Table 9.... Recommended Construction for Rectangular Low Pressure Ducts

Dimension of Longest Side, Inches	Sheet Metal Gage (All Four Sides)[a]			Transverse Reinforcing[a]						
				Between Joints[d]	At Joints[e]					
					Flat S Slip / Drive Slip	Standing S Slip		Standing Seam Joint / Pocket Lock / Alternate Standing S Slip		
	Steel	Aluminum Alloy[b]	Copper	Minimum Reinforcing Angle Size and Maximum Longitudinal Spacing	Min. Gage	Min. Gage	Min. Angle Size	Min. Gage for Pocket Lock or Standing S Slip	Min. Angle Size	Min. Height, Inches
	Gage	Thickness, In.	Oz Per Sq Ft							
Up thru 12	26	0.020	16	None Required	26	24	None Required	24	None Required	1
13–18	24	0.025	24	None Required	24	24	None Required	24	None Required	1
19–30	24	0.025	24	1×1×⅛@60 in.	— —	24	None Required	24	None Required	1
31–42	22	0.032	32	1×1×⅛@60 in.	— —	22	None Required	22	None Required	1
43–48	22	0.032	32	1½×1½×⅛@60 in.	— —	22	1½×1½×⅛	22	None Required	1½
49–54	22	0.032	32	1½×1½×⅛@48 in.	— —	22	1½×1½×⅛	22	None Required	1½
55–60	20	0.040	36	1½×1½×⅛@48 in.	— —	22	1½×1½×⅛	22	None Required	1½
61–84	20	0.040	36	1½×1½×⅛@24 in.	— —	22	1½×1½×⅛	22	1½×1½×⅛	1½
85–96	18	0.050	48	1½×1½×¼@24 in.	— —	22	1½×1½×¼	22	1½×1½×¼	1½
97–120	18	0.050	48	2×2×⅛@24 in.	— —	22	2×2×⅛	22	2×2×⅛	1½
121 and Over	18	0.050	48	2×2×⅛@24 in. with tie rods @120 in. along angle	— —	— —		22	2×2×⅛ with tie rods @120 in. along joint	1½

[a] Flat areas of duct over 18 in. wide shall be stiffened by crossbreaking unless duct will have non-conductive covering or sound absorbing lining.
[b] Suitable aluminum alloys are: Commercial Designation 3003 Temper H14 and Duct Sheet.
[c] Transverse reinforcing size is determined by dimension of side to which angle is applied. Angle sizes are based on mild steel. Reinforcing made in other shapes or of other materials must be of equivalent strength and rigidity.
[d] There is no restriction on the length of duct sections between joints. Ducts are normally made in sections of 4, 8, 10 or 12 ft in length. The longitudinal spacing of the transverse reinforcing between joints may necessarily be less than the spacing recommended in the table in order to conform to the selected length module.
[e] Other joint types of equivalent strength, rigidity and air tightness may be used.
[f] For aluminum or copper ducts 43 in. through 48 in. maximum dimensions, the maximum longitudinal spacing of transverse reinforcing is 48 in.

maximum branch-duct velocities will then vary from 2000 fpm to 5000 fpm:

5. Round ducts are used to a great extent in high-velocity systems because they are easier to seal and do not require bracing or stiffening. However, it is commercially practicable to utilize rectangular ductwork in high-velocity systems. The duct aspect ratio should be kept low and should not exceed 8:1. The duct must be rigidly braced to withstand the static pressure of the system. All longitudinal seams and cross-seams must be made tight. Mastic sealing compounds are available as less expensive substitutes for positive seals such as soldering or welding. (See the section on Duct Construction.)

6. Low-loss take-offs and fittings should be used. Rigid turning vanes should be installed in all rectangular duct right-angle elbows. In round ducts, turning vanes should be avoided and long-radius elbows used instead. Both 90-deg and 45-deg duct take-offs are used. However, the use of conical take-offs or angular take-offs is recommended, to keep take-off pressure loss as low as possible.[22,23]

7. Duct dampers are not required in the inlet connections to an acoustic terminal device. Capacity dampering at each outlet can be adjusted by means of the acoustic terminal damper. A branch duct supplying air to a number of acoustic terminals may be equipped with a branch-line balancing damper as an aid in field balancing. In a single-duct system, the branch-line damper may be manually adjusted. In a dual-duct system, the branch-line balancing damper may be a static-pressure regulating damper, controlling the pressure in the branch-line duct. In this manner the branch-duct capacity may be raised or lowered by adjusting the setting on the branch-duct damper. Face dampers on the two decks of a one-fan dual-duct system may also be used as static-pressure regulating dampers. An inlet-vane damper on the fan is usually effective for system capacity control.

8. Special considerations used in design of duct systems for high-velocity dual-duct installations are also discussed in Chapter 2 of the 1964 ASHRAE Guide And Data Book.

9. High velocity apparatus casings present substantial structural problems. Recommendations on arrangement and construction are presented in Section II of the *Duct Manual and Sheet Metal Construction for Ventilation and Air Conditioning Systems*.[11]

10. It is imperative that all high-pressure ducts be pressure tested in convenient sections during installation and that all detectable air leaks be eliminated.

Control

In primary-air high-velocity systems, it is not necessary to control static pressures in order to prevent static-pressure unbalance because this system operates with constant air volume. In all-air high-velocity systems operating with variable air flow, some control of static pressures may be required in order to prevent *static-pressure unbalance*, which is a large deviation from design static pressure at the inlet of a terminal, caused by large deviations in air flow.

Table 10.... Recommended Construction For Round Ducts

Duct Diameter, Inches	Steel—Galv. Sheet Gage				Girth Reinforcing	Girth Joints[a] (Continuously Welded or as Below)	
	Low Pressure Ducts and Fittings	Medium and High-Pressure Ducts			Minimum Reinforcing Angle Size and Maximum Longitudinal Spacing		
		Spiral Lock Seam Duct	Longitudinal Seam Duct	Welded Fittings[a]		Low Pressure Ducts	Medium and High Pressure Ducts
Up thru 8	26	26	24	22	None required	Crimped and beaded joint	2 in. long slip joint
9–13	26	24	22	20	None required	Crimped and beaded joint	4 in. long slip joint
14–22	24	24	22	20	None required	Crimped and beaded joint	4 in. long slip joint
23–36	→	22	20	20	None required	—	4 in. long slip joint
37–50	→	20	20	18	1½×1½×⅛@72 in.	—	1½×1½×⅛ angle flanged joint
51–60	→	—	18	18	1½×1½×⅛@72 in.	—	1½×1½×⅛ angle flanged joint
61–84	→	—	16	16	1½×1½×⅛@48 in.	—	1½×1½×⅛ angle flanged joint

[a] Flanged joints may be considered as girth reinforcing. → = use next recommended construction.

In single-duct high-velocity systems, operating with changing air volume, the variations in static pressures can be limited by:

a. Static-pressure controllers operating dampers in the air-distributing system.

b. Static-pressure controllers operating inlet vane dampers on the fan.

c. Zoning and changing air-supply temperature in response to static-pressure changes.

In dual-duct systems, the daily and seasonal variations in heating and cooling loads produce constantly changing demands for cold and warm air, causing a wide variance in flow and consequently in duct static pressures. It is therefore necessary to control the total fan delivery and, in some cases, the duct static pressure to limit pressure at the terminals.

At present, there are two methods used by the industry to control static pressures in dual-duct systems:

a. With dampers operated by static-pressure regulators located at critical points in the air-distributing system. The number, arrangement, and location of such dampers and static taps are dictated entirely by the complexity of the air-distributing systems, the initial fan pressure, and the particular fan characteristics.

b. By volume regulators in each individual air-mixing valve or acoustic terminal device. When this method is used, fixed volumetric delivery is maintained at each outlet, and the system characteristics remain constant through the entire range of operation.

Performance and pressure-volume characteristics of dual-duct systems are discussed in Reference 24. In the other papers listed in the reference section of this chapter may be found further discussions of the types of air-conditioning systems which use high-velocity ducts. (References 16–23 and 25–31.) (See also Chapter 30.)

DUCT CONSTRUCTION

The following discussion refers to the construction of ducts for commercial and industrial heating, ventilating and air-conditioning systems. The construction of industrial exhaust system ducts is discussed in Chapter 35 of the 1964 Guide And Data Book.

Ducts are classified as follows:

1. Low Pressure, mean velocities less than 2000 fpm and static pressures in duct 2 in. of water or less.
2. Medium Pressure, static pressures in duct up through 6 in. of water.
3. High Pressure, static pressures in duct over 6 in. of water and up to 10 in. of water.

It should be noted that the static pressure in the duct is not the total pressure rating of the fan, and that the actual value must be obtained by computation. Since the computation involves certain assumptions, it is recommended that the system designer specify the pressure classification of various ducts.

Table 9 shows recommendations for construction of low pressure rectangular ducts. Table 10 shows recommendations for round ducts for all pressure classifications. These recommendations are based on past industry practice. Recommendations for construction of medium and high pressure rectangular ducts are shown in Tables 11 and 12, and are based on results of tests.[19]

All duct construction details should be in accordance with Sections I[20] and II[21] of the *Duct Manual and Sheet Metal Construction for Ventilation and Air Conditioning Systems*, published by the Sheet Metal and Air Conditioning Contractors' National Association, Inc.

Weights and thicknesses of various sheet metal materials are shown in Tables 13 and 14. In calculating the total weight of material required for a given length of duct, the designer customarily adds an allowance for hangers, formed joint material, seams, and scrap, to the theoretical net weight of the sheet. Weights and properties of reinforcing angles are shown in Table 15.

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.