TABLE 4. PIPE SIZES FOR EXAMPLE 2[a]

VOLUME OF AIR (CFM)	DIAMETER OF PIPE (INCHES)	EQUIVALENT SIZE OF RECTANGULAR DUCT (INCHES)
22,935	56	60 x 44
12,510	45	58 x 30
10,425	42	50 x 30
8,340	39	42 x 30
6,255	35	42 x 24
4,170	29.5	30 x 24
2,085	23	30 x 15

[a]Velocity through grilles (not shown) to be approximately 300 fpm.

of each riser, or in each branch duct, and adjusted for proper distribution. At points where branches leave the main it may be advisable, depending upon the nature of the installation, to install adjustable splitters similar to those shown in Fig. 6 where the main duct divides into the 58 x 30 in. and 50 x 30 in. branches.

Resistance Losses for the System

(1) Outdoor air intake, 1000 fpm velocity (1.5 heads × 0.0625) .... 0.094 in.
(2) Filters (from manufacturer's tables) .... 0.250 in.
(3) Tempering coil loss (from manufacturer's tables) .... 0.074 in.
(4) Air washer loss (from manufacturer's tables) .... 0.250 in.
(5) Reheating coil loss (from manufacturer's tables) .... 0.083 in.
(6) Duct resistance:

The longest run is .... = 150 ft

Two, 58 x 30 in. elbows (150% ratio) $\frac{2 \times 13 \times 58}{12}$ .... = 126 ft

Two, 30 x 15 in. elbows (150% ratio) $\frac{2 \times 13 \times 30}{12}$ .... = 65 ft

Three, 15 x 30 in. elbows (75% ratio) $\frac{3 \times 35 \times 15}{12}$ .... = 131 ft

Total equivalent run .... 472 ft

472 ft at 0.033 in. per 100 ft .... 0.156 in.

(7) Allowance for damper adjustment, 25% of 0.156 .... 0.039 in.
(8) Supply grille resistance (from manufacturer's tables) .... 0.036 in.

Total static pressure loss of system .... 0.982 in.

The fan is selected from the manufacturer's ratings to deliver 22,935 cfm at a static pressure of 0.982 in. as outlined in Chapter 32.

Example 3. If the rooms and offices of the hotel building of Example 2 are to be served from a manufactured unit with a capacity of 22,935 cfm against an external resistance of 0.35 in., the known resistances are calculated as:

(1) Outdoor air inlet .... 0.094 in.
(2) Supply grille resistance (from manufacturer's tables) .... 0.036 in.

Total known resistance .... 0.130 in.

Subtracting this from the total available resistance: 0.35 in. − 0.130 in. = 0.220 in. available for duct resistance and damper adjustment.

If 25 per cent is allowed for damper adjustment, the total allowable duct friction = 0.220 ÷ 1.25 = 0.176 in.

Known length of run .... 150 ft

The duct width is then estimated for the following elbow calculations:

Four 150% ratio elbows, 4 x 13 x 3.5 ft .... 182 ft
Three 75% ratio elbows, 3 x 35 x 1.5 ft .... 158 ft

Total estimated length .... 490 ft

The duct friction per 100 ft is then 0.176 ÷ 4.90 = 0.036 in. and the mains and branches are sized from the 0.036 in. friction line in Fig. 2.

If it is desired to size each branch for equal resistance, the total resistance back to the point of juncture is calculated and the branch is then sized in a manner similar to that outlined in Example 3.

DUCT CONSTRUCTION DETAILS

Straight sections of round duct are usually formed by rolling the sheets to the proper radius and grooving the longitudinal seam. Rectangular ducts are generally constructed by breaking the corners and grooving the longitudinal seam, although some fabricators still use the standing seam due to lack of equipment. Elbows and transformation sections are generally formed with *Pittsburgh* corner seams because this seam is easier to lock in place than the double seam, but complicated fittings such as double compounded elbows are usually constructed with double seam corners. The construction of these various seams as well as the types of girth connections are shown in Fig. 7. The application of the various slips and connections is outlined in Table 5. The end slip may be used wherever S slips are recommended. Where drive slips are used the end slip may be applied on the narrow side of the duct and the drive slips on only the maximum side. Ducts 25 to 30 in. in size should be reinforced between the joints, but not necessarily at the joint. Ducts 31 in. and up should be reinforced at the joint and between the joints; if drive slips are used the angles are usually riveted to the duct about 2 in. from the slips. It is good practice to cross-break or kink all flat surfaces to prevent vibration or buckling due to the air flow and accompanying variations in internal pressure. Round ducts are sometimes swedged 1.5 in. from the ends so that the larger end will butt against the swedge and are held in place with sheet metal screws. Where swedges are not used it is general practice to paste the joint with asbestos paper to insure a tight joint.

The construction of elbows and changes of shape cannot be definitely outlined because of the varied conditions encountered in the field, but in general long radius elbows and gradual changes in shape tend to maintain uniform velocities accompanied by decreased turbulence, lower resistance and a minimum of noise.

Heavy canvas connections (asbestos cloth if there is a fire hazard) are recommended on both the inlet and outlet to all fans. The fan discharge connections shown in Fig. 7 are marked *good*, *fair*, and *poor* in the order of the amount of turbulence produced. An inspection of the heater connections shown in Fig. 7 will readily show that uniform velocity through the heater cannot be expected in the diagram noted *poor*. When obstructions cannot be avoided, the duct area should never be decreased more than 10 per cent and then a *streamlined* collar should be used. Larger obstructions require an increase in the duct size in order to maintain as nearly uniform velocity as possible. Branch take-offs should always be arranged to cut or slice into the air stream in order to reduce as far as possible the losses in velocity head.