

TABLE 2. ATTENUATION IN STRAIGHT SHEET METAL DUCT RUNS

DUCT	SIZE, IN.	ATTENUATION PER FT, db
Small.....	6 x 6	0.10
Medium.....	24 x 24	0.05
Large.....	72 x 72	0.01

taken as 3 db higher than a similar single width fan operating under the same conditions of speed and pressure.

NATURAL ATTENUATION OF DUCT SYSTEM

Straight Sheet Metal Ducts. The attenuation of sound in straight sheet metal ducts is a function of the length, shape, and size of the duct¹. Attenuation values are given in Table 2. In general this attenuation is so negligible except for long runs that it may be disregarded for all practical purposes.

Elbows and Transformations. Due to reflective interference, attenuation will take place at elbows and transformations. The magnitude of the attenuation will depend on the size and abruptness of the elbow or transformation as shown in Table 3.

When the area of a duct increases abruptly, an attenuation of noise level takes place in the duct. In duct design practice the total area of the branch ducts is greater than the supply duct. Similarly with outlets, the area of the outlet plus the area of the duct after the outlet is greater than the duct area before the outlet. Therefore in an outlet run, attenuation occurs in the duct as it passes each outlet. Table 4 gives the db reduction for various ratios of total branch duct and outlet area to supply duct area.

Grilles to Room. The large abrupt change in area between the grilles and the surfaces within a room results in an appreciable noise attenuation. This attenuation is a function of the total grille area (supply and return) and the total sound absorption of the room in *sabins*. (The sound absorption of a room in *sabins* is the summation of the products of each surface of the room measured in square feet multiplied by its corresponding absorption coefficient. The *sabin* is a unit of sound absorption equivalent to the

TABLE 3. ATTENUATION OF ELBOWS*

ELBOW	SIZE, IN. ^b	ATTENUATION PER ELBOW, db
Very small.....	2 wide	3
Small.....	3 to 15	2
Medium.....	15 to 36	1.5
Large.....	36 plus	1

*The attenuation in vaned elbows should be considered the same as in elbows having the same dimensions as the radius of curvature of the vanes. If the vanes are lined for the purpose of damping any vibrations in them, one third may be added to the attenuation values listed.

^bThese attenuation values are based on elbows having a center line radius 1.5 to 2 times the diameter or width of the duct. The attenuation will be greater if the ratio is less than 1.5 and less when the ratio is greater than 2.

TABLE 4. ATTENUATION AT DUCT BRANCHES OR OUTLETS

RATIO BRANCH DUCT + OUTLET AREA SUPPLY DUCT AREA OR SUM OF BRANCH AREAS SUPPLY DUCT AREA	ATTENUATION PER TRANSFORMATION, db
1.00	0.0
1.20	0.8
1.35	1.3
1.50	1.8
1.75	2.5
2.00	3.0

absorption of one square foot of a totally sound-absorbent surface). The attenuation is given in Equation 3 as:

$$db \left(\begin{array}{c} \text{Attenuation between} \\ \text{grilles and room} \end{array} \right) = 10 \log_{10} \frac{\text{Total Room Absorption in Sabins}}{\text{Total Grille Area}} \quad (3)$$

Values in Table 5 approximate the attenuation for various rates of air change, and general types of room surfaces.

DUCT SOUND ABSORBERS

The difference between the required sound attenuation and the natural attenuation is that which must be supplied by the proper sound treatment of the ducts.

Selection of the Absorptive Material

When a sound wave impinges on the surface of a porous material, a vibrating motion is set up within the small pores of the material by the

TABLE 5. APPROXIMATE ATTENUATION BETWEEN GRILLES AND ROOM

OUTLET VELOCITY FFM	AIR CHANGE MIN.	LIVE ROOM ^b $\alpha = 0.05$ db	MEDIUM ROOM ^c $\alpha = 0.15$ db	DEAD ROOM ^d $\alpha = 0.25$ db
500	5	11	16	18
	10	14	19	21
	15	16	21	23
	20	17	22	24
750	5	13	18	20
	10	16	21	23
	15	18	23	25
	20	19	24	26
1000	5	14	19	21
	10	17	22	24
	15	19	24	26
	20	20	25	28
1250	5	15	20	22
	10	18	23	25
	15	20	25	27
	20	21	26	28

*Average absorption coefficient for the room.

^bLive room-average absorption coefficient 0.05. Bare wood or concrete floor—hard plaster walls and ceiling—minimum of furniture.

^cMedium room-average absorption coefficient 0.15. Carpeted floor, upholstered furniture, hard plaster walls and ceiling or bare room with acoustically treated ceiling.

^dDead room-average absorption coefficient 0.25. Heavy carpeted floor. Walls and ceiling acoustically treated. Upholstered furniture.