

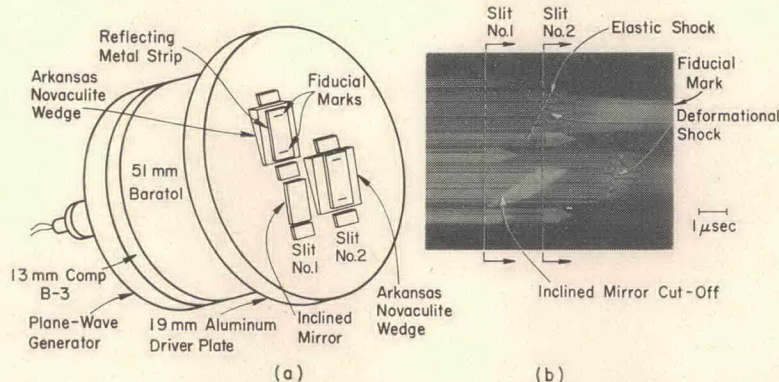


Fig. 3. Plane wave wedge experiment. (a) Assembly is viewed along slits 1 and 2 by streak camera. (b) Streak camera record showing grid lines displaced first by elastic shock and then by deformational shock.

(Figure 3). For each type of metal strip the relation of the deflection of the light image, which is a measure of free-surface velocity [Ahrens and Gregson, 1964], and the particle velocity in the underlying rock must be examined at different times. For simplicity the velocity at the free surface of the metal is assumed to be equal to twice the particle velocity of the metal.

The quality of the record for shot 10,464, with a polished aluminum reflecting strip, was the best of the three shots fired. The free-surface velocity measured corresponds to the shock transmitted into the aluminum by incidence of the elastic wave in the novaculite on the novaculite-aluminum interface because the aluminum is thick enough (3.2 mm) for the reverberation time of a disturbance in the metal to be long ($\approx 1 \mu\text{sec}$) compared with the time in which the wave profile is measured (0.2 μsec). Specimen particle velocities are obtained graphically (Figure 4).

Since the elastic shock is actually attenuating, the shock pressure inferred from the aluminum will be slightly lower than that in the rock. Because of the close impedance matching between the aluminum and elastic states in Arkansas novaculite, the measured Hugoniot elastic limit and its decrease with shock propagation path length are insensitive to errors arising from the straight-line cross-curve assumption.

The Hugoniot elastic limits shown in Figure 5 and Table 3 all correspond to elastic waves

preceding deformational shocks with amplitudes of about 155 kb. The mean decay rate of 3.3 kb/mm can be compared with the value 1.4 kb/mm, at a level of 40 kb reported for two-dimensional geometry by Duvall [1964]. Though the two different measurements cannot be directly compared because of material and geometry differences, it may be considered significant that the results are of the same order of magnitude. The effect of this difference on the relaxation time is to reduce it from the value 2.0 μsec , reported by Duvall [1964], to approximately 0.7 μsec .

In shot 10,465, the particle velocity experimentally obtained for the 0.152-mm-thick steel strip (shim) is assumed to correspond to the state F (Figure 4) achieved in the steel by transmission of a steady shock at the specimen-steel interface. This assumption is made because the initial displacement of the grid image used in calculating the steel free-surface velocity remained nearly steady for 0.04 μsec after its initial displacement. This time is of the same order as that (0.06 μsec) required for the shock, reflected at the steel free surface, to reflect at the rock-steel interface and again arrive at the free surface. Specular reflectivity of the steel is lost upon the apparent arrival of this (first) reverberation. For this shot the cross curve of the novaculite is again approximated by a straight line of slope $-\rho_0 U_1$ in order to infer the specimen state S from the state F measured for the steel strip. The true form of the cross curve is unknown, and, be-

TABLE 2. Hugoniot Elastic Limit versus Propagation Distance and Intrinsic Attenuation Function for Arkansas Novaculite

Shot No.	Free-Surface Velocity, 2024-Al Driver Plate, mm/ μ sec	Initial Density, Arkansas Novaculite, g/cm ³	Elastic Shock Velocity U, mm/ μ sec	Shock Propagation Path Length, mm	Hugoniot Elastic Limit (Elastic-Wave Amplitude), kbar	Rate of Elastic Wave Decrease $-Dp_z/Dx$ kb/mm	Rate of Particle Velocity Decrease $-du/dt$ mm/(μ sec) ²	Intrinsic Attenuation Function F, kb/ μ sec	Contribution to Dp_z/Dx from Intrinsic Term in equation 28, %
10,280*	1.68	2.635	6.235 $\pm$ 0.009	7.38-11.94	73.7 [†]	2.6 0.51 [§]	0.133 [†] 0.158 [†] 0.515 0.164	30.4 29.6 20.1 38.2	90 88 60 89
10,464* Slit 1	1.78	2.628	6.24 $\pm$ 0.07	11.38 7.49	78 84	3.31 2.35 [§] 3.31	0.075	40.7	95
10,464* Slit 2			6.215 $\pm$ 0.005	11.65 11.53 11.41	73 72 72			36.6	87
10,465*¶	1.78	2.628	6.014	6.28-11.36	63.0	3.31 3.2 2.58 [§]	0.212		

* Light reflecting metal strips affixed to specimen with Eastman 910 cement. Shot 10,280, 0.051 mm steel shim; shot 10,464, 3.2 mm 1060 Al; shot 10,465 0.152 mm steel shim.

† Average value.

‡ Minimum value.

§ Least-squares fit.

|| Maximum value.

¶ Average data analyses A and B (Figure 6).