

TABLE 2. PRESSURE LOSSES DUE TO ELBOWS
(Additional Equivalent Losses in Excess of Friction to Intersection of Center Lines)

TYPE	ILLUSTRATION	CONDITIONS	PRESSURE LOSS		
			C*	L/D	L/W
N-DEG.		RECTANGULAR OR ROUND; WITH OR WITHOUT VANES	N TIMES VALUE FOR SIMILAR 90-DEG. ELBOW ^b		
90-DEG. ROUND SECTION		MITER R/D=0.5 0.75 1.0 1.5 2.0	1.30 ^b 0.90 0.45 0.33 0.24 0.19	65 ^b 23 17 12 10	
90-DEG. RECTANGULAR SECTION		R/W	1.25 ^b		25 ^a
		MITER	1.25		25
		0.5	0.60		12
		0.25	0.75		7
		1.0	0.37		4
		1.5	0.19		49
		MITER	1.47		40
		0.5	1.10		18
		0.75	0.50		9
		1.0	0.28		4
		1.5	0.13		75
		MITER	1.50		50
90-DEG. SQUARE SECTION WITH SPLITTER VANES		R/W	1.00		21
		MITER	1.00		11
		0.5	0.41		4.5
		0.75	0.22		110
		1.0	0.09		65
		1.5	0.04		43
		MITER	1.38		17
		0.5	0.96		6
		0.75	0.37		
		1.0	0.19		
		1.5	0.07		
		MITER	1.38		
90-DEG. SQUARE SECTION WITH SPLITTER VANES		R/W	0.5		28 ¹⁰
		MITER	0.5		19
		0.5	0.4		12
		0.7	0.6		7.2
		1.0	0.1		
		1.5	0.12		
		MITER	0.3		22 ¹⁰
		0.5	0.2		16
		0.75	0.4		
		1.0	0.7		
		1.5	1.3		
		MITER	0.5		
MITER WITH TURNING VANES		PLATE VANES	0.35 ^a		
		FORMED VANES	0.10 ^a		
MITER TEE WITH VANES		CONSIDER EQUAL TO A SIMILAR ELBOW. BASE LOSS ON ENTERING VELOCITY.			
RADIUS TEE					

* Values based on f values of approximately 0.02.

^b Values calculated from L/D and L/W values of Reference 6 for $f = 0.02$.

Note: Superscript numbers refer to references at end of chapter.

DYNAMIC LOSSES

Wherever eddy flow is present, brought about by sudden changes in the direction or magnitude of the velocity of the air flowing, a greater loss in pressure takes place than would occur in a steady flow through a similar length of straight duct having a uniform cross section. The amount of this loss, in excess of straight duct friction, is termed *dynamic loss*. Although dynamic losses may be assumed to be caused by changes in area actually occupied by the air flow, for convenience they are divided into two general classes: (1) those caused by *changes in direction* of the duct and (2) those caused by *changes in cross-sectional area* of the duct.

TABLE 3. PRESSURE LOSSES DUE TO AREA CHANGES

TYPE	ILLUSTRATION	CONDITIONS	LOSS COEFFICIENT		TYPE	ILLUSTRATION	CONDITIONS	LOSS COEFFICIENT	
			A_1/A_2	C				A_2/A_1	C
ABRUPT EXPANSION			0.1	0.81	ABRUPT CONTRACTION			0.0	0.34 ¹²
			0.2	0.64				0.2	0.32
			0.3	0.49				0.4	0.25
			0.4	0.36				0.6	0.16
			0.5	0.25				0.8	0.06
			0.6	0.16	GRADUAL CONTRACTION			0.0	0.02 ⁹
			0.7	0.09				30°	0.04
			0.8	0.04				45°	0.07
			0.9	0.01				60°	
			0						
GRADUAL EXPANSION			5°	0.17 ⁹	EQUAL AREA TRANSFORMATION			A_1/A_2	C
			7°	0.22				$\theta \leq 14°$	0.15 ⁹
			10°	0.26					
			20°	0.45					
			30°	0.59					
ABRUPT EXIT			A_2/A_1	1.00	FLANGED ENTRANCE			A_2/A_1	C
			(A_2/∞)					A_2/∞	0.34 ¹²
SQUARE EDGE ORIFICE EXIT			A_2/A_1	C	DUCT ENTRANCE			A_2/A_1	C
			0.0	2.50 ¹²				A_2/∞	0.85 ⁹
			0.2	2.44				A_2/∞	C
			0.4	2.26				A_2/∞	0.03 ⁹
			0.6	1.96					
BAR ACROSS DUCT			E/D	C	SQUARE EDGE ORIFICE ENTRANCE			A_2/A_1	C
			0.10	0.7 ⁹				0.0	2.50 ¹²
			0.25	4				0.2	1.90
			0.50	4.0				0.4	1.39
								0.6	0.96
PIPE ACROSS DUCT			E/D	C	SQUARE EDGE ORIFICE IN DUCT			A_2/A_1	C
			0.10	0.20 ⁹				0.0	2.50 ¹²
			0.25	0.55				0.2	1.66
			0.50	2.0				0.4	1.21
								0.6	0.64
STREAM-LINED STRUT ACROSS DUCT			E/D	C				0.6	0.20
			0.10	0.07 ⁹				1.0	0.0
			0.25	0.23					
			E/D	C					
			0.10	0.07 ⁹					
			0.25	0.23					
			E/D	C					
			0.10	0.07 ⁹					
			0.25	0.23					

Note 1: Subscript on C indicates cross section at which velocity is calculated. (See, for example, Equation 10 in text.)

Note 2: Superscript numbers refer to references at end of chapter.

Dynamic losses vary substantially as the square of the mean velocity of the air, and are therefore conveniently expressed as a fraction of the velocity head:

$$H_d = C \left(\frac{V}{4005} \right)^2 \quad (7)$$

where

H_d = dynamic pressure loss, inches of water.

V = mean velocity of air flow, feet per minute.

C = an experimentally determined constant (dynamic loss coefficient).

Where different areas are involved, subscripts are used to denote the area to which the coefficient applies, as C_1 for inlet area, C_2 for outlet area, and C_0 for orifice area.

The dynamic loss coefficient C is dimensionless and represents the number of velocity heads lost at the conduit transition or bend. Values of the dynamic loss coefficient for elbows and other duct elements have been determined experimentally and are given in Tables 2 and 3. It should be