TABLE I. Yield stresses[a] (kbar).

Material	As-received	Air-quenched	Annealed
II	0.32 ± 0.02	0.12 ± 0.01	0.47 ± 0.01
III b	0.46 ± 0.01	0.32	0.57[b]

[a]The applied strain rate for these tests was 5×10^{-4} sec.
[b]This annealing technique has been reported earlier (Ref. 7).

location density when quenched from 400 °C. This was carefully checked.

Heat Treatment

Material II

The heat treatments employed here follow Dryden *et al.*[6]; this was done to compare their clustering effects with ours. The specimens were first annealed at 400 °C in a well-insulated pyrophyllite box for approximately 12 h, then quenched in air. These have been referred to as air-quenched samples. For the annealed samples, the crystals were first quenched in air for 10 min, reannealed at 150 °C for approximately 30 h, and then oven cooled for approximately 12 more hours.

Material III b

The air-quenched samples were obtained by heating the material at 400 °C for 1 h in the pyrophyllite box and then quenching in air. The annealing procedure for this material consisted of annealing at 600 °C for 8 h and then oven cooling over a period of 24 h, as reported earlier.[7]

Yield Stress Measurements

Quasistatic yield stresses were measured with an Instron machine modified for compression testing. Specimen dimensions were approximately 4×4 mm laterally with heights ranging from 8 to 16 mm. The applied strain rate in these measurements was 5×10^{-4} sec^{-1}.

Shock Wave Measurements

In preparation for impact experiments, the samples were cleaved along (100) planes and heat treated as above. For each material, samples were obtained from adjacent positions; this minimized the scatter due to impurity variations, as reported by Asay *et al.*[7] They were then lapped and finally polished with 0.3-μ Al_2O_3 powder. The gas gun used for these impact studies has been described in the paper by Fowles *et al.*[10] Polished aluminum projectiles impacted the specimens, and the initial impact stress was taken to be 29 kbar. This stress is consistent with the assumption that the initial response of the material is elastic. The stress time profiles at the back of the sample were measured by the usual quartz gauge technique of Graham *et al.*[11] The dimensions of both the specimen and gauge recording areas were controlled in order to maintain uniaxial strain for times of interest.

Impact stresses were calculated from the following equations of state for LiF and Al[7]:

$$\text{LiF: } P_x(L)=Z_L u_x(L)+Z'_L u_x^2(L)\ \text{Mbar}, \tag{1}$$

where $Z_L=1.735\pm0.002$ gm/μsec cm^2, and $Z'_L=6.23\pm0.35$ gm/cm^3;

$$\text{Al: } P_x(\text{Al})-0.0064=Z_{\text{Al}}[u_x(\text{Al})-0.0038]+Z'_{\text{Al}}[u_x(\text{Al})-0.0038]^2\ \text{Mbar}, \tag{2}$$

where $Z_{\text{Al}}=1.50$ gm/μsec cm^2, and $Z'_{\text{Al}}=0.72$ gm/cm^3, for u_x in cm/μsec.

Precursor amplitudes (HEL) reported in the table were determined from measured values in quartz, $P_x(Q)$, by using Eq. (1) and the reported equation of state of quartz[11]:

$$P_x(Q)=Z_Q u_x(Q)\ \text{Mbar}, \tag{3}$$

where $Z_Q=1.521\pm0.011$ gm/μsec cm^2.

Continuity of stress and particle velocity at the interface between the LiF specimen and the quartz require that both Eq. (1) and the relation

$$P_x(Q)=Z_L[2u_x(L)-P_x(Q)/Z_Q]+Z'_L[2u_x(L)-P_x(Q)/Z_Q]^2 \tag{4}$$

be satisfied.[7] Since all quantities except $u_x(L)$ are known in Eq. (4), it can be determined and then substituted in Eq. (1) to obtain $P_x(L)$.

Although this method of impedance matching which yields $P_x(L)$ in terms of $P_x(Q)$ is only valid for the precursor front, it was also used to estimate stress minima behind the wavefronts.

RESULTS

Effects of heat treatment for quasistatic yield stresses are listed in Table I and for precursor amplitudes in Table II.

Material II

For this material, it was found earlier that dynamic yielding was not affected if the quasistatic yield stress

TABLE II. Shock data.

Material	Heat treatment	Thickness (mm)	Projectile velocity (mm/μsec)	Impact tilt (mrad)	Impact stress (kbar)	Yield stress (kbar)	HEL (kbar)	Stress minima (kbar)
II[a,b]	Annealed	2.145	0.347	0.14	29.1	0.47	17.34	9.50
II[a,b]	Air-quenched	1.025	0.343	0.50	28.9	0.11	5.60[c]	• • •
II[a,b]	Air-quenched	2.028	0.347	0.14	29.1	0.13	5.60[d]	• • •
III b[a]	Air-quenched	2.007	0.348	0.18	29.2	0.32	6.61	6.16

[a]Polished with 0.3 Al_2O_3 and impacted with 6061-T6 Al projectile of similar finish.
[b]Samples of II were cleaved from adjacent positions in a larger crystal.
[c]HEL given by break in wavefront, which was immediately followed by plastic wave.
[d]Stress was uniform behind the elastic wavefront in this experiment.