Thus, D_{50} is a measure of the per-cent total sound energy arriving within 50 *msec* after an initial pulse of sound. If most of the energy of the sound impulse is within this 50 *msec* window, then it will be {much} easier for people in this room to understand speech than if *e.g.* there are many echoes over a longer time for people to try to comprehend. This sound parameter can only be determined (reasonably easily) with ray-tracing acoustical simulation software, for a realistic room. A "good" listening room from a speech-intelligibility perspective has $D_{50} > 50\%$.

A related statistic is ***speech*** Clarity, C_{50} defined as:

$$C_{50} \equiv 10 \log_{10} \left(\frac{\int_{t=0}^{t=50ms} p^2(t)dt}{\int_{t=0}^{t=\infty} p^2(t)dt - \int_{t=0}^{t=50ms} p^2(t)dt} \right) \quad (dB)$$

For > 80% syllable intelligibility, a clarity of $C_{50} > -2dB$ is required, and is considered the minimum admissible limit for good speech intelligibility.

Music Clarity, C_{80} defined as:

$$C_{80} \equiv 10 \log_{10} \left(\frac{\int_{t=0}^{t=80ms} p^2(t)dt}{\int_{t=0}^{t=\infty} p^2(t)dt - \int_{t=0}^{t=80ms} p^2(t)dt} \right) \quad (dB)$$

Another statistic is the Center Time $\langle t_s \rangle$, the mean/average time associated with a sound impulse, defined as:

$$\langle t_s \rangle \equiv \left[\frac{\int_{t=0}^{t=\infty} t \cdot p^2(t)dt}{\int_{t=0}^{t=\infty} p^2(t)dt} \right]$$

The {subjective} mean/average syllable intelligibility $\langle V_s \rangle$ is related to the center time $\langle t_s \rangle$ by:

$$\langle V_s \rangle \equiv 96 \cdot \left(1 - 10^{-5} \langle t_s \rangle^2 \right) \quad (\%)$$ *n.b.* $\langle t_s \rangle$ in *msec* time units, here.

For mean/average syllable intelligibility $\langle V_s \rangle > 80\%$, a center time of $\langle t_s \rangle \leq 130$ *msec* is required. If the center time is measured *vs.* octave bands center frequencies, then for speech one wants $\langle t_s (f_{ctr}) \rangle \leq 60 - 80$ *msec* for the 4 octave band centers at 500 *Hz*, 1000 *Hz*, 2000 *Hz* & 4000 *Hz*.

In the ***reverberant*** portion of the sound field of a large listening room/auditorium (*i.e.* far enough away from a sound source, *e.g.* located at the front of the large room/auditorium – please see/read UIUC Physics 406 Lecture Notes 10 *p.* 1-3 for more details), the center time $\langle t_s \rangle$ associated with short impulsive sounds is related to the reverberation time T_{60} by $\langle t_s \rangle \simeq T_{60}/13.8$.