

and is available for detailed reference⁵. Another empirical method uses a *duct lining factor* evaluated by experience. Attention is specifically called to its empirical nature and to the necessity of exercising judgment in applying it.

Use of Duct Lining Factor

A duct lining factor (f) giving numerical values for use at various equipment noise levels is shown in Fig. 1. When properly used with Table 1 this chart (Fig. 1) provides a solution which may be both useful

Duct lining factor f	Equipment		
	Noisy	Average	Quiet
0	75	65	55
5	65	55	45
10	55	45	35
15	45	35	25
20	35	25	15
25	25	15	5
30	15	5	-5

FIG. 1. CHART FOR DETERMINING NOISE REDUCTION IN DECIBELS FROM DUCT LINING FACTOR^a

^aValues for equipment noise are only general. Wherever possible substitute actual values as supplied by equipment manufacturer or as measured.

and simple. It is important to understand that the levels referred to in this chart are the *average* noise levels set up in the room by the ventilating or air conditioning equipment. In the case of a piece of equipment which generates a noise level of 95 db, when the noise is measured immediately next to the machine, there might be a reduction of 15 db in passing through the duct, and a further difference of 15 db⁶ between the noise at the outlet supply grille and the average level in the room, leaving an effective

⁵The Prediction of Noise Levels from Mechanical Equipment, by J. S. Parkinson (*Heating and Ventilating*, March 1939, pp. 23-26).

⁶The drop between the level at the grille and the average level in the room will be governed by the absorbing power of the room. This is expressed in sabines and is equal to $2as$ where a is the absorption coefficient of the surface and s the area of that surface. The total absorbing power of the room is thus the summation of the absorbing power of the various room surfaces. For a discussion of the effect of the room absorption see Loc. Cit. Note 5.

level of 65 db in the room. Reductions of noise level ranging from 5 to 25 db through duct systems have been encountered without the use of sound absorbing linings and the drop from supply opening to average room level may vary from 5 to 20 db.

To determine whether to use column 1, 2, or 3 in Fig. 1, in forming an estimate of the relative amount of noise generated by the system, the length of the untreated duct system and the number of bends or elbows or splitters should be considered, since the longer and the more complex the system, the more reduction of noise level will occur before the sound reaches the room grilles. Also the sound absorbing power of the room should be taken into account, since in rooms where there is a great deal of absorptive material, such as rugs, draperies, curtains and furniture, there will be a higher loss between the outlet grille noise and the average room level. The ventilating engineer will have to judge whether the conditions deviate from the typical.

Manufacturers' ratings on equipment should be considered in connection with the foregoing discussion. The quantity determined involves

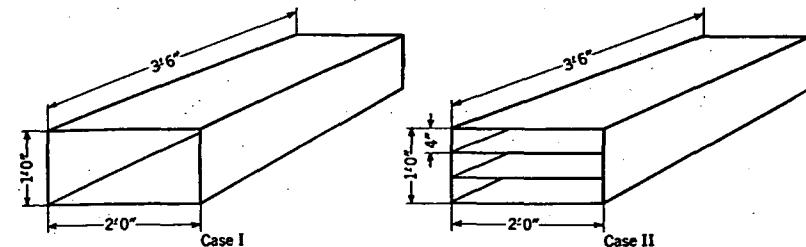


FIG. 2. DIAGRAM OF BRANCH DUCT TREATMENT WHERE LENGTH IS INSUFFICIENT FOR ADEQUATE ABSORPTION

the noise level which will be produced in the room and the manufacturer's method of rating must be considered before allowances previously mentioned are accepted.

To use Fig. 1, proceed by consulting Table 1 and determine the probable noise level already existing in the room, and, as suggested, assume that this level is satisfactory for current practice. This gives a noise level in decibels and with this enter the chart of Fig. 1. Read across the chart and determine the value of the duct lining factor (f) in the column at the left. Then multiply the smallest cross sectional dimension (inches) of the duct by this factor. The result will be the length of duct in inches to be lined to attenuate an average fan noise. If circular ducts are used, the length to be lined will be $f \times$ diameter of duct.

Example 2. A 7 x 30 in. duct is connected to a private office space in a quiet location. Determine the length of lining necessary to attenuate a fan noise satisfactorily.

From Table 1 the noise level in this office will be 35 db.

Length to be lined for noisy equipment is $22 \times 7 = 154$ in.

Length to be lined for average equipment is $17 \times 7 = 119$ in.

Length to be lined for quiet equipment is $12 \times 7 = 84$ in.

The sound absorbent properties of duct lining are extremely important and materials which have coefficients as high as possible should be used.