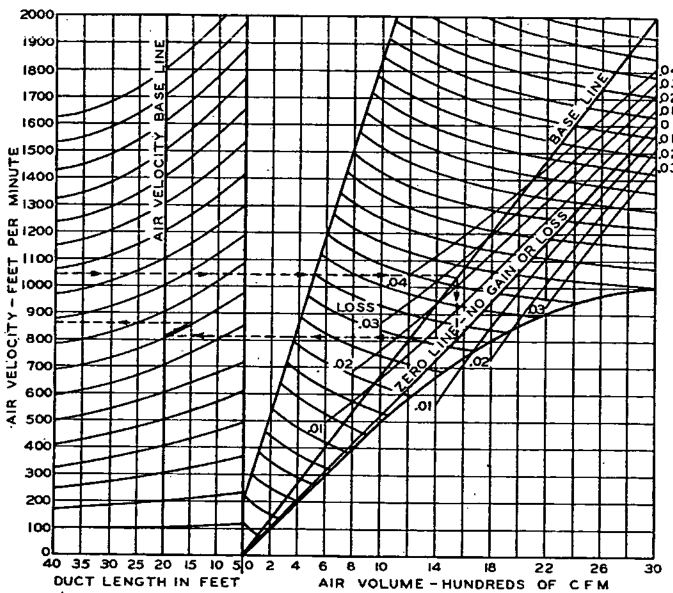

Fig. 14 . . . . Static-Regain Chart*-For Determining Velocity in Ducts Carrying 0 to 3000 Cfm

* Based on Equation 13.

and installation of high-velocity air-conditioning systems.[16-27] For general information on these systems, the reader is referred to Chapter 19—Central Systems for Air Conditioning.

The design of high-velocity duct systems involves a compromise between reduction of duct size and the consequent necessity for higher fan horsepower. While the size of the ducts and hence the air velocities are governed in large part by the available building space, the maximum velocities given later in this section should not be exceeded without careful examination of all factors involved.

The following *general rules* will prove helpful in designing high-velocity duct systems:

1. The same general rules which apply to conventional duct design also apply to high-velocity duct design. (See Section—Design Methods.)

2. When designing high-velocity systems, static regain must be accounted for. Latest data indicate that approximately 85 percent of the original velocity pressure can be regained. This may easily account for 1 in. water static pressure and, therefore, a method which does not take into consideration static regain will result in the selection of oversized fans and motors.

3. Proper sound control must be provided. To take care of low-frequency fan noise, a sound attenuator must usually be installed after the fan. When acoustic terminal devices are not used, attenuator chambers or sound-lined ducts must be installed after mixing valves, in order to attenuate duct and valve noise to acceptable levels.

4. Air velocities in main ducts may vary from 2500 fpm in some installations to over 6000 fpm in others. Corresponding maximum branch-duct velocities will then vary from 2000 fpm to 4500 fpm.

One general procedure for duct sizing used by many designers is to maintain velocities approximately constant in main riser and trunks until the friction loss reaches 1 in. per 100 feet. When further reductions in duct size take place, velocities are selected to maintain a constant friction loss of 1 in. per 100 feet. Final branches are generally designed with constant area so that decreasing capacity and velocity will allow full static regain. With this procedure the final velocity of an end branch duct may be 1000 fpm, or even lower.

The above procedure is not intended to be exclusive, since ducts may also be designed by other methods. (See foregoing section.)

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 4:1. 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 and special tapes are available as less expensive substitutes for positive seals such as soldering or welding. (See Duct Construction Details.)

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, in order to keep duct friction as low as possible.[25]

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 also may be used as static-pressure regulating dampers. An inlet-vane damper on the fan is usually effective for system capacity control.

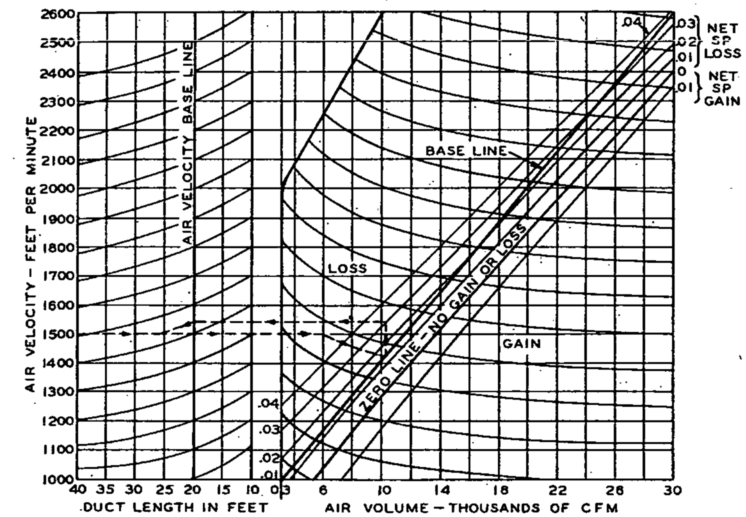

Fig. 15 . . . . Static-Regain Chart*-For Determining Velocity in Ducts Carrying 3000 to 30,000 Cfm

* Based on Equation 13.

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.

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 three methods used by the industry to control static pressures in dual-duct systems:

a. By 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 static-pressure controllers, regulating cold and warm air temperatures in order to limit the variations in the air flow in individual ducts. This method is applicable to centrally zoned systems and may involve an increase in total fan capacity.

c. 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 the paper by N. S. Shataloff.[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 25–27.)