

TABLE 6. END REFLECTION OF PLATE ABSORBERS

PERCENTAGE FREE AREA OF ABSORBER	ATTENUATION, db
50	1
40	2
30	4
25	5
20	6

rock wool blanket or 1 in. sound absorbing board preferably nailed to wood strips on the inside of the plenum. With such a lining the plenum is particularly effective in reducing low frequency fan noise. The absorption of the plenum in sabines is the sum of the products of each interior area of the plenum measured in square feet multiplied by its corresponding absorption coefficient.

Plate Cells

One of the most economical methods of applying sound absorbent material from the standpoint of both labor and material is the plate cell. The plate cell consists of $\frac{1}{2}$ or 1 in. sound absorbent board, spaced on 2, 3 or 4 in. centers. The attenuation given in Table 6 depends on the spacing, depth, and the absorption of the material. At each end of the cell further attenuation results from the reflection of sound from the face of the cell. An important objection to the plate cell is the increase in duct cross sectional area required. Often on the fan discharge, particularly with unitary equipment, where a number of branch ducts take off, the plate cell may be installed with little or no difficulty. The attenuation per foot of length for 1 in. board neglecting the end effect is given approximately by Equation 6.

$$R = \frac{7La^{1.4}}{S} \quad (6)$$

where

R = attenuation, decibels.

L = linear length of duct, feet.

S = spacing between plates up to 3 inches.

a = absorption coefficient of plates. For value of a see Table 7.

Outlet Sound Absorbers

Outlet sound absorbers are rectangular or plate cells installed directly behind an outlet or they may be the lining of a pan or plaque outlet.

TABLE 7. DECIBEL ATTENUATION FORMULAE FOR TYPICAL DUCT LINING MATERIAL

FREQUENCY	ABSORPTION COEFFICIENT	ATTENUATION REDUCTION, db
256	0.37	3.0 L P/A
512	0.69	7.5 L P/A
1024	0.78	9.5 L P/A
2048	0.78	9.5 L P/A

They are particularly effective in the elimination of high frequency whistles which are generated by air flow in the ducts. They are also employed in large systems with long runs where only a few outlets near the fan require treatment. Frequently outlet cells are the only means of correcting existing noisy installations, as the duct sections directly behind the outlets may be the only sections accessible for treatment. (See Fig. 2.)

Duct Lining or Rectangular Cells

One series of experiments⁶ made on a commonly used type of duct lining material (1 in. rock wool sheet) has shown that, subject to certain restrictions, the attenuation of single-frequency sounds may be expressed by the approximate Equation 7. This equation is accurate within plus or minus 10 per cent for duct sizes ranging from 9 x 9 in. to 18 x 18 in., for

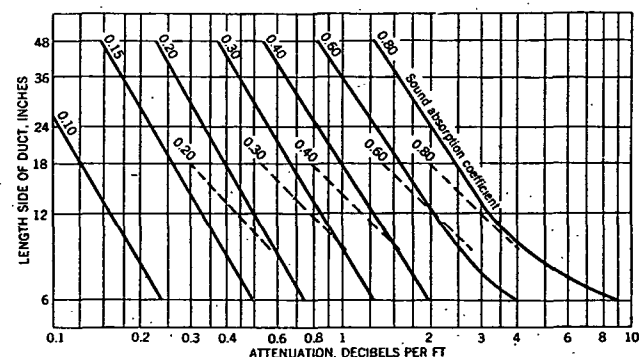


FIG. 3. SOUND ATTENUATION FOR VARIOUS ABSORBING DUCT LINERS

cross-sectional dimension ratios of 1:1 to 2:1, for frequencies between 256 and 2048 cycles, and for absorption coefficients between 0.20 and 0.80.

$$R = 12.6 L \frac{P}{A} a^{1.4} \quad (7)$$

where

R = attenuation, decibels.

L = length of lined duct, feet.

P = perimeter of duct, inches.

A = cross-sectional area of duct, square inches.

a = absorption coefficient of lining.

In Table 7, the absorption coefficients at different frequencies of a material of the previously mentioned type are listed, together with the corresponding values for Equation 7.

Results of other experiments indicate, however, that Equation 7 may be in error when applied to other types of duct lining material and to duct

⁶The Absorption of Noise in Ventilating Ducts, by Hale J. Sabine (*Journal Acoustical Society of America*, Vol. 12, p. 53, 1940).