where r = source - listener separation distance (m), D_{crit} = a ***critical distance*** (m), beyond which the articulation loss remains ***constant***, T_{60} = reverberation time (s), Q = directivity factor, V = room volume (m^3) and k is a constant associated with each listener, associated with his/her intrinsic listening ***inability***. The listener inability constant ranges from k = 1.5% for the ***best*** listener to k = 12.5% for the ***poorest*** listener, with k = 7.0% for an ***average*** listener.

The ***critical distance***, D_{crit} beyond which the articulation loss remains ***constant*** is given by the formula: $D_{crit} = 0.2121\sqrt{QV/T_{60}}\,(m)$.

The *%ALCONS* in this region is given by: $\%ALCONS\left(r \geq D_{crit}\right) = 9T_{60} + k$.

$$\text{At } r = D_{crit}:\ \%ALCONS\left(r = D_{crit}\right) = \frac{200D_{crit}^2 T_{60}^2}{QV} + k = 9T_{60} + k \ \Rightarrow\ D_{crit} = \sqrt{\frac{9QV}{200T_{60}}} = 0.2121\sqrt{\frac{QV}{T_{60}}}$$

For ***skilled*** speakers ***and*** listeners, a *%ALCONS* of ~ 25-30% as calculated from these formulas ***may*** be acceptable, but only because human speech includes a fair amount of redundancy. Undoubtably, a *%ALCONS* of ~ 25-30% also causes a fair amount of momentary/ transitory distraction/loss of concentration on the part of the listener, ultimately resulting in loss of retention by the listener of what is being said by the speaker… Thus, it is a much better strategy to reduce the *%ALCONS* to the ~ 10-15% level.

Example:

Using the above room example, determine the *%ALCONS* for the room, assuming k = 7% for an ***average*** listener, but here, for simplicity, we assume a directivity factor of Q = 1 for the speaker.

Using the Sabine formula, the reverberation time for this room is:

$$T_{60} = 0.161\left(V/A\right) = 0.161\left(6000/330\right) = 2.93\,s\,.$$

The *%ALCONS* for the room for an ***average*** listener is:

$$\%ALCONS\left(r \leq D_{crit}\right) = \frac{200r^2T_{60}^2}{V} + k = \frac{200\left(2.9\right)^2 r^2}{6000} + 7\% = 0.2856r^2 + 7\%$$

For an ***average*** listener located at a distance of r = 5 m from the speaker:

$$\%ALCONS\left(r = 5\,m\right) = 14.14\%\,.$$

The critical distance for the room is: $D_{crit} = 0.2121\sqrt{V/T_{60}} = 0.2121\sqrt{6000/2.9} = 9.6\,(m)$.

Beyond the critical distance, $\%ALCONS\left(r \geq D_{crit}\right) = 9T_{60} + k = \left(9 \cdot 2.9\right) + 7 = 33.35\%$, which is clearly excessive. In order to keep this to $\%ALCONS\left(r \geq D_{crit}\right) < 15\%$, *e.g.* the reverberation time of the room would need to be reduced to $T_{60} < 0.9\,s$, *e.g.* by increasing A (*i.e.* adding significant amounts of sound-absorbing material to the room), or using sound reinforcement.