Table 1
The Variation of Strain, Stored Energy and Crystallite Size with Position in each Capsule

Capsule B: single layer of explosive
Capsules A and C: double layer of explosive

Sample	*Mean strain as milled* $E \times 10^{-3}$	*Stored strain energy* (*cal* g^{-1})	*Surface area of equivalent strain energy* ($m^2 g^{-1}$)	*X-ray crystallite size* (Å)	*Equivalent surface area* ($m^2 g^{-1}$)	*Equivalent surface energy* (*cal* g^{-1})
A	5·66	2·43	10·17	2,620	6·54	1·56
B1	*1·2	0·04	0·17			
B2	*1·5	0·06	0·25			
B3	*2·4	0·46	1·92			
C1	*2·3	0·41	1·71			
C2	*2·3	0·41	1·71			
C3	2·64	0·54	2·26	2,213	7·75	1·85
C4	3·72	1·05	4·39	1,927	8·90	2·13
C5	4·57	1·59	6·65	3,114	5·51	1·32
C6	3·21	0·82	0·34	1,540	12·81	3·07
Glen-Creston milled (8 h)	2·0	0·51	2·13	1,870	9·17	2·19

*Values estimated from X-ray powder patterns

contact with the capsule, iron contamination was found, most of which, however, could be removed with a magnet. In order to determine whether this explosive shocking gave rise to any spatial distribution of strained particles within the capsule, or to a distribution of particle sizes within the capsules, specimens of the strained alumina were carefully taken from various parts of each capsule. Details of this sampling are shown in Figure 1.

2.2 Strain Measurement

In order to obtain a general appraisal of the amount of strain induced into the alumina powder particles, X-ray powder patterns were obtained from every sample using a conventional 11·46 cm camera with CoKα radiation.

The experimental method and the computer analysis used throughout the quantitative determination of strain and crystallite size were those described previously [5] and were based on the Williamson–Hall method.

Before the shocked powders were studied, the starting material, which had been lightly milled to break down particle agglomerates, was examined by X-ray diffraction, but very little line broadening was observed. Subsequently some of the starting material was heat-treated at 750°C for 1 h to relieve any inherent strain. The X-ray line broadening from this powder was found to be the same as that measured for the unheated powder. Analysis of the diffraction line profiles indicated that the strain level in both samples was very low ($< 10^{-5}$). The lightly milled starting material used in the present experiments, therefore, can be considered to be essentially strain-free.

The separation of the contributions of strain and crystallite size to the broadening of the X-ray diffraction peaks from the explosively shocked materials was carried out under the assumption of Cauchy and Gaussian distributions for the line profiles. Since experimental studies have shown that the profile shapes lie between Cauchy and Gaussian curves, the values of strain and crystallite size presented (in Table 1) are the averages of the values obtained assuming these two profile shapes.

For each measured crystallite size, the equivalent surface energy was calculated, assuming the crystallites to be free spheres (i.e. not joined together) of specific surface energy of 1000 ergs cm^{-2}.[9,10] In addition, from each value of the mean strain, E, measured from the β^*/d^* plot, the strain energy, V, was calculated using Faulkner's equation, which has been shown [2] to reduce to

$$V = 3.E^2.M$$

where M is the average Young's modulus. The results are given in Table 1.

2.3 Sintering

Because of the small quantities of explosively shocked powder produced in these experiments, it was not possible to make a detailed assessment of the sintering behaviour. It was decided that some of the most highly strained powder should be pressed and sintered under standard conditions together with specimens prepared from two other alumina powders. Hence the following powders were hydrostatically pressed at 25 tf/in^2 in $\frac{1}{4}$ in. diameter latex bags.

(1) Hopkins and Williams AnalaR grade "as received".

(2) Hopkins and Williams AnalaR grade explosively shocked from capsule A.

(3) Hopkins and Williams AnalaR grade dry-milled for 8 h in a Glen-Creston M280 vibratory ball mill using alumina grinding-chamber and ball.

The different powders behaved in the following ways during pressing. The compact originating from the shocked specimen had fractured into several pieces, the