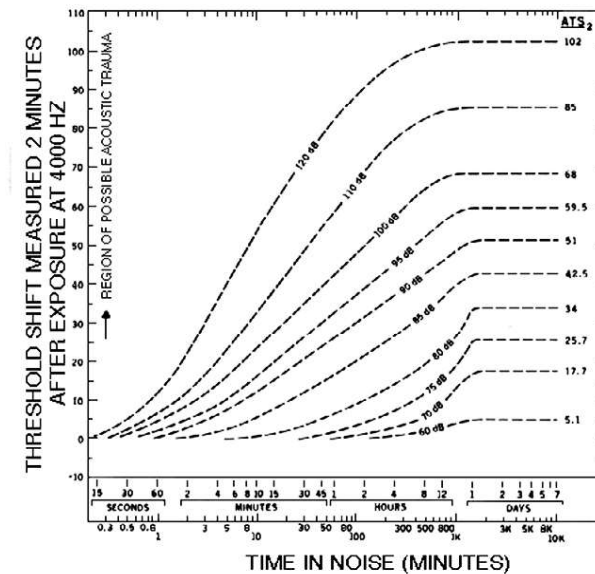
TTS and Intensity

- TTS increases with the SIL of the fatiguing sound
 - At low intensities
 - TTS increases after longer exposure.
 - Only impacts perception of frequencies similar to those of the fatiguing sound.
 - As intensity increases
 - TTS increases after shorter exposure.
 - It impacts an increasingly larger bandwidth around the fatiguing frequencies, extending more above than below it. Maximum impact at $\sim 1/2$ - 1 octave above the fatiguing frequencies.
 - At high intensities
 - TTS increases rapidly, especially so for SIL >97dBA (A-weighted). This level may mark the transition from temporary reduction in sensitivity to permanent hearing damage.

TTS / Exposure Duration / Recovery

- TTS increases with prolonged exposure to a fatiguing signal, particularly for high frequencies (the middle-ear reflex mechanism may be protecting against overexposure to lower frequencies)
- In general, TTS decreases as the recovery interval (RI) increases but is more persistent at high frequencies
- TTS may take up to 3 weeks to fully disappear.
TTS lasting more than 16 hours indicates potentially permanent damage.

Temporary Threshold Shifts - Exposure



Temporary Threshold Shifts - Recovery

