$$E = \frac{(KA)\ P}{(C_S + C_C)} \qquad (1)$$

where the nomenclature is

E . . . signal voltage, volts

KA . . . gage sensitivity, picocoulombs/psi

C_S . . . standard capacitance, picofarads

C_C . . . cable capacitance, picofarads

P . . . pressure, psi

Equation (1) can be written as

$$KA = \frac{E(C_S+C_C)}{P} \qquad (2)$$

The application of a known static pressure pulse on a piezoelectric gage creates a voltage across the standard capacitor, and by means of the electronic circuitry, this voltage is displayed on the oscilloscope screen. The image of the voltage-time curve is captured by a fixed-film camera, thus providing a permanent record that can be analyzed on a standard film reader. Once the signal voltage is determined for a given capacitance and pressure, the gage sensitivity is determined directly from equation (2).

The signal voltage determined in this manner is based on the assumption that all of the charge delivered by the piezoelectric gage is stored on the standard capacitor. This assumption is valid provided the time involved in establishing the signal (pressure-release time) is sufficiently short as to prevent leakage of a significant quantity of stored charge through the equivalent crystal circuit resistance. The decay of the signal voltage is exponential in character, its rate being determined by the product of the total capacitance and the leakage resistance (that is, the time constant of the gage circuit). In Appendix A it is shown that due to the time constant of the gage circuit, the measured positive pressure pulse is lower than the true value by a fractional error not in excess of

$$E_1 \leq \frac{T_R}{\Theta_2} \tag{3}$$

where the nomenclature is

E_1 . . . fractional error of true pressure pulse

T_R . . . positive duration of pressure pulse (pressure-release time), msec

Θ_2 . . . time constant of gage circuit, msec

For an assumed piezoelectric gage sensitivity of 2 picocoulombs per psi (all of the gages used in this Program have sensitivities of this order) and a pressure range of 20,000 - 100,000 psi, a standard capacitor of 50,000 picofarads is employed. Under these conditions the leakage resistance of the circuit is approximately 200 megohms, and for a pressure-release time of 100 msec, it is seen from equation (3) that

$$E_1 \leq 0.01$$

A further study of this type indicates that a pressure-release time of 10 milliseconds or less is sufficient to ensure that the loss of the signal voltage is less than one percent for the time and pressure ranges required in this Program. Additional information concerning the method of operation of the instrumentation is presented more conveniently in the section Experimental Procedures and Results.

Time-Constant Equation. The experimental pressure-time traces shown in Figures 5, 6, and 7 indicate that in the pressure pot, the decay in pressure with respect to time can be represented by an exponential function. A look at the work done in the area of shock wave phenomena provides the motivation to try a simple exponential relation of the form