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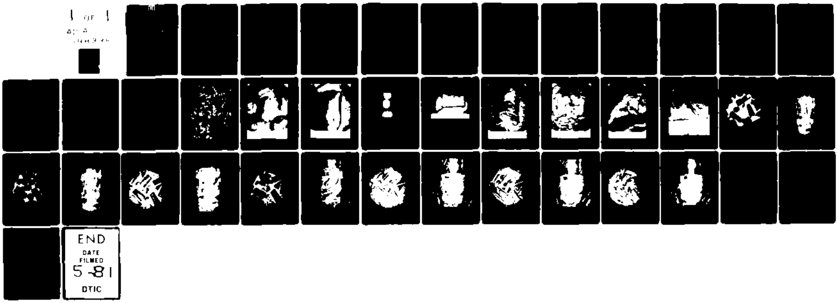

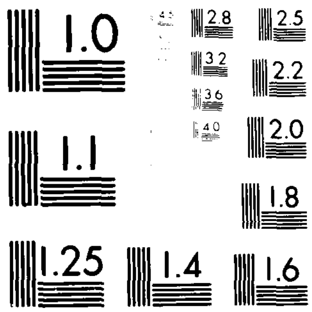


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## TECHNICAL MEMORANDUM

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# COMPRESSIBILITY OF AR 2206 GUN PROPELLANT GRAINS

C.W. FONG





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TECHNICAL MEMORANDUM

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# COMPRESSIBILITY OF AR2206 GUN PROPELLANT GRAINS.

C.W. Fong

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## S U M M A R Y

(U) Grains of AR2206 gun propellant have been compressed individually and in bulk at rates from 5 to 50 mm/min at 20°C. At these rates, extensive plastic deformation of the grains occurs, with no signs of brittle shattering of the grains. At 5 mm/min, individual grains can deform up to 25% before fracture occurs, and in bulk, the grains can be compressed by 52% without showing any significant fracture. Small cracks at geometrical stress points have been observed.

POSTAL ADDRESS: Chief Superintendent, Weapons Systems Research Laboratory, Box 2151, G.P.O., Adelaide, South Australia, 5001



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## 1. INTRODUCTION

The 7.62 mm tracer and ball cartridges currently in production in Australia are both filled with 43.5 grains of single base propellant designated AR 2206. However the tracer projectile is longer than the ball projectile but the overall cartridge length in both tracer and ball cartridges have a specified length of 2.800 in maximum and 2.770 in minimum(refs.1,2). The tight tolerance on length is required to prevent jamming in the feed mechanisms of automatic weapons. It is therefore necessary to accommodate the extra length of the tracer projectile within the cartridge case thereby reducing the case volume, and as a result the propellant bed is compressed when the projectile is inserted. Concern has been expressed that this compression could cause powder grain fracture, which would result in irregular ballistic performance, and/or the residual compressive forces acting on the base of the projectile could cause debulleting to occur during the service life of the cartridge.

This work examines the effect of compression on grains of propellant AR 2206, both singly and in bulk. Compression rates varied from 5 mm/min to 50 mm/min with the tests conducted at a temperature of 20°C. The compression rates were limited by the available instrumentation and were lower than the rate of 350-400 mm/min at which the projectile is inserted into the cartridge case during manufacture(ref.3). This limitation was not considered to be critical.

## 2. EXPERIMENTAL

The compression tests were carried out on an Instron TTCM testing machine at 20°C. The single perforated tubular grains of AR 2206 conformed(ref.4) to the following specifications : mean length, 1.5 mm (nominal); mean web, 0.3 mm (nominal); mean perforation diameter, 0.14 mm (max). Individual grains were tested side-on at compression rates of 5, 10, 20 and 50 mm/min, the latter rate representing the upper instrumental limit. Single grains tested end-on were compressed at a rate of 10 mm/min, whilst loosely supported in a small metal holder to prevent the grains from falling over. Grains compressed end-on were carefully inspected to ensure the metal holder did not introduce any extraneous forces. All compression data from individual grains were the average of ten tests.

Special jigs composed of a small well and a close fitting, though reasonably free moving plunger were used to examine the compressability of one hundred randomly packed propellant grains (figure 1). These studies were carried out at a cross head speed of 10 mm/min. Two jigs were used : one was constructed from a brass well with a steel plunger; the other had a clear perspex well with a steel plunger. The latter jig was used in the photographic studies. Comparison of experimental data from both jigs indicated that the results were equivalent within experimental error.

The photographic studies in the perspex well were made using conventional techniques, whilst the micrographs of individual grains, or groups of grains, were obtained with a scanning electron microscope.

## 3. RESULTS AND DISCUSSION

### 3.1 Compression of individual grains

Single grains of AR 2206 were compressed side-on at cross heads speeds varying from 5 to 50 mm/min. All grains displayed considerable plastic deformation before fracture occurred. This behaviour can be clearly seen in figures 2 and 3, which represent side-on compression at a constant speed of 5 mm/min. The onset of fracture occurs at 3.2 kg and 2.9 kg in figure 2 and figure 3 respectively. The two figures are representative of the typical behaviour of the propellant grains, although it is difficult to attach any physical significance to the "shoulder" observed in figure 3 after the onset of fracture.

From load-displacement figures such as 2 and 3, it is possible to estimate the percentage plastic compression which occurs before the onset of fracture. Assuming at close to zero load (indicated by point "a" on the displacement axis in figure 2) that the dimensions of a grain are unaltered, and that at infinite load (indicated by point "b" on the displacement axis in figure 2) the dimension of the grain approaches zero in the direction of compression, then it is possible to roughly estimate from the displacement axis that, in figure 2, approximately 23% compression occurs before fracture begins. Likewise in figure 3, some 21% compression of the original diameter of the grain has occurred before fracture begins. Thus, at a cross head speed of 5 mm/min, grains of AR 2206 can be compressed side-on up to 20-25% of their original dimensions in the direction of the applied load before fracture occurs.

As the cross head speed increases from 5 to 50 mm/min, the percentage compression which occurs before the onset of fracture decreases to roughly 5-10% at 50 mm/min. This qualitative observation is in line with the expected decrease of plasticity as the rate of compression increases(ref.5).

Similar percentage compression occurs before the onset of fracture for grains compressed end-on. Figures 4 and 5 show load-displacement curves for grains compressed end-on at a rate of 10 mm/min. Approximately 26% plastic deformation occurs before fracture begins (at 3.2 kg) in figure 4, and about 25% deformation occurs before the onset of fracture (at 3.1 kg) in figure 5. The compression of grains end-on without bowing or other geometrical perturbations was experimentally difficult to achieve so data are available only at a cross head speed of 5 mm/min.

The average maximum loads required to induce fracture of the individual grains are assembled in Table 1 for the various cross head speeds. It appears that the average loads observed at 20 and 50 mm/min (for side-on compression) are significantly less than the average value experienced at 10 mm/min. However owing to the reduced precision of the former measurements ($\pm$ 1 kg), it is not possible to say with any certainty whether the increase in cross head speed from 10 to 20 or 50 mm/min has any effect on the average maximum load before fracture. However, the increase in the average load from 3.1 ($\pm$ 0.10) kg at 5 mm/min to 3.9 ($\pm$ 0.10) kg at 10 mm/min does appear to be real. The average load before fracture for grains compressed end-on at 10 mm/min is 3.49 ($\pm$ 0.5) kg.

From the data given in Table 1, we may conclude that grains of AR 2206 require loads up to ca 3.4 kg (average of all average maximum loads in Table 1, including end-on values) to induce fracture. Also a small compression rate effect may influence the average loads. The fact that the grains are singly perforated has no detectable effect on the load-displacement curves before the onset of fracture.

3.2 Compression of grains in bulk

In an attempt to simulate the conditions involved when the projectile is inserted into the grain filled cartridge case, compressive loads were applied upon a propellant bed composed of one hundred randomly packed propellant grains contained in a special jig (figure 1). The compressive loads upon the grains will be approximately triaxially distributed, as opposed to the essentially uniaxial compression of individual grains as described in Section 3.1. It is assumed that friction between the plunger and the well walls is negligible.

A number of tests using both perspex and brass wells confirmed an essentially smooth logarithmic relationship exists between load and displacement, as illustrated schematically in figure 6 for cross head speeds of 5 to 50 mm/min. For example, at 5 mm/min, at loads of 100, 200, 300, 400, 500, 600 and 700 kg, the corresponding percentage compression of the original length (or volumes) of the propellant bed is 40.5, 53, 58.5, 61.5, 64, 66 and 67.5% respectively. Thus the load is linearly related to the log of the percent compression in this particular example ($r = 0.90$) .

The smooth logarithmic relationship between load and displacement appears to imply the propellant bed is acting as a single coherent mass. In an effort to determine whether this smooth relationship is an artifact of the insensitivity of the instrumental recording system, we have determined loading displacement curves using a recording system with a response time greater than 1 ms (the response time of the load cell is less than 1 ms). However, smooth logarithmic load-displacement relationships were always observed at cross head speeds from 5 to 50 mm/min.

Hence, in view of the propensity towards plastic deformation displayed by single grains during compression as described in Section 3.1, it seems reasonable to conclude that under the compressive loading conditions described here, individual grains can easily deform into the voids contained in the propellant bed at such a rate (comparable to the cross head speeds) that the propellant bed appears to act as a coherent entity.

## 3.3 Photographic and microscopic studies

### 3.3.1 Compression of individual grains

The optical photographs and scanning electron micrographs provide ample evidence of the plastic deformation of propellant grains compressed individually or in bulk. Figures 7, 8 and 9 show a photograph and micrographs of a selection of grains compressed in bulk at a rate of 10 mm/min up to a maximum load of 250 kg. The degree of plastic deformation varies from apparently minor deformation to quite extreme deformation which quite obviously occurs as various grains are plastically "squeezed" into the various voids amongst the individual grains within the gradually compressing propellant bed. Figure 9 clearly shows the deformation of the surface of a grain resulting from another grain being pushed end-on to that surface.

Figure 10 shows the history of a single grain compressed side-on at a rate of 10 mm/min. Figure 10(a) shows the grain before compression, 10(b) shows the same grain compressed to a maximum load of 3.75 kg (the load-displacement diagram reveals some fracture process occurred at 3.36 kg), and reveals evidence of fracture as indicated. Figure 10(c) shows the same grain after a maximum load of 6.5 kg, where considerable "flattening" of the grain has occurred, and the rupture site has expanded.

Figure 11 shows a single grain deformed end-on at a rate of 10 mm/min. The fact that deformation has largely occurred at only one end of the grain is not significant, as various geometrical factors and the effect of friction between the grain and the compression devices are unknown.

From studies of the load-displacement relationships for compression of single grains, as discussed in Section 3.1, the evidence appeared to suggest that up to 25% compression of individual grains can occur before the onset of fracture. However, the fracture processes were unspecified, and it is possible that small cracks could occur before the macroscopic "fracture process" is registered by a change in the load-displacement diagram. That is, the sensitivity of the Instron instrumentation may be such that small cracks could occur and not be detected in the load-displacement relationship.

From first principles, it is possible to anticipate the likely geometrical stress points for a single grain compressed side-on. Figure 12 indicates schematically the likely major stress points for such a situation. Figure 13 shows a single grain from a bulk compression study which has apparently been compressed side-on by another grain lying across it. Whilst the degree of plastic deformation appears small (probably significantly less than 25%), small cracks can be seen at the junction of the end face and the long axis. Figures 14 and 15 are enlarged micrographs of the cracked section in figure 13, with the latter micrograph clearly showing the presence of nitrocellulose fibres inside the crack. Hence figures 13-15, and other similar micrographs, suggest small cracks can occur at geometrical stress points quite probably before the onset of fracture is indicated from the load-displacement diagrams, as discussed in Section 3.1.

Further evidence of the soft plastic nature of the grains can be seen in figure 16 where evidence of "gouging" of the surface, possibly by the edge of another grain, is evident.

### 3.3.2 Compression of grains in bulk

At this stage, all the evidence thus considered is strongly in favour of the idea that at compression rates from 5 to 50 mm/min, propellant grains of AR 2206 can undergo significant plastic deformation without extensive shattering of the grains, individually or in bulk. Individual grains can undergo up to 25% deformation, side-on or end-on, before the onset of a major fracture process. However small cracks at geometrical stress points may possibly occur before this process begins, but such cracks are highly unlikely to cause a major increase in surface area, as would occur if brittle fracture occurred.

In an effort to discover the effect of compressing the whole propellant bed under the previously described experimental conditions, we have used a special clear perspex jig to allow visual inspection of this process. Hence, at a compression rate of 10 mm/min, we have photographed the various stages corresponding to 0%, 19%, 29%, 38%, 46%, 49% and 52% compression of the original volume of a bed of randomly packed grains. Figures 17, 18, 19, 20, 21, 22 and 23 respectively correspond to these degrees of compression. The corresponding maximum loads are 0, 30, 60, 100, 150, 200 and 250 kg respectively.

From figures 17 to 23 it is quite evident that extensive plastic deformation of grains occurs, expecially deformation into the voids in the propellant bed. Even at 52% compression there is no sign of any shattering of the grains although small cracks probably occurred at geometrical stress points.

## 4. CONCLUSIONS

Within the available compression rate range of 5 to 50 mm/min, single grains of AR 2206 can be deformed plastically by up to 20-25% before the onset of a major fracture process. However, when compressed in bulk, up to 50% compression of the original volume of the bed is possible without any signs of extensive fracture of individual grains.

Some evidence is available from scanning electron microscopy that small cracks, which are not instrumentally detectable, can arise at geometrical stress points in the grain. However such fracture still requires considerable deformation of the grain.

These results, whilst only pertaining to comparatively low compression rates, do suggest that when a propellant bed is compressed at 350-400 mm/min (the rate at which the projectile is inserted into the cartridge during manufacture), the substantial plasticity of the grains would allow deformation into the free spaces within the propellant bed, rather than result in fracture of the grains.

## 5. ACKNOWLEDGEMENTS

I am grateful to Mr A. Wilson (for the optical photographs) and Mr J. Terlet (for the scanning electron micrographs).

TABLE 1. AVERAGE MAXIMUM LOADS REQUIRED TO INDUCE FRACTURE OF SINGLE GRAINS COMPRESSED SIDE ON AND END ON AT 20°C

| Strain rate (mm/min) | Test mode | Average maximum load[a] (kg) | SD%[b] |
|---|---|---|---|
| 5 | Side-On | 3.1[c] | 30.3 |
| 10 | Side-On | 3.9[c] | 32.6 |
| 20 | Side-On | 3.3[d] | 46.2 |
| 50 | Side-On | 3.3[d] | 41.0 |
| 10 | End-On | 3.5[c] | 41.0 |

a. Average of ten observations
b. Standard Deviation as percentage of maximum range of observations
c. Absolute experimental error ± 0.5 kg
d. Absolute experimental error ± 1.0 kg

## REFERENCES


| No. | Author | Title |
| --- | --- | --- |
| 1 | | Specification Army (Aust) 293 for Cartridge, 7.62 mm, Ball, F4 |
| 2 | | Specification Army (Aust) 165 for Cartridge, 7.62 mm, Tracer, F3 |
| 3 | | Private Communication from Ammunition Factory Footscray |
| 4 | | Specification Army (Aust) 1305 for Propellant AR 2206 for use in 7.62 mm Ammunition |
| 5 | Fong, C.W. | "Mechanical Properties of Gun Propellants. An Assessment of Possible Approaches to Laboratory Testing". WSRL-0120-TM, December 1979 |

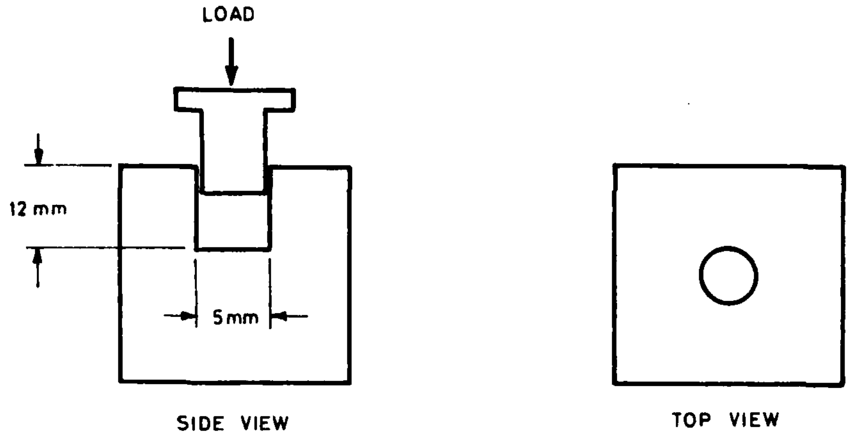



Figure 1. Schematic representation of jig used for compression studies of grains in bulk, showing well and plunger

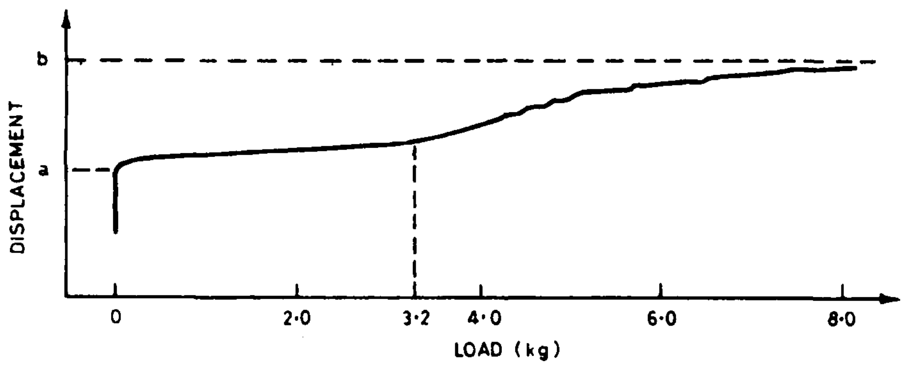



Figure 2. Load-displacement relationship for side-on compression of a single grain at a compression rate of 5 mm/min. The onset of fracture is indicated by the dotted line

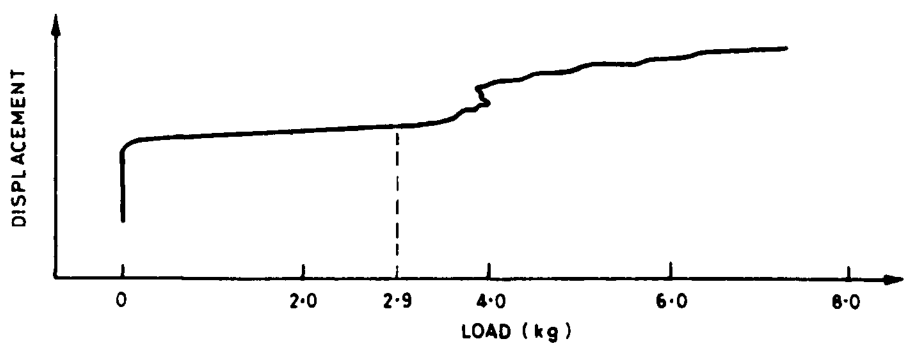



Figure 3. Load-displacement relationship for side-on compression of a single grain at a compression rate of 5 mm/min. The onset of fracture is indicated by the dotted line

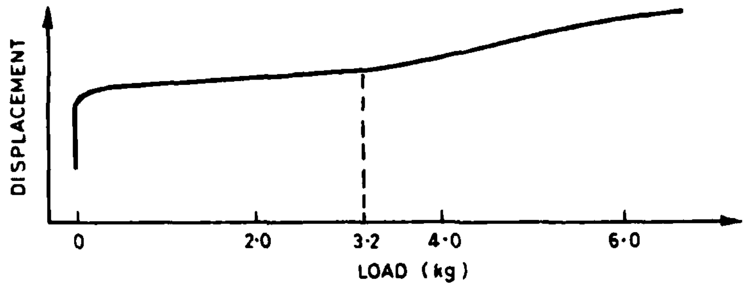



Figure 4. Load-displacement relationship for end-on compression of a single grain at a compression rate of 5 mm/min. The onset of fracture is indicated by the dotted line

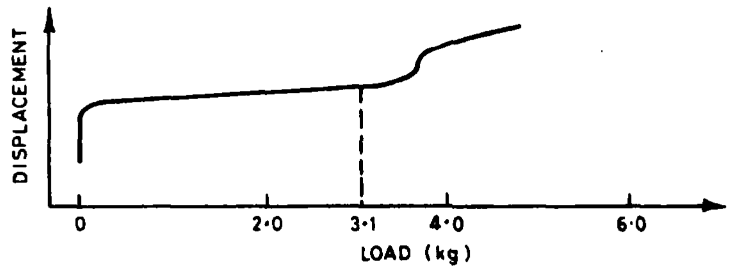



Figure 5. Load-displacement relationship for end-on compression on a single grain at a compression rate of 5 mm/min. The onset of fracture is indicated by the dotted line

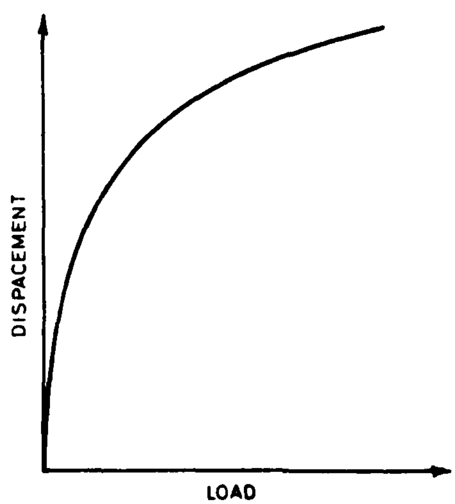
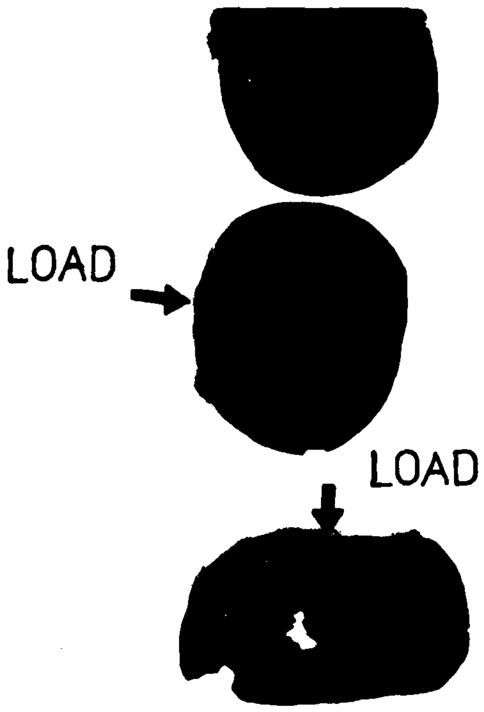



Figure 6. Schematic representation of load-displacement relationship for grains compressed in bulk

Figure 7. Photograph of an assortment of grains compressed in bulk at 10 mm/min to a maximum load of 250 kg


Figure 8. Scanning electron micrograph (magnification x20) of an assortment of grains compressed in bulk at 10 mm/min to a maximum load of 250 kg


Figure 9. Scanning electron micrograph (magnification x48) of an individual grain from figure 8




(a)

(b)

(c)

Figure 10(a). Photograph (end-on) of a single virgin grain

Figure 10(b). Photograph (end-on) of a single grain which has been compressed side-on at 10 mm/min to a maximum load of 3.75 kg. The grain fractured at a load of 3.36 kg

Figure 10(c). Photograph (end-on) of the same propellant grain in figure 10(b) which has been subjected to a maximum load of 6.50 kg

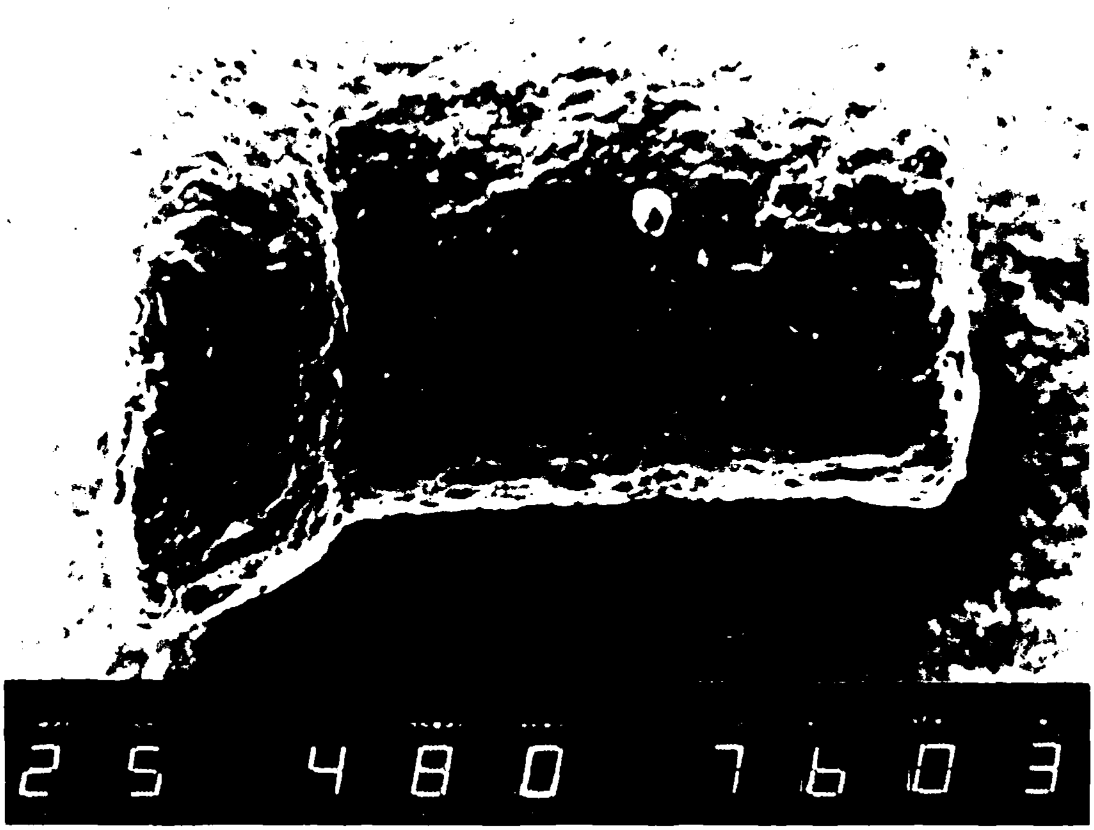



Figure 11. Scanning electron micrograph (magnification x48) of a single grain which has been compressed end-on at 10 mm/min to a maximum load of 5 kg

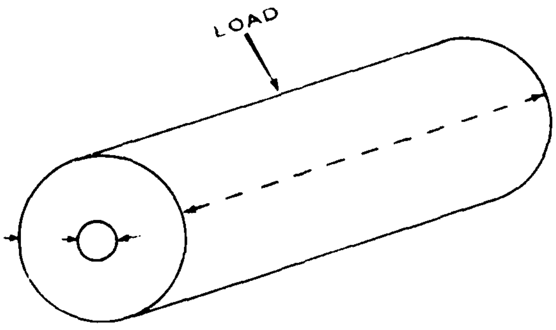



Figure 12. Schematic representation of the likely stress points for a single grain. The likely stress points are indicated by the arrows


Figure 15. Scanning electron micrograph (magnification x181) of a single grain from a ball compression study showing small cracks at a geometrical stress point


Figure 14. Scanning electron micrograph (magnification x400) of the region showing small cracks in figure 13

Figure 15. Scanning electron micrograph (magnification x1500) of a crack from figure 14 showing individual nitrocellulose fibres


Figure 16. [illegible] ...tion X18) of a single
[illegible] ...sing "gouged" regions

Figure 17(a). Photograph of top view of perspex well containing randomly packed grains

Figure 17(b). Photograph of side view of perspex well containing randomly packed grains

Figure 18(a). Photograph of top view of perspex well containing randomly packed grains after the propellant bed has been compressed 19% by an applied load of 30 kg at a rate of 10 mm/min

Figure 18(b). Photograph of side view of perspex well containing randomly packed grains after the propellant bed has been compressed 19% by an applied load of 30 kg at a rate of 10 mm/min

Figure 19(a). Photograph of top view of perspex well containing randomly packed grains after the propellant bed has been compressed 29% by an applied load of 60 kg at a rate of 10 mm/min

Figure 19(b). Photograph of side view of perspex well containing randomly packed grains after the propellant bed has been compressed 29% by an applied load of 60 kg at a rate of 10 mm/min

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Figure 23(a). Photograph of top view of perspex well containing randomly packed grains after the propellant bed has been compressed 52 by an applied load of 250 kg at a rate of 10 mm/min

Figure 23(b). Photograph of side view of perspex well containing randomly packed grains after the propellant bed has been compressed 52% by an applied load of 250 kg at a rate of 10 mm/min

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