CHAPTER XXII

HOW TO USE THE PITOT TUBE

THE Committee rendered a careful report which included two tables and a list of references on the theory of the Pitot tube and the derivation of formulæ. An extract from the report is given below.

The reading should be taken at a cross section where the pipe is straight and the flow undisturbed. This should be preferably at least 10 diameters from the fan outlet, from an elbow, or from a change in cross section in the duct. The readings should be taken over a plane at right angles to, and the tube should be pointed in a direction parallel to, the direction of the air flow.

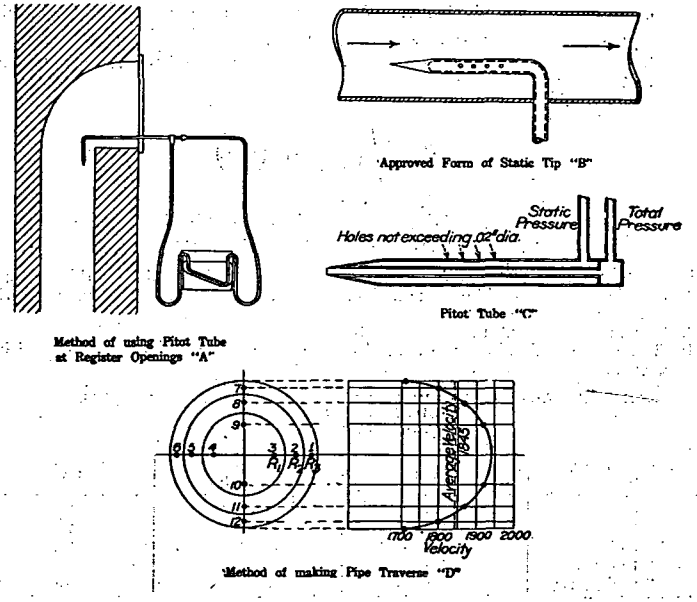

FIG. 67. STANDARD METHOD OF USING PITOT TUBE

The most difficult reading to take accurately in a current of air is the static pressure. The approved form of static tip shown by Fig. 67, diagram *B*, is the form recommended for fan-testing work. There should be eight or more clean holes 0.02 in. in diameter, an equal number on each side of a ¼-in. tube $\frac{1}{32}$-in. thick. The most approved form of Pitot tube combines the foregoing static tip with an impact tube as shown by diagram *C*, by means of which total, static, or velocity pressure may be read.

From Report of Committee on Standardization of the Use of the Pitot Tube, A. S. H. V. E. TRANSACTIONS, Vol. XX, 1914.

In making a traverse of a rectangular duct, the cross sectional area may be divided into a number of smaller rectangles and a reading taken in the center of each small rectangle.

A round pipe should be divided into at least three concentric zones of equal area *per foot in diameter* and four readings taken on a circle drawn through the center of area of each zone or ring.

That is, readings should be taken across the horizontal and vertical axis of the pipe as shown on diagram *D*. The location of these points from the center is shown together with the accompanying Table 106, which gives the distance from the center of the pipe to point of reading, expressed in per cent of the pipe diameter.

To get exact results a small pipe should be divided into more zones than a pipe of larger diameter, as the ratio of frictional surface to cross sectional area is greater, hence the more static pressure in proportion to the impact pressure, which correspondingly reduces the velocity pressure.

The corresponding velocities for each of these readings should be determined and an average taken of all of these velocities in order to compute the air quantity. *Inasmuch as the velocity varies as the square root of the pressure, accurate results cannot be obtained by averaging the pressure readings and taking the corresponding velocity as the average.*

TABLE 106. PIPE TRAVERSE FOR PITOT TUBE READINGS

Distance from Center of Pipe to Point of Reading in Per Cent of Pipe Diameter

No. of Equal Areas in Traverse	No. of Readings	1st R_1	2nd R_2	3rd R_3	4th R_4	5th R_5	6th R_6	7th R_7	8th R_8
3	12	20.4	35.3	45.5					
4	16	17.7	30.5	39.4	46.6				
5	20	15.5	27.2	35.3	41.7	47.4			
6	24	14.5	25.0	32.3	38.2	43.3	47.9		
7	28	13.4	23.1	29.9	35.3	40.1	44.3	48.2	
8	32	12.5	21.6	28.0	33.2	37.6	41.5	45.1	48.4

The velocity may be determined from the velocity pressure by use of the formula,

$$v = 1096.5\sqrt{\frac{P}{W}}$$

v = velocity in ft. per min.
P = pressure in in. of water.
W = weight of air in lb. per cu. ft. under the existing conditions of temperature, barometer and humidity.

With dry air at 70 deg. and 29.92 in. barometer,

$W = 0.0749$ whence the formula becomes
$v = 4005\sqrt{P}$.

With saturated air at 70 deg. and 29.92 in. barometer,

$W = 0.0735$ and
$v = 4046\sqrt{P}$.

For dry air at any temperature and pressure,

$$W = \frac{0.0028862B}{1 + 0.00217587T}$$