a Fractional change in area per degree C, and taken as equal to the sum of the thermal coefficients of linear expansion of the piston and cylinder,

t Temperature of the piston gage in degrees C,

t_s Reference temperature at which the value for A_o is known,

b Fractional change in effective area for 1 psi change in pressure,

d Fractional change in effective area for 1 psi change in jacket pressure,

p_{zo} Jacket pressure in psi required to reduce the piston-cylinder clearance to zero when $p_p = 0$, (see Footnote 2)

S_z Rate of change of zero clearance jacket pressure, p_z, with measured pressure, p_p, in psi, (see Footnote 2),

p_j Jacket pressure in psi.

1.2 Load Correction. A correction in pounds to be added to the mass load on the piston may be required because of constant load errors of undetermined origin. Possible causes of these errors are air currents around the weights, helical scratches on the piston or cylinder or guide bearing (cork screwing), or eccentric load effect.

1.3 Fluid Head. The reference level of the piston gage is the level at which the pressure, p_p, is determined from equation (1). It usually happens that the gage being tested, or the point at which the pressure is to be measured, is not at the reference level of the piston gage. Correction should, therefore, be made for the pressure difference due to the head of fluid between these points.

When a liquid is used to transmit the pressure and h_{fp} is kept small, the pressure head, H, may be determined by the approximation:

$$H\ (liq) = -\rho_{fp}\ h_{fp} \qquad (4)$$

Where ρ_{fp} is the mean density of the liquid and h_{fp} is the height of the liquid column measured from the piston gage reference level. The results are in pounds per square inch when ρ_{fp} is in pounds per cubic inch and h_{fp} is in inches.

Footnote 2. The quantity, p_z, is used in Monograph #65 but the quantities p_{zo} and S_z are not. The relation between them is expressed by the equation,

$$p_z = p_{zo} + S_z p_p. \qquad (3)$$

When air at about 23°C is used to transmit the pressure and h_{fp} is kept small, the pressure, p, at the test level may be determined from the approximation

$$p = p_p(1 - 2.9 \times 10^{-6} h_{fp}) \qquad (5)$$

for h_{fp} in inches, p and p_p in psi.

1.4 Mass and Buoyancy. The mass of the piston and loading weights may be determined either as true mass or as apparent mass determined by weighing in air, having a density of 0.000043 lbs/cu in. by comparison with standard brass weights (density 0.303 lbs/cu in.). The mass of the load on the piston should be reduced by an amount equal to the mass of the air displaced by the weights. This is accomplished by the factor $(1 - \frac{\rho_a}{\rho_m})$ in equation (1). When true mass values are used, the actual value of density of the weights should be used for ρ_m, but when apparent mass values are used, ρ_m should be assumed to be 0.303 lbs/cu in. The density of the air at room temperature and sea level pressure is about 0.000043 lbs/cu in., and the mass under these conditions will be reduced by about one part in 7,000.

The mass of any oil in a cavity in the piston, or the mass of oil displaced by an enlargement of a piston of otherwise uniform cross-section between the cylinder and the free oil surface, should be added to or substracted from the load on the piston. When the submerged cross-section is less than A_o, V will be positive, and when it is larger than A_o, V will be negative.

The buoyancy resulting from variations of the cross-section of the piston below the cylinder are taken into account by choosing a reference level above or below the lower end of the piston so that the resulting head of oil is equal to the buoyancy correction.

The height of the reference level, with respect to the lower end of the piston, is equal to the difference between the actual length of the piston below the cylinder and the length of a piston of uniform cross-section A_o, and of equal volume. When the actual cross-section is larger than A_o, the reference level is below the lower end of the piston and when it is smaller than A_o, it is above.

1.5 Gravity. In a piston gage loaded by dead weights, as with a liquid column manometer, the pressure is proportional to the local value of gravity. Readings on these instruments are reduced to standard gravity by introduction in equation (1) of the factor kg_L, where k is 1/980.665. The absolute value g_L of the gravity is given approximately by the formula:

$$g_L = 980.616 - 2.5862 \cos 2\phi + .0058 \cos^2 2\phi - .000094 h \qquad (6)$$