

TABLE 2. CIRCULAR EQUIVALENTS OF RECTANGULAR DUCTS FOR EQUAL FRICTION—(CONCLUDED)

Size Rectangular Duct	26	28	30	32	34	36	38	40	42	44	46	48	50	54	60	66	72	78	84	88
50	28.6	29.7	30.7	31.9	33.0	34.1	35.2	36.3	37.4	38.5	39.6	40.7	41.8	42.9	44.0	45.1	46.2	47.3	48.4	49.5
52	29.7	30.7	31.9	33.0	34.1	35.2	36.3	37.4	38.5	39.6	40.7	41.8	42.9	44.0	45.1	46.2	47.3	48.4	49.5	50.6
54	30.7	31.9	33.0	34.1	35.2	36.3	37.4	38.5	39.6	40.7	41.8	42.9	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7
56	31.7	32.9	33.9	35.1	36.3	37.4	38.5	39.6	40.7	41.8	42.9	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8
58	32.7	33.9	35.1	36.3	37.4	38.5	39.6	40.7	41.8	42.9	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8	53.9
60	33.7	34.9	36.1	37.3	38.5	39.6	40.7	41.8	42.9	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8	53.9	55.0
62	34.6	35.9	37.1	38.4	39.5	40.7	41.8	42.9	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8	53.9	55.0	56.1
64	35.3	36.7	38.0	39.3	40.5	41.7	42.9	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8	53.9	55.0	56.1	57.2
66	36.0	37.6	39.0	40.3	41.5	42.7	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8	53.9	55.0	56.1	57.2	58.3
68	36.9	38.5	39.9	41.2	42.5	43.7	44.9	46.1	47.2	48.4	49.5	50.6	51.7	52.8	53.9	55.0	56.1	57.2	58.3	59.4
70	37.8	39.3	40.8	42.2	43.5	44.8	46.0	47.2	48.4	49.5	50.6	51.7	52.8	53.9	55.0	56.1	57.2	58.3	59.4	60.5
72	38.5	40.0	41.5	43.0	44.4	45.6	46.9	48.1	49.3	50.5	51.6	52.8	53.9	55.0	56.1	57.2	58.3	59.4	60.5	61.6
74	39.2	40.8	42.3	43.8	45.2	46.5	47.9	49.1	50.4	51.6	52.9	54.0	55.1	56.2	57.3	58.4	59.5	60.6	61.7	62.8
76	40.0	41.6	43.1	44.7	46.1	47.5	48.9	50.1	51.3	52.5	53.8	55.0	56.1	57.2	58.3	59.4	60.5	61.6	62.7	63.8
78	40.7	42.4	44.0	45.5	47.0	48.4	49.9	51.1	52.3	53.5	54.8	56.0	57.1	58.2	59.3	60.4	61.5	62.6	63.7	64.8
80	41.3	43.0	44.6	46.2	47.7	49.1	50.6	52.0	53.3	54.6	55.9	57.0	58.1	59.2	60.3	61.4	62.5	63.6	64.7	65.8
82	42.1	43.8	45.4	47.0	48.5	50.0	51.5	52.9	54.2	55.5	56.8	58.0	59.1	60.2	61.3	62.4	63.5	64.6	65.7	66.8
84	42.7	44.3	46.1	47.8	49.3	50.9	52.3	53.8	55.0	56.4	57.7	58.9	60.0	61.1	62.2	63.3	64.4	65.5	66.6	67.7
86	43.4	45.1	46.8	48.4	50.0	51.7	53.0	54.5	55.9	57.2	58.5	59.7	60.8	61.9	63.0	64.1	65.2	66.3	67.4	68.5
88	44.0	45.8	47.5	49.2	50.9	52.4	53.9	55.4	56.8	58.1	59.4	60.6	61.7	62.8	63.9	65.0	66.1	67.2	68.3	69.4
90	44.7	46.5	48.2	50.0	51.6	53.1	54.7	56.2	57.6	59.1	60.4	61.6	62.7	63.8	64.9	66.0	67.1	68.2	69.3	70.4
92	45.3	47.2	48.9	50.7	52.2	53.8	55.5	56.9	58.4	59.9	61.3	62.6	63.7	64.8	65.9	67.0	68.1	69.2	70.3	71.4
94	46.0	47.8	49.5	51.3	52.9	54.5	56.2	57.7	59.1	60.6	62.1	63.5	64.6	65.7	66.8	67.9	69.0	70.1	71.2	72.3
96	46.5	48.4	50.1	51.9	53.7	55.4	57.0	58.7	60.0	61.3	62.6	63.8	64.9	66.0	67.1	68.2	69.3	70.4	71.5	72.6

resistance equivalent to the pressure drop in the elbows. Curves *B* and *C* are based on tests of round and square elbows⁶ of ordinary good sheet metal construction.

Values obtained from Curve *A* should be used when there is any doubt as to quality of duct construction. It is suggested that this curve be used for rectangular elbows and five-piece elbows as it will thus allow an additional factor of safety without seriously affecting the design.

As indicated in Fig. 6, long radius elbows will offer much less resistance to the flow of air than short radius elbows. Experience has

TABLE 3. EFFECT OF VANES ON PRESSURE LOSS OF 7-INCH SQUARE VENTILATING DUCT^a
Expressed in feet of total equivalent length of duct (ELD)

SQUARE MITER ELBOW								STANDARD ELBOWS WITH VARIOUS RADII									
	Radius Ratio	R1 W	0	.2	.4	.6	.8	1.0		Radius Ratio	R1 W	0	.2	.4	.6	.8	1.0
	ELD, ft		41.1	30.5	27.5	30.1	37.7	38.5		ELD, ft		39.7	23.3	22.0	25.7	28.9	39.7
	Radius Ratio	R1 W	0	.2	.3					Radius Ratio	R1 W	0	.2	.3	.4	.5	.6
	ELD, ft		41.1	23.5	23.3					ELD, ft		39.7	20.0	22.0	23.0	23.8	25.7
	Radius Ratio	R1 W	0	.2	.3					Radius Ratio	R1 W	0	.4	.6	.8	1.0	1.2
	ELD, ft		41.1	20.7	22.2				1 1/2" I. R.	ELD, ft		25.3	17.7	16.5	18.7	23.5	25.6
									Radius Ratio	R1 W	0	.7	.8	.9	1.0	1.2	
VANE	A	B	C	D					4" I. R.	ELD, ft		14.2	13.3	13.0	12.7	12.5	12.7
ELD, ft	21.8	17.0	17.9	17.8													

^aFor more complete data see A.S.H.V.E. RESEARCH REPORT No. 1216—Effect of Vanes in Reducing Pressure Loss in Elbows in 7-inch Square Ventilating Duct, by M. C. Stuart, C. F. Warner and W. C. Roberts (A.S.H.V.E. TRANSACTIONS, Vol. 48, 1942, p. 409).

Note A: Vane *A* made up of a large number of small splitters; *B* made up of a small number of large splitters bent on a large radius; *C* hollow vanes having different outside and inside curvature; and *D* four splitters with $R/W = 0.4$. Elbow same as *D* except 2 in. trailing edge on the end of each splitter, ELD in feet = 17.0.

Note B: The air velocity has no effect on the loss of elbows when the loss is expressed as equivalent length of duct.

shown that good results may be expected when the radius to the center of the elbow is 1.5 times the pipe diameter or duct width parallel to the radius. Examination of the curve will indicate that little advantage is to be gained by selecting elbows having a centerline radius of more than two diameters⁷. Elbows having a radius of more than three diameters show a slightly increased resistance due to the increased length of pipe but, when used, they reduce the over-all resistance of the system and therefore should not be avoided.

Where space conditions necessitate the use of short radius or miter elbows in square or rectangular duct work, turning vanes should be used to reduce the pressure losses. Rough or raw edges on the vanes should be avoided to prevent objectionable noise. Table 3 shows typical types