where ϕ is the latitude and h is the altitude above sea level in feet.

Because of variations in the density of rocks below the surface, the value of gravity at any location may differ substantially from that of the formula. Deviations in excess of 0.100 cm/sec^2 (one part in 10,000) are observed in mountainous areas of the U. S. Observed values at over 1,000 locations are given in U. S. Coast and Geodetic Survey Publication No. 244 (price 75 cents at the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20234). These are in the International (Potsdam) System, and should be reduced by 0.012 cm/sec^2 to obtain the absolute values of gravity.

Estimates of the value of gravity at particular locations can be made by the Geodesy Division, U.S. Coast and Geodetic Survey, Washington, D. C. For greatest accuracy, gravity meter observations can be made at the laboratory by a survey team from the U.S. Coast and Geodetic Survey, the U.S. Geological Survey, or a private geophysical organization. (Efficient accomplishment of this work demands a lead time of several months).

1.6 Elastic Distortion. The distortion of the piston and cylinder under pressure depends greatly on the design and materials, and may either increase or decrease the effective area by as much as a part in ten thousand at a thousand pounds per square inch. The factor $(1 + bp_p)$ in equation (1) accounts for the change in area as the pressure increases.

1.7 Calibration. The direct measurement of the diameters of some pistons and most cylinders is difficult to do with adequate accuracy, and calculations of the pressure coefficient of area may be unreliable. It is, however, possible to balance a piston gage against another with high precision, and when the effective area and pressure coefficient of one are known, the effective area, pressure coefficient, and load correction of the other can be determined. The usual method used by the National Bureau of Standards to calibrate piston gages, is to weigh the load and then determine the values of A_o and b by the balancing method. The values of V, C, and height of the reference level are computed from measurements of the piston and cylinder assembly. A value of load correction is reported only when it is believed to be characteristic of the instrument. Whenever possible the calibration is done with the piston and weights rotating by their own inertia after bringing the piston to operating speed by spinning the weights manually. When this method cannot be used, the drive system, supplied with the instrument is used.

The drive error, corkscrew error, and eccentric load error are functions of speed of rotation or oscillation. To keep them small the speed should be only great enough to maintain lubrication.

The best value of pressure is the mean of equal numbers of observations taken in each direction of rotation.

The instrument level should be adjusted so that the axis of rotation of the piston is vertical. Whenever possible the level is observed by placing a bubble level on the piston assembly and the instrument is adjusted so that the indication is unchanged when the piston and bubble level are turned together to any position.

Controlled clearance piston gages are calibrated by an indirect (absolute) method. The value of A_o is determined by measurement of the piston diameter.

The zero clearance jacket pressure, p_z, is determined at several loads by observing the fall rate at each of several jacket pressures for each load. The volume of pressure fluid beneath the piston is kept as small as possible, all connections are made leak tight and the temperature is kept constant at temperature t_s. The cube root of the fall rates at each load are plotted versus jacket pressure and the straight line portions are extrapolated to zero fall rate to obtain values of p_z for each load. The values of p_z are plotted against piston gage pressure and a straight line extrapolation to zero pressure gives the value of p_{zo}. The value of p_{zo} can be verified when the piston is large and air lubricated by turning the piston with the fingers and increasing the jacket pressure until the piston is locked. The slope of the p_z line is the value of S_z.

The value of the rate of change of area with jacket pressure, d, is obtained by balancing against another piston gage and observing the change in load that is required to maintain the balance when the jacket pressure is changed. This experiment is done at a constant temperature.

The determination of d is made at several loads and provides data for the determination of A_o. The value thus obtained should agree with the value determined by direct measurement of the piston within the limitations of the instrument performance.

The pressure coefficient of area, b, for controlled clearance piston gages, is determined from the elastic properties of the piston and the theoretical relation

$$b = \frac{3\mu - 1}{y} \qquad (7)$$

where μ is Poisson's ratio for the piston, and y is Young's modulus for the piston.