Under certain conditions it is possible to calculate the approximate sound pressure level produced in various parts of a room as a result of a simple sound source near the center of the room.[8] The results of these calculations for rooms having various average absorption coefficients, $\bar{\alpha}$, are shown in Figure 14. The horizontal axis is the distance, r, from the source to the pressure-measuring microphone divided by the radius, r_0, of a sphere whose surface area is the same as that of the room: that is, $r_0 = \sqrt{\text{surface area}/4\pi}$. For example, the radius of

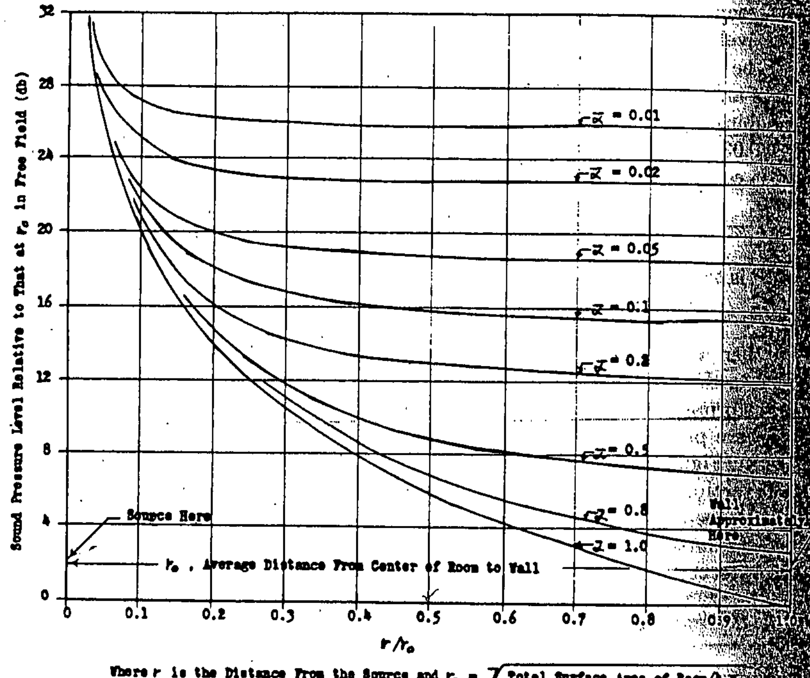

Figure 14. Curves showing the variations in sound pressure level in rooms with partially absorbing walls.

a sphere whose surface area is the same as that of a cube will be $r_0 = \sqrt{6l^2/4\pi} = 0.69l$, where l is the length of a side of the cube. The vertical axis of Figure 14 shows the increase in sound pressure level that exists at any point in the room over the sound pressure level that would exist at r_0 with the source

[8] H. F. Hopkins and N. R. Stryker, A proposed loudness-efficiency rating for loudspeakers and the determination of system power requirements for enclosures, *Proc. Inst. Radio Engrs.* **36**, 315 (1948).

radiating into free space. The various curves on this chart are drawn for average absorption coefficients, $\bar{\alpha}$, between 0.01 and 1.

The curves in Figure 14 show that there are two distinct parts of the sound field in a room. In the reverberant part of the field the sound pressure level is independent of location. However, closer to the source the field behaves like that of a source in free space. For many practical sources this free field does not extend all the way to the source. In these cases a third kind of field exists called the near field. Without a detailed knowledge of the sound source itself, it is impossible to predict the sound pressure level in the near field of a sound source.

The curves shown in Figure 14 will hold only when both the sound source and the pressure-measuring microphone are located at least one half of a wave length away from the walls. Thus, if the room is very small or the frequency very low, there will be large portions of the room in which Figure 14 will give incorrect results. In addition, the curves will be more nearly correct for a source that radiates wide-band noise than for one that radiates a pure tone.

G. THE TRANSMISSION OF SOUND THROUGH PARTITIONS

So far the discussions have centered upon the transmission of sound from a source to some point in the space surrounding the source. If the sound source is, in some way, partitioned off from the measuring microphone, the transmission of sound will, as a rule, be drastically reduced.

There are important exceptions to this rule. For example, "acoustical materials" will not cause large reductions in the sound transmitted through them. Unfortunately, there is some confusion about this matter resulting from the fact that a good sound absorber is often a good heat insulator. The heat-insulating properties of the material are derived from the air trapped in the many tiny air spaces. It is difficult for a current of hot air to move through the material and, therefore, it is possible to take advantage of the poor heat conductivity of a stationary air mass. Some materials have no connections between the air spaces and as a result are very good heat insulators, but poor sound absorbers.

The word *insulation* should have no application in acoustics or noise control. It is often erroneously associated with quieting because many manufacturers claim that their (heat) insulating material has good acoustical properties. They mean that it is a good sound absorber. The public, however, often concludes that the material will transmit but a small amount of the sound incident upon it. In other words, the consumer assumes that the heat-insulating material will provide excellent sound isolation. As we can see from Figures 15, 16, and 17, this is not the case. The intensity of the sound is reduced as a result of passage through the absorbing material, but considerably greater reductions can be obtained with less expensive materials. Figure 15 demonstrates the effect of a 4-inch thick glass fiber blanket weighing 6 pounds per cubic foot. The frequency is 250 c.p.s. Most sound-absorbing materials are either thinner or less dense so that a larger fraction of the incident sound is transmitted than is shown in Figure 15.