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CHAPTER 11

INSTRUMENTS AND MEASUREMENTS

Temperature Measurement, Pressure Measurement, Measurement of Air Movement, Air Change Measurements, Measurement of Relative Humidity, Dust Determination, Heat Transfer Through Building Materials, Measurement of Heat Exchange for Comfort Conditions, Combustion Analysis, Smoke Density Measurements, Sound and Vibration Measurements

HEATING and air conditioning engineers and technicians require instruments for both laboratory and field use and somewhat more precision is attainable and essential in the laboratory, where research and development are undertaken, than in the field, where acceptance and adjustment tests are conducted. Some instruments have attained an adequate state of development while others fall far short of the desirable. For instance temperatures can now be measured readily with ample accuracy for most purposes while a convenient and precise method for determining or comparing the dustiness of atmospheres is lacking and improvement in existing hygrometers and humidity controllers is essential.

Codes and standards covering different types of heating and air conditioning devices and apparatus have been promulgated by various authoritative organizations and instruments essential for performance or compliance testing are enumerated in the relevant publications.[1, 2, 3, 4] The present purpose is to discuss the use and characteristics of the more important instruments.

TEMPERATURE MEASUREMENT[5, 6]

Thermometers

Any device capable of indicating temperature is a thermometer but in common usage the term *thermometer* without qualification has come to signify the ordinary mercury-in-glass temperature indicating device. This type has a useful range from −40 F, the freezing point of mercury, to about 1000 F, at or near which the glass usually softens. Lower temperatures can be measured with alcohol-filled thermometers for which the range is about −94 F to +248 F. The better thermometers have their scales, either Fahrenheit or Centigrade, etched with acid into the glass which forms their stems. The probable error for etched stem thermometers is plus or minus one scale division, and calibration is desirable for much test work. Thermometers are calibrated during manufacture at not less than two temperatures—the freezing and boiling points of water—and calibration is often accomplished with the instrument completely immersed in a bath at the known temperature. The intervening scale divisions are then applied to the stem. When such a thermometer is used with the stem incompletely immersed, a correction known as the stem correction is necessary for accurate measurements, and its magnitude is usually computed by means of the following formula:

$$K = 0.00009\ D\ (t_1 - t_2) \qquad (1)$$

where

K = correction to be added, Fahrenheit degrees.