

VOLUMETRIC AIR MEASUREMENTS

Volumetric air measurements must be made with skill and precision and great care must be taken in securing the right conditions under which such measurements are made. There are two general methods in use for measuring air volumes, the first being the anemometer method, and the second, by means of determining the kinetic energy of the moving air current by the use of suitable U-gages containing a fluid (known as the Pitot tube method). The use of these two methods is described in Chapter XXXIV.

While the anemometers give the air velocities directly, the kinetic measurements of the air current require specially constructed gages, tubes, etc. Generally speaking, it will require considerable more skill to take volumetric air measurements by means of the latter method, whereas the anemometer method can be used fairly accurately after a short experience.

ANEMOMETERS

The ordinary anemometers should be used for the lower velocities only, the maximum range being considered as from 2 to 20 ft. per second.

In testing the air flow in a large ventilating plant a preliminary measurement should first be made as to secure a general knowledge of the air distribution. Before preliminary readings are taken all dampers and registers should be opened. Preliminary readings can be made by holding the anemometer 2 in. from the register face or grille and going slowly back and forth over the entire area of the register for one-half minute's time. The amount of air should be computed for the entire area travelled by the anemometer, no deduction being made for the metal of the register itself.

After preliminary readings and adjustments, the final readings should be taken. The registers or openings should then be proportioned off in about 8 in. squares and a reading taken on each square, the average of velocities to be taken as the average air velocity through the register or grille.

Where exterior diffusers are used, the average velocity should be determined by placing over the diffuser a suitable cellar of not less than four times the length of the distance that the diffuser extends beyond the wall face and readings taken as above described for registers.

The time for taking readings should be not less than one-half minute for the preliminary measurements and as much time as is required to secure accurate readings for the final measurements.

Anemometers should be calibrated frequently as to their accuracy under the varying velocities, and all readings should be corrected in accordance with the calibration curve for the particular instrument used.

(See Report on Measuring Air Velocities with the Anemometer, with discussion, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS TRANSACTIONS 1913, Vol. 19, pp. 202 to 207.)

PITOT TUBES

Measurements of air velocities exceeding 20 ft. per second should be made by means of pitot tubes. Volumetric determinations from pitot

tube readings must take into account the barometric pressure, temperature, humidity, and the possible dust of the air. These factors determine the weight or density of the air.

In general, no accurate velocity pressure readings can be taken of any air current which is affected by changes of directions of the ducts. Accurate readings can only be taken in a duct which is straight and without turns and elbows for a distance of at least 50 times the diameter of the circular duct, or the greatest dimension of a rectangular duct. Where space conditions do not make such conditions possible, baffling or dividing the duct into numerous smaller ducts by division plates becomes necessary. Pressure conditions must be determined over the entire area in the drawings of duct traverses as taken from the Standard Code for Testing Centrifugal and Disc Fans of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and the *National Association of Fan Manufacturers*.

For determining the velocity of moving air current in ventilating ducts standard tables of velocity pressures will assist in giving quick but approximate results.

Where greater accuracy is desired the density of the air must be determined and the pitot tube readings must be converted into velocities.

The velocities corresponding to the velocity pressure readings should be averaged to obtain the average velocity for each traverse. Average velocity pressures should be calculated from the average velocities thus determined.

$$V = 1096.2 \sqrt{\frac{P_v}{W}}$$

V = velocity in feet per minute.

P_v = velocity pressure in inches of water.

For dry air at 70 deg. and a barometric pressure of 29.92 in. the formula becomes:

$$V = 4005 \sqrt{P_v}$$

Gages or Manometers

In view of the fact that the velocity pressure exerted by moving air in ordinary duct systems is very slight, frequently going below 1/1000 in. of water, the most accurate gages for measuring these low pressures must be used. For all such measurements gasoline, benzine, or preferably alcohol should be used, with levels for setting the instrument horizontal in both directions. The instruments must be placed upon a firm support to avoid vibration. The tube should be inclined for accurate measurements on low velocities about 1 to 50, and even 1 to 100 may become necessary where extreme accuracy at low velocities is desired. With care it is possible to read with accuracy very nearly 1/100 in. of water.

(See Report on the use of the Pitot Tube, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS TRANSACTIONS 1914, Vol. 20, p. 211, and Standard Code for the testing of Centrifugal and Disc Fans, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS TRANSACTIONS 1923, Vol. 29, pp. 407 to 416.) Also Chapter XXXIV of THE GUIDE.