

TABLE I. Output signals for z -cut lithium niobate gauges relative to quartz gauges.

Sample	$\rho_0 c^a$ ($\text{g cm}^{-2} \mu\text{sec}^{-1}$)	i_L/i_Q^b
PMM _A ^c	0.35	5.2
6061-T6 aluminum	1.74	6.7
Mild steel	4.67	8.3
Tungsten	10.0	9.1

^aNominal acoustic impedance values are shown for illustrative purposes. ρ_0 is the density and c is the dilatational wave velocity.

^b i_L and i_Q are currents from z -cut lithium niobate and x -cut quartz, respectively, for common gauge dimensions and common stress in the sample. The ratio is calculated in the low-stress limit utilizing the linear acoustic mismatch $\sigma_g = 2Z_g(Z_g + Z_s)^{-1}\sigma_s$, where σ_g and σ_s are the stress in the gauge and the incident stress in the sample, respectively. Similarly, Z_g and Z_s are acoustic impedances, $\rho_0 c$, of the gauge and sample. $Z_Q = 1.52 \text{ g cm}^{-2} \mu\text{sec}^{-1}$, and $Z_L = 3.4 \text{ g cm}^{-2} \mu\text{sec}^{-1}$.

^cPolymethyl methacrylate.

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¹W.B. Gauster, *J. Mech. Phys. Sol.* **19**, 137 (1971).

²J.C. Bushnell and D.J. McCloskey, *J. Appl. Phys.* **39**, 5541 (1968).

³R.A. Graham and R.E. Hutchison, *Appl. Phys. Lett.* **11**, 69 (1967).

⁴R.A. Graham, R.E. Hutchison, and W.B. Benedick, in *Record of IEEE 9th Annual Symposium on Electron, Ion and Laser Beam Technology*, edited by R.F.W. Pease (San Francisco Press, Calif., 1967).

⁵R.A. Graham, F.W. Neilson, and W.B. Benedick, *J. Appl. Phys.* **36**, 1775 (1965).

⁶L.M. Barker, *Exp. Mech.* **12**, 209 (1972).

⁷L.M. Barker and R.E. Hollenbach, *Rev. Sci. Instrum.* **36**,

1617 (1965).

⁸L.M. Barker, in *Behavior of Dense Media Under Dynamic Pressures* (Gordon and Breach, New York, 1968).

⁹L.M. Barker and R.E. Hollenbach, *J. Appl. Phys.* **43**, 4669 (1972).

¹⁰W.B. Gauster, *Phys. Rev. B* **4**, 1288 (1971).

¹¹F.C. Perry, *J. Appl. Phys.* **41**, 1870 (1970).

¹²R.B. Oswald, Jr., F.B. McLean, D.R. Schallhorn, and L.D. Buxton, *J. Appl. Phys.* **42**, 3463 (1971).

¹³R.B. Oswald, Jr., D.R. Schallhorn, and L.D. Buxton, *J. Appl. Phys.* **42**, 3474 (1971).

¹⁴J.H. Shea, A. Mazzella, and L. Avrami, in *Fifth Symposium on Detonation*, Office of Naval Research Report No. ACR-184 (U.S. GPO, Washington, D.C., 1970).

¹⁵N.C. Anderholm and R.R. Boade, *J. Appl. Phys.* **43**, 434 (1972).

¹⁶N.C. Anderholm and P.D. Anderson, *J. Appl. Phys.* **43**, 1820 (1972).

¹⁷P.S. Peercy, E.D. Jones, J.C. Bushnell, and G.W. Gobel, *Appl. Phys. Lett.* **16**, 120 (1970).

¹⁸E.D. Jones, *Appl. Phys. Lett.* **18**, 33 (1971).

¹⁹C.H. Skeen and C.M. York, *Appl. Phys. Lett.* **12**, 369 (1968).

²⁰A.J. Palmer and J.F. Asmus, *Appl. Opt.* **9**, 227 (1970).

²¹J.D. O'Keefe and C.H. Skeen, *Appl. Phys. Lett.* **21**, 464 (1972).

²²R.A. Graham, *Sol. State Commun.* **12**, 503 (1973).

²³The linear approximation assumes that (i) particle velocities are negligibly small, (ii) the permittivity is constant, (iii) the gauge material is linearly elastic, (iv) electromechanical coupling effects are negligible, and (v) the conductivity is less than $10^{-8} \Omega^{-1} \text{cm}^{-1}$. These assumptions are applied under the conditions which the gauge material experiences, which are typical stresses of tens of kilobars and typical electric field magnitudes of 10^5 V cm^{-1} .

²⁴G.E. Ingram and R.A. Graham, in *Fifth Symposium on Detonation*, Office of Naval Research Report No. ACR-184 (U.S. GPO, Washington, D.C., 1970).

²⁵R.A. Graham, *Phys. Rev. B* **6**, 4779 (1972).

²⁶W.J. Halpin, O.E. Jones, and R.A. Graham, in *Symposium on Dynamic Behavior of Material*, ASTM Special Technical Publication No. 336 (ASTM, Philadelphia, Pa., 1963).

²⁷R.A. Graham and W.J. Halpin, *J. Appl. Phys.* **39**, 5077 (1968).

²⁸R.A. Graham and G.E. Ingram, *J. Appl. Phys.* **43**, 826 (1972).

²⁹K.R. Prestwich, *IEEE Trans. Nucl. Sci.* **18**, 493 (1971).

