LOS ALAMOS SHOCK WAVE PROFILE DATA

LOS ALAMOS SERIES ON DYNAMIC MATERIAL PROPERTIES

LOS ALAMOS DATA CENTER
FOR DYNAMIC MATERIAL PROPERTIES

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LOS ALAMOS SHOCK WAVE PROFILE DATA

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INTRODUCTION

This volume of the Los Alamos Series on Dynamic Material Properties is designed to provide a single source of shock wave profiles determined at the Los Alamos National Laboratory.

The first wave profiles were measured at Los Alamos National Laboratory by Minshall (1955) using high-precision pin work by which a very accurate x-t map was made of the free-surface displacement and the two-wave structure indicating elastic-plastic flow was demonstrated. Later Minshall and his coworkers (1956) established the polymorphism of iron in a work now considered a classic. Other phase transitions studied by Minshall and his coworkers include bismuth (1957), antimony (1962), and many iron alloys (1961). To eliminate the need to differentiate x-t data and the subsequent loss of precision, techniques were developed to measure directly time-resolved stress and velocity wave profiles. R. G. McQueen, one of the workers in the field at the time, reminisces:

Historical Perspective by Robert G. McQueen

It was an exciting time in shock wave physics when the first efforts were made to make time-resolved pressure and velocity measurements. These efforts were directed primarily to resolve the structure in shocks due to elastic-plastic flow. The basic phenomena were well understood but the details of the mechanism governing the flow were not. It was recognized that if the measurements could be made, elastic-plastic phenomena could be studied at the highest possible strain rates, those governed by the elastic properties of the material itself. The basic difficulty encountered in making the measurements did not lie with the time resolution. For example, if the wave coming through a 5-mm sample had a longitudinal velocity of 5 mm/μs and a plastic wave velocity of 4 mm/μs there would be 0.25 μs to study the elastic to plastic behavior. However, for a material like iron the pressure of the elastic wave of about 1 GPa would result in a velocity of only 0.05 mm/μs, which means that the measurements must be made in a distance of less than 0.015 mm. This is the problem that Minshall overcame by meticulously locating shorting pins on the surface of the iron plate he used in making his classic measurements of the amplitude of the elastic wave of the shocked iron. This work was an inspiration to those working in shock wave physics. It was also obvious that there were very few people around that could do the type of work that Stan Minshall did and that there just had to be a better way to make these measurements. It was during this time that a concentrated effort was made to develop techniques to resolve the elastic-plastic behavior of shock-loaded materials. There were three efforts: two at Los Alamos, the Free-Surface Condenser Method devised and developed by Mel Rice, the Optical Lever Arm by Stan Marsh and me, and the Quartz Pressure Transducer by Frank Neilson and his group at Sandia. Although the basic concepts seemed quite straightforward, the developments of successful working systems were more difficult. All three groups did some of their development work using iron because we knew from Minshall's work that there would be a measurable effect. I do not remember the problems the quartz gage and the capacitor technique encountered although we had several meetings to discuss our progress. In developing the optical lever technique problems included sample preparation with a mirror finish, modifying our smear camera to do a job it was not designed to do, developing low-pressure HE systems and high-intensity light sources, and the most bothersome thing of all, originally, developing a method for optically aligning the system.

It was with some pleasure and excitement that Stan and I got our first good record. However, our joy was short-lived when we showed it to Mac Walsh, who was Group Leader here at Ancho Canyon Site. I think his remark was something like this, "I'm sorry, guys, but you're not out of the woods yet. This record shows a decreasing elastic wave velocity." And so it did, but the following week Rice obtained his first successful iron record showing the same phenomena. Neilson's group observed the same thing a week or so later. I have always thought it was interesting that these three endeavors initiated at the same time also came to fruition within a few days of one another. It was also exciting that one of the first materials investigated exhibited such a well-defined stress relaxation behavior. This was indeed a most interesting time.

Rice (1961) developed the free-surface capacitor technique, which measured directly the free-surface velocities of shocked loaded targets. The first wave profile measurements were made in 1959, and the results were published in 1961. This technique has been very successful in the study of low-amplitude elastic and plastic waves generated by impact of projectiles from smooth-bore guns. The stress relaxation of elastic waves in Armco iron was one of the initial discoveries made using this technique [Taylor and Rice (1963), Taylor (1965)], stimulating much research in the rheology of metals under shock loading.

A variety of techniques has been used at Los Alamos to measure wave profiles. Some of the techniques include the quartz gage [Neilson (1961)], the wire reflection technique

[Davis and Craig (1961)], the inclined mirror [Fowles (1962)], the optical lever technique [McQueen (1964)], the Manganin gage [Fuller and Price (1962)], the ASM probe [Fritz and Morgan (1973)], and the VISAR [Barker and Hollenbach (1972)]. A few of the experimental techniques listed were used only briefly whereas others were used extensively. The most widely used techniques at Los Alamos over the last 20 years were the free-surface capacitor, the quartz gage, the Manganin gage, and the axially symmetric magnetic (ASM) probe. Wave profiles of these techniques will be presented in this compendium, and for readers who are unfamiliar with these techniques, each is described briefly.

The wave profiles presented are arranged by material, independent of the experimental technique used. The materials are divided into six classifications similar to those used in Marsh's *LASL Shock Hugoniot Data* volume: elements; alloys; minerals and compounds; rocks and mixtures of minerals; plastics; and high explosives, high-explosive simulants, and propellants.

The letters and numerals found in some of the shock wave profiles are defined under "Graph Symbols" in the glossary.

The appendix lists the longitudinal and shear velocities of materials investigated at Los Alamos. Marsh, using a pulse transmission technique, measured the velocities [Birch (1960) and Schreiber, Anderson, and Soga (1973)]. Transit times through the samples were determined by echo spacing or, for highly attenuating materials, by the difference in arrival times for samples of differing thickness. The estimated precision is 1/2-2% depending on the ultrasonic attenuation of the samples.

The appendix also has a compilation of Hugoniot elastic limit data obtained by the free-surface capacitor technique, the ASM probe, and the optical lever technique. Except in special cases where a "yield point" effect is well defined, the decision about exact amplitudes is made arbitrarily, but a consistent attempt is made to take the first point where the free-surface-velocity-versus-time record shows significant curvature. In most materials, the elastic limit is determined to within 10%; the error in some cases is probably even greater. In many materials the Hugoniot elastic limit is a decreasing function of sample thickness [Taylor and Rice (1963)], so the sample thickness is also listed.

FREE-SURFACE CAPACITOR TECHNIQUE

This capacitor technique developed by Rice (1961) measures the velocity of a plane conducting surface by electronically differentiating the signal and has proved valuable in studying elastic-plastic behavior of materials at modest pressures. The capacitor circuit used typically is shown in Fig. 1. Initially, the capacitor C_0 is charged to a constant voltage E_0 through two isolating resistors R_1 and R_2. The capacitance C_0 is chosen large enough so that the voltage across it will be essentially constant during the measuring time interval. The variable capacitor C consists of a fixed disk positioned a known distance above the surface whose velocity is to be measured. The capacitor assembly is shown in Fig. 2. The

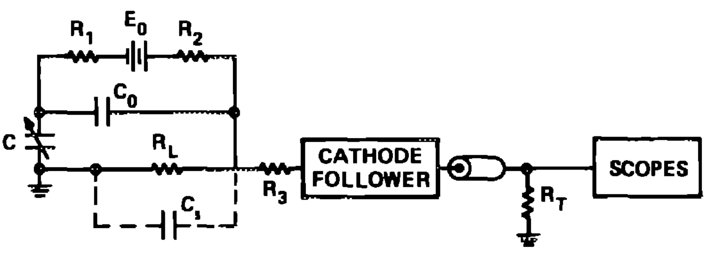


Fig. 1.
Circuit for free-surface capacitor. Typical values for circuit parameters: $E_0 = 1200$ V, $R_1 = R_2 = 2$ MΩ, $C_0 = 0.01$ μF, $C = 2$ pF, $C_s = 12$ pF, $R_L = 1$ kΩ, $R_3 = 50$ Ω, and R_T is the terminating resistor for coaxial cable.

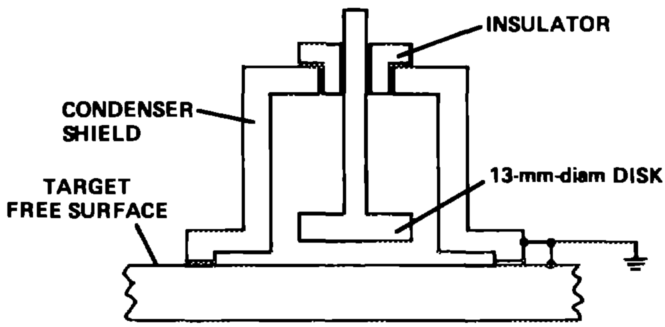


Fig. 2.
Free-surface capacitor assembly.

fixed disk is mounted inside a metal shield, which restricts the free-surface area that contributes to the output signal. The target's free surface and the shield are at ground potential. In the early 1960s when experiments were performed on a 165-mm-diameter gun, the fixed disk's diameter was 25 mm. This diameter was reduced by a half when the experiments were transferred to a 51-mm gun. With target free-surface movement, the capacitance C increases, and because the charging voltage is held constant, the charge on C also increases, causing current flow and voltage development across the load resistor R_L. Neglecting transient effects, the output signal is given by

$$V(t) = E_0 R_L \frac{dC}{dx} U_{fs}(t) ,$$

where E_0 = charging voltage, R_L = load resistance, dC/dx = derivative of the capacitance with respect to the surface displacement x, and U_{fs} = free-surface velocity. The output voltage across the resistor R_L is fed into a cathode follower, which powers the coaxial cable connecting the experimental assembly to the recording oscilloscopes. To minimize stray capacitance, the cathode follower and the capacitor circuit are mounted directly on the capacitor assembly and are expended with each shot. C_s is the sum of the cathode follower input capacitance and the circuit wiring stray capacitance. The resistor R_3 being connected to the cathode follower grid is required for stability. The estimated time resolution of this measurement system is 10-20 ns, and the calibration accuracy is a few per cent [Taylor (1973)].

Before the capacitor assembly is used, it must be calibrated to determine dC/dx. Initially, dC/dx was determined by measuring the force of attraction between the capacitor disks using an analytical balance. The force of attraction is directly related to dC/dx through the equation $F = E^2 (dC/dx)/2$. For convenience and improved accuracy, the calibration scheme was changed later to Taylor's arrangement (1973), shown in Fig. 3, in which the capacitance was measured as a function of disk spacing with a General Radio model 1615 capacitance bridge. If the capacitor's diameter is at least ten times the spacing, the capacitance is represented very accurately by $C/C_0 = x_0/(x_0 - \Delta x)$, where Δx is the displacement.

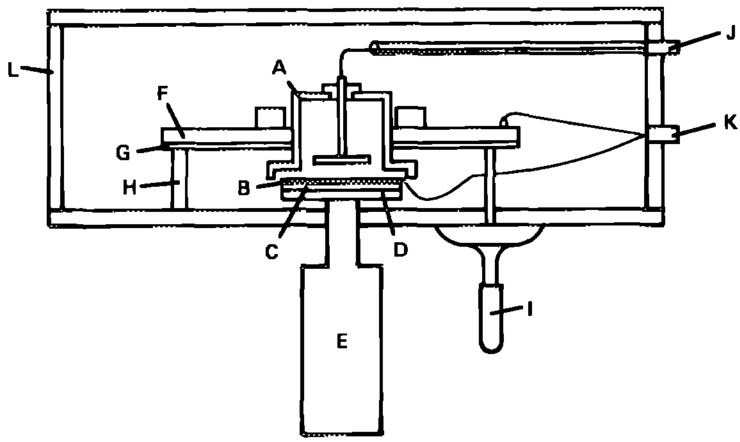


Fig. 3.
Calibrator for 0.5-10 pF dc capacitors. Capacitor A is held in mounting and centering fixture F, insulated by plastic spacer G from support points H and leveling micrometer I. The second plate of capacitor B is insulated from "case ground" L by insulator C supported on plate D, attached to the high-precision micrometer E. Connectors J and K are used with coaxial cables to connect to high- and low-impedance terminals, respectively, of a General Radio model 1615 capacitance bridge. The bridge is in the three-terminal mode, which automatically zeros out capacitance to case ground. Capacitance is then measured as a function of the position of plate B.

The free-surface capacitor technique applies to virtually all experiments involving shocks in metals as long as the main shock velocity does not exceed the material's longitudinal sound speed. Stronger shocks in metals produce an internally generated electrical signal (whose origin and mechanism remains a complete mystery), which mixes with the capacitor record and cannot be unfolded readily. The technique can also be used with insulators whenever a thin metal film on the material surface can be evaporated or otherwise deposited. If such materials are severely inhomogeneous and if some penalty in time resolution is acceptable, an aluminum or copper foil can be attached to the target surface.

THE AXIALLY SYMMETRIC MAGNETIC (ASM) PROBE

The ASM probe [Fritz and Morgan (1973)] has been used to study insulators [Morgan and Fritz (1979)], detonating explosives [Hayes and Fritz (1970), Davis (1976)], HE-driven metal plates, and the quasi-elastic structure in metals. Figure 4 illustrates an ASM probe assembly designed to measure the acceleration of an HE-driven metal plate. A permanent magnet provides a nonuniform steady magnetic field through which the plate is accelerated. Because of the magnetic field, eddy currents generated in the moving

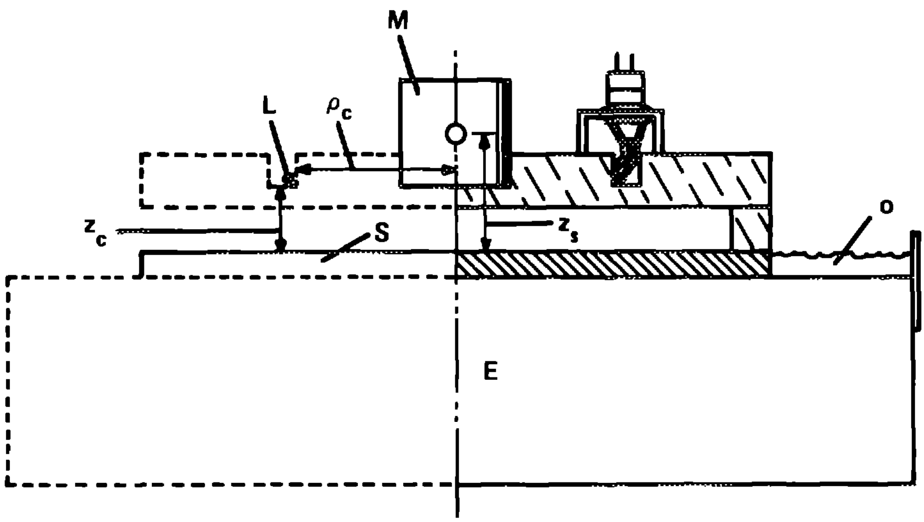


Fig. 4.
An axially symmetric magnetic probe assembly. The small ceramic magnet M is surrounded by a single turn of wire L connected to a cable. All are mounted on a premachined Lucite plate. Double arrows indicate critical dimensions. Sample S rests on explosive E and is surrounded by mineral oil O, which helps reduce electrical noise from the explosive. The sample-explosive joint is sealed with grease.

conductor produce a time-varying magnetic field. These time-varying fields induce a voltage signal in a pickup coil from which the velocity of the metal plate is determined [Fritz and Morgan (1973)]. The metal surface need not be a free-metal surface, as in this example, but may be a metal foil sandwiched between insulators or a metal surface beneath an insulator. The presence of the intervening insulator does not impair the probe functioning in most instances because the shock-induced permeability changes are parts per thousand in the worst cases (excluding ferromagnetic materials), and the shock-induced conductivity must be substantial before it effectively retards the field line motion and prevents the signal's appearance on the pickup coil. For example, detonated high explosives are transparent to the probe [Hayes and Fritz (1970), Davis (1976)]. The capability to look through shock-intervening insulators and the absence of electrical leads inside the high-pressure environment make the ASM probe an excellent tool for investigating material properties at high pressures. Measurements have been made on copper to 140-GPa pressure [Morris (1981)].

To obtain a calibrated response for the ASM probe, the pertinent physical dimensions z_c, z_s, and ρ_c are needed (see Fig. 4), in addition to the accurate measurement of $B_\rho(\rho, z)$ of the magnet over the range of interest. The axial Hall-effect field measuring probe maps out the B_ρ field. With this calibration and the recorded wave profile, the data are analyzed by an elaborate computer code solving the complete electrodynamic problem, including the metal foil's effect of finite conductivity [Fritz and Morgan (1973)]. An absolute check on the computed wave profile, $U_p(t)$, can be done with the experimental assembly shown in Fig. 4. The integrated particle velocity to impact time with the fiducial impact surface (FIS) should agree with the measured FIS spacing. Several experiments were done to check the probe's calibration. The rms deviation between the calculated and measured FIS spacing was 1.7%. This is a measure of the particle velocity accuracy using the ASM probe. The inherent probe time resolution is one nanosecond per centimeter coil diameter, but the time resolution is limited usually by the nonplanarity of impact and the resultant lack of simultaneous wave arrival.

One effective use of the ASM probe is to deposit 50- to 75-nm-thick aluminum films on insulating surfaces where timing information is desired. When the shock wave emerges at these surfaces, a brief twitch of the magnetic field [and thus a brief twitch of V(t)] is produced. These films have negligible surface conductivity and are active elements of the experiment only during large accelerations. This technique is often used in "front door" experiments, where the mechanical properties of insulators are being measured [Morgan and Fritz (1979)].

MANGANIN GAGE

Manganin is a copper-manganese alloy (typically, 84 wt% copper, 12 wt% manganese, and 4 wt% nickel), which has an extremely low temperature resistivity coefficient and a relatively large positive piezoresistive coefficient. These characteristics enhance its use in shock-wave physics applications. The gages most commonly used are manufactured by Micro-Measurements from shunt-stock-grade Manganin using a photo-etch process. These gages are 0.013 mm thick and have a resistance of 50 Ω. To isolate the piezoresistive signal to the grid portion of the gage, the gage leads are overplated with a few micrometers of copper. In applications where a durable gage is required, such as in the study of detonating explosives, a low-impedance (0.020-Ω) gage is used and is encapsulated with 0.25-mm-thick Teflon layers to prevent premature shunting [Vantine et al. (1980)]. The introduction of gages into detonating explosives can significantly change the flow. The Manganin gage locations are specified here as the distance from the impact surface to the actual gage location. For insulated gages, the distance is to the midpoint of the gage-insulator package.

Manganin gages are in-material stress gages and thus the records have no boundary effects that complicate interface measurements. The gages are used in studying wave evolution by embedding gages at varying depths in the target. The wave profiles can be analyzed then by a Lagrangian analysis scheme [Seaman (1974)]. A pulsed Wheatstone bridge circuit has aided Manganin gage work [Rice (1970) and Taylor (1973)] and is shown in Fig. 5. This circuit's output signal is approximately proportional to the fractional change in the gage resistance ($X = \Delta R_G/R_G$). Before firing, the bridge is balanced by varying R_3 until zero voltage is sensed at the output terminals AC. When this balanced condition is observed, $R_3 = R_G + R_L$. For this bridge configuration the input bridge impedance at AB matches a 50-Ω cable to avoid reflections in the gage cable. This circuit's output voltage is given by

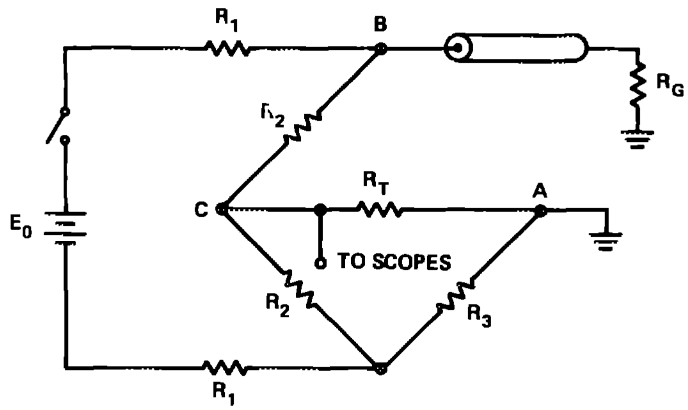


Fig. 5.
Wheatstone bridge circuit. Typical values for circuit parameters: $E_0 = 290$ V, $R_1 = 51$ Ω, $R_2 = 31$ Ω, $R_3 = 50.5$ Ω, $R_T = 50$ Ω, and $R_G = 50$ Ω.

$$\frac{V(t)}{E_0} = \frac{AX}{(1 + BX)} ,$$

where $X = \Delta R_G/R_G$, $V(t)$ = signal voltage, E_0 = supply voltage, and

$$A = \frac{R_2 R_T R_G}{[2R_1R_2 + R_3(2R_1 + 2R_2)] [R_2 + R_3 + 2R_T]}$$

$$B = \frac{R_G(2R_1 + 2R_2) (R_3 + R_T) + R_2R_G(2R_1 + R_2)}{[2R_1R_2 + R_3(2R_1 + 2R_2)] [R_2 + R_3 + 2R_T]} .$$

Note that the initial resistance R_3 of the signal portion of the bridge is not the initial gage resistance R_G because the signal cable and gage leads may introduce some additional series resistance ($R_L = 0.5\ \Omega$). When a 50-Ω Manganin gage is used, the output sensitivity is ~0.3 V/GPa.

One of the problems in using Manganin gages is gage calibration. Experience at Los Alamos has shown that there is no unique calibration for Manganin [Wackerle, Johnson and Halleck (1975)]. Different encapsulations will generally yield different calibration curves, which explains the variety of calibration curves in this compendium even though, in some cases, the same supplier was used. The estimated precision of these calibrations is 5%, which could be improved by designing self-calibrating shots in which certain features of the wave profile are known. Another complicating feature of the Manganin gage is that the release calibration curve differs from the loading curve [Steinberg and Banner (1979), Morris (1981)]. Steinberg and Banner have measured 10% hysteresis in unloading when the gage was encapsulated between 0.025-mm-thick Kapton layers. A 30% hysteresis was observed by Morris (1981) when a bare gage was encapsulated between single-crystal corundum substrates. No correction to the unloading portion of the wave profiles presented here accounts for this hysteresis.

When Manganin gages are embedded in insulators, the response time to come into equilibrium with their surroundings can be as fast as 10-20 ns. However, when the gages are used in a conductor, the gage has to be encapsulated. Kapton is used commonly for this purpose. In this environment the response time for the gage package is increased considerably. The equilibration time is a function of the gage-package thickness and the impedance mismatch between the target and the encapsulating material. Response times of 100 ns in this configuration are not unusual.

QUARTZ GAGE

The piezoelectric response of crystalline quartz has been used in various ways for pressure measurements. Here, the term quartz gage refers explicitly to the quartz gage developed by Graham and his coworkers [(1965) and (1970)] for measuring interface pressures in one-dimensional shock configurations. Such a gage is simply a disk of synthetic x-cut quartz in contact with a shock-loaded sample. The stress wave transmitted into the quartz element induces a dielectric polarization generating a current approximately proportional to the instantaneous difference in stress at the gage faces. Pressure histories of sample-gage interface are obtained during the stress wave transit time through the gage element, typically 1-2 μs. The dynamic elastic limit of x-cut quartz imposes a 6-GPa useful upper pressure limit for these gages, and they are most accurate when used below 4-GPa pressure.

The quartz gage experiments in these data used the front-back configuration (Fig. 6). [See Wackerle, Johnson, and Halleck (1975); and Halpin, Jones, and Graham (1963)]. With this configuration, the front, or projectile gage determines the pressure history in the sample at the impact face. The pressure history measured at the back interface is a reflected-wave state in the sample. In addition to the pressure histories, the shock transit time through the sample, and thus an average shock velocity, is obtained by relating the start times of the two gage signals through a common fiducial.

Generally, the quartz gages were used in the condition received from the manufacturer. Specifications on the crystals are those developed at Sandia National Laboratories, Albuquerque, and approach those detailed in Ingram and Graham (1970). The gages were used in either the shunted guard ring or the grounded guard ring geometry (Fig. 7) with the latter being the most commonly used configuration. The quartz gage calibration for the reported wave profiles is detailed by Wackerle, Johnson, and Halleck (1975). Briefly stated, at pressures below 4.1 GPa, the piezoelectric coefficient of Graham, Neilson, and Benedick (1965) and of Ingram and Graham (1970) was used; above 4.1 GPa, the piezoelectric coefficient of Graham and Ingram (1969) was applied. To account for the current increases for time in a step-function loading of the quartz gage, a deconvolution technique was used with the field-fringe correction similar to that described by Bickle, Reed, and Keltner (1971). The precision of the quartz gage profiles is estimated to be 2-3%. Intrinsically, the quartz gage response time is subnanosecond but time resolution is usually limited by the nonplanarity of impact.

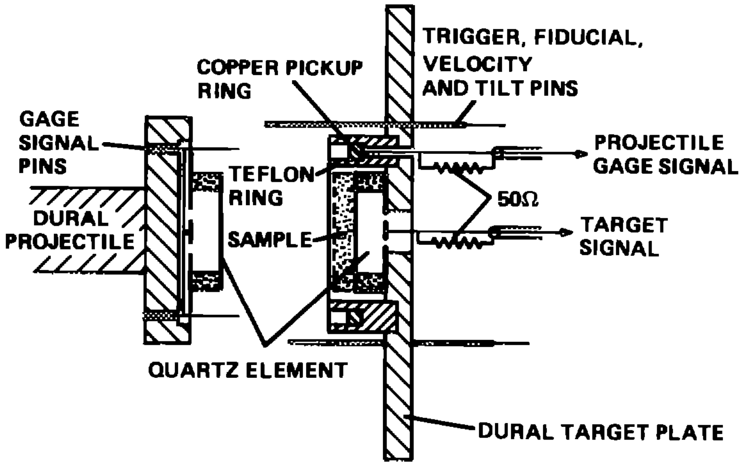


Fig. 6.
Quartz-gage front-back experimental assembly. A system with grounded guard ring gages is shown.

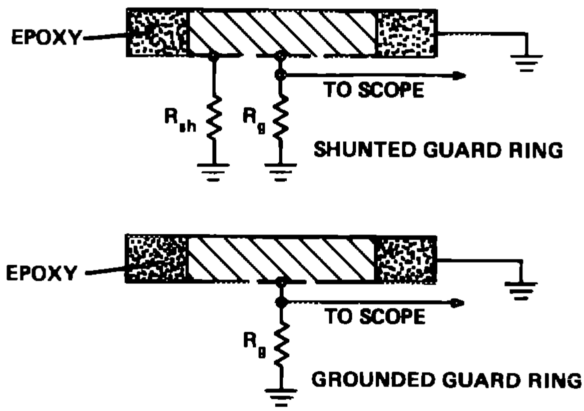


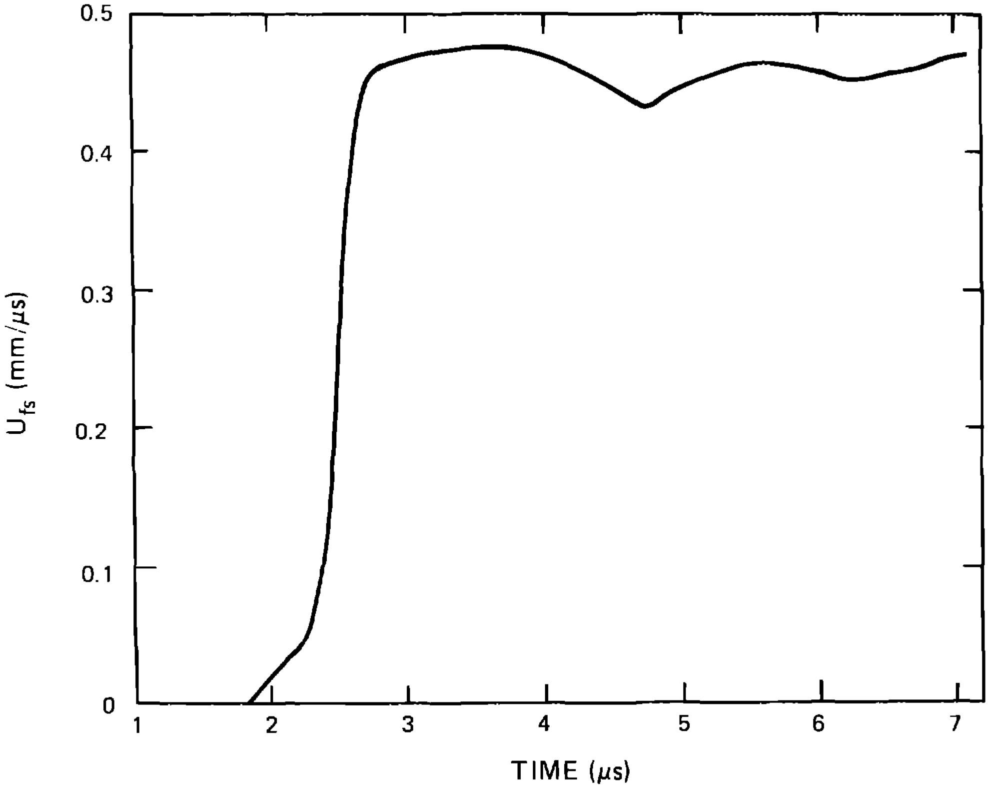
Fig. 7.
Quartz-gage guard ring configurations. Heavy lines indicate conducting surfaces. R_g is usually 50 Ω and R_{sh}/R_g is properly equal to electrode area/guard ring area.

ELEMENTS

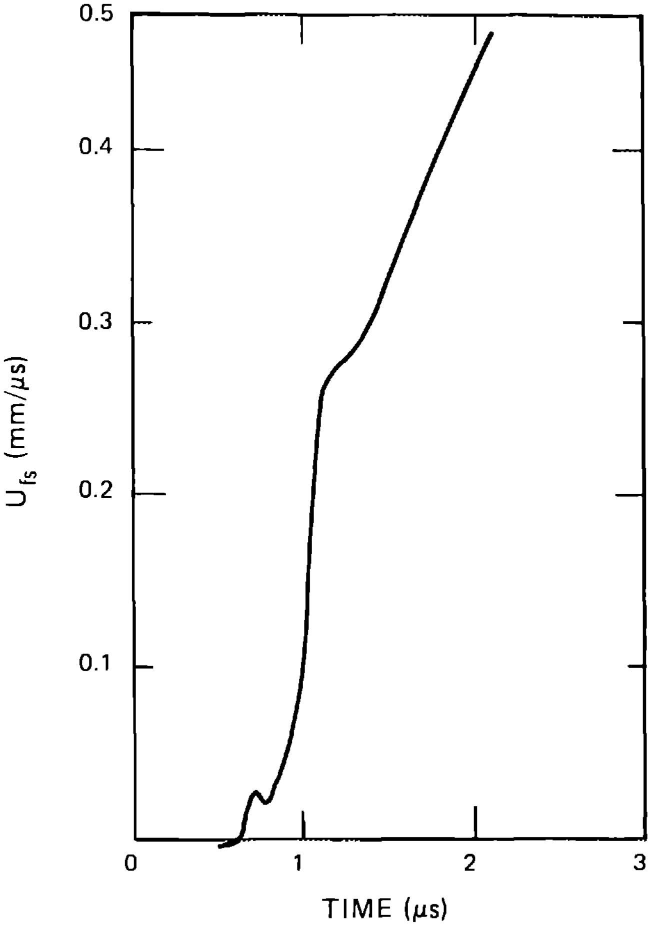
TARGET Material: Beryllium
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: J. W. Taylor (1968)
Shot no.: 56-65-358 Date: August 11, 1965
Thickness: 25.4 mm Diameter: 153 mm

IMPACTOR Beryllium, 12.7 mm thick, backed with low-density polyurethane foam, mounted on 165-mm-diam aluminum alloy projectile
Impact velocity: 0.507 mm/μs

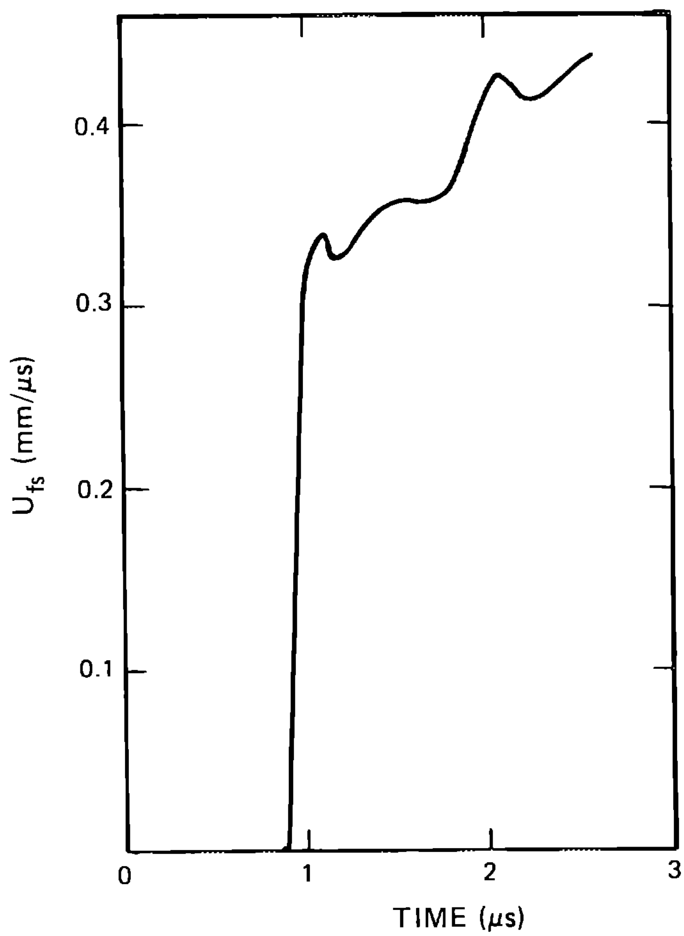
TRANSDUCER Free-surface capacitor
Time: Relative



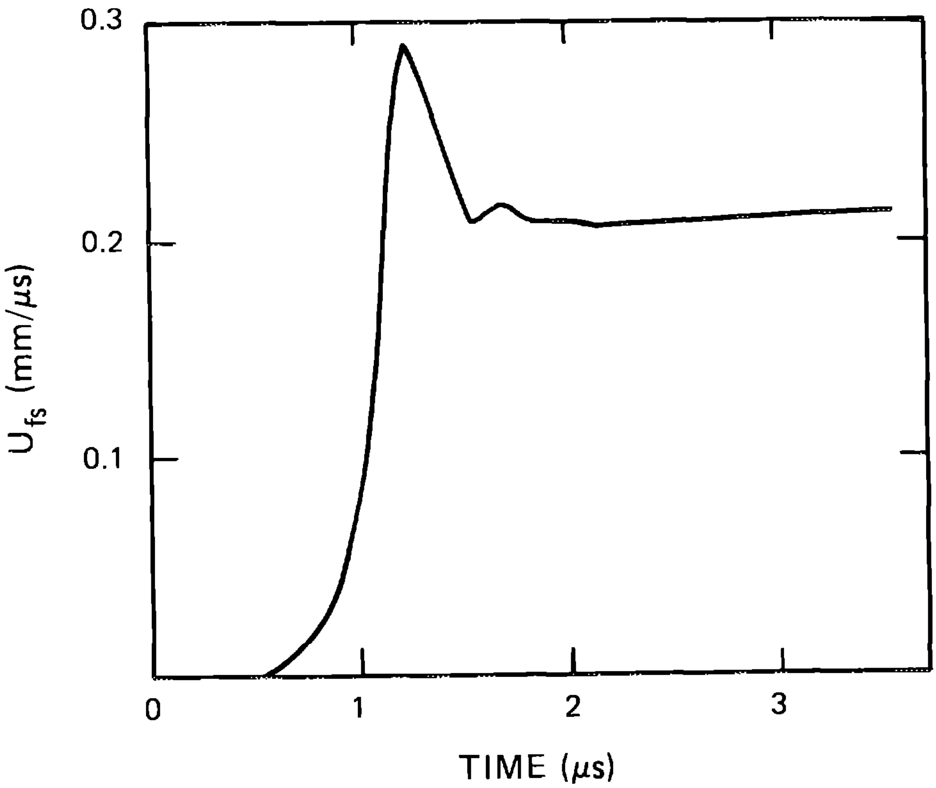
TARGET	Material: Beryllium, single crystal, perpendicular to C-axis Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Reference: J. W. Taylor (1968) Shot no.: 56-63-221 Date: April 25, 1963 Density: 1.848 g/cm^3
IMPACTOR	Steel, 6.35 mm thick, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



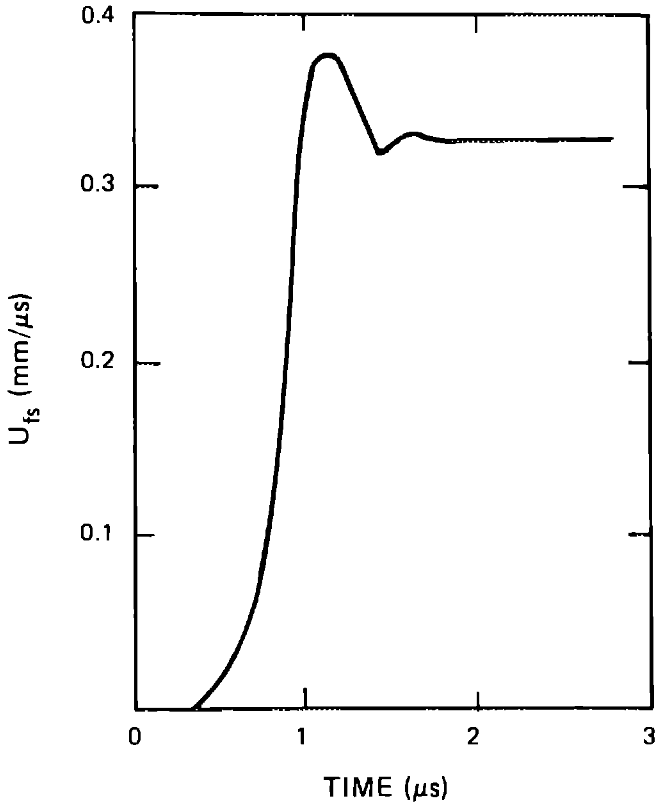
TARGET	**Material:** Beryllium, single crystal, parallel to C-axis **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** J. W. Taylor (1968) **Shot no.:** 56-63-222 **Date:** April 25, 1963 **Density:** 1.848 g/cm^3
IMPACTOR	Steel, 6.35 mm thick, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative



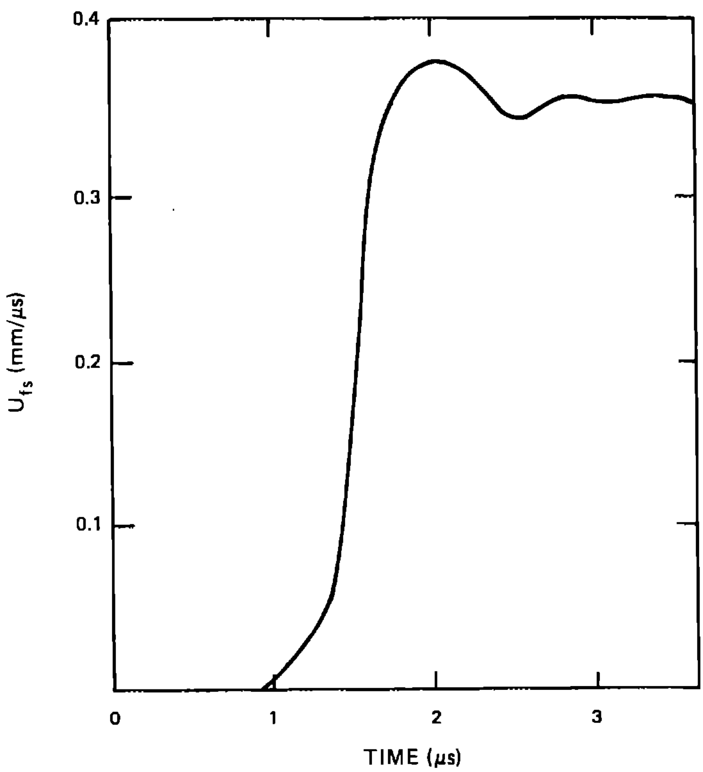
TARGET	**Material:** Beryllium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-67-428 **Date:** March 29, 1967 **Thickness:** 12.70 mm **Diameter:** 38.1 mm
IMPACTOR	Beryllium, 1.59 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.410 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-67-428, 56-67-429, and 56-67-430 are a series of overtaking unloading wave profiles with varied driver thickness at constant impact stress.



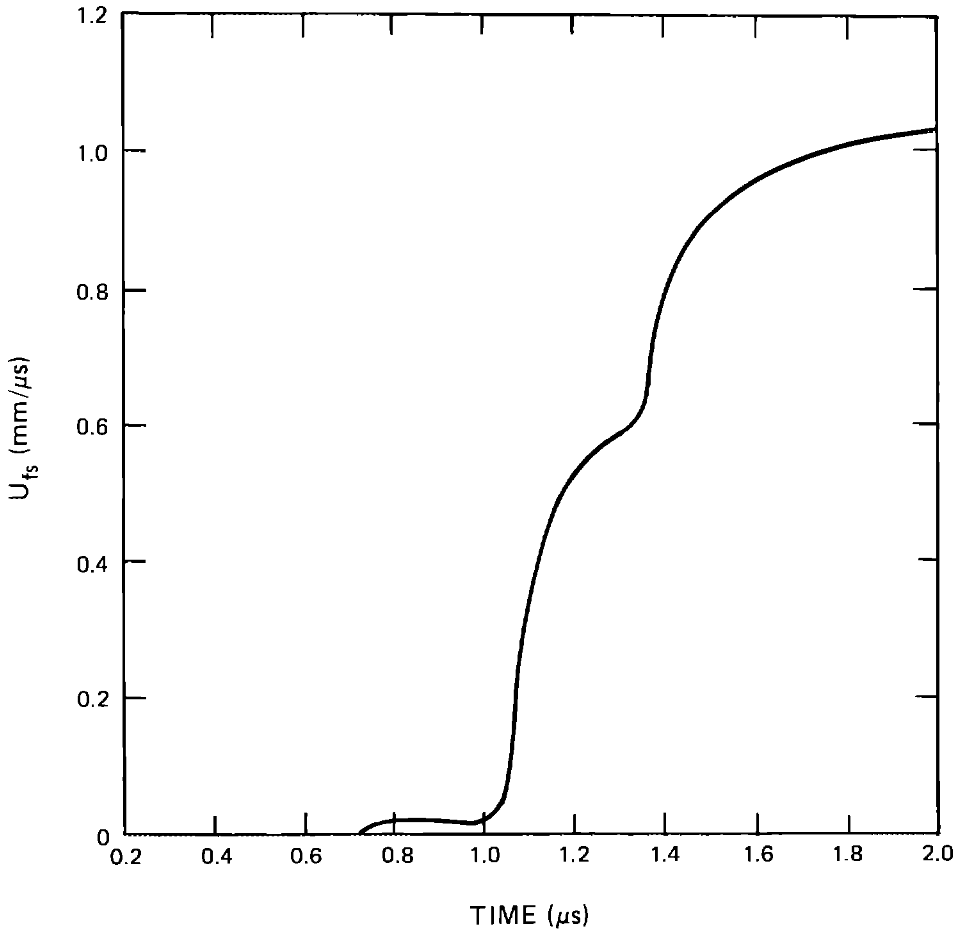
TARGET	**Material:** Beryllium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-67-429 **Date:** March 29, 1967 **Thickness:** 12.7 mm **Diameter:** 38.1 mm
IMPACTOR	Beryllium, 3.18 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.410 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-67-428, 56-67-429, and 56-67-430 are a series of overtaking unloading wave profiles with varied driver thickness at constant impact stress.



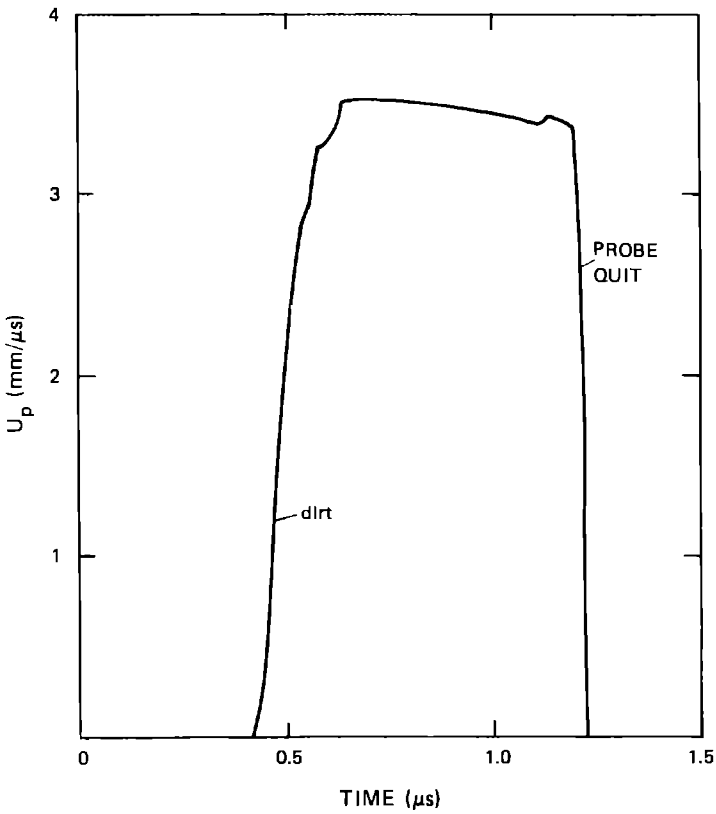
TARGET	**Material:** Beryllium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** J. W. Taylor (1968) **Shot no.:** 56-67-430 **Date:** March 30, 1967 **Thickness:** 12.70 mm **Diameter:** 38.1 mm
IMPACTOR	Beryllium, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.410 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-67-428, 56-67-429 and 56-67-430 are a series of overtaking unloading wave profiles with varied driver thickness at constant impact stress.



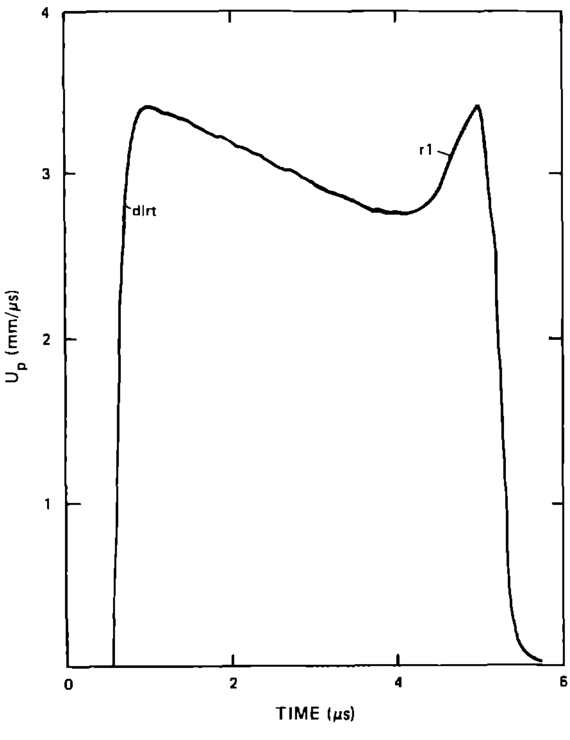
TARGET	**Material:** Boron **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80802 **Date:** July 17, 1968
HE SHOT GEOMETRY	102-mm baratol/2024 aluminum base plate/6.34 mm boron
SHOT COMPONENTS	Boron **Density:** 2.33 g/cm³ C_L = 13.90 mm/μs C_S = 9.00 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	**Material:** Carbon, $\rho = 0.315$ g/cm^3 **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 51 **Date:** September 21, 1971
HE SHOT GEOMETRY	P-081 lens/102 mm PBX 9404/12.76 mm 2024 aluminum// 9.65 mm carbon/5.00 mm air//
SHOT COMPONENTS	Carbon **Density:** 0.315 g/cm^3 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_s = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 14.65 mm

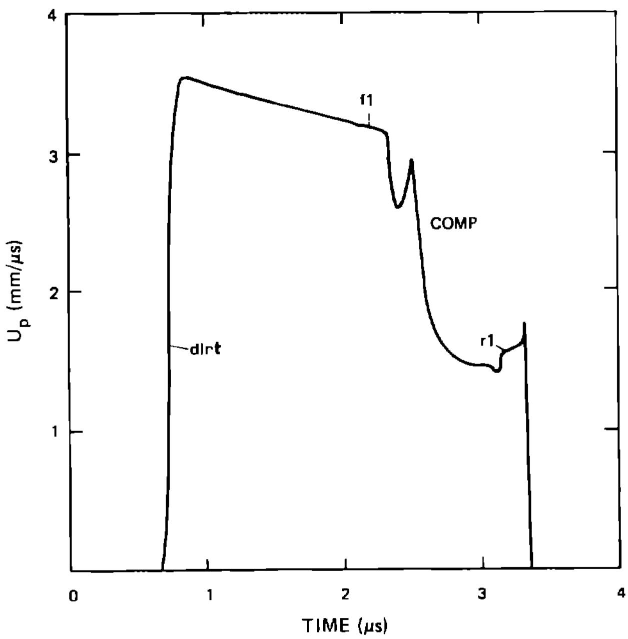


TARGET	**Material:** Carbon, $\rho = 0.326$ g/cm^3 **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 52 **Date:** September 27, 1971
HE SHOT GEOMETRY	P-081 lens/102 mm PBX 9404/12.78 mm 2024 aluminum// 12.75 mm carbon/4.96 mm air//
SHOT COMPONENTS	Carbon **Density:** 0.326 g/cm^3 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_s = 3.16$ mm/µs PBX 9404 **Density:** 1.830 g/cm^3 $C_L = 2.90$ mm/µs $C_s = 1.57$ mm/µs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 17.71 mm



TARGET	**Material:** Carbon, $\rho = 0.3247$ g/cm^3 **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 53 **Date:** December 16, 1971
HE SHOT GEOMETRY	P-120 lens/152 mm PBX 9404/12.75 mm 2024 aluminum// 6.60 mm carbon/f- 6.37 mm corundum mixture*//
SHOT COMPONENTS	Carbon **Density:** 0.3247 g/cm^3 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_s = 3.16$ mm/μs Corundum mixture* **Density:** 3.389 g/cm^3 $C_L = 8.94$ mm/μs $C_s = 5.25$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.65 mm **Initial coil spacing:** 12.97 mm

*85.2 wt% Al_2O_3/9.7 wt% SiO_2/2.7 wt% MgO/2.4 wt% CaO-BaO



TARGET

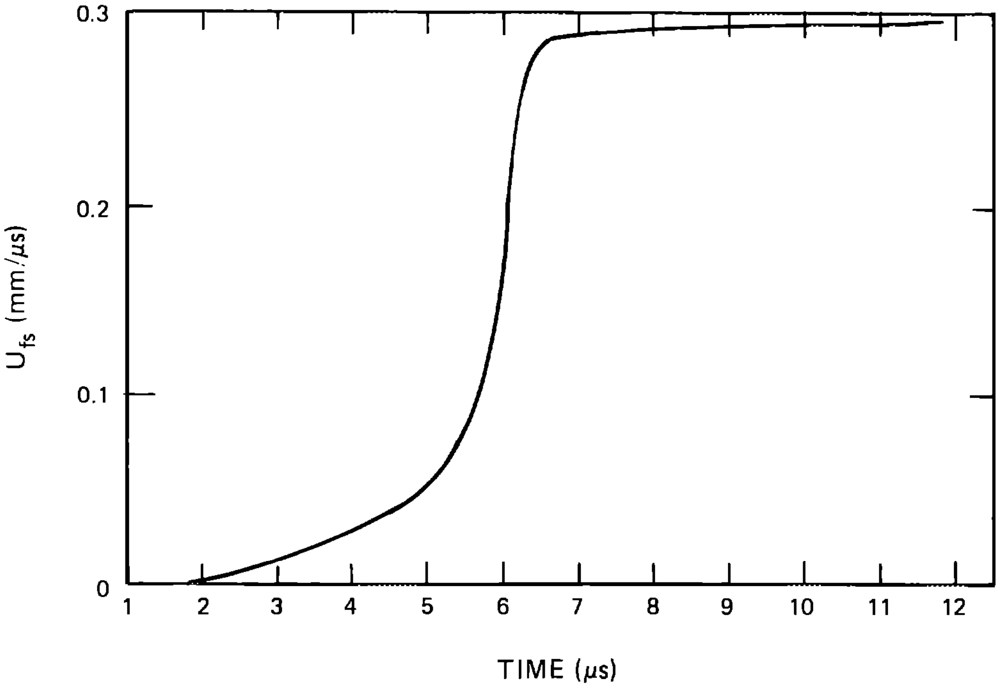
Material: Carbon (PT 0178 graphite)
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970)
Shot no.: 56-65-365 Date: November 19, 1965
Thickness: 6.35 mm Diameter: 38.1 mm
Density: 1.55 g/cm^3

IMPACTOR

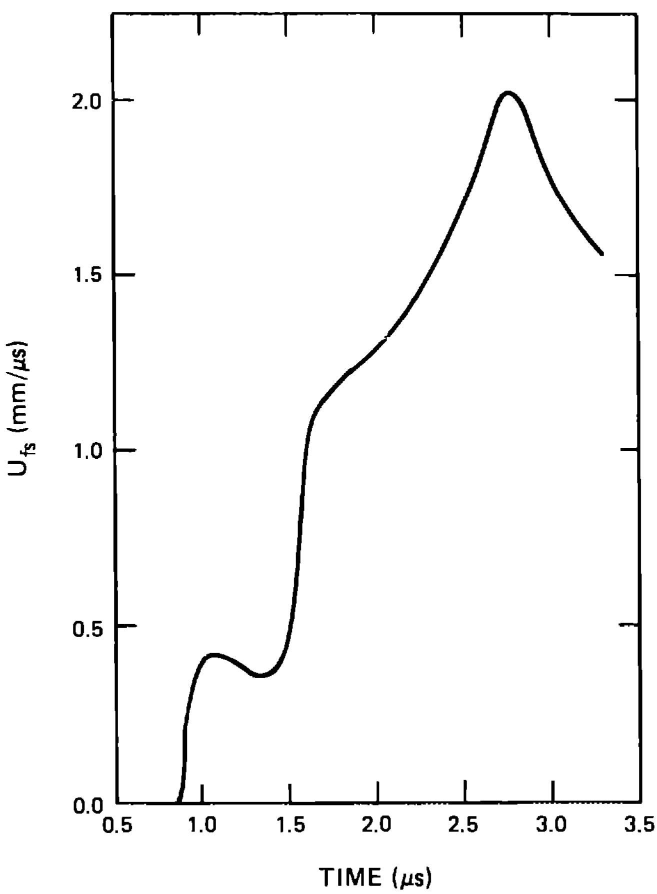
PT 0178 graphite, 6.35 mm thick, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.290 mm/μs

TRANSDUCER

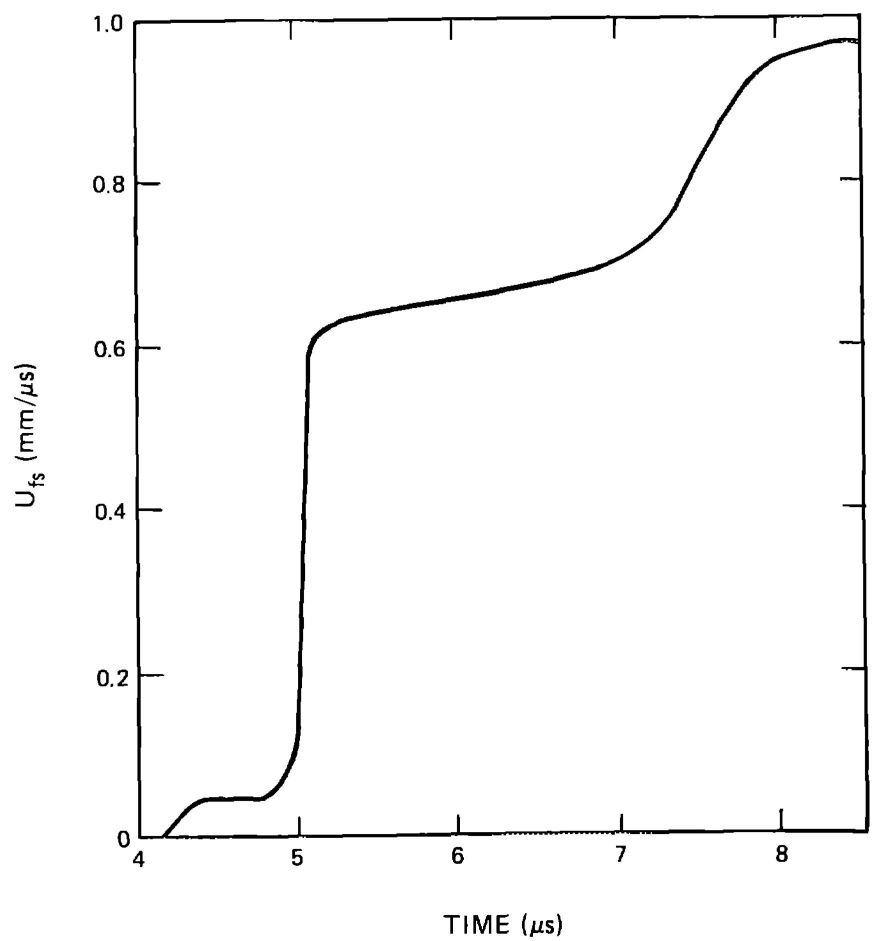
Free-surface capacitor
Time: Relative



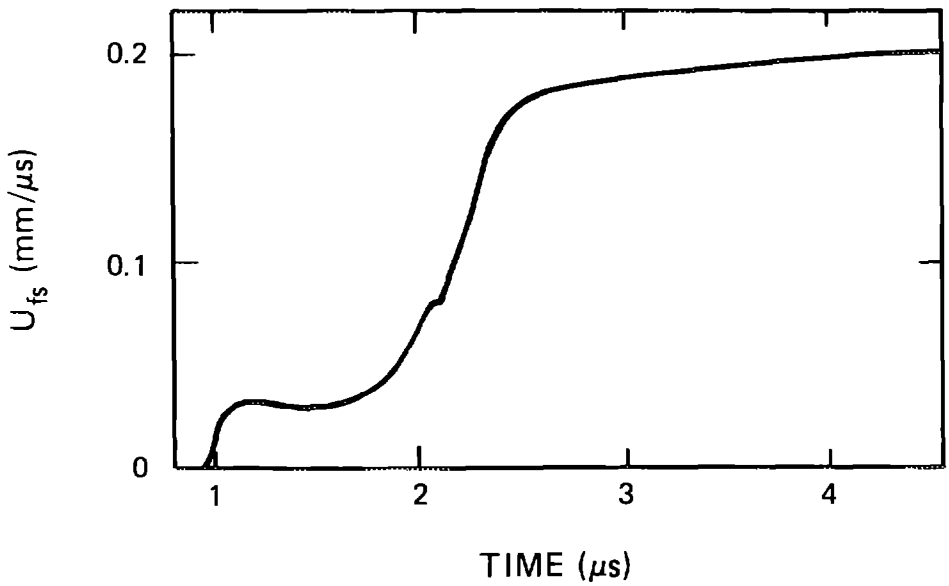
TARGET	**Material:** Germanium [100] direction **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-65-348 **Date:** June 21, 1965 **Thickness:** 7.70 mm **Density:** 5.323 g/cm³
IMPACTOR	Tungsten carbide backed by 2024 aluminum, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	**Material:** Armco iron **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-64-328 **Date:** September 3, 1964 **Thickness:** 25.40 mm **Diameter:** 152.4 mm **Density:** 7.87 g/cm^3 $C_L = 5.94$ mm/µs $C_S = 3.26$ mm/µs
IMPACTOR	Armco iron mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.977 mm/µs
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET	**Material:** Armco iron **Experiment type:** Free-surface capacitor **Experimenters:** J. W. Taylor and M. H. Rice **Reference:** J. W. Taylor and M. H. Rice (1963) **Shot no.:** 56-60-50 **Date:** November 4, 1960 **Thickness:** 25.4 mm **Diameter:** 153 mm **Density:** 7.87 g/cm^3 $C_L = 5.94$ mm/µs $C_s = 3.26$ mm/µs **Heat treatment:** Annealed
IMPACTOR	Armco iron, 25.4 mm thick, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.372 mm/µs
TRANSDUCER	Free-surface capacitor Time after impact
NOTES	Shots 56-60-50, 56-60-55, 56-61-66, and 56-61-99 are a series with varied target thickness.



TARGET

Material: Armco iron
Experiment type: Free-surface capacitor
Experimenters: J. W. Taylor and M. H. Rice
Reference: J. W. Taylor and M. H. Rice (1963)
Shot no.: 56-60-55 Date: December 22, 1960
Thickness: 12.70 mm Diameter: 153 mm
Density: 7.87 g/cm^3
$C_L = 5.94$ mm/μs $C_S = 3.26$ mm/μs
Heat treatment: Annealed

IMPACTOR

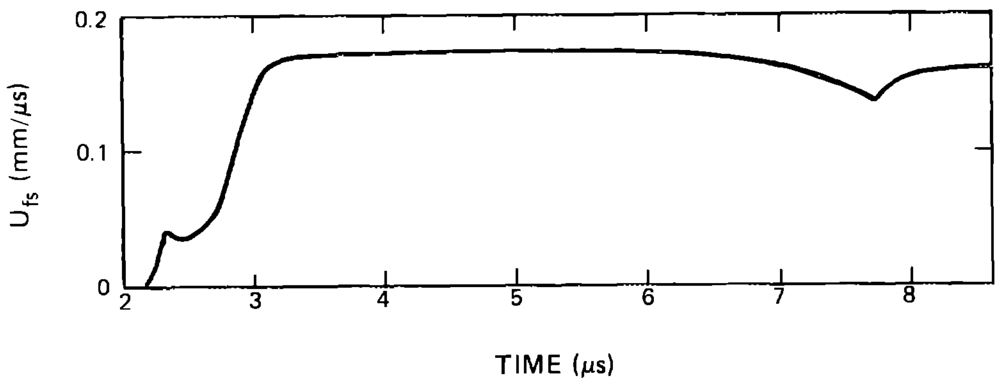
Armco iron, 12.70 mm thick, mounted on 165-mm-diam aluminum alloy projectile
Impact velocity: 0.164 mm/μs

TRANSDUCER

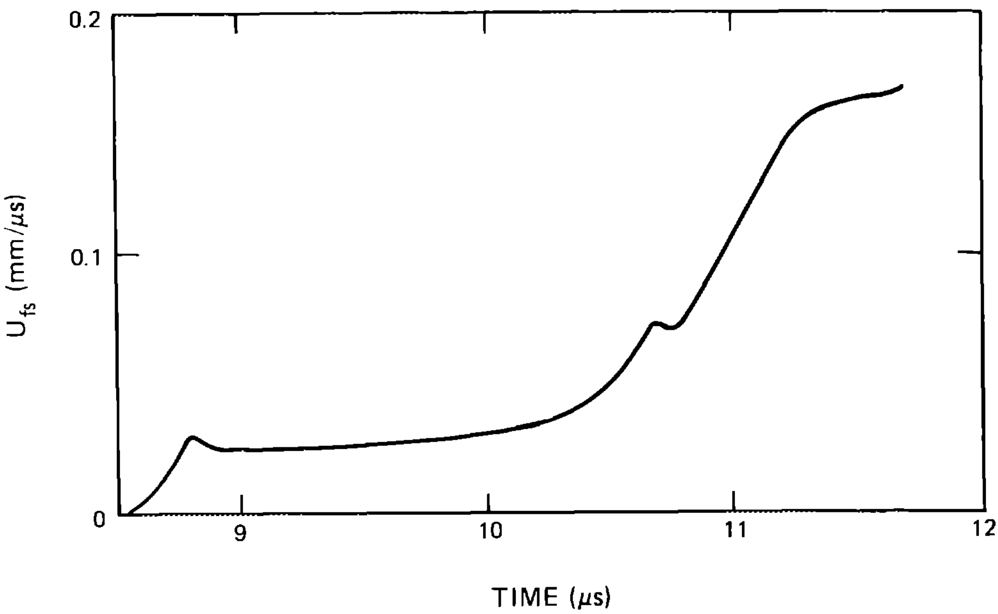
Free-surface capacitor
Time after impact

NOTES

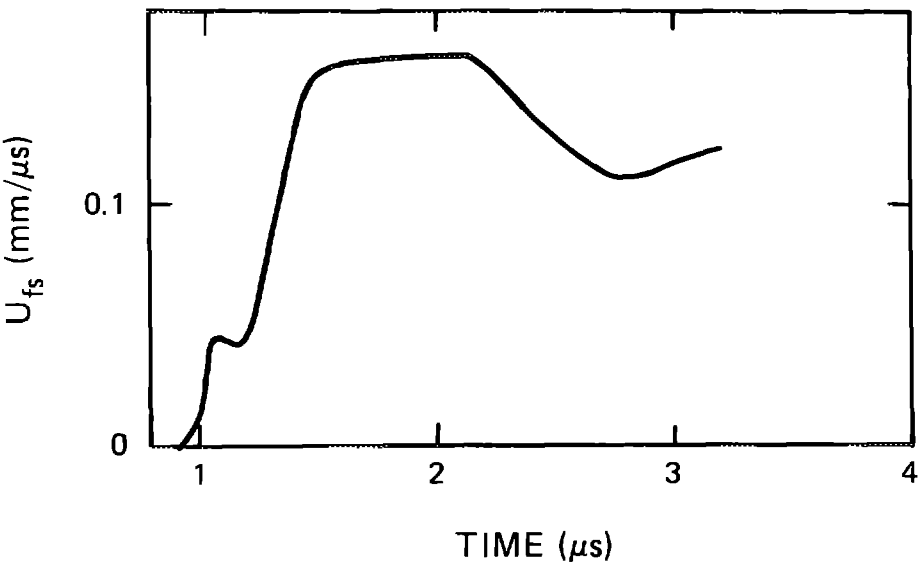
Shots 56-60-50, 56-60-55, 56-61-66, and 56-61-99 are a series with varied target thickness.



TARGET	Material: Armco iron Experiment type: Free-surface capacitor Experimenters: J. W. Taylor and M. H. Rice Reference: J. W. Taylor and M. H. Rice (1963) Shot no.: 56-61-66 Date: March 1, 1961 Thickness: 50.80 mm Diameter: 153 mm Density: 7.87 g/cm^3 $C_L = 5.94$ mm/μs $C_s = 3.26$ mm/μs Heat treatment: Annealed
IMPACTOR	Armco iron, 25.4 mm thick, mounted on 165-mm-diam aluminum alloy projectile Impact velocity: 0.170 mm/μs
TRANSDUCER	Free-surface capacitor Time after impact
NOTES	Shots 56-60-50, 56-60-55, 56-61-66, and 56-61-99 are a series with varied target thickness.



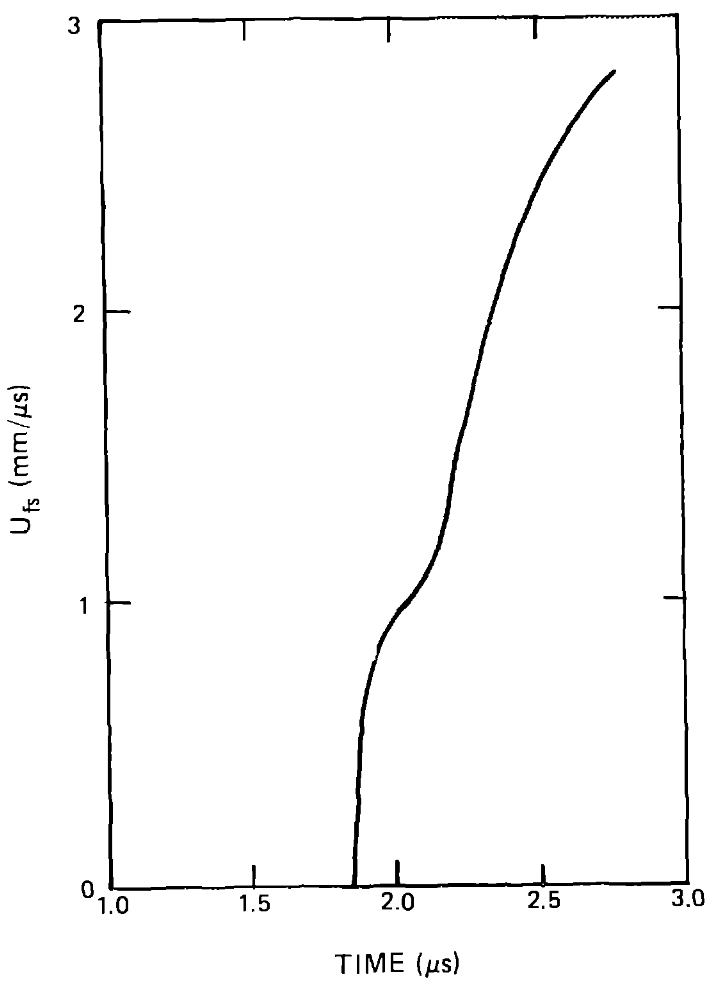
TARGET	**Material:** Armco iron **Experiment type:** Free-surface capacitor **Experimenters:** J. W. Taylor and M. H. Rice **Reference:** J. W. Taylor and M. H. Rice (1963) **Shot no.:** 56-61-99 **Date:** September 19, 1961 **Thickness:** 6.35 mm **Diameter:** 153 mm **Density:** 7.87 g/cm^3 C_L = 5.94 mm/μs C_S = 3.26 mm/μs **Heat treatment:** Annealed
IMPACTOR	Armco iron, 3.18 mm thick, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.157 mm/μs
TRANSDUCER	Free-surface capacitor Time after impact
NOTES	Shots 56-60-50, 56-60-55, 56-61-66, and 56-61-99 are a series with varied target thickness.



TARGET — Material: Armco iron preshocked to 80 GPa
Experiment type: Free-surface capacitor
Experimenters: J. W. Taylor
Shot no.: 56-63-176 Date: January 23, 1963
Density: 7.87 g/cm^3
$C_L = 5.94$ mm/μs $C_s = 3.26$ mm/μs

IMPACTOR — Iron, 6.35 mm thick, mounted on aluminum alloy projectile

TRANSDUCER — Free-surface capacitor
Time: Relative



TARGET

Material: Armco iron
Experiment type: Free-surface capacitor
Experimenters: J. W. Taylor and M. H. Rice
Shot no.: 56-61-91 Date: August 18, 1961
Thickness: 12.70 mm Diameter: 152.4 mm
Density: 7.87 g/cm^3
$C_L = 5.94$ mm/µs $C_S = 3.26$ mm/µs
Heat treatment: Annealed

IMPACTOR

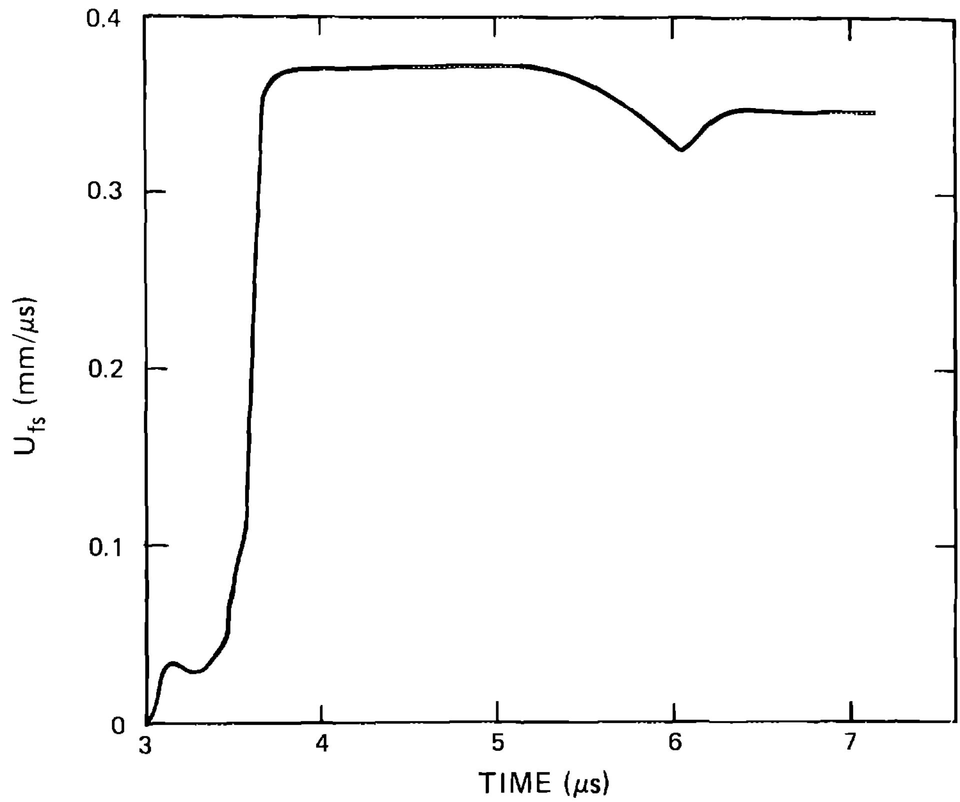
Armco iron, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 165-mm-diam aluminum alloy projectile
Impact velocity: 0.361 mm/µs

TRANSDUCER

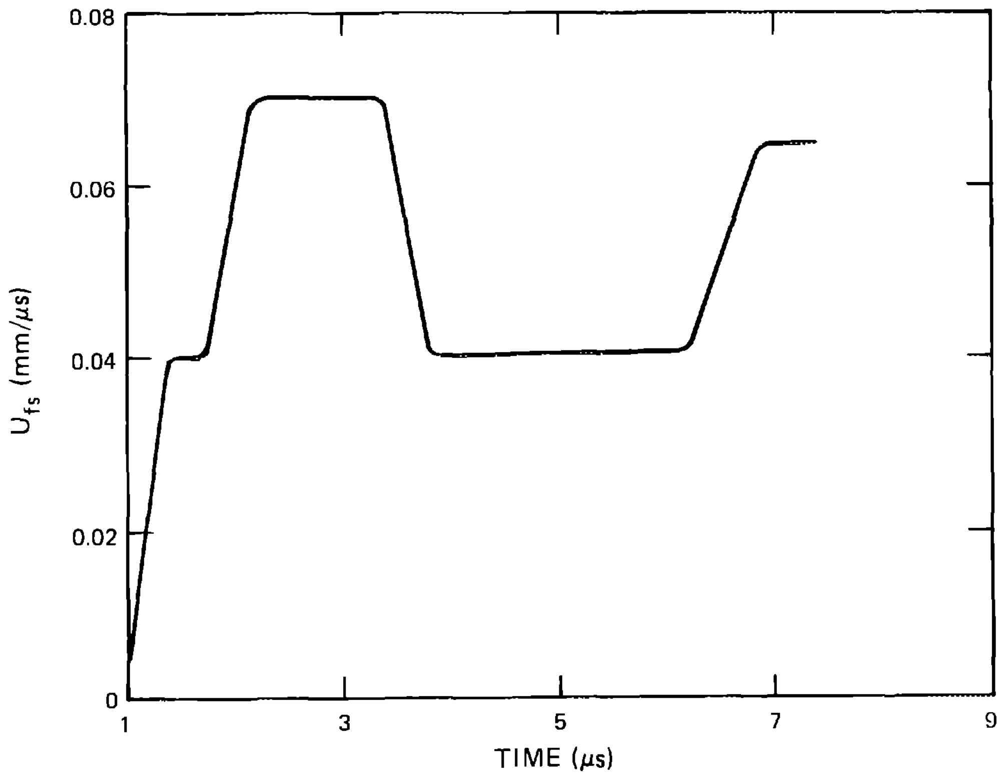
Free-surface capacitor
Time: Relative

NOTES

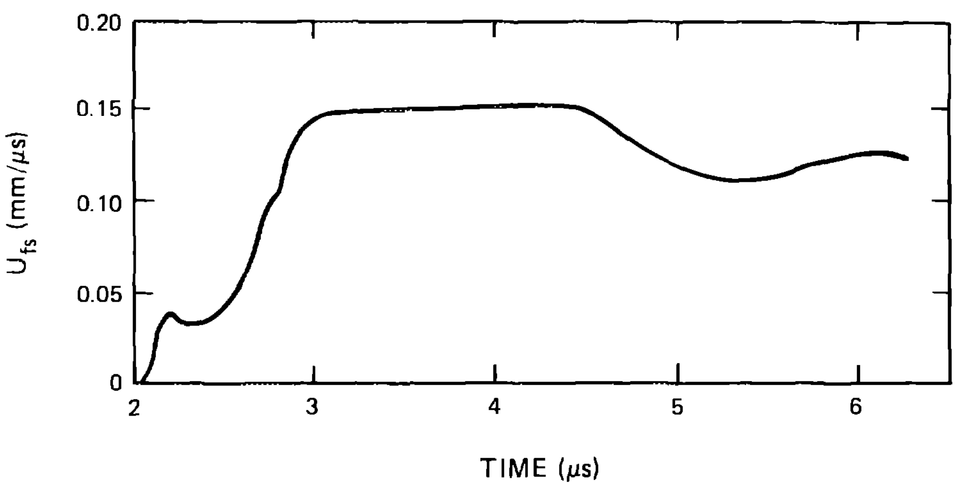
Shots 56-61-91, 56-61-92, and 56-61-94 are a series of wave profiles with varied impact stress.



TARGET	**Material:** Armco iron **Experiment type:** Free-surface capacitor **Experimenters:** J. W. Taylor and M. H. Rice **Shot no.:** 56-61-92 **Date:** August 21, 1961 **Thickness:** 12.70 mm **Diameter:** 152.4 mm **Density:** 7.87 g/cm^3 $C_L = 5.94$ mm/μs $C_S = 3.26$ mm/μs **Heat treatment:** Annealed
IMPACTOR	Armco iron, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.064 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-61-91, 56-61-92, and 56-61-94 are a series of wave profiles with varied impact stress.



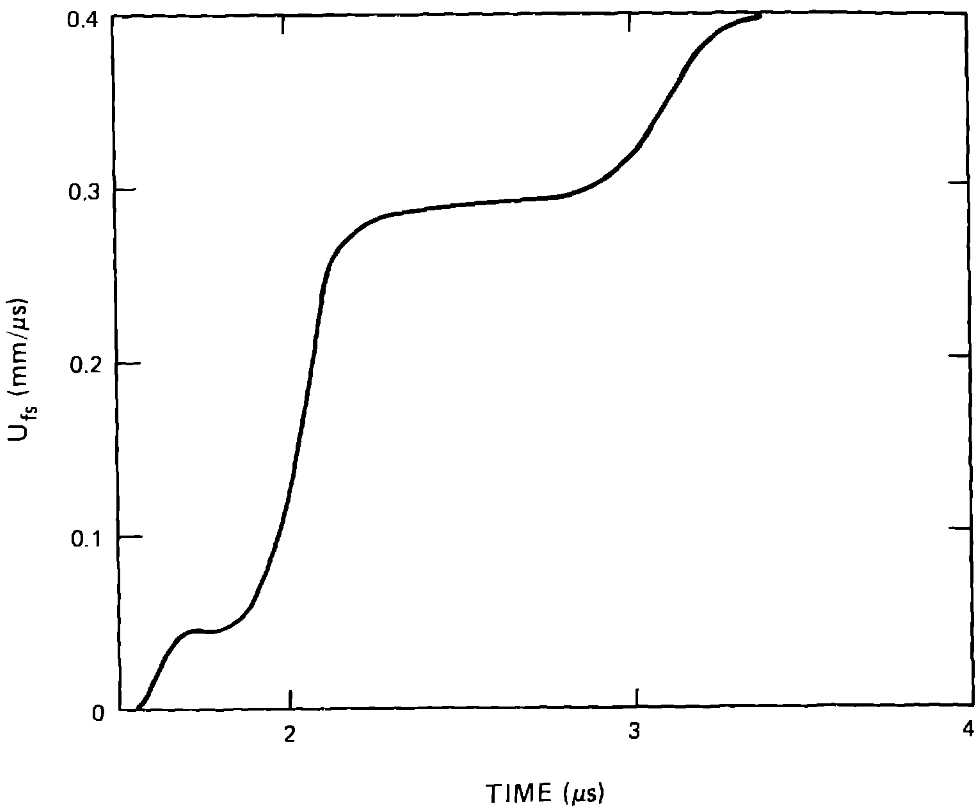
TARGET	Material: Armco iron Experiment type: Free-surface capacitor Experimenters: J. W. Taylor and M. H. Rice Reference: J. W. Taylor and M. H. Rice (1963) Shot no.: 56-61-94 Date: August 28, 1961 Thickness: 12.70 mm Diameter: 152.4 mm Density: 7.87 g/cm^3 C_L = 5.94 mm/µs C_s = 3.26 mm/µs Heat treatment: Annealed
IMPACTOR	Armco iron, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 165-mm-diam aluminum alloy projectile Impact velocity: 0.154 mm/µs
TRANSDUCER	Free-surface capacitor Time: Relative
NOTES	Shots 56-61-91, 56-61-92, and 56-61-94 are a series of wave profiles with varied impact stress.



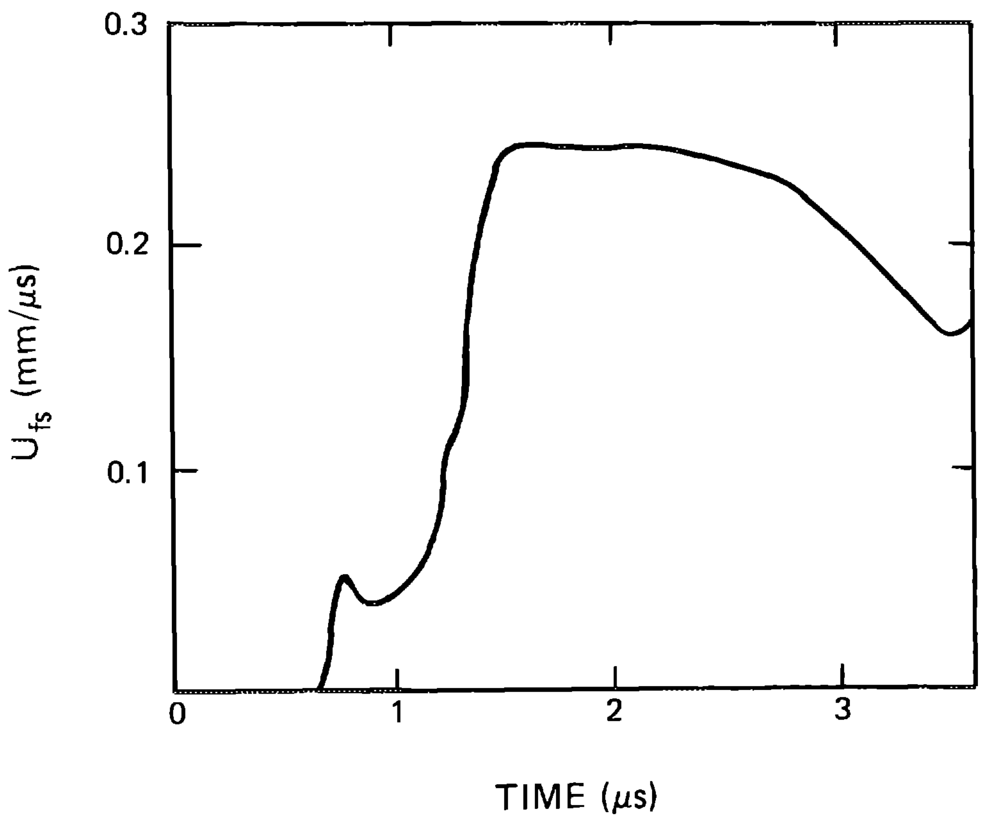
TARGET — Material: Armco iron
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Shot no.: 56-64-327 Date: September 3, 1964
Thickness: 9.53 mm
Density: 7.87 g/cm^3
$C_L = 5.94$ mm/μs $C_S = 3.26$ mm/μs

IMPACTOR — Armco iron, 3.18 mm thick, backed by tungsten, mounted on aluminum alloy projectile
Impact velocity: 0.977 mm/μs

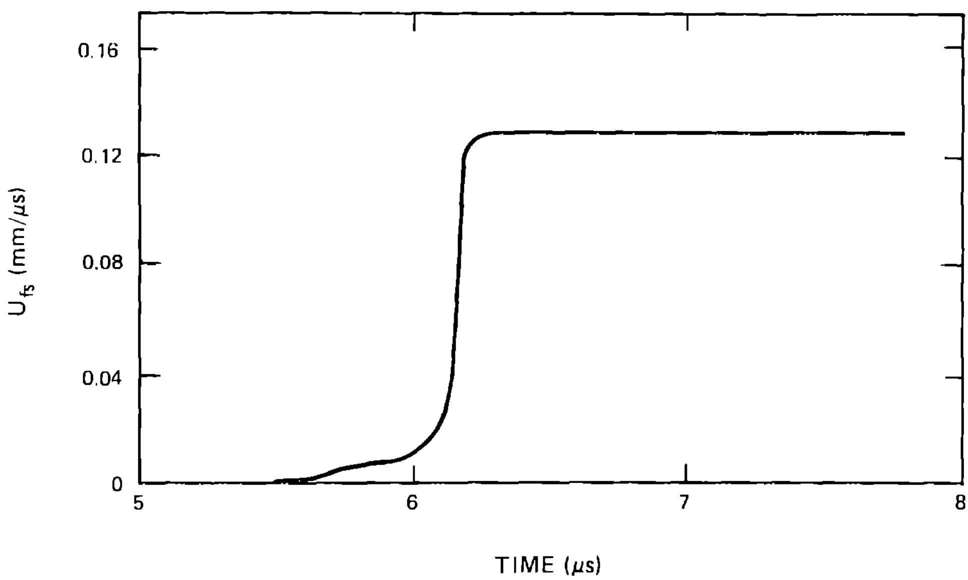
TRANSDUCER — Free-surface capacitor
Time: Relative



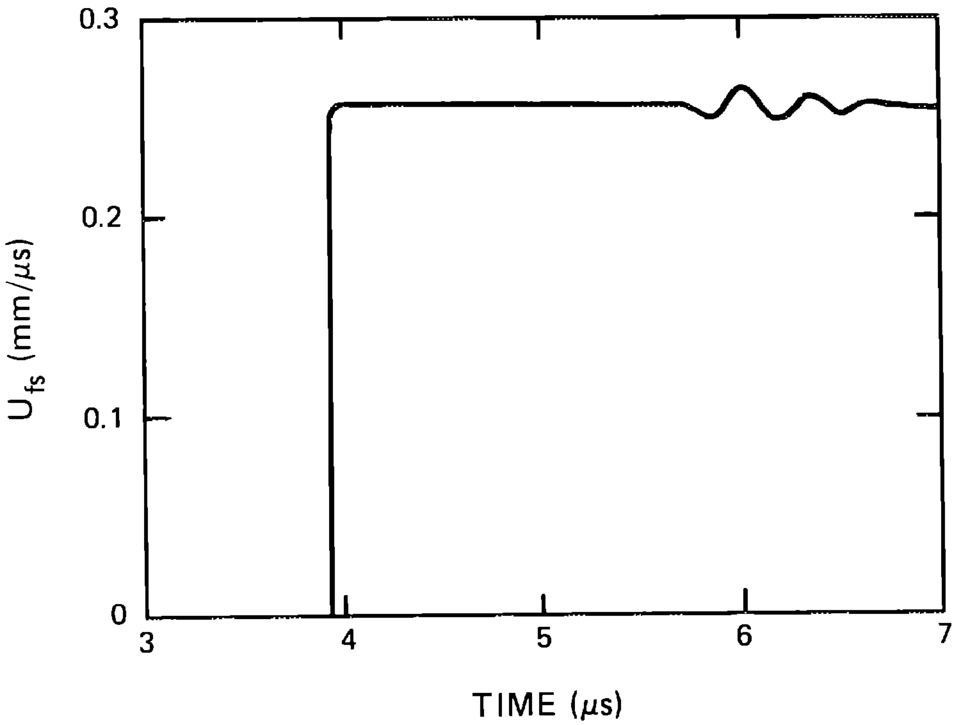
TARGET	**Material:** Armco iron at 96°C
	Experiment type: Free-surface capacitor
	Experimenter: J. W. Taylor
	Shot no.: 56-65-372 **Date:** March 1, 1965
	Thickness: 12.70 mm **Diameter:** 38.1 mm
	Density: 7.87 g/cm^3
	$C_L = 5.94$ mm/µs $C_S = 3.26$ mm/µs
IMPACTOR	Steel C-1018, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor
	Time: Relative



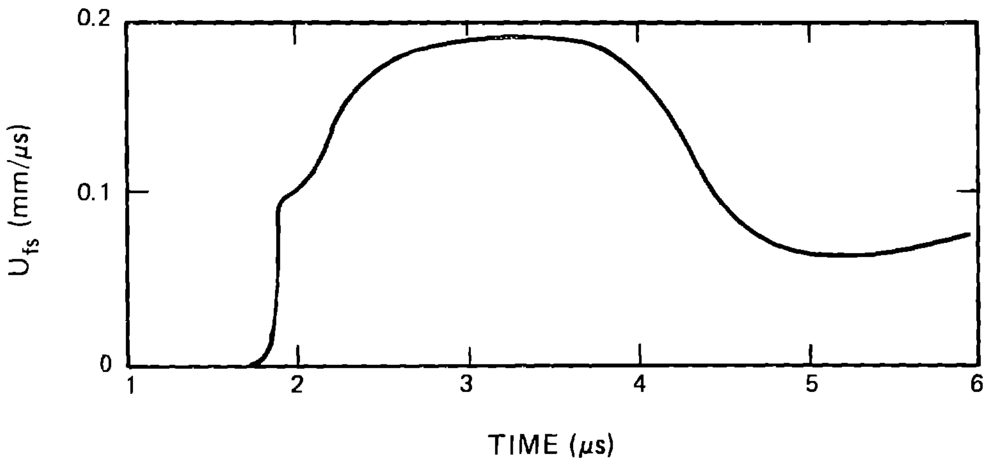
TARGET	**Material:** Lead
	Experiment type: Free-surface capacitor
	Experimenters: J. W. Taylor and M. H. Rice
	Shot no.: 56-61-82 **Date:** July 13, 1961
	Thickness: 12.65 mm **Diameter:** 153 mm
	Density: 11.34 g/cm^3
	$C_L = 2.25$ mm/μs $C_S = 0.89$ mm/μs
IMPACTOR	Lead mounted on 165-mm-diam aluminum alloy projectile
	Impact velocity: 0.116 mm/μs
TRANSDUCER	Free-surface capacitor
	Time: Relative



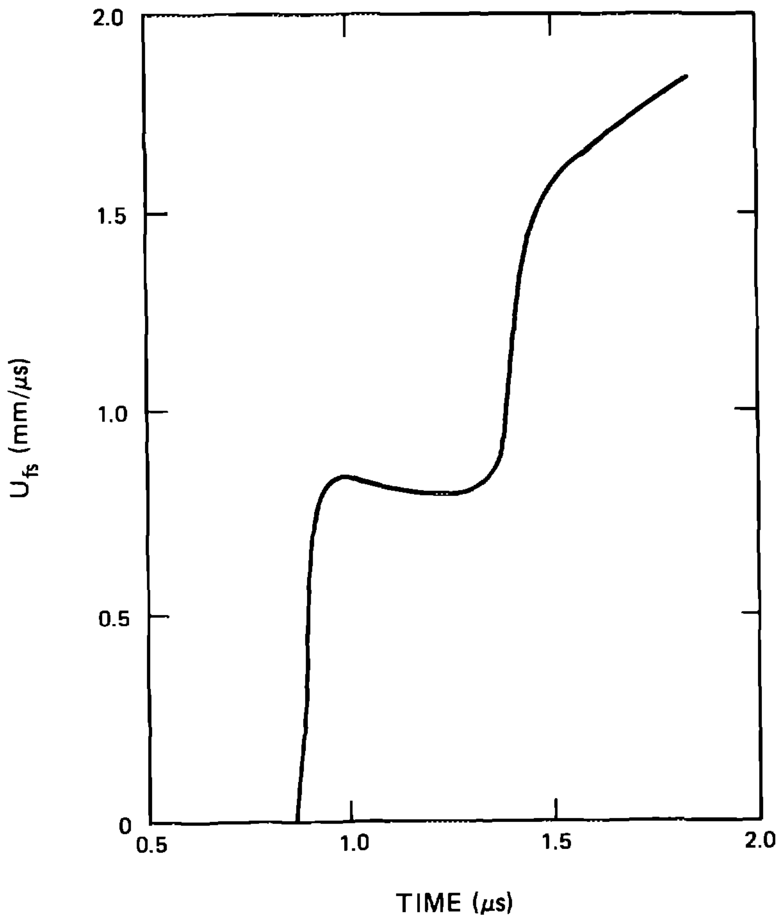
TARGET	**Material:** Mercury **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-63-183 **Date:** February 13, 1963 **Thickness:** 1.29 mm iron, 6.34 mm mercury **Diameter:** 38.1 mm **Density:** 13.595 g/cm^3 C_L =1.45 mm/µs
IMPACTOR	Cold-rolled steel, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.257 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	The mercury target was supported by 1.29-mm-thick iron at the impact surface.



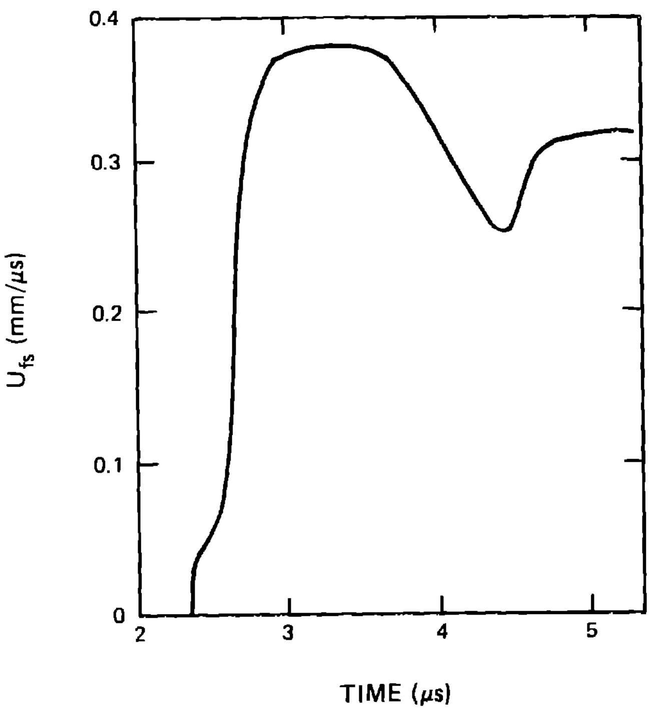
TARGET	**Material:** Niobium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-63-229 **Date:** May 16, 1963 **Thickness:** 12.07 mm **Diameter:** 38.1 mm **Density:** 8.68 g/cm^3 C_L =5.03 mm/μs C_s =2.11 mm/μs
IMPACTOR	Iron, 6.35 mm thick, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.199 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



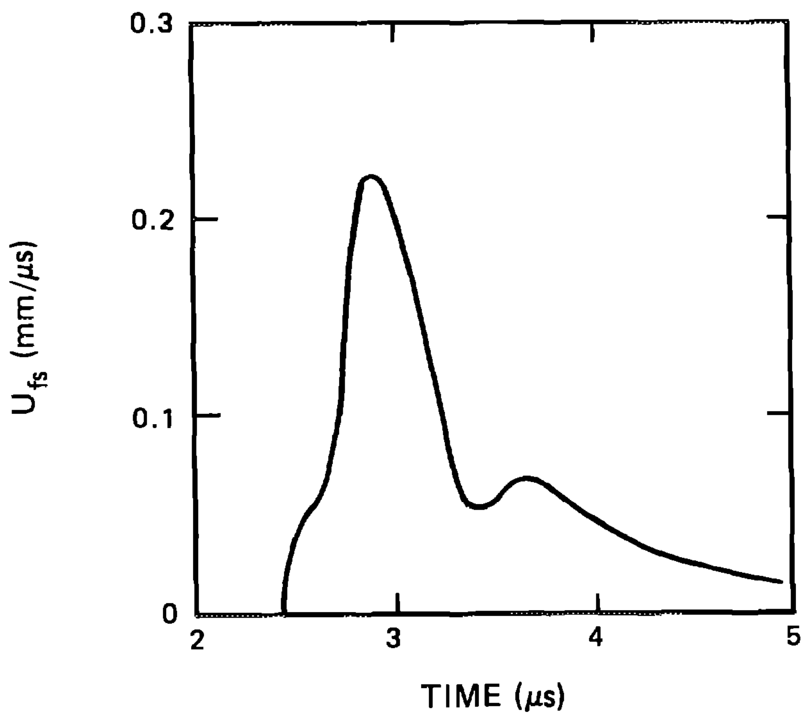
TARGET	**Material:** Silicon [100] direction **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80101 **Date:** August 7, 1968
HE SHOT GEOMETRY	P-080 lens/127 mm Comp B/4.83 mm stainless steel/ 25.4 mm free run/12.7 mm 2024 aluminum base plate/ 7.62 mm silicon [100]
SHOT COMPONENTS	Silicon [100] **Density:** 2.32 g/cm³
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	**Material:** Tantalum **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-67-432 **Date:** February 7, 1967 **Thickness:** 9.60 mm **Diameter:** 38.1 mm **Density:** 16.68 g/cm^3 $C_L = 4.14$ mm/µs $C_S = 2.16$ mm/µs
IMPACTOR	Tantalum, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.390 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-67-432, 56-67-458, and 56-67-459 are a series of overtaking unloading wave profiles at a constant impact stress.



TARGET	**Material:** Tantalum **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-67-458 **Date:** September 5, 1967 **Thickness:** 9.60 mm **Diameter:** 38.1 mm **Density:** 16.68 g/cm^3 $C_L = 4.14$ mm/µs $C_S = 2.16$ mm/µs
IMPACTOR	Tantalum, 0.51 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.403 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-67-432, 56-67-458, and 56-67-459 are a series of overtaking unloading wave profiles at a constant impact stress.



TARGET

Material: Tantalum
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970)
Shot no.: 56-67-459 Date: October 24, 1967
Thickness: 9.60 mm Diameter: 38.1 mm
Density: 16.68 g/cm^3
$C_L = 4.14$ mm/µs $C_s = 2.16$ mm/µs

IMPACTOR

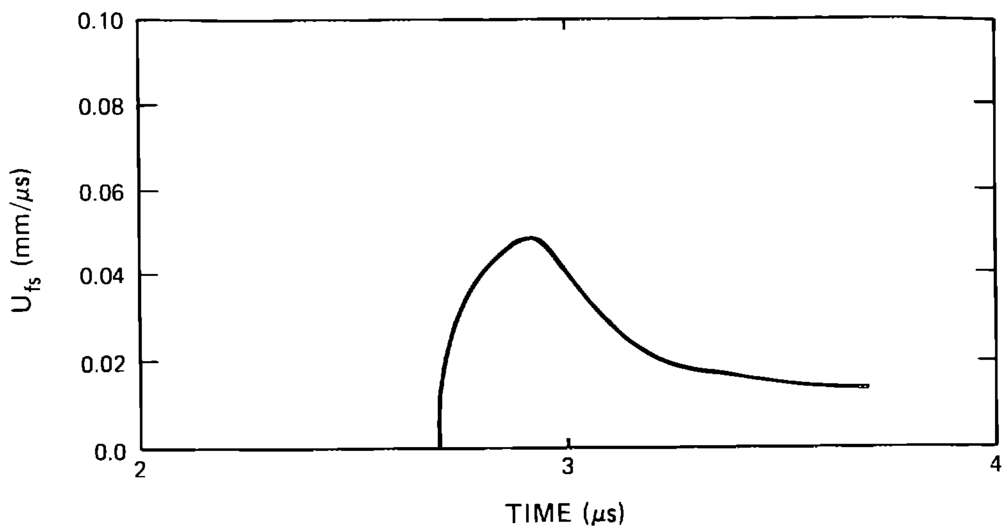
Tantalum, 0.13 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.410 mm/µs

TRANSDUCER

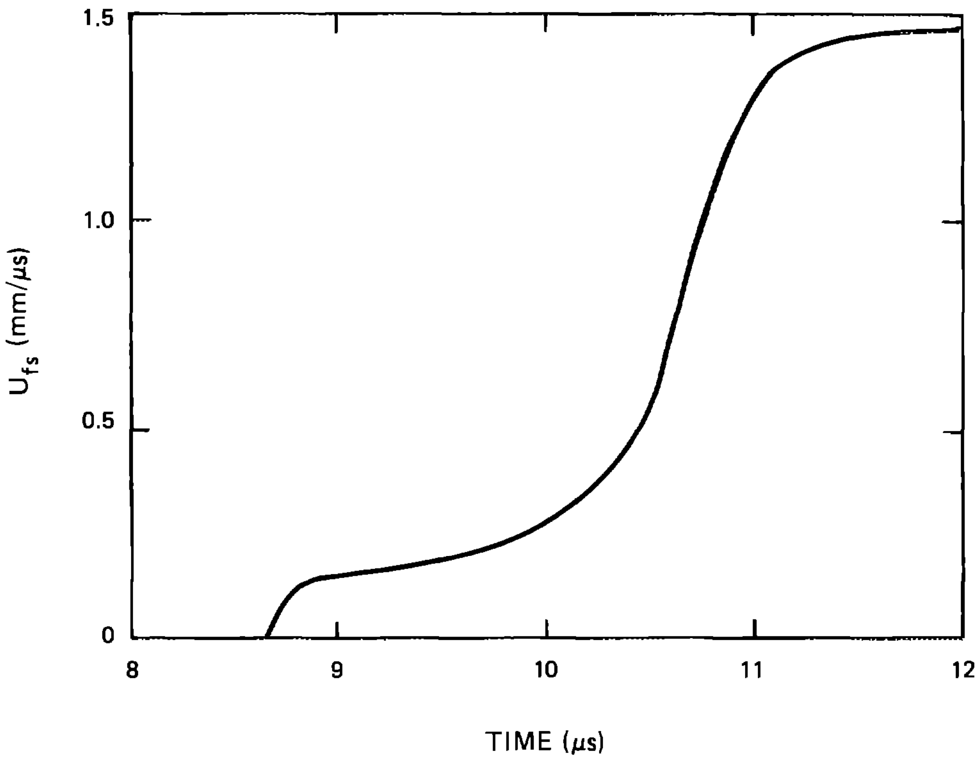
Free-surface capacitor
Time: Relative

NOTES

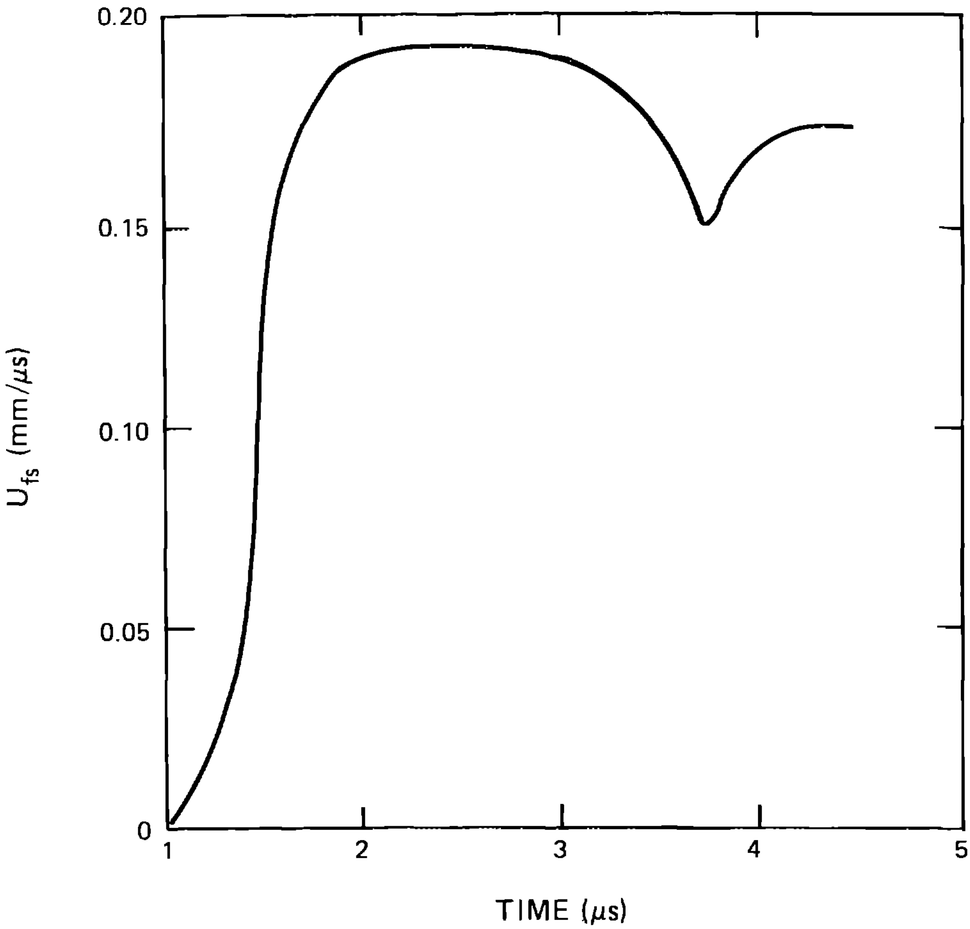
Shots 56-67-432, 56-67-458, and 56-67-459 are a series of overtaking unloading wave profiles at a constant impact stress.



TARGET	**Material:** Thorium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen (1964) **Shot no.:** 56-62-149 **Date:** September 19, 1962 **Thickness:** 25.40 mm **Diameter:** 152.4 mm **Density:** 11.68 g/cm^3 $C_L = 2.95$ mm/µs $C_s = 1.57$ mm/µs
IMPACTOR	Thorium mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.15 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	Material: Tin Experiment type: Free-surface capacitor Experimenter: J. W. Hopson Shot no.: 56-73-8 Date: February 14, 1973 Thickness: 8.87 mm Diameter: 38.1 mm Density: 7.28 g/cm^3 $C_L = 3.43$ mm/μs $C_S = 1.77$ mm/μs
IMPACTOR	OFHC copper, 4.93 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET

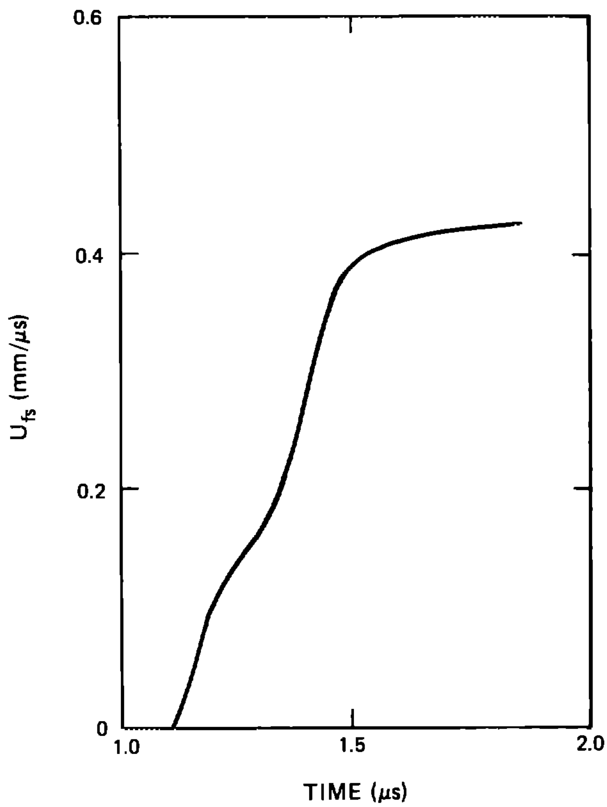
Material: Titanium
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-27 Date: April 30, 1973
Thickness: 9.50 mm Diameter: 38.1 mm
Density: 4.52 g/cm^3
$C_L = 6.01$ mm/µs $C_s = 3.06$ mm/µs
Heat treatment: Annealed

IMPACTOR

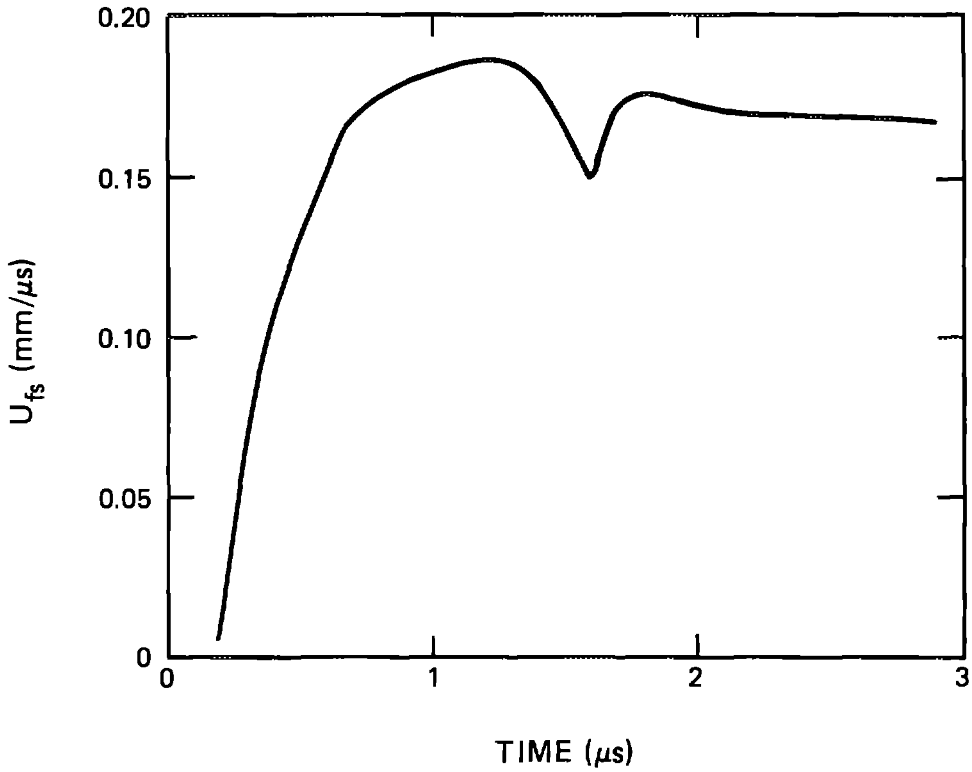
OFHC copper, 2.97 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.371 mm/µs

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET	Material: Tungsten Experiment type: Free-surface capacitor Experimenter: J. W. Hopson Shot no.: 56-73-2 Date: February 5, 1973 Thickness: 4.93 mm Diameter: 38.1 mm Density: 19.24 g/cm^3 $C_L = 5.18$ mm/µs $C_s = 2.85$ mm/µs
IMPACTOR	OFHC copper, 4.93 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.306 mm/µs
TRANSDUCER	Free-surface capacitor Time: Relative

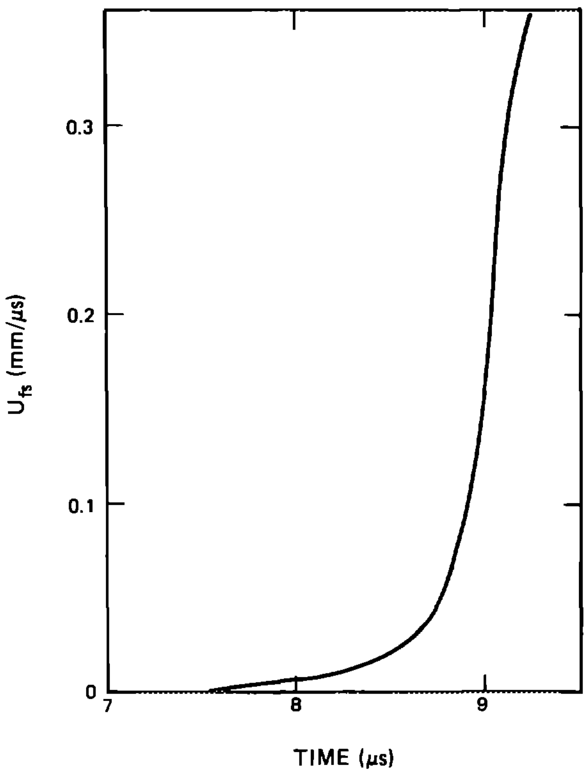


TARGET — Material: Uranium
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Shot no.: 56-62-144 Date: August 29, 1962
Thickness: 25.47 mm Diameter: 152 mm
Density: 19.00 g/cm^3
$C_L = 3.45$ mm/µs $C_S = 2.12$ mm/µs

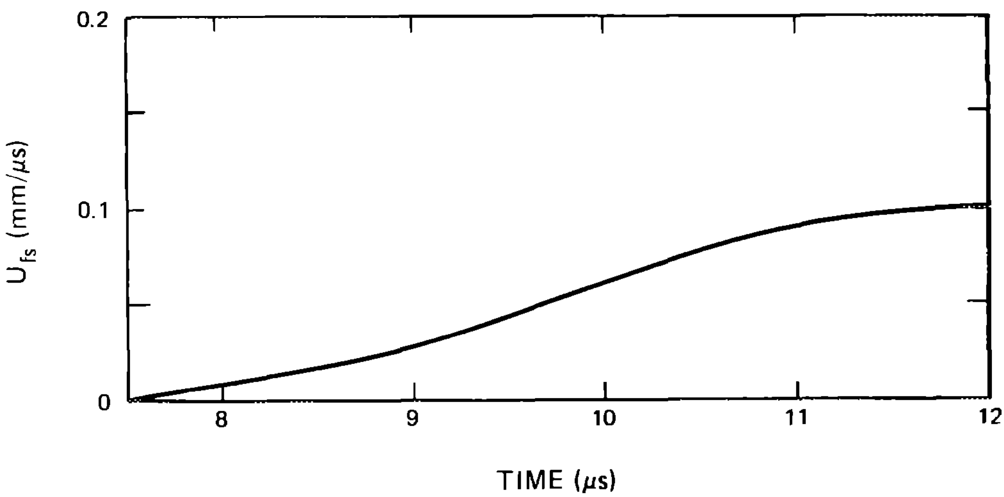
IMPACTOR — Uranium, 25.4 mm thick, mounted on 165-mm-diam aluminum alloy projectile
Impact velocity: 0.390 mm/µs

TRANSDUCER — Free-surface capacitor
Time after impact

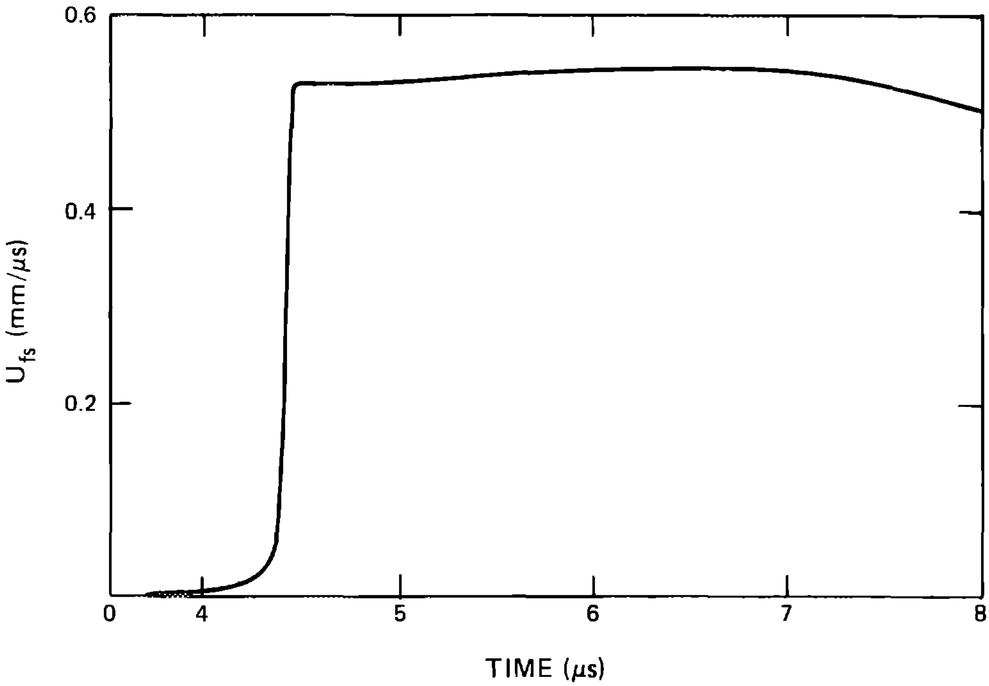
NOTES — Shots 56-62-144, 56-62-145, and 56-62-152 are a series with varied impact stress.



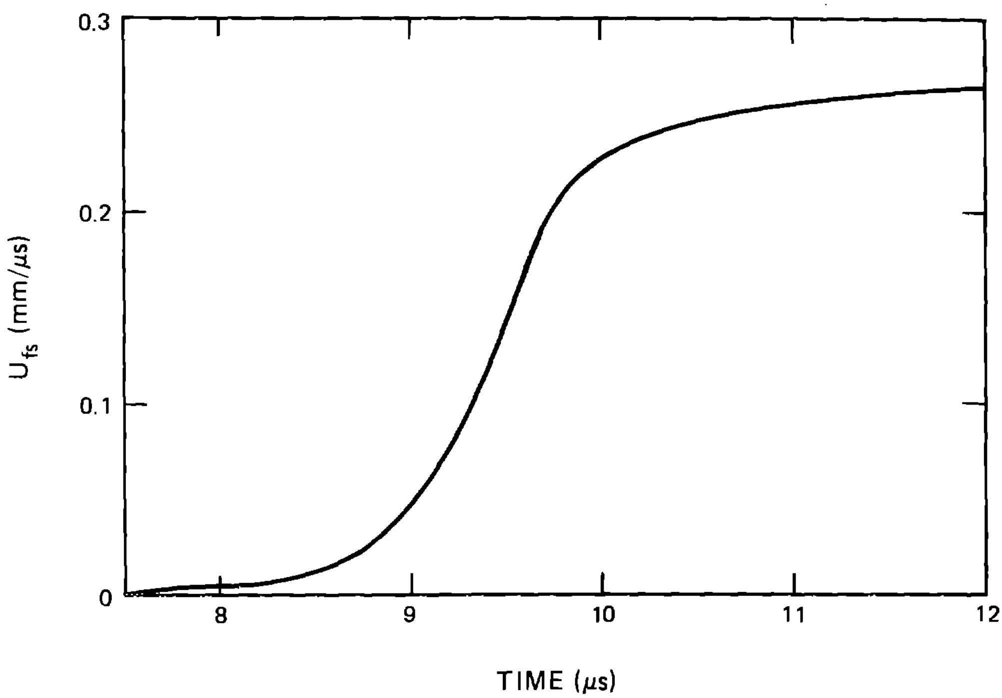
TARGET	**Material:** Uranium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-62-145 **Date:** September 7, 1962 **Thickness:** 25.50 mm **Diameter:** 152 mm **Density:** 19.00 g/cm^3 $C_L = 3.45$ mm/µs $C_s = 2.12$ mm/µs
IMPACTOR	Uranium, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.105 mm/µs
TRANSDUCER	Free-surface capacitor Time after impact
NOTES	Shots 56-62-144, 56-62-145, and 56-62-152 are a series with varied impact stress.



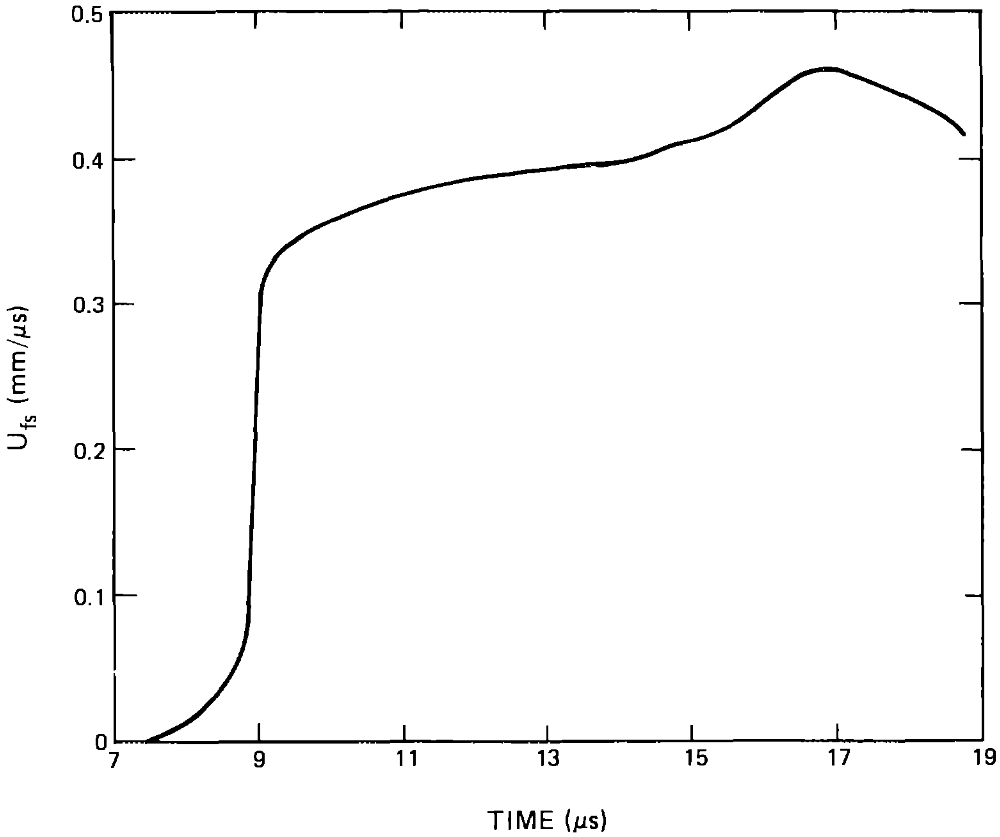
TARGET	**Material:** Uranium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-62-146 **Date:** September 11, 1962 **Thickness:** 12.79 mm **Diameter:** 152 mm **Density:** 19.00 g/cm^3 $C_L = 3.45$ mm/μs $C_S = 2.12$ mm/μs
IMPACTOR	Uranium, 6.35 mm thick, , backed with low-density polyurethane foam, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.525 mm/μs
TRANSDUCER	Free-surface capacitor **Time after impact**



TARGET	**Material:** Uranium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-62-152 **Date:** October 2, 1962 **Thickness:** 25.48 mm **Diameter:** 152 mm **Density:** 19.00 g/cm³ $C_L = 3.45$ mm/μs $C_S = 2.12$ mm/μs
IMPACTOR	Uranium, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.267 mm/μs
TRANSDUCER	Free-surface capacitor Time after impact
NOTES	Shots 56-62-144, 56-62-145, and 56-62-152 are a series with varied impact stress.

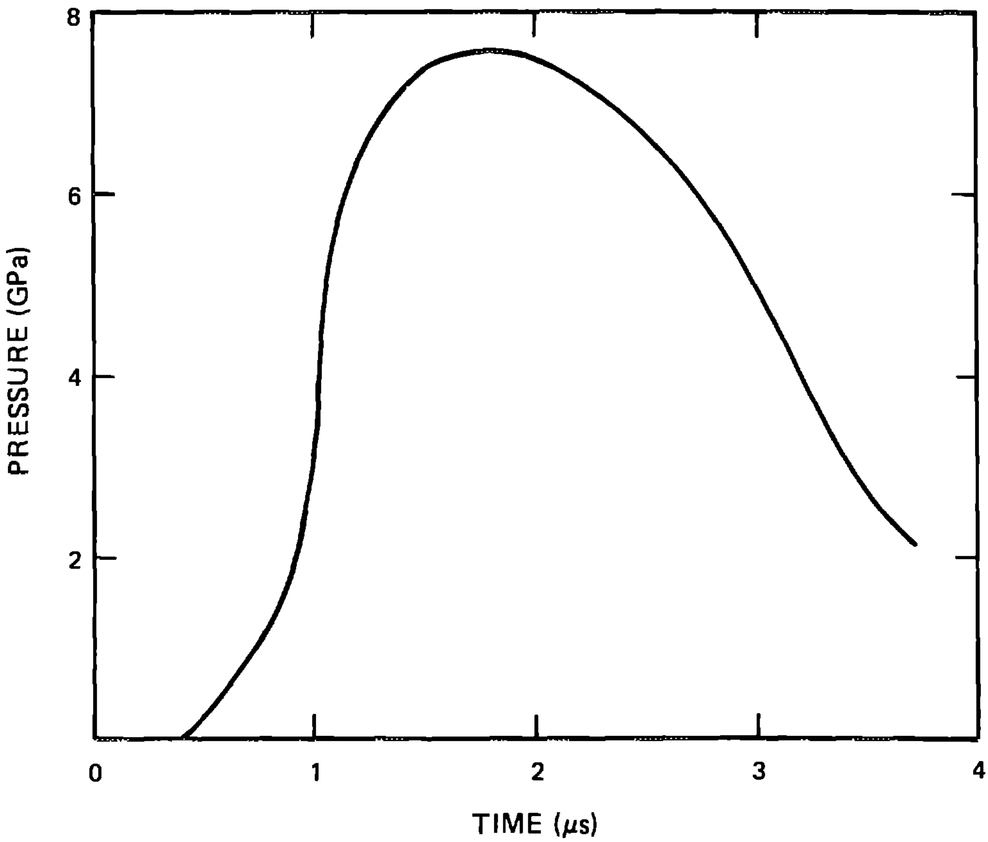


TARGET	**Material:** Uranium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-62-167 **Date:** December 12, 1962 **Thickness:** 25.40 mm **Diameter:** 152 mm **Density:** 19.00 g/cm^3 $C_L = 3.45$ mm/μs $C_S = 2.12$ mm/μs
IMPACTOR	12.76 mm uranium backed by 6.35 mm tungsten, mounted on 165-mm-diam aluminum alloy projectile Impact velocity: 0.385 mm/μs
TRANSDUCER	Free-surface capacitor Time after impact



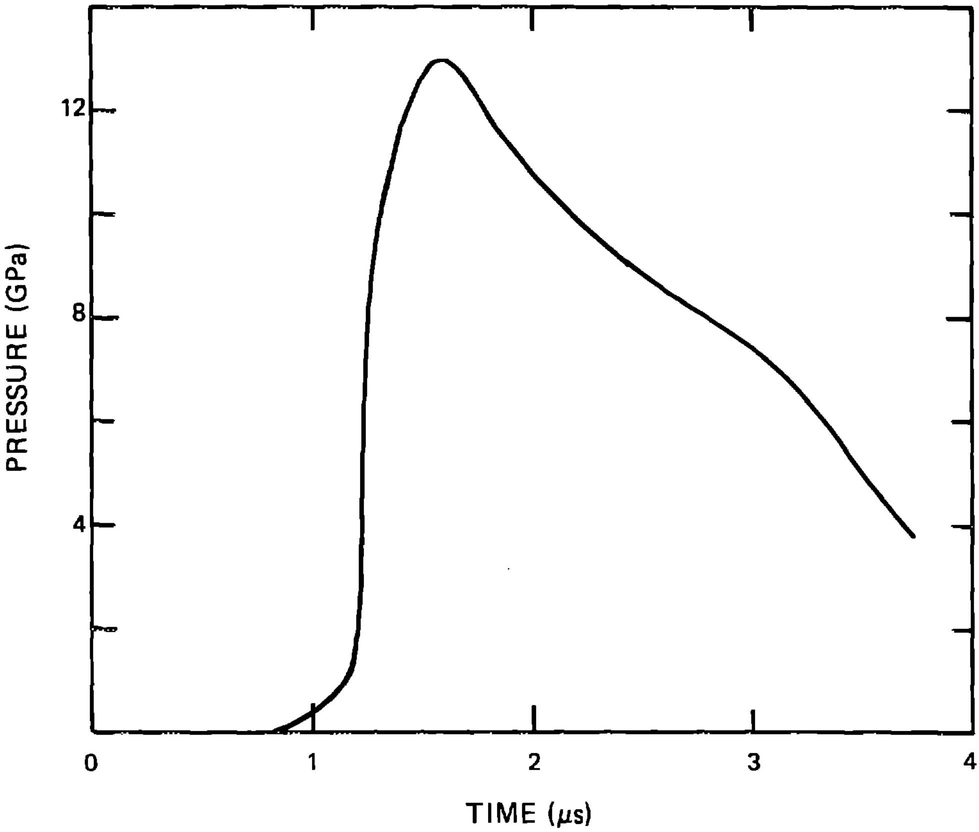
0.5
0.4
0.3
0.2
0.1
0
U_{fs} (mm/μs)
7
9
11
13
15
17
19
TIME (μs)

TARGET	Material: Uranium Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-78-87 Date: November 21, 1978 Thickness: 15.077 mm Diameter: 39.7 mm Density: 19.000 g/cm^3 $C_L = 3.45$ mm/μs $C_S = 2.12$ mm/μs
IMPACTOR	Uranium, 2.809 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.255 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 7.488 mm Heat treatment: Annealed Encapsulation: 0.53 mm Al_2O_3 [1$\bar{1}$02] on both sides Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative



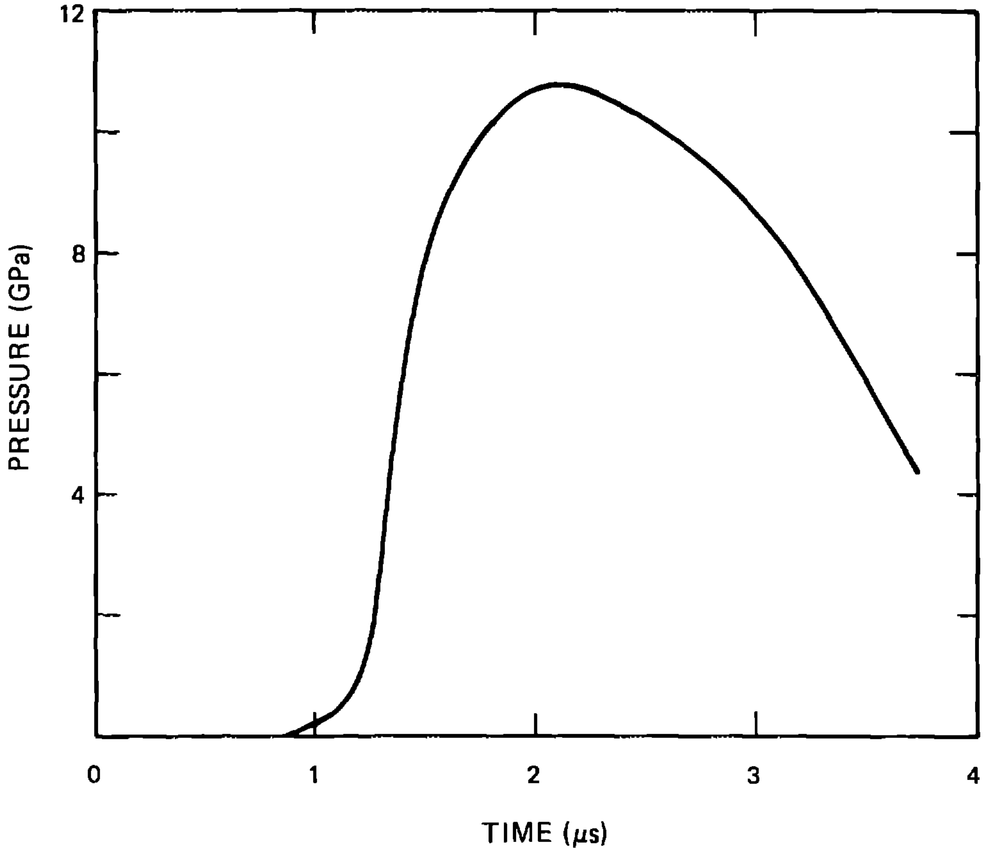
PRESSURE (GPa)
8
6
4
2
0
1
2
3
4
TIME (μs)

TARGET	**Material:** Uranium **Experiment type:** Embedded Manganin gage **Experimenter:** C. E. Morris **Shot no.:** 56-8-88 **Date:** November 15, 1978 **Thickness:** 15.252 mm **Diameter:** 39.7 mm **Density:** 19.000 g/cm^3 $C_L = 3.45$ mm/μs $C_S = 2.12$ mm/μs
IMPACTOR	Uranium, 2.819 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.481 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Location from impact surface:** 7.599 mm **Heat treatment:** Annealed **Encapsulation:** 0.514 mm Al_2O_3 [1$\bar{1}$02] on both sides **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative

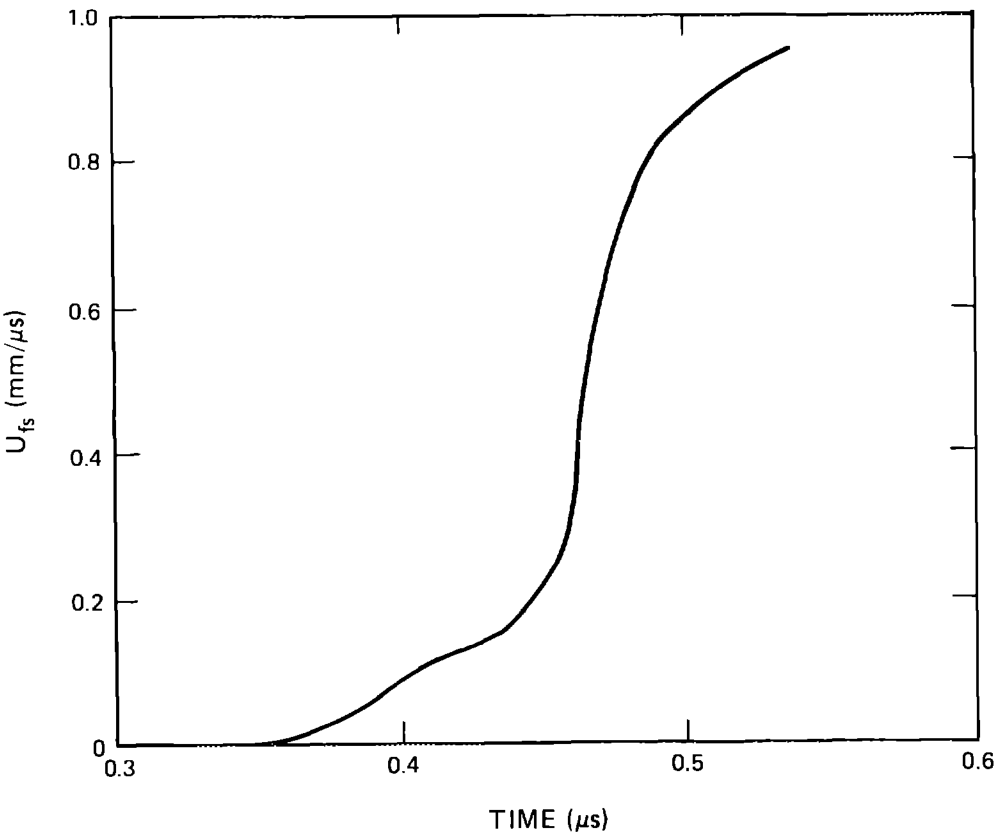


PRESSURE (GPa)
12
8
4
0
1
2
3
4
TIME (μs)

TARGET	Material: Uranium Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-78-89 Date: November 15, 1978 Thickness: 15.213 mm Diameter: 39.7 mm Density: 19.000 g/cm^3 $C_L = 3.45$ mm/μs $C_S = 2.12$ mm/μs
IMPACTOR	Uranium, 2.832 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.371 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 7.571 mm Heat treatment: Annealed Encapsulation: 0.53 mm Al_2O_3 $[1\bar{1}02]$ on both sides Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative

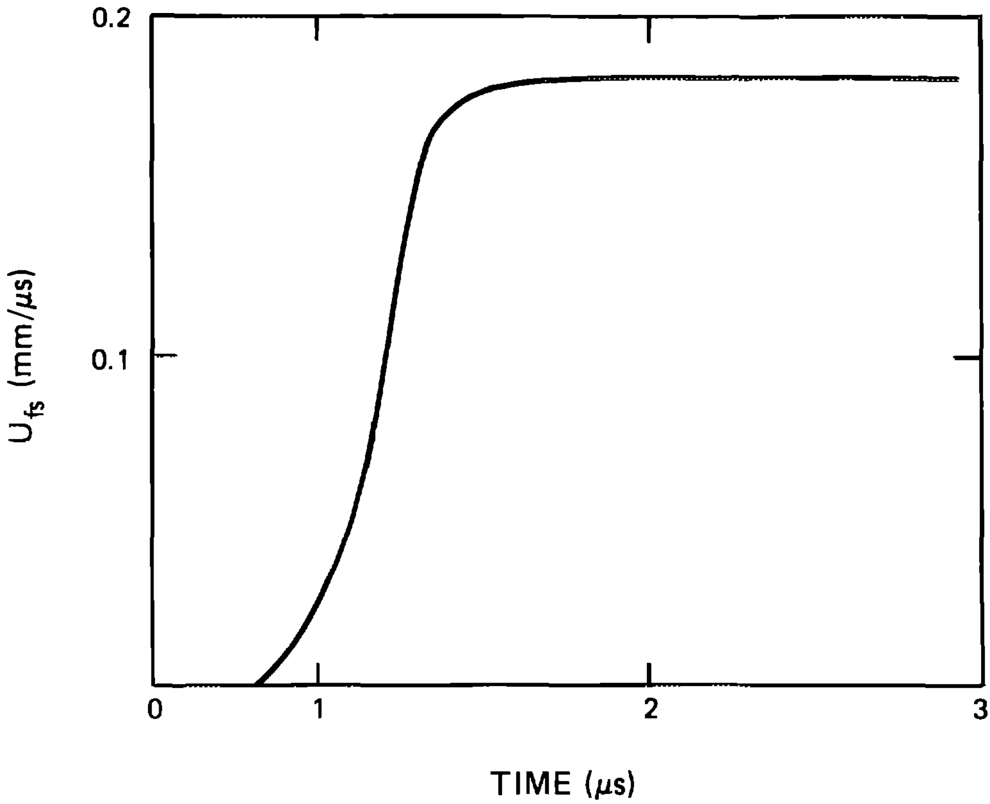

12
8
4
PRESSURE (GPa)
0
1
2
3
4
TIME (μs)

TARGET	**Material:** Zirconium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-72-19 **Date:** February 9, 1972 **Thickness:** 6.34 mm **Diameter:** 38.1 mm **Density:** 6.51 g/cm^3 $C_L = 4.77$ mm/µs $C_S = 2.39$ mm/µs
IMPACTOR	Tantalum, 3.20 mm thick, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.641 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative

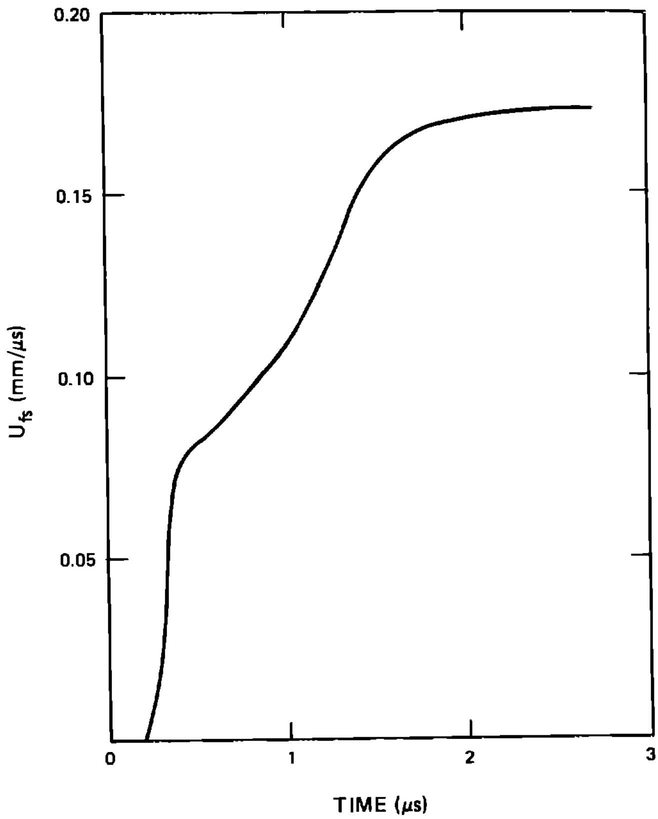


ALLOYS

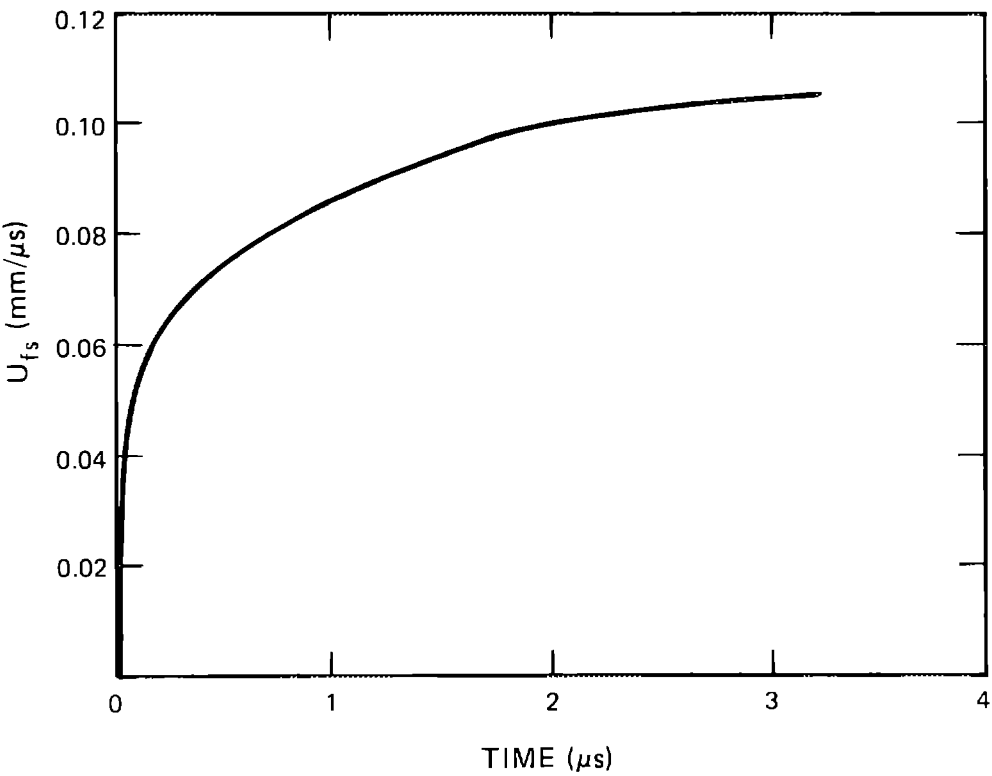
TARGET	Material: 921T aluminum Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Shot no.: 56-63-220 Date: April 24, 1963 Thickness: 6.73 Density: 2.813 g/cm^3 $C_L = 6.29$ mm/μs $C_s = 3.11$ mm/μs
IMPACTOR	Iron, 6.35 mm thick, mounted on aluminum alloy projectile Impact velocity: 0.202 mm/μs
TRANSDUCER	Free-surface capacitor Time: Relative



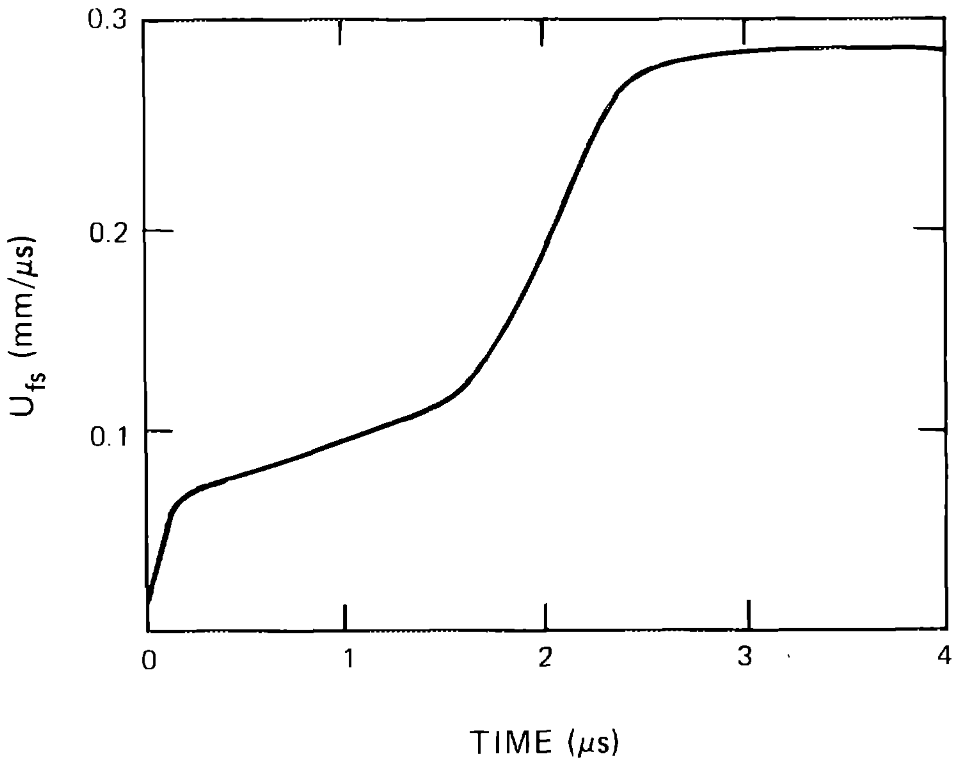
TARGET	**Material:** 2024 aluminum **Experiment type:** Free-surface capacitor **Experimenter:** M. H. Rice **Shot no.:** 56-59-14 **Date:** July 14, 1959 **Thickness:** 38.10 mm **Diameter:** 153 mm **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_s = 3.16$ mm/µs
IMPACTOR	2024 aluminum, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.175 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	This was the first free-surface capacitor record.



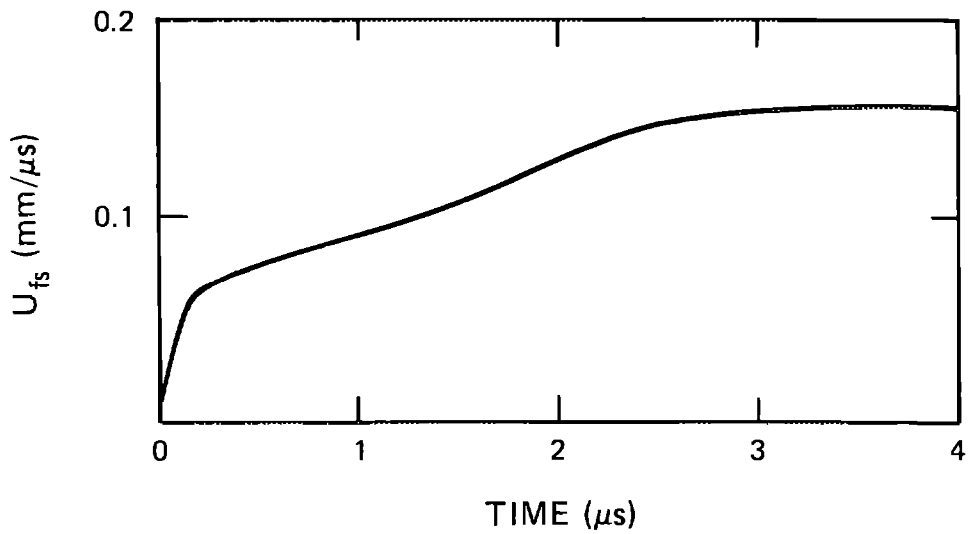
TARGET	**Material:** 2024 aluminum **Experiment type:** Free-surface capacitor **Experimenters:** M. H. Rice and J. W. Taylor **Reference:** R. G. McQueen (1964) **Shot no.:** 56-60-35 **Date:** June 6, 1960 **Thickness:** 76.20 mm **Diameter:** 152 mm **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_s = 3.16$ mm/µs
IMPACTOR	2024 aluminum, 51 mm thick, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.117 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-60-35, 56-60-38, and 56-60-41 are a series with varied impact stress.



TARGET	**Material:** 2024 aluminum **Experiment type:** Free-surface capacitor **Experimenters:** M. H. Rice and J. W. Taylor **Reference:** R. G. McQueen (1964) **Shot no.:** 56-60-38 **Date:** June 16, 1960 **Thickness:** 76.20 mm **Diameter:** 152 mm **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_s = 3.16$ mm/µs
IMPACTOR	2024 aluminum, 51 mm thick, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.307 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-60-35, 56-60-38, and 56-60-41 are a series with varied impact stress.



TARGET	**Material:** 2024 aluminum **Experiment type:** Free-surface capacitor **Experimenters:** M. H. Rice and J. W. Taylor **Reference:** R. G. McQueen (1964) **Shot no.:** 56-60-41 **Date:** June 24, 1960 **Thickness:** 76.20 mm **Diameter:** 152 mm **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_S = 3.16$ mm/µs
IMPACTOR	2024 aluminum, 51 mm thick, mounted on 165-mm-diam aluminum alloy projectile **Impact velocity:** 0.168 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-60-35, 56-60-38, and 56-60-41 are a series with varied impact stress.



TARGET

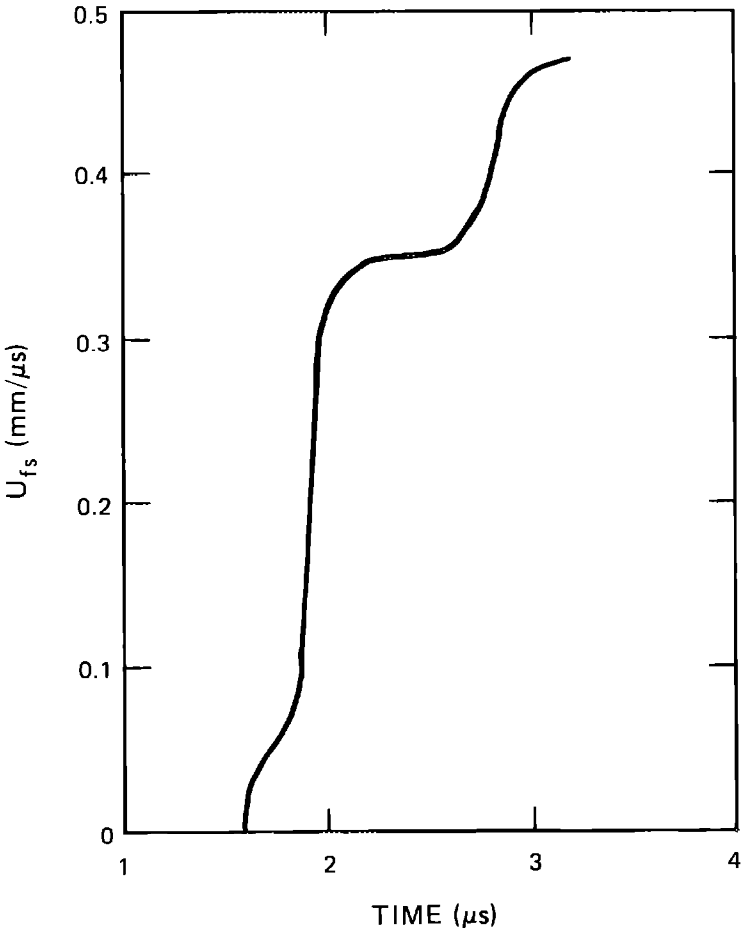
Material: 2024 aluminum
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: J. W. Taylor (1968)
Shot no.: 56-65-394 Date: May 22, 1965
Thickness: 12.70 mm
Density: 2.785 g/cm^3
$C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs

IMPACTOR

2024 aluminum, 3.18 mm thick, backed by iron, mounted on aluminum alloy projectile

TRANSDUCER

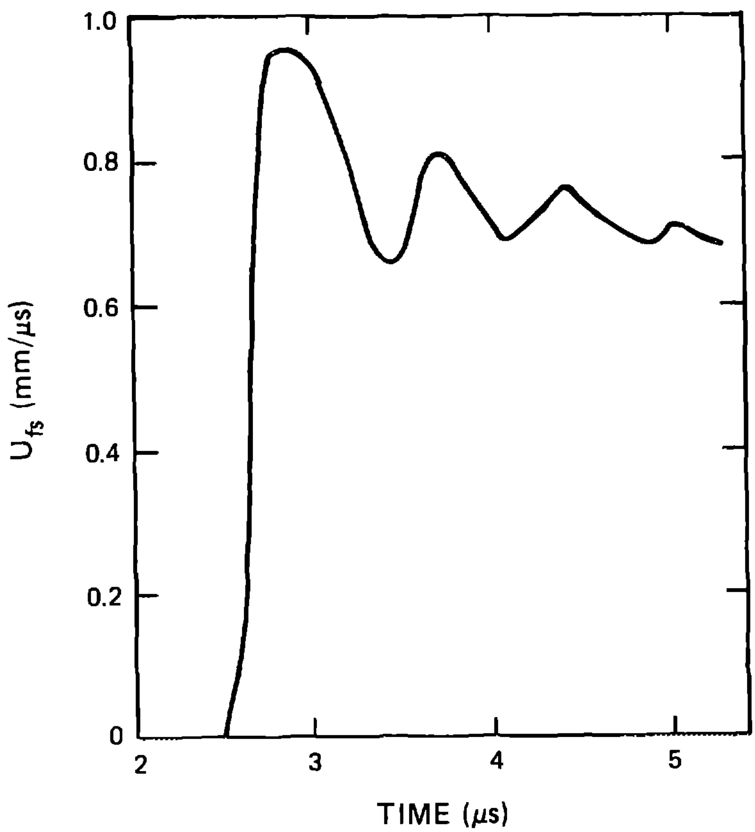
Free-surface capacitor
Time: Relative



TARGET — Material: 2024 aluminum
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: J. W. Taylor (1968)
Shot no.: 56-66-407 Date: December 12, 1966
Thickness: 12.70 mm Diameter: 152.4 mm
Density: 2.785 g/cm^3
$C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs

IMPACTOR — 2024 aluminum, 3.18 mm thick, backed with low-density polyurethane foam, mounted on 165-mm-diam aluminum alloy projectile
Impact velocity: 1.00 mm/μs

TRANSDUCER — Free-surface capacitor
Time: Relative



TARGET

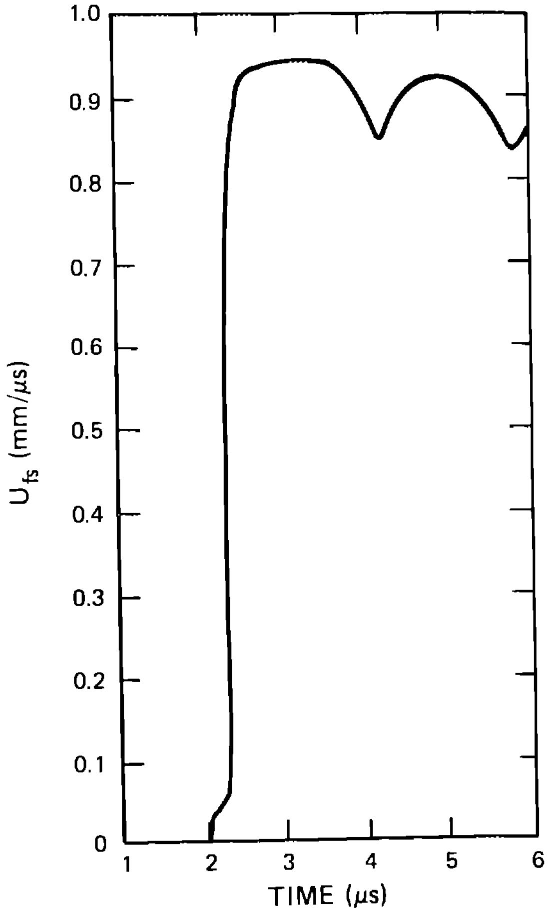
Material: 2024 aluminum
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: J. W. Taylor (1968)
Shot no.: 56-66-412   Date: December 23, 1966
Thickness: 12.70 mm   Diameter: 152.4 mm
Density: 2.785 g/cm^3
$C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs

IMPACTOR

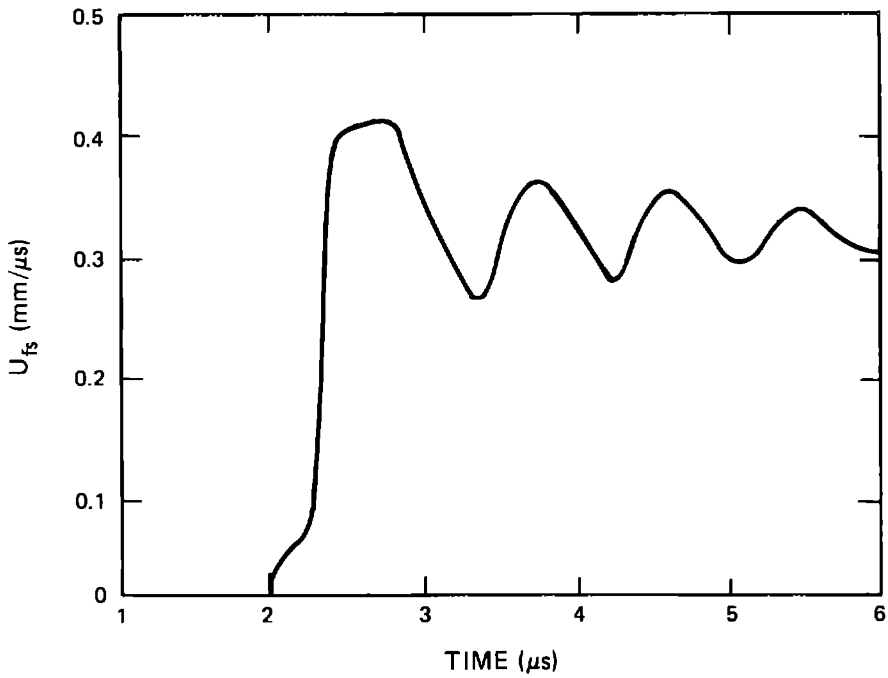
2024 aluminum, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 165-mm-diam aluminum alloy projectile
Impact velocity: 0.995 mm/μs

TRANSDUCER

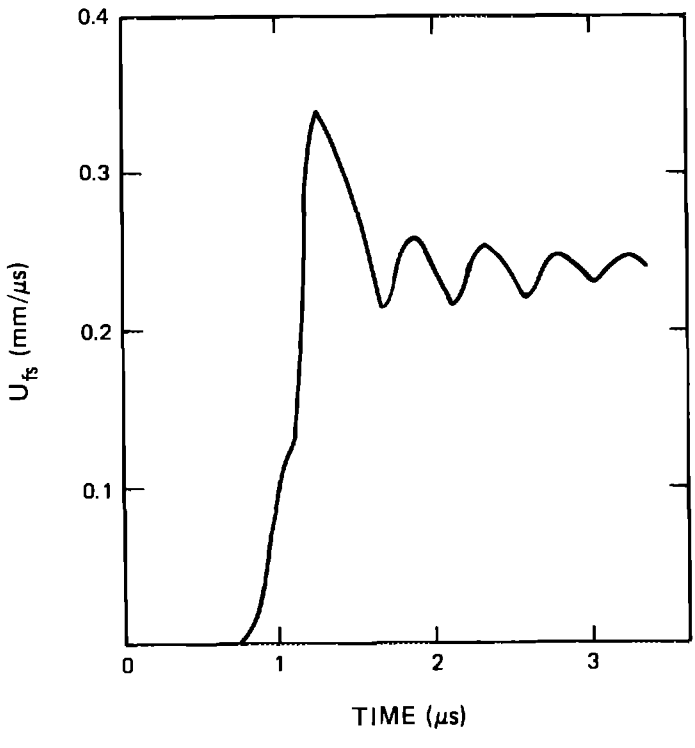
Free-surface capacitor
Time: Relative



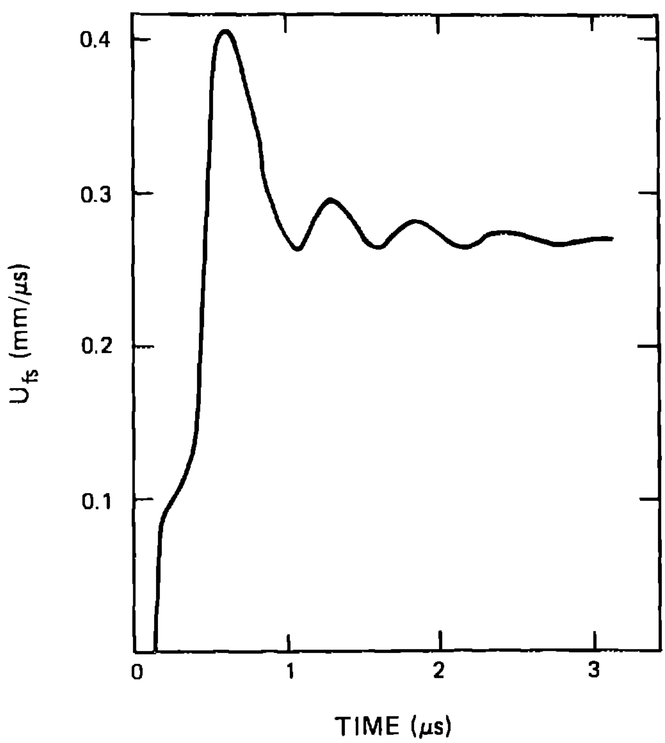
TARGET	Material: 2024 Aluminum Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Reference: J. W. Taylor (1968) Shot no.: 56-66-383 Date: June 21, 1966 Thickness: 12.70 mm Diameter: 38.1 mm Density: 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
IMPACTOR	2024 aluminum, 3.18 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.408 mm/μs
TRANSDUCER	Free-surface capacitor Time: Relative
NOTES	Shots 56-66-383, 56-67-414, 56-67-415, and 56-67-424 are a series of overtaking unloading wave profiles with varied driver thicknesses.



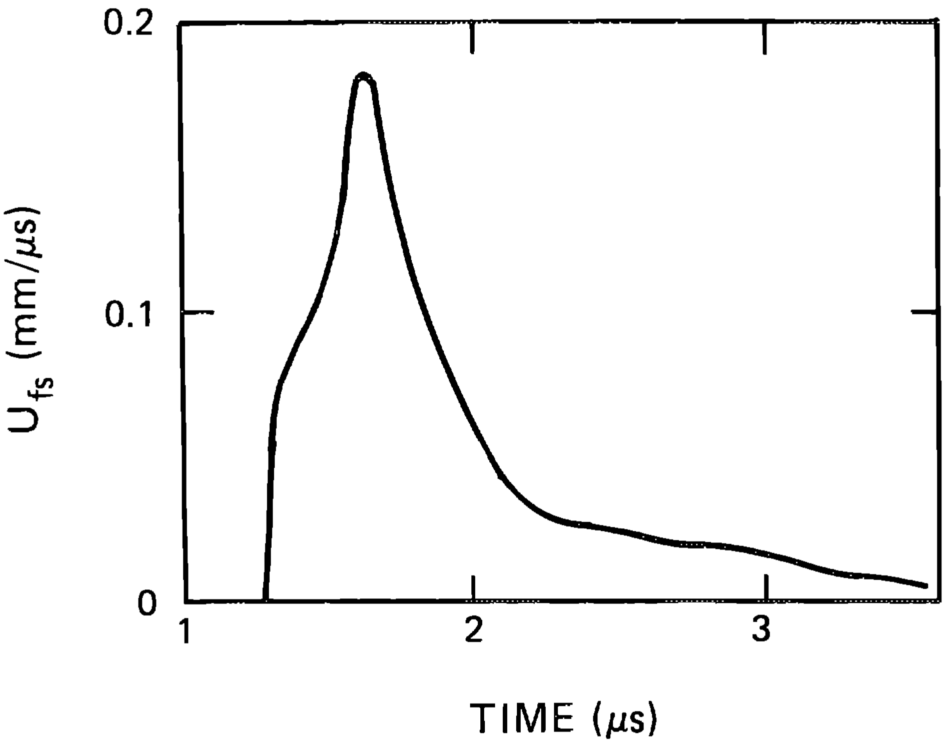
TARGET	**Material:** 2024 aluminum **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-67-414 **Date:** January 10, 1967 **Thickness:** 12.70 mm **Diameter:** 38.1 mm **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_S = 3.16$ mm/µs
IMPACTOR	2024 aluminum, 1.47 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.455 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-66-383, 56-67-414, 56-67-415, and 56-67-424 are a series of overtaking unloading wave profiles with varied driver thicknesses.



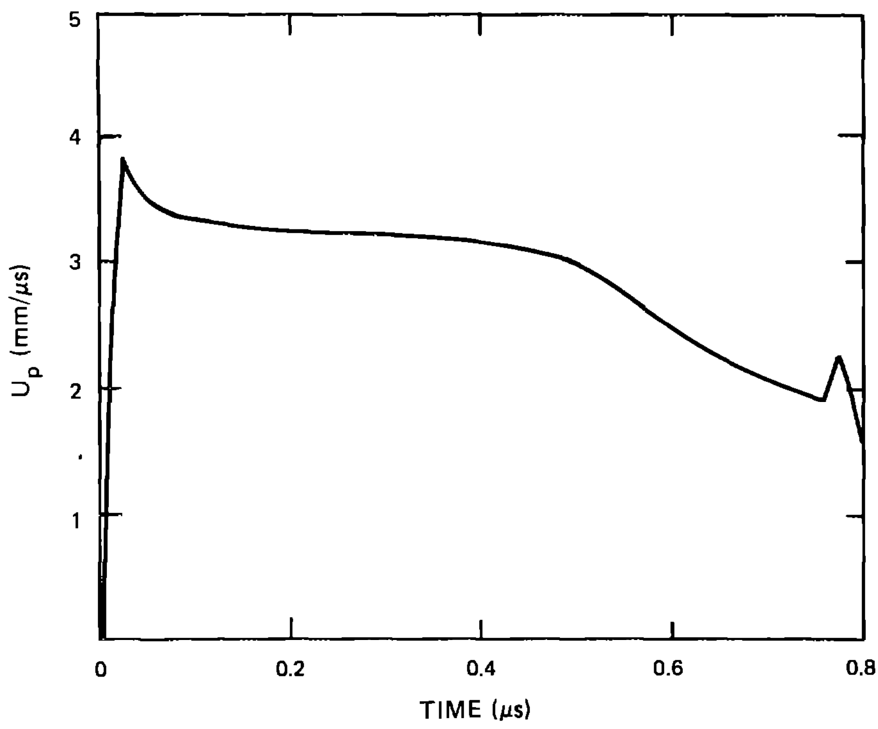
TARGET	Material: 2024 aluminum Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Shot no.: 56-67-415 Date: January 10, 1967 Thickness: 12.70 mm Diameter: 38.1 mm Density: 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_s = 3.16$ mm/μs
IMPACTOR	2024 aluminum, 2.03 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.410 mm/μs
TRANSDUCER	Free-surface capacitor Time: Relative
NOTES	Shots 56-66-383, 56-67-414, 56-67-415, and 56-67-424 are a series of overtaking unloading wave profiles with varied driver thicknesses.



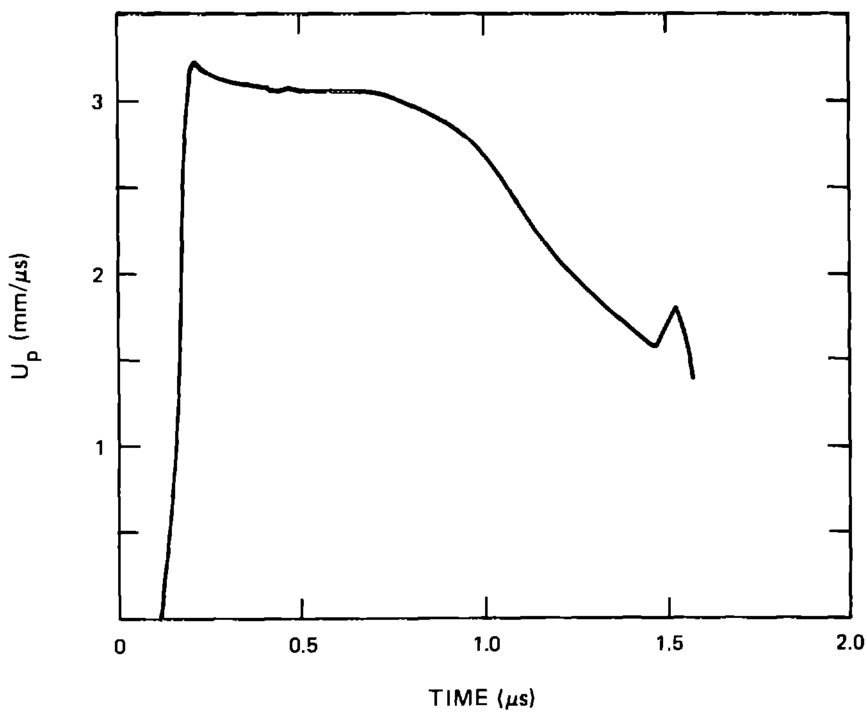
TARGET	**Material:** 2024 aluminum **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-67-424 **Date:** March 3, 1967 **Thickness:** 12.70 mm **Diameter:** 38.1 mm **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_s = 3.16$ mm/µs
IMPACTOR	2024 aluminum, 0.076 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.413 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-66-383, 56-67-414, 56-67-415, and 56-67-424 are a series of overtaking unloading wave profiles with varied driver thicknesses.



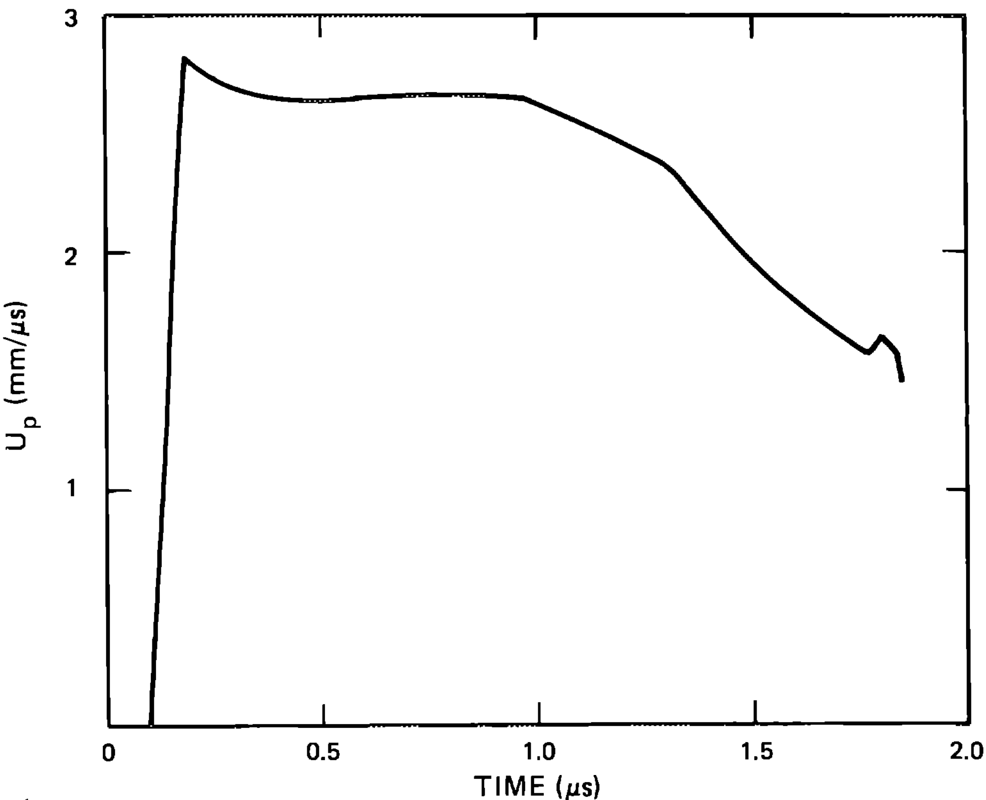
TARGET	**Material:** 2024 aluminum **Experiment type:** ASM probe **Experimenters:** C. E. Morris and J. N. Fritz **Shot no.:** 88S86 **Date:** January 26, 1981
HE SHOT GEOMETRY	P-120 lens/152 mm cyclotol/89 mm PBX 9501/6.35 mm air/0.25 mm polyethylene/3.228 mm 2024 aluminum/ 25 mm HE/4.184 mm 2024 aluminum//epoxy/6.003 mm Teflon//
SHOT COMPONENTS	2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_S = 3.16$ mm/µs Teflon **Density:** 2.151 g/cm^3 $C_L = 1.23$ mm/µs $C_S = 0.41$ mm/µs
TRANSDUCER	ASM probe **Coil radius:** 19.148 mm **Initial coil spacing:** 6.601 mm



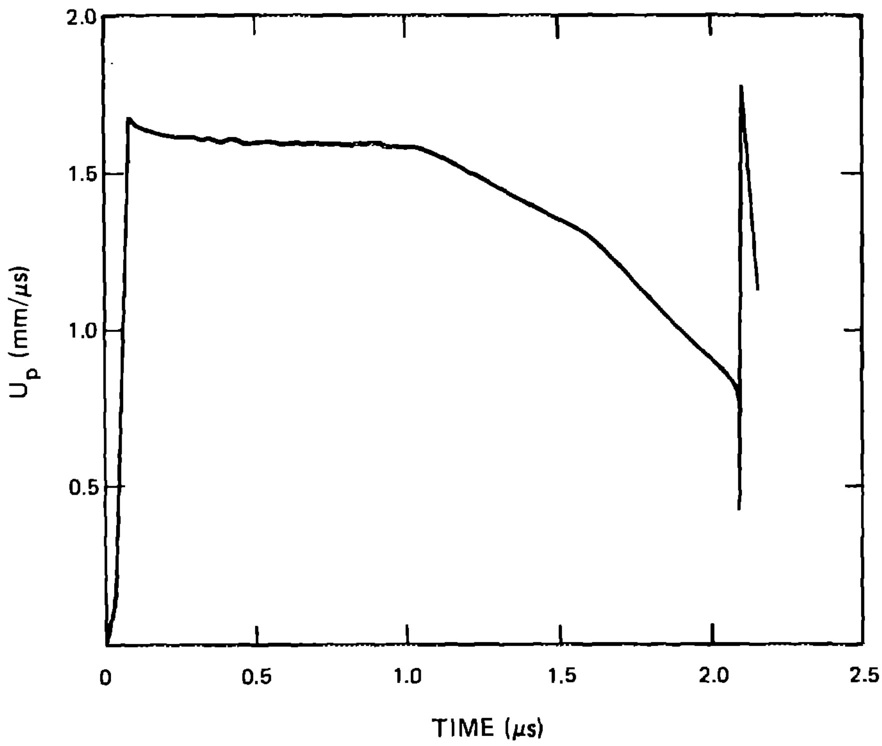
TARGET	**Material:** 2024 aluminum **Experiment type:** ASM probe **Experimenters:** C. E. Morris and J. N. Fritz **Shot no.:** 88S83 **Date:** January 23, 1981
HE SHOT GEOMETRY	P-120 lens/229 mm cyclotol/51 mm PBX 9501/6.35 mm air/0.25 mm polyethylene/5.072 mm 2024 aluminum/ 2 5 mm HE/7.016 mm 2024 aluminum//epoxy/ 10.014 mm Teflon//
SHOT COMPONENTS	2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/µs $C_S = 3.16$ mm/µs Teflon **Density:** 2.151 g/cm^3 $C_L = 1.23$ mm/µs $C_S = 0.41$ mm/µs
TRANSDUCER	ASM probe **Coil radius:** 25.499 mm **Initial coil spacing:** 10.624 mm



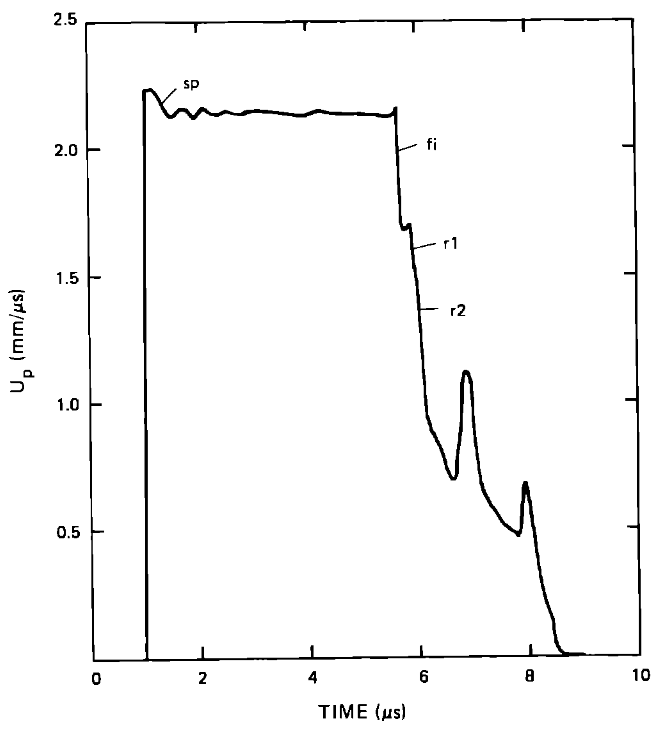
TARGET	**Material:** 2024 aluminum **Experiment type:** ASM probe **Experimenters:** C. E. Morris and J. N. Fritz **Shot no.:** 88S85 **Date:** January 26, 1981
HE SHOT GEOMETRY	P-120 lens/203 mm Comp B/6.35 mm air/0.25 mm polyethylene/6.368 mm 2024 aluminum/25 mm HE/9.009 mm 2024 aluminum//epoxy/10.980 mm Teflon//
SHOT COMPONENTS	2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs Teflon **Density:** 2.151 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 25.497 mm **Initial coil spacing:** 11.571 mm



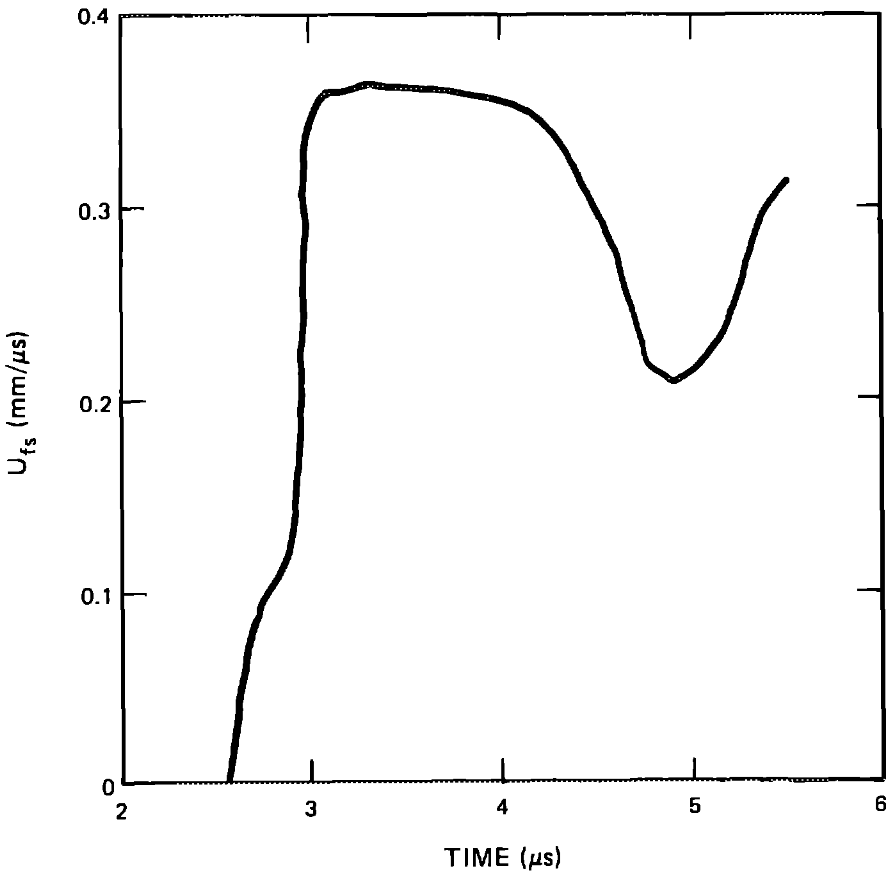
TARGET	**Material:** 2024 aluminum **Experiment type:** ASM probe **Experimenters:** C. E. Morris and J. N. Fritz **Shot no.:** 57S88 **Date:** March 11, 1981
HE SHOT GEOMETRY	P-120 lens/152 mm baratol/12.7 mm air/0.25 mm polyethylene/6.370 mm 2024 aluminum/25 mm HE/11.006 mm 2024 aluminum//epoxy/10.012 mm Teflon//
SHOT COMPONENTS	2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs Teflon **Density:** 2.151 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 25.479 mm **Initial coil spacing:** 10.571 mm



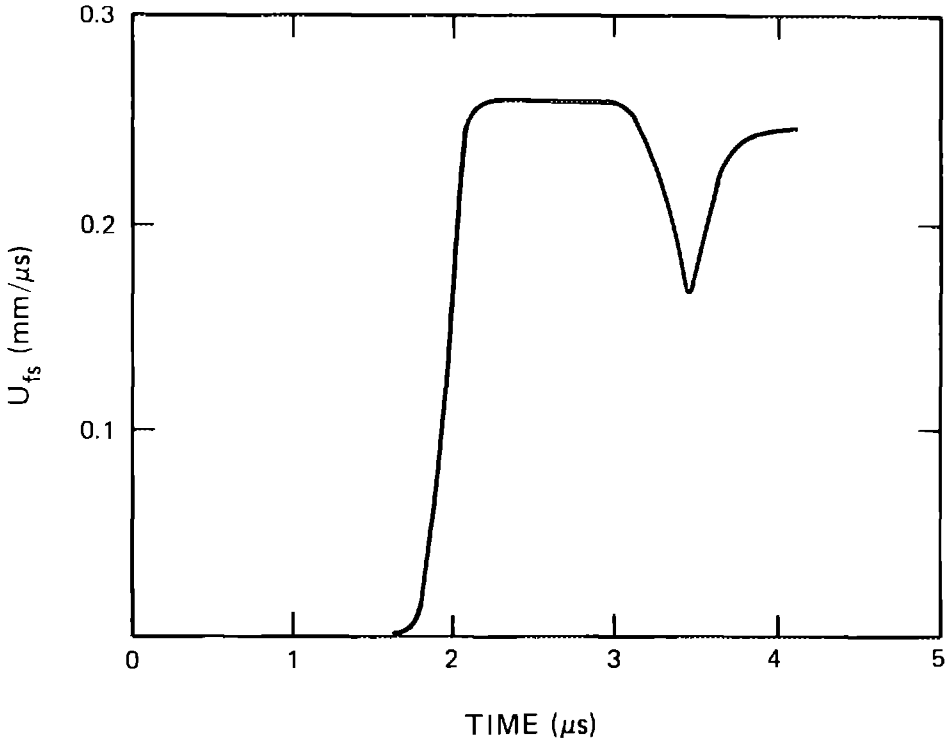
TARGET	**Material:** 2024 aluminum, spall strength measurement **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 37s1 **Date:** June 8, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/19.55 mm OFHC copper/ 3.189 mm 2024 aluminum/6.36 mm vacuum/6.323 mm 2024 aluminum//10 mm vacuum/10.0 mm polymethyl methacrylate//
SHOT COMPONENTS	2024 aluminum Density: 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_s = 3.16$ mm/μs OFHC copper Density: 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_s = 2.33$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 38.17 mm **Initial coil spacing:** 20.00 mm



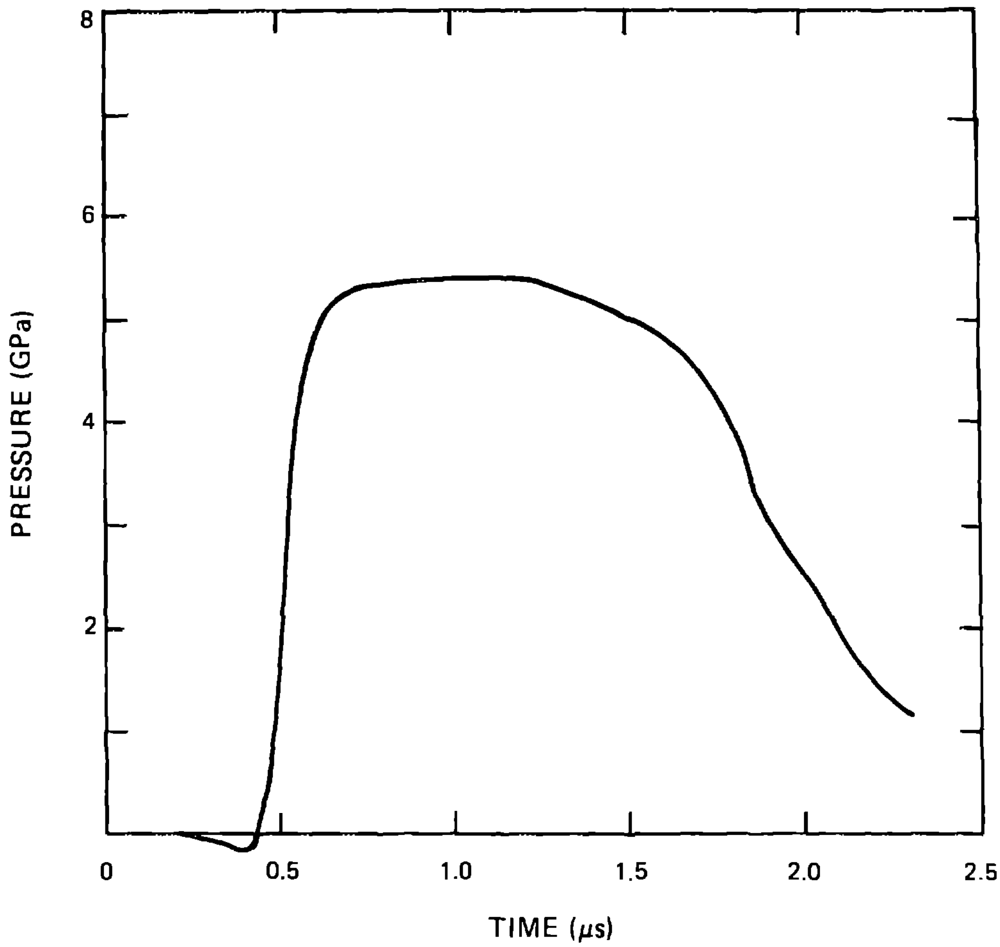
TARGET	**Material:** 6061 aluminum
	Experiment type: Free-surface capacitor
	Experimenter: J. W. Hopson
	Shot no.: 56-70-46 **Date:** May 15, 1970
	Thickness: 12.70 mm **Diameter:** 44.5 mm
	Density: 2.703 g/cm^3
	$C_L = 6.40$ mm/µs $C_S = 3.15$ mm/µs
IMPACTOR	6061 aluminum, 6.08 mm thick, mounted on 51-mm-diam aluminum alloy projectile
	Impact velocity: 0.390 mm/µs
TRANSDUCER	Free-surface capacitor
	Time: Relative



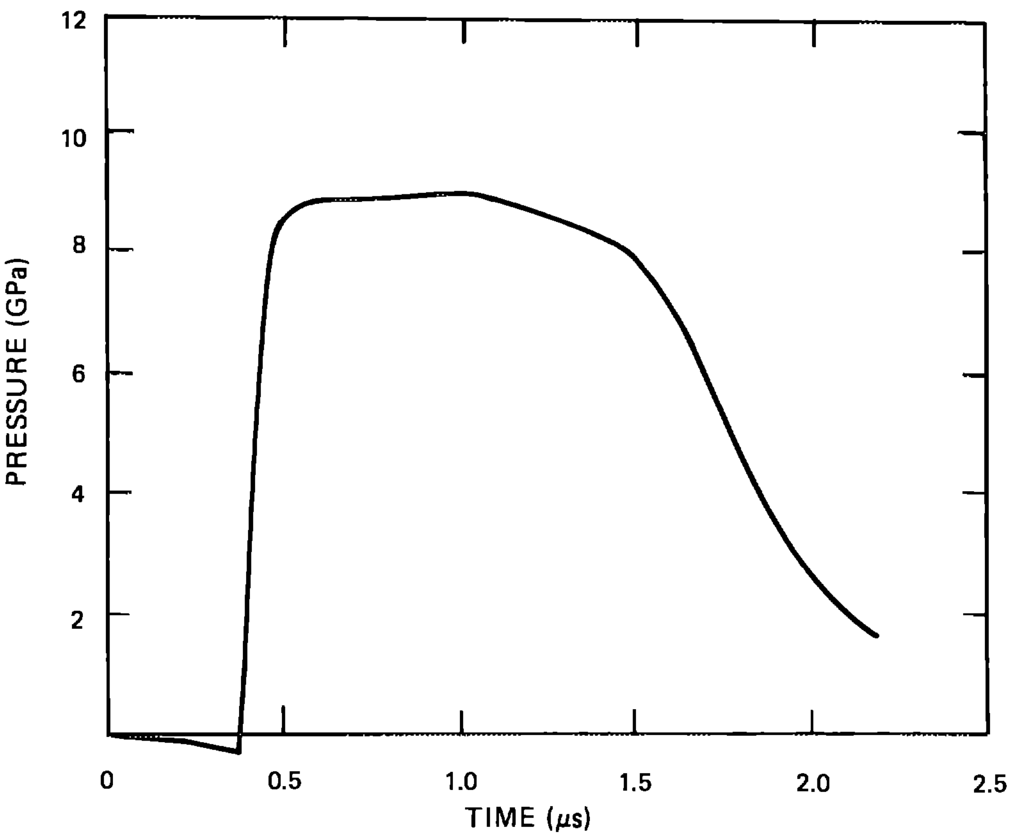
TARGET	**Material:** 98.2 wt% copper with 1.8 wt% beryllium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-73-28 **Date:** May 1, 1973 **Thickness:** 6.13 mm **Diameter:** 38.1 mm **Density:** 8.33 g/cm^3 $C_L = 4.97$ mm/µs $C_s = 2.46$ mm/µs **Heat treatment:** Solution annealed and overaged
IMPACTOR	OFHC copper, 2.97 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative


0.3
0.2
0.1
U_{fs} (mm/μs)
0
1
2
3
4
5
TIME (μs)

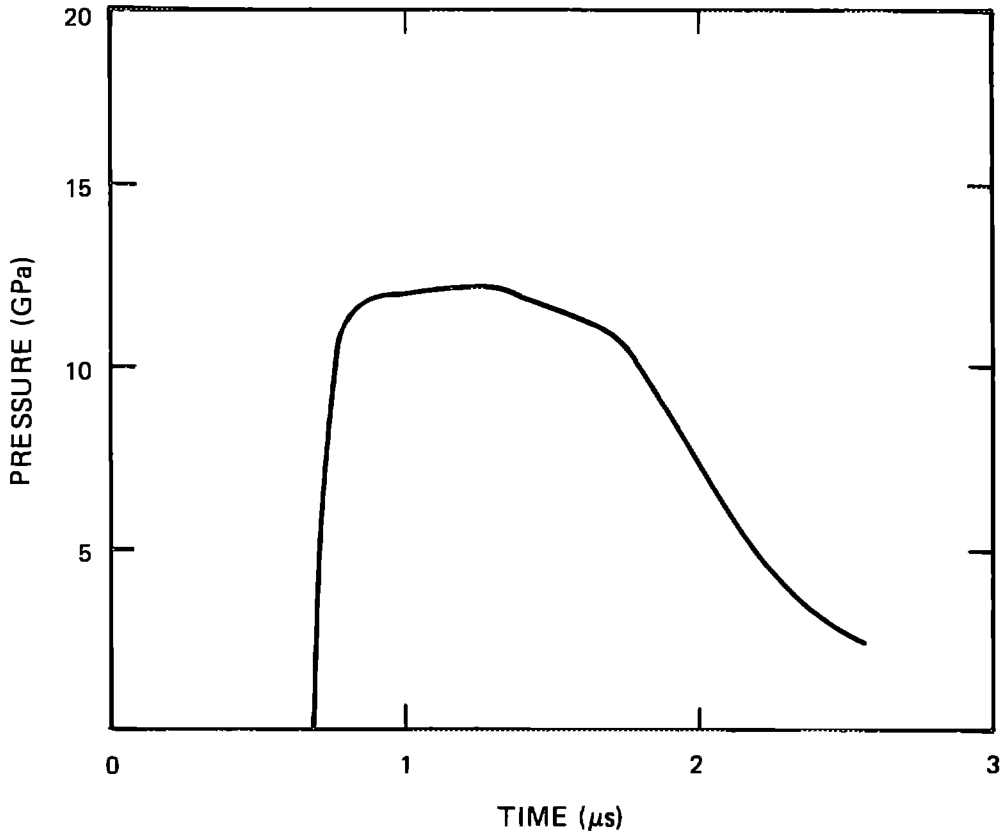
TARGET	Material: OFHC copper Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-78-9 Date: April 6, 1978 Thickness: 18.24 mm Diameter: 39.7 mm Density: 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_s = 2.33$ mm/μs
IMPACTOR	OFHC copper, 2.946 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.285 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 9.103 mm Heat treatment: Annealed Encapsulation: 0.041 mm polyimide on each side Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


8
6
4
2
PRESSURE (GPa)
0
0.5
1.0
1.5
2.0
2.5
TIME (μs)

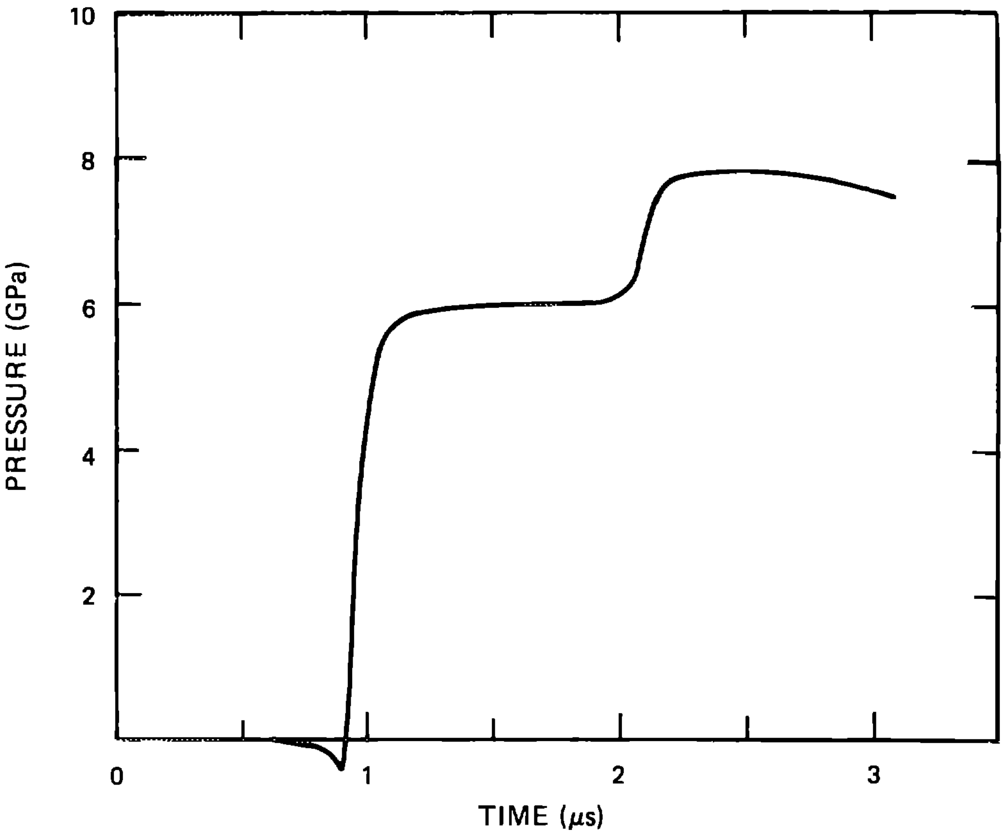
TARGET	Material: OFHC copper Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-78-10 Date: April 6, 1978 Thickness: 18.230 mm Diameter: 39.7 mm Density: 8.93 g/cm^3 $C_L = 4.76$ mm/µs $C_S = 2.33$ mm/µs
IMPACTOR	OFHC copper, 2.865 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.468 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 9.103 mm Heat treatment: Annealed Encapsulation: 0.041 mm polyimide on each side Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


12
10
8
6
4
2
PRESSURE (GPa)
0
0.5
1.0
1.5
2.0
2.5
TIME (μs)

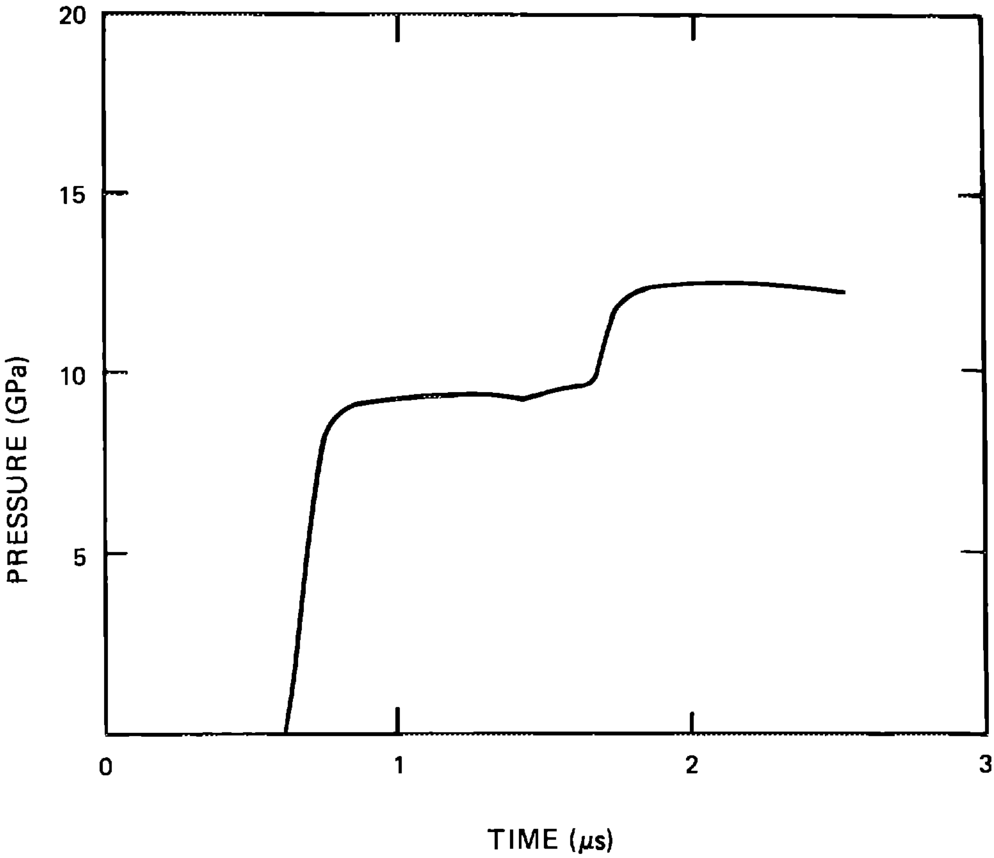
TARGET	Material: OFHC copper Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-78-15 Date: May 4, 1978 Thickness: 18.383 mm Diameter: 39.7 mm Density: 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_S = 2.33$ mm/μs
IMPACTOR	OFHC copper, 2.934 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.645 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 9.191 mm Heat treatment: Annealed Encapsulation: 0.041 mm polyimide on each side Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


20
15
10
5
PRESSURE (GPa)
0
1
2
3
TIME (μs)

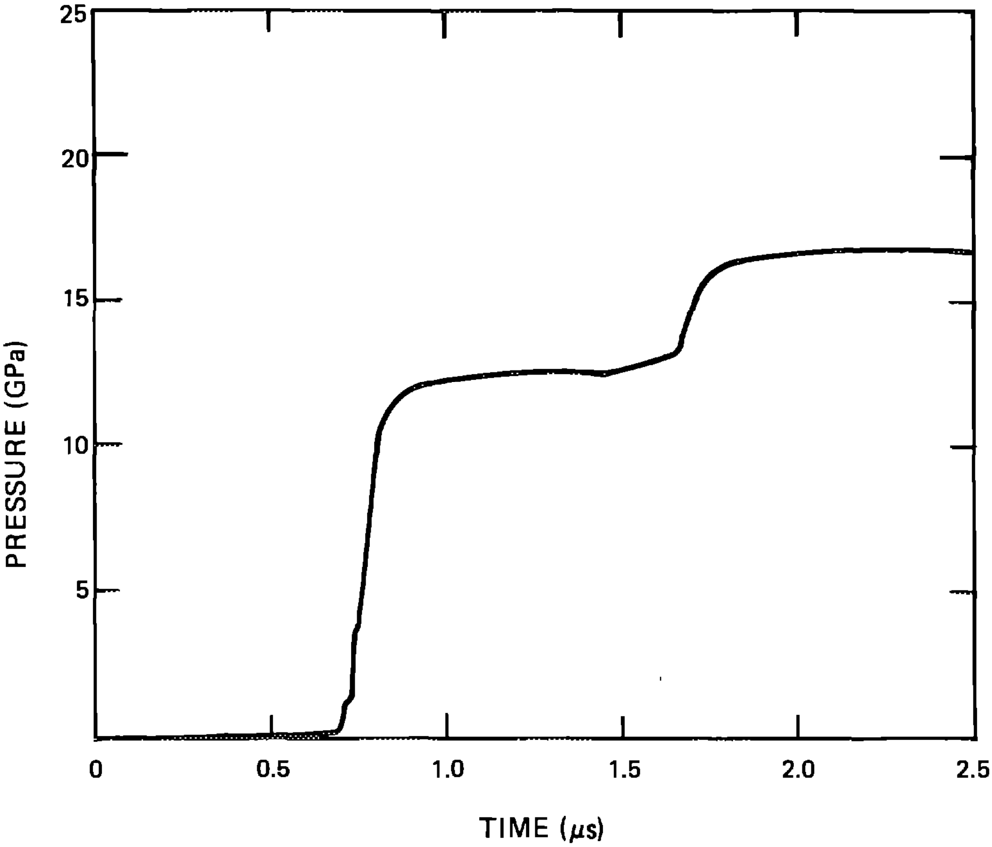
TARGET	Material: OFHC copper Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-78-16 Date: May 4, 1978 Thickness: 18.380 mm Diameter: 39.7 mm Density: 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_s = 2.33$ mm/μs
IMPACTOR	OFHC copper, 2.959 mm thick, backed with tungsten carbide ($\rho = 18.84$ g/cm^3), mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.311 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 9.193 mm Heat treatment: Annealed Encapsulation: 0.041 mm polyimide on both sides Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


10
8
6
4
2
0
1
2
3
PRESSURE (GPa)
TIME (μs)

TARGET	Material: OFHC copper Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-78-17 Date: May 8, 1978 Thickness: 18.382 mm Diameter: 39.7 mm Density: 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_S = 2.33$ mm/μs
IMPACTOR	OFHC copper, 2.952 mm thick, backed with tungsten carbide ($\rho = 18.83$ g/cm^3), mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.488 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 9.150 mm Heat treatment: Annealed Encapsulation: 0.041 mm polyimide on both sides Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative

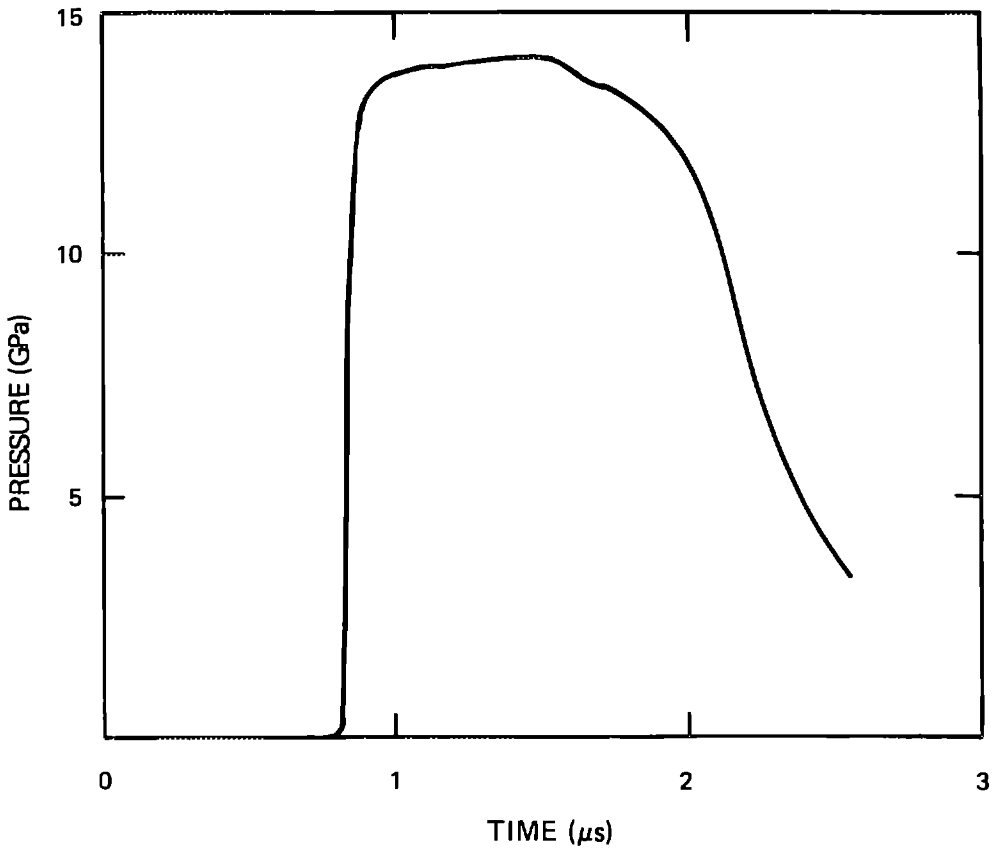

20
15
10
5
PRESSURE (GPa)
0
1
2
3
TIME (μs)

TARGET	**Material:** OFHC copper **Experiment type:** Embedded Manganin gage **Experimenter:** C. E. Morris **Shot no.:** 56-78-18 **Date:** May 9, 1978 **Thickness:** 18.344 mm **Diameter:** 39.7 mm **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_s = 2.33$ mm/μs
IMPACTOR	OFHC copper, 2.922 mm thick, backed with tungsten carbide ($\rho = 18.04$ g/cm^3), mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.612 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Location from impact surface:** 9.161 mm **Heat treatment:** Annealed **Encapsulation:** 0.041 polyimide on both sides **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative

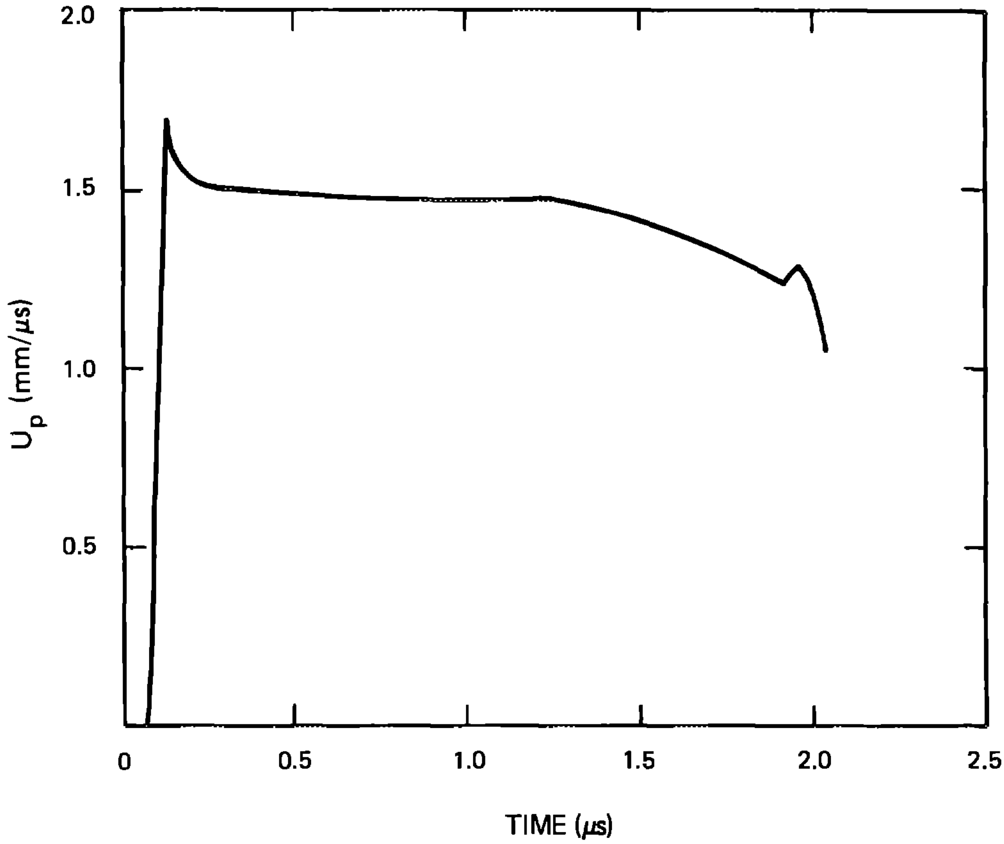


25
20
15
10
5
PRESSURE (GPa)
0
0.5
1.0
1.5
2.0
2.5
TIME (μs)

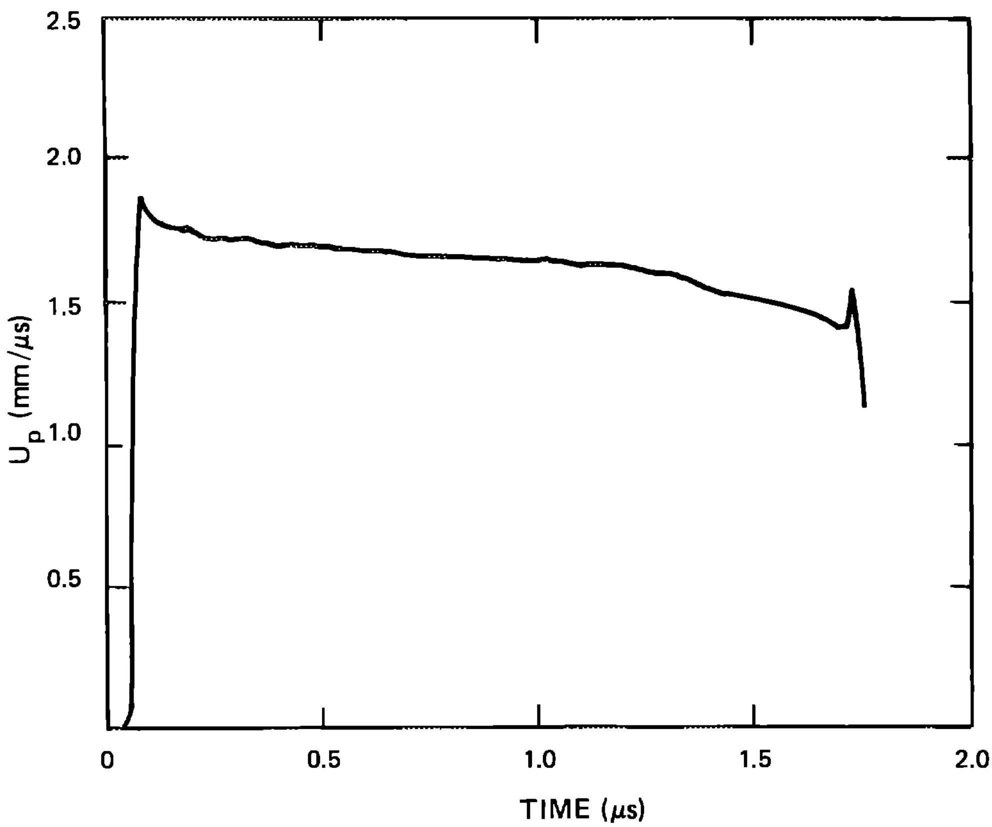
TARGET	**Material:** OFHC copper **Experiment type:** Embedded Manganin gage **Experimenter:** C. E. Morris **Shot no.:** 56-78-70 **Date:** October 17, 1978 **Thickness:** 18.254 mm **Diameter:** 39.7 mm **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/µs $C_S = 2.33$ mm/µs **Heat treatment:** Fully annealed
IMPACTOR	OFHC copper, 3.005 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.540 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Location from impact surface:** 9.673 mm **Heat treatment:** Annealed **Encapsulation:** 0.544 mm Al_2O_3 [1$\bar{1}$02] on both sides **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative


15
10
5
PRESSURE (GPa)
0
1
2
3
TIME (μs)

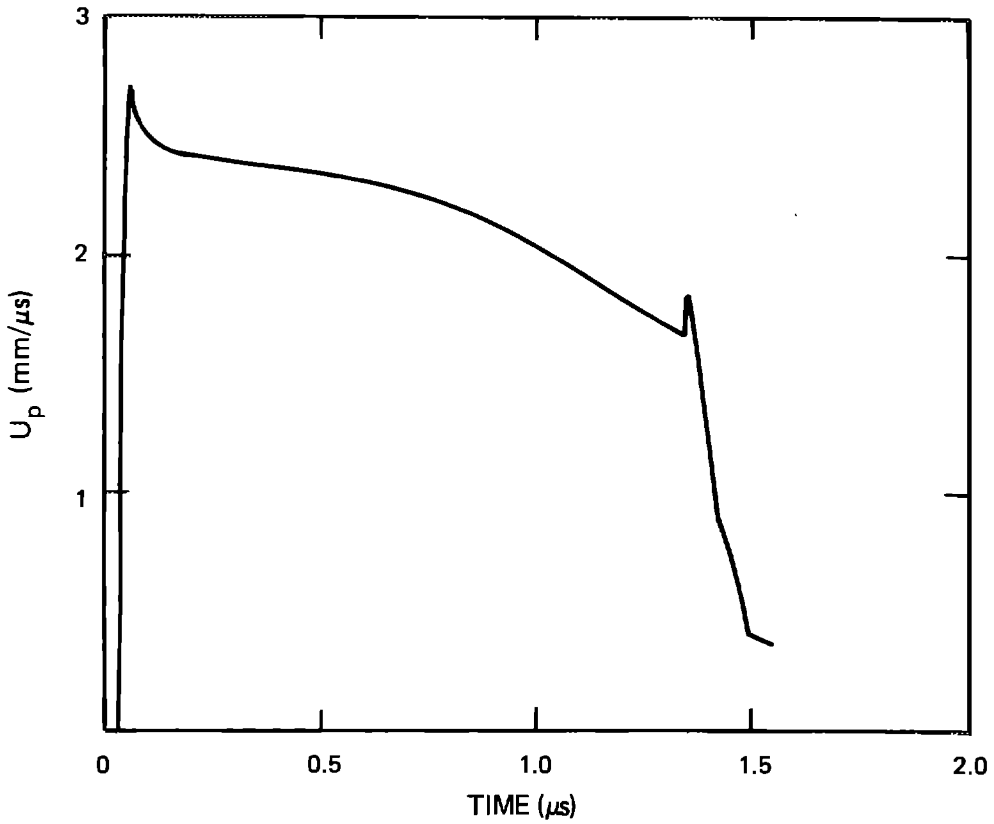
TARGET	**Material:** OFHC copper **Experiment type:** ASM probe **Experimenters:** C. E. Morris and J. N. Fritz **Shot no.:** 88S79 **Date:** December 23, 1980
HE SHOT GEOMETRY	P-120 lens/102 mm TNT/6.35 mm air/6.370 mm OFHC copper/25 mm HE/12.985 mm OFHC copper//epoxy/ 7.891 mm dense glass//
SHOT COMPONENTS	OFHC copper **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/µs $C_S = 2.33$ mm/µs Dense glass **Density:** 5.197 g/cm^3
TRANSDUCER	ASM probe **Coil radius:** 19.143 mm **Initial coil spacing:** 8.484 mm


2.0
1.5
1.0
0.5
U_p (mm/μs)
0
0.5
1.0
1.5
2.0
2.5
TIME (μs)

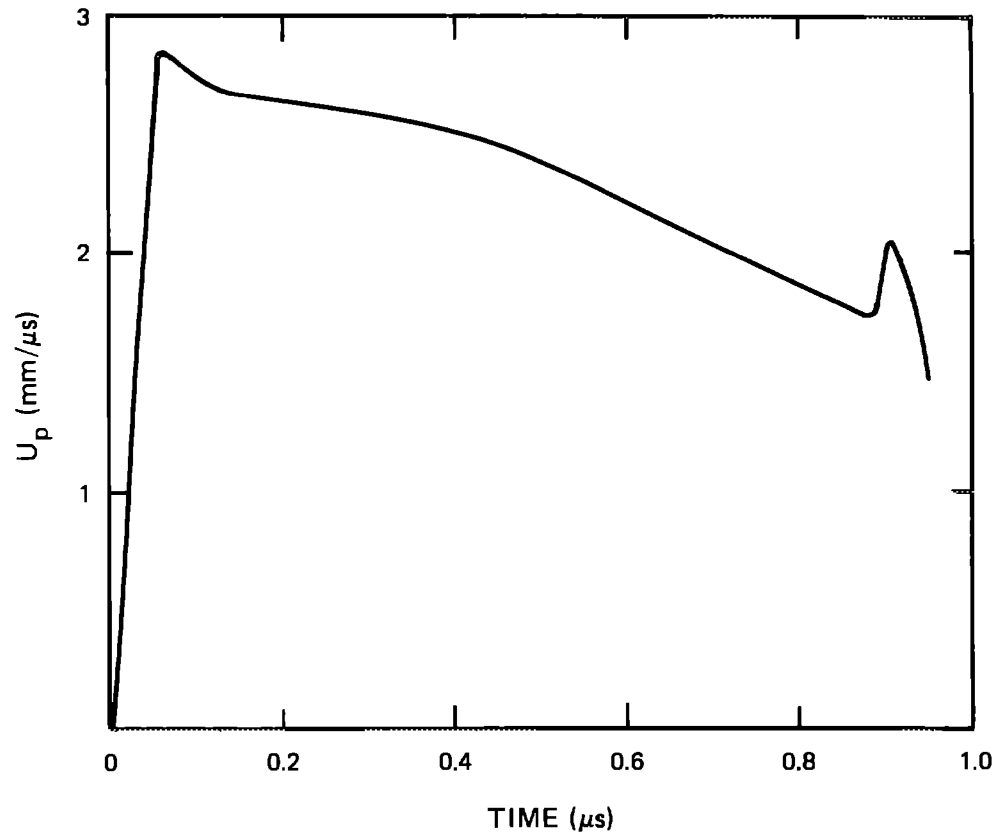
TARGET	Material: OFHC copper Experiment type: ASM probe Experimenters: C. E. Morris and J. N. Fritz Shot no.: 88S80 Date: December 24, 1980
HE SHOT GEOMETRY	P-120 lens/102 mm Comp B/6.35 mm air/0.25 mm polyethylene/6.401 mm OFHC copper/25 mm HE/12.984 mm OFHC copper//epoxy/7.844 mm dense glass//
SHOT COMPONENTS	OFHC copper Density: 8.93 g/cm^3 $C_L = 4.76$ mm/µs $C_S = 2.33$ mm/µs Dense glass Density: 5.204 g/cm^3
TRANSDUCER	ASM probe Coil radius: 19.120 mm Initial coil spacing: 8.443 mm



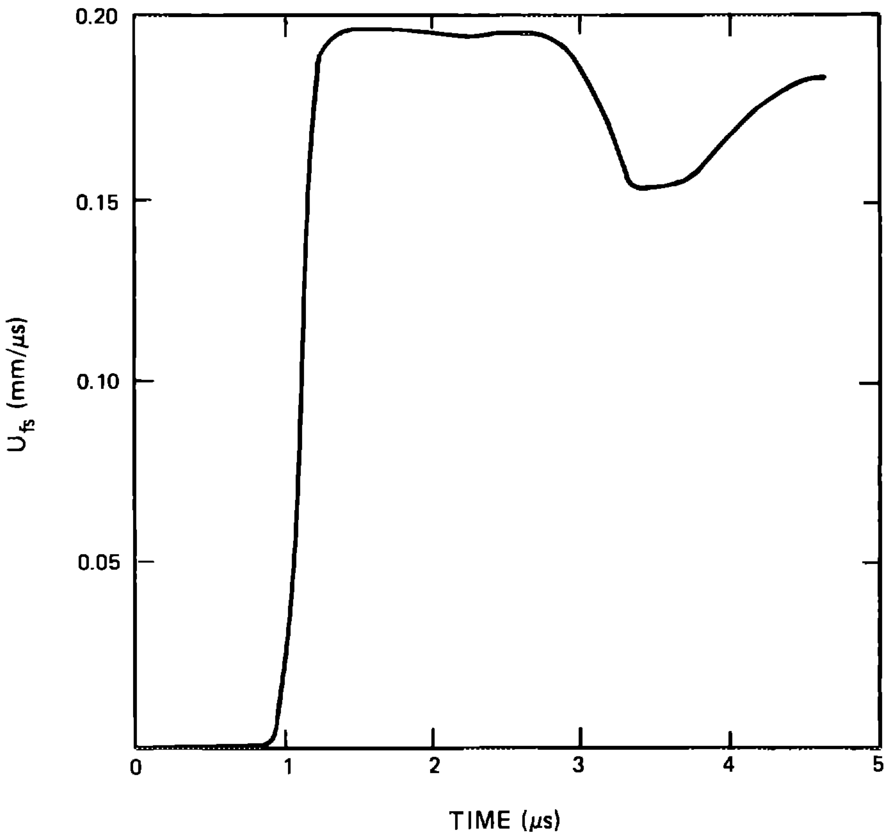
TARGET	**Material:** OFHC copper **Experiment type:** ASM probe **Experimenters:** C. E. Morris and J. N. Fritz **Shot no.:** 88S81 **Date:** January 21, 1981
HE SHOT GEOMETRY	P-120 lens/203 mm PBX 9501/6.35 mm air/0.25 mm polyethylene/5.131 mm OFHC copper/25 mm HE/12.992 mm OFHC copper//epoxy/7.737 mm dense glass//
SHOT COMPONENTS	OFHC copper **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_S = 2.33$ mm/μs Dense glass **Density:** 5.197 g/cm^3
TRANSDUCER	ASM probe **Coil radius:** 25.462 mm **Initial coil spacing:** 8.325 mm



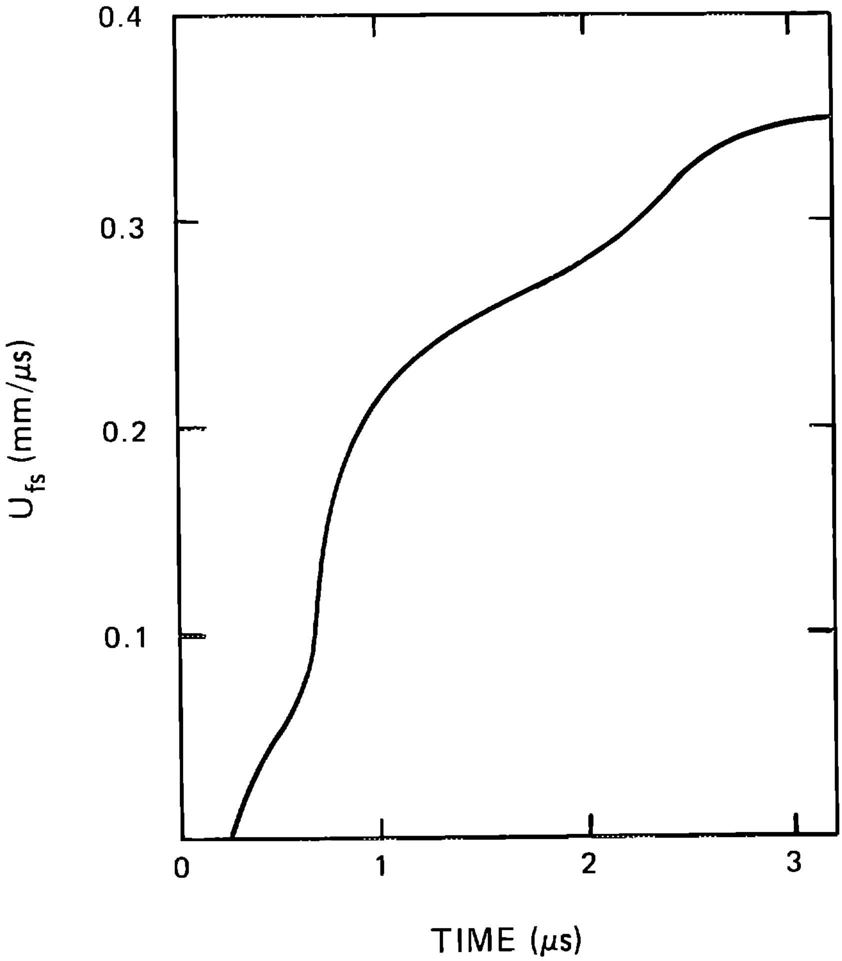
TARGET	**Material:** OFHC copper **Experiment type:** ASM probe **Experimenters:** C. E. Morris and J. N. Fritz **Shot no.:** 88S82 **Date:** January 22, 1981
HE SHOT GEOMETRY	P-120 lens/203 mm PBX 9501/6.35 mm air/0.25 mm polyethylene/3.155 mm OFHC copper/8.980 mm OFHC copper//epoxy/5.523 mm dense glass//
SHOT COMPONENTS	OFHC copper **Density:** 8.93 g/cm^3 C_L = 4.76 mm/μs C_S = 2.33 mm/μs Dense glass **Density:** 5.163 g/cm^3
TRANSDUCER	ASM probe **Coil radius:** 19.122 mm **Initial coil spacing:** 6.114 mm



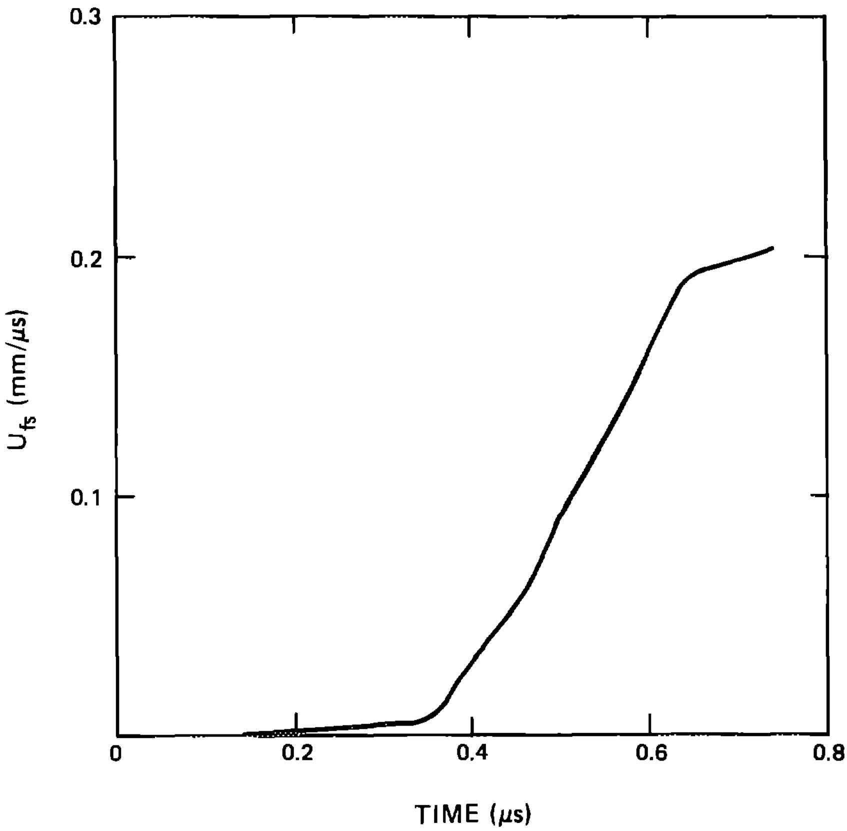
TARGET	**Material:** 98 wt% gold with 2 wt% copper **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-73-29 **Date:** May 1, 1973 **Thickness:** 8.13 mm **Diameter:** 38.1 mm **Density:** 18.73 g/cm^3 $C_L = 3.36$ mm/μs $C_S = 1.21$ mm/μs **Heat treatment:** Annealed
IMPACTOR	OFHC copper, 4.83 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



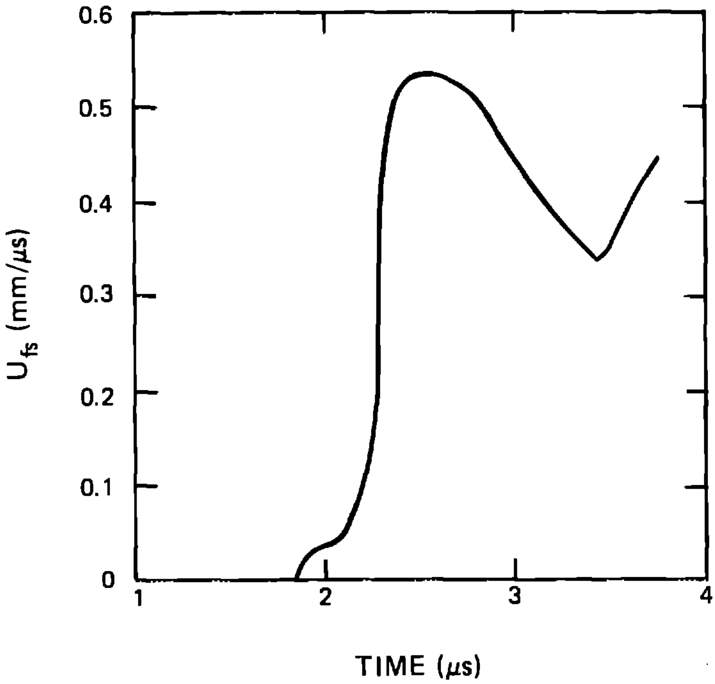
TARGET	**Material:** Iron-manganese alloy **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-66-366 **Date:** January 5, 1966
IMPACTOR	Armco iron, mounted on aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	Material: 97 wt% lead with 3 wt% antimony Experiment type: Free-surface capacitor Experimenter: J. W. Hopson Shot no.: 56-73-4 Date: February 8, 1973 Thickness: 9.51 mm Diameter: 38.1 mm Density: 11.16 g/cm^3 $C_L = 5.89$ mm/μs $C_S = 4.0$ mm/μs Heat treatment: Rolled and annealed
IMPACTOR	OFHC copper, 4.93 mm thick, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.219 mm/μs
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET	**Material:** Magnesium alloy, AZ31 B **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-67-460 **Date:** November 2, 1967 **Thickness:** 12.7 mm **Diameter:** 38.1 mm **Density:** 1.78 g/cm^3 C_L = 5.73 mm/μs C_S = 3.05 mm/μs
IMPACTOR	2024 aluminum, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.400 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-67-460 and 56-67-461 are sequential overtaking unloading wave profiles with varied driver thicknesses.



TARGET

Material: Magnesium alloy, AZ31 B
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970)
Shot no.: 56-67-461 Date: November 2, 1967
Thickness: 12.7 mm Diameter: 38.1 mm
Density: 1.78 g/cm^3
$C_L = 5.73$ mm/μs $C_S = 3.05$ mm/μs

IMPACTOR

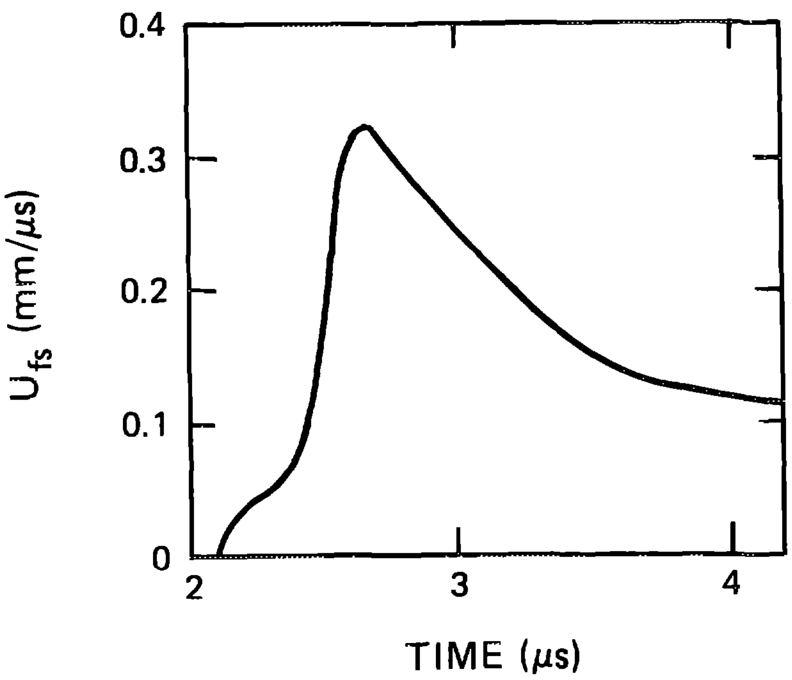
2024 aluminum, 0.81 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.400 mm/μs

TRANSDUCER

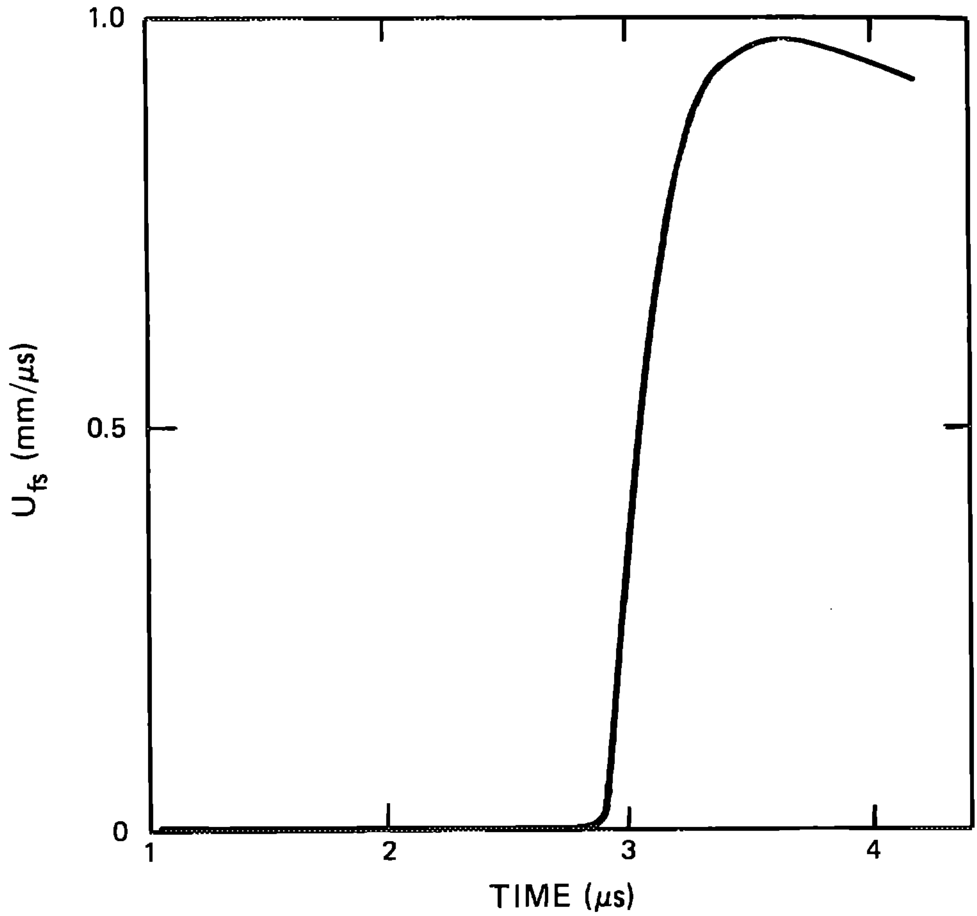
Free-surface capacitor
Time: Relative

NOTES

Shots 56-67-460 and 56-67-461 are sequential overtaking unloading wave profiles with varied driver thicknesses.



TARGET	Material: Molybdenum carbide, $MoC_{0.60}$ Experiment type: Free-surface capacitor Experimenter: J. W. Hopson Shot no.: 8B623 Date: May 6, 1969
HE SHOT SYSTEM	P-080 lens/102 mm baratol/2024 aluminum base plate/ 7.24 mm molybdenum carbide
SHOT COMPONENTS	Molybdenum carbide, $MoC_{0.60}$ Density: 8.94 g/cm^3
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET

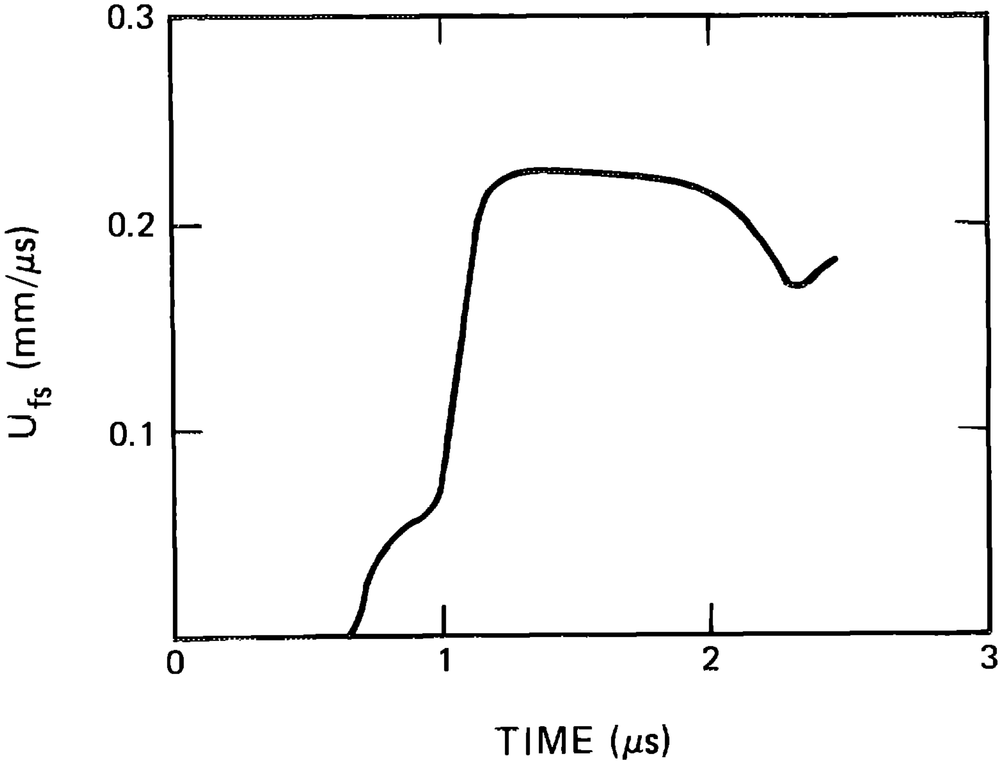
Material: 50 wt% molybdenum with 50 wt% rhenium
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-31 **Date:** May 2, 1973
Thickness: 8.50 mm **Diameter:** 38.1 mm
Density: 14.633 g/cm^3
$C_L = 5.84$ mm/µs $C_S = 3.10$ mm/µs
Heat treatment: Annealed at 1650°C

IMPACTOR

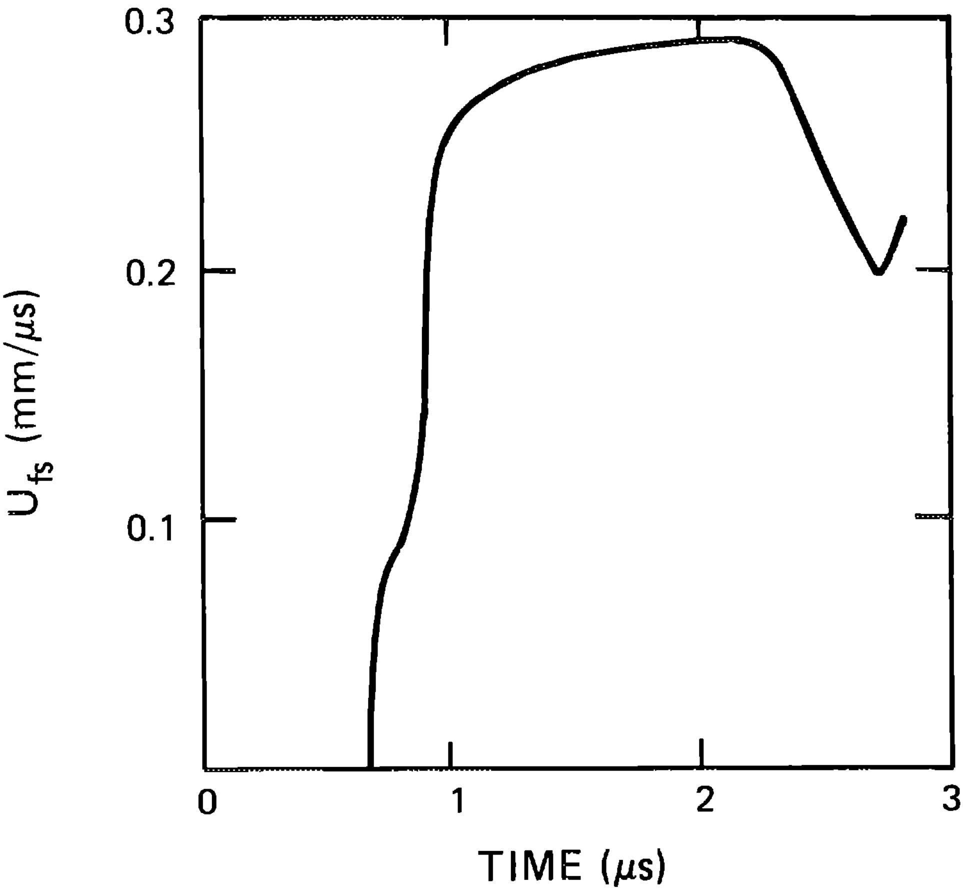
OFHC copper, 2.97 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile

TRANSDUCER

Free-surface capacitor
Time: Relative



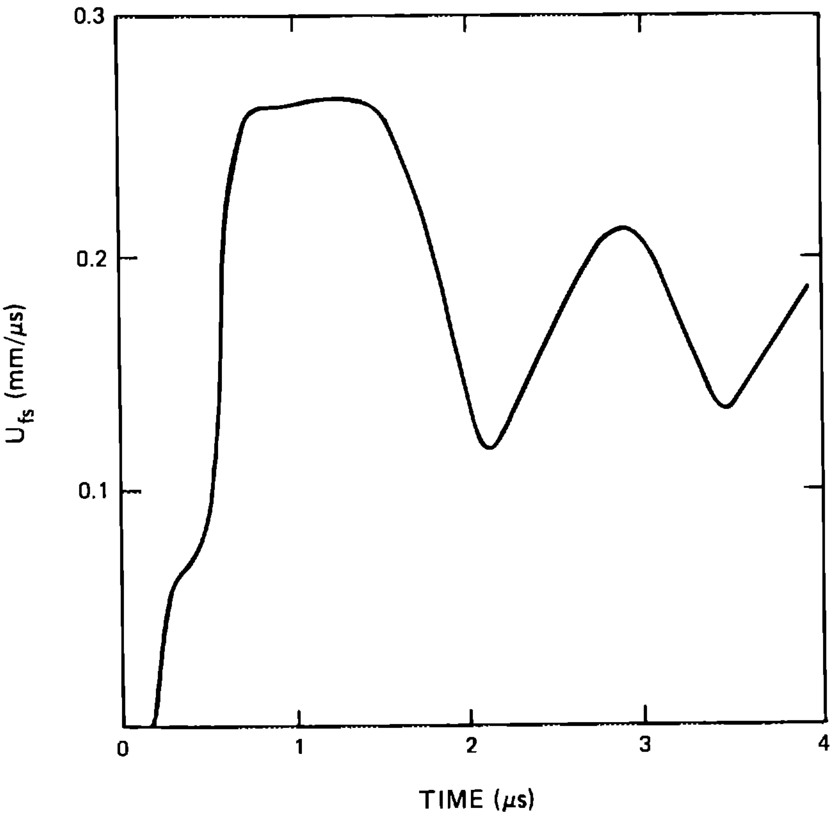
TARGET	**Material:** Almar 362 steel **Experiment type:** Free-surface capacitor **Experimenters:** J. W. Hopson and J. W. Taylor **Shot no.:** 56-71-36 **Date:** October 13, 1971 **Thickness:** 6.42 mm **Diameter:** 38.1 mm **Density:** 7.78 g/cm^3 $C_L = 5.68$ mm/µs $C_S = 3.18$ mm/µs
IMPACTOR	Steel, 6.06 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.319 mm/µs
TRANSDUCER	Free-surface capacitor Time: Relative



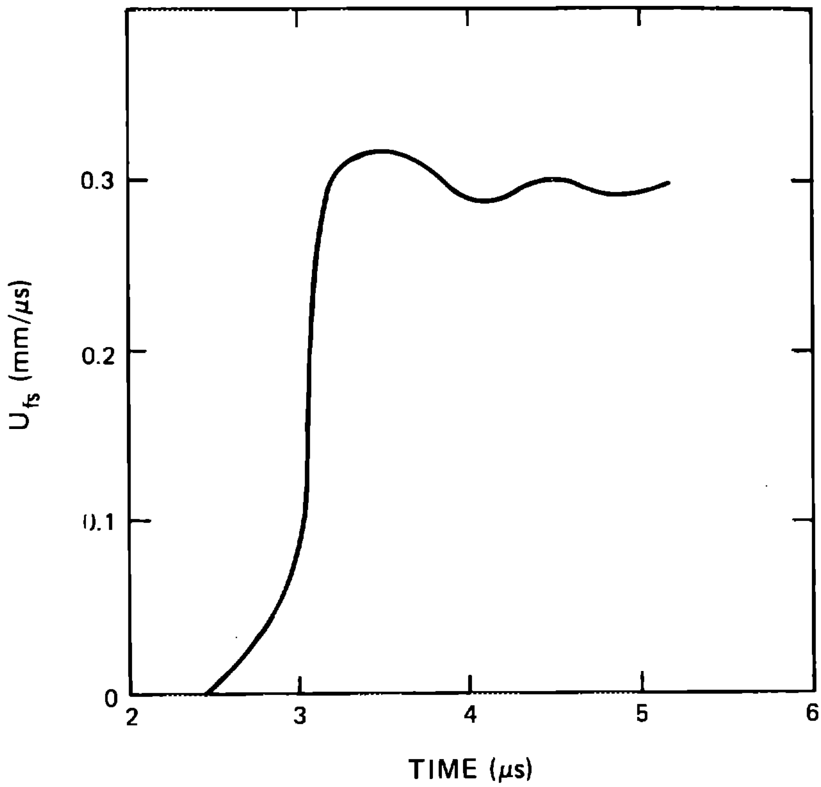
TARGET — Material: A-256 Austenitic stainless steel
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-3 Date: February 5, 1973
Thickness: 9.53 mm Diameter: 38.1 mm
Density: 7.96 g/cm^3
$C_L = 5.70$ mm/μs $C_S = 3.14$ mm/μs
Heat treatment: Solution annealed and aged at 1325°F for 16 hours

IMPACTOR — OFHC copper, 2.972 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.271 mm/μs

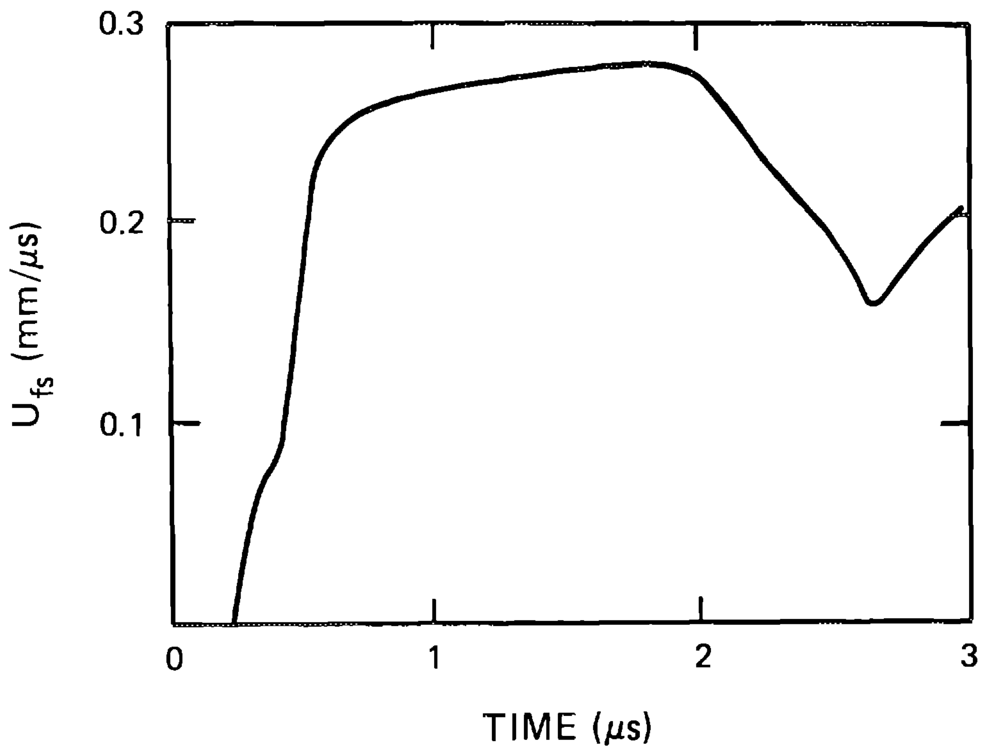
TRANSDUCER — Free-surface capacitor
Time: Relative



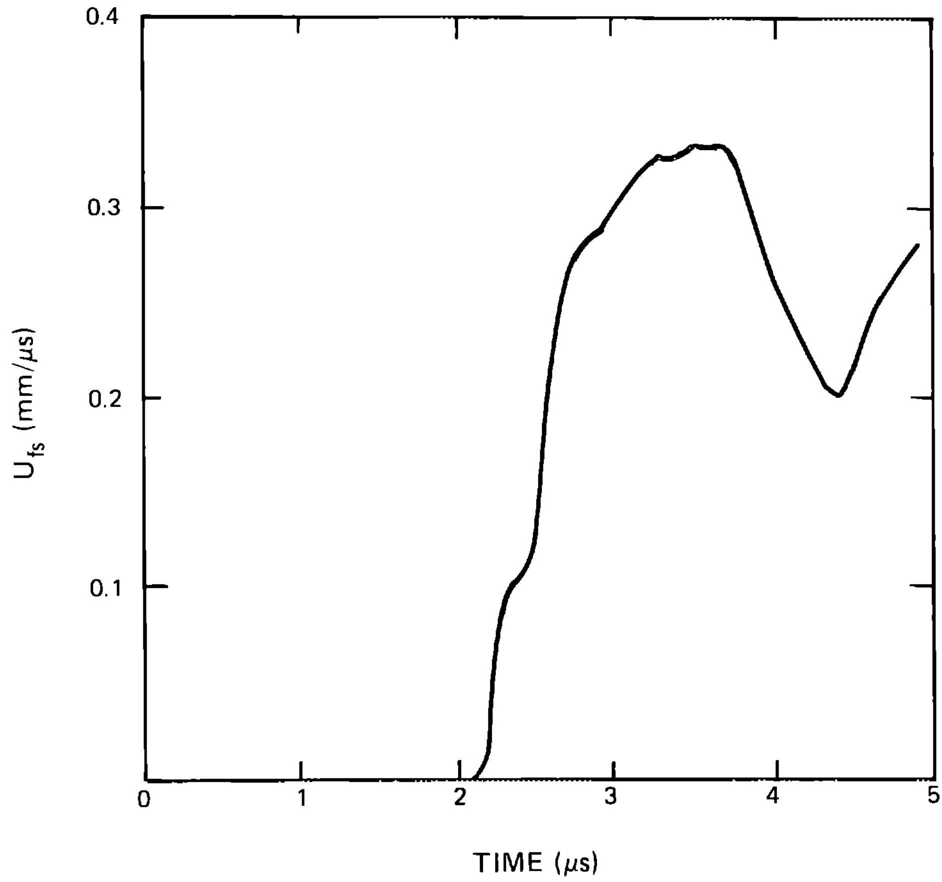
TARGET	**Material:** Fansteel 77 **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-67-427 **Date:** February 5, 1967 **Thickness:** 12.70 mm **Diameter:** 38.1 mm **Density:** 17.48 g/cm^3 $C_L = 5.10$ mm/µs $C_S = 3.95$ mm/µs **Hardness:** Rc 35
IMPACTOR	Tantalum, 3.18 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	Material: HP-9-4-20 steel Experiment type: Free-surface capacitor Experimenters: J. W. Hopson and J. W. Taylor Shot no.: 56-71-38 Date: November 2, 1971 Thickness: 6.19 mm Diameter: 38.1 mm Density: 7.84 g/cm^3 $C_L = 6.09$ mm/μs $C_S = 3.10$ mm/μs
IMPACTOR	Steel disk, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET	**Material:** Military specification 12560-B armor plate **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-72-32 **Date:** April 21, 1972
IMPACTOR	Armor steel, 4.75 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.296 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET

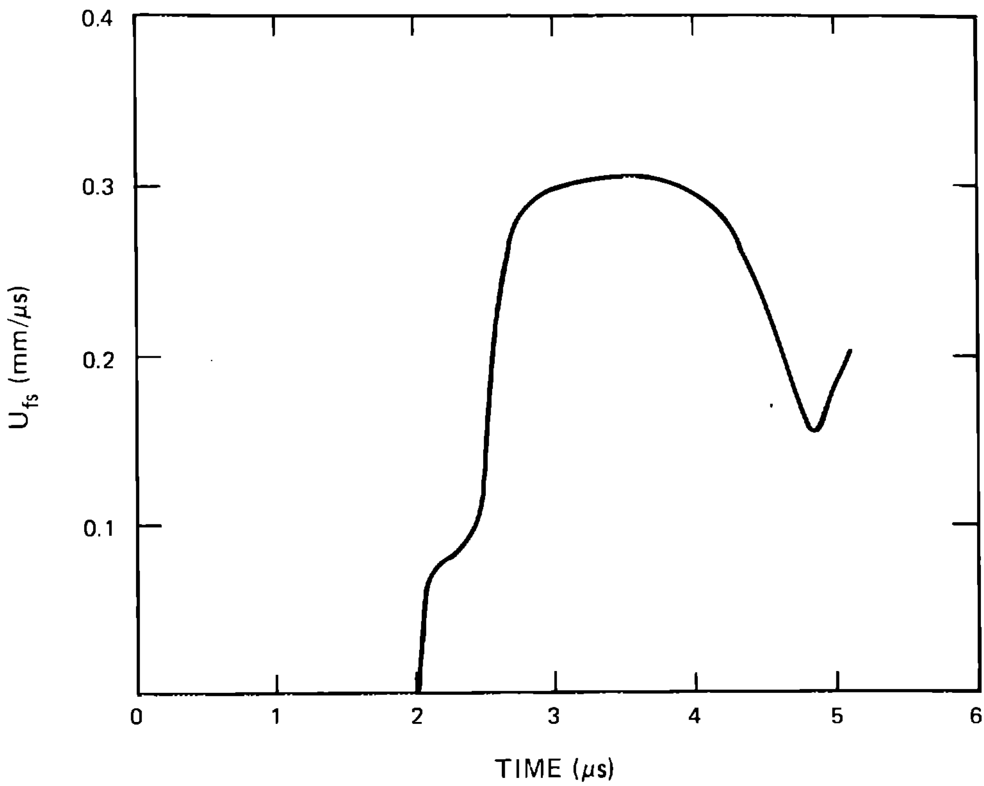
Material: HY-80 naval armor steel
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-74-9 Date: April 1, 1974
Thickness: 12.56 mm Diameter: 38.1 mm
Density: 7.84 g/cm^3
$C_L = 6.28$ mm/μs $C_S = 3.44$ mm/μs

IMPACTOR

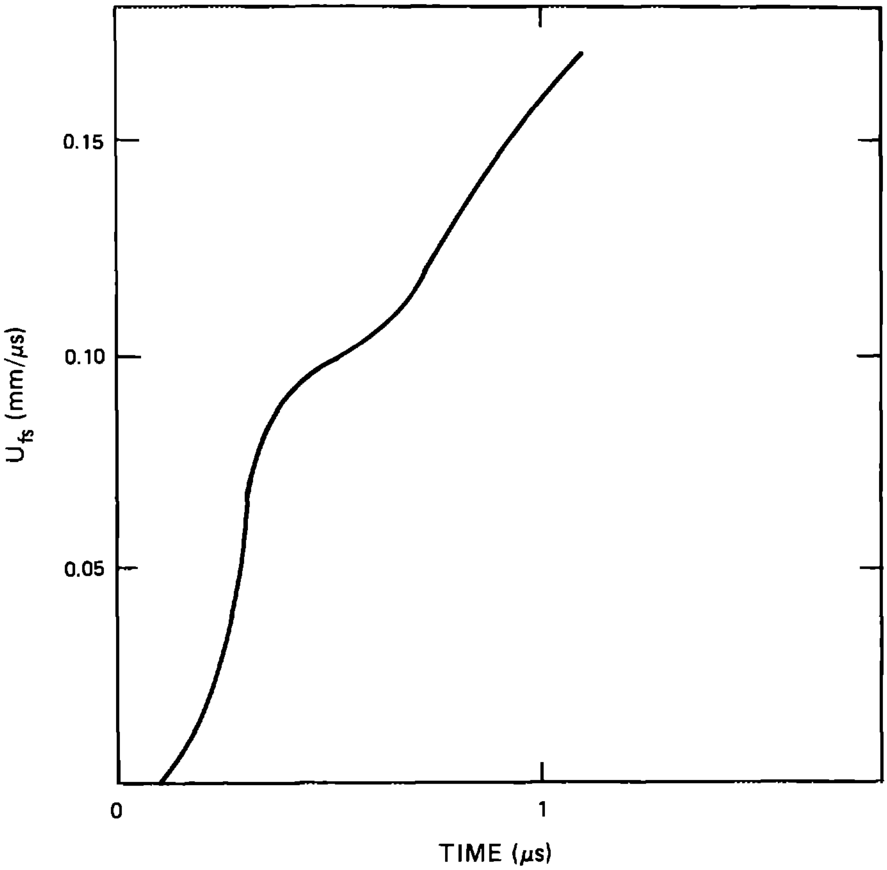
OFHC copper, 4.76 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile

TRANSDUCER

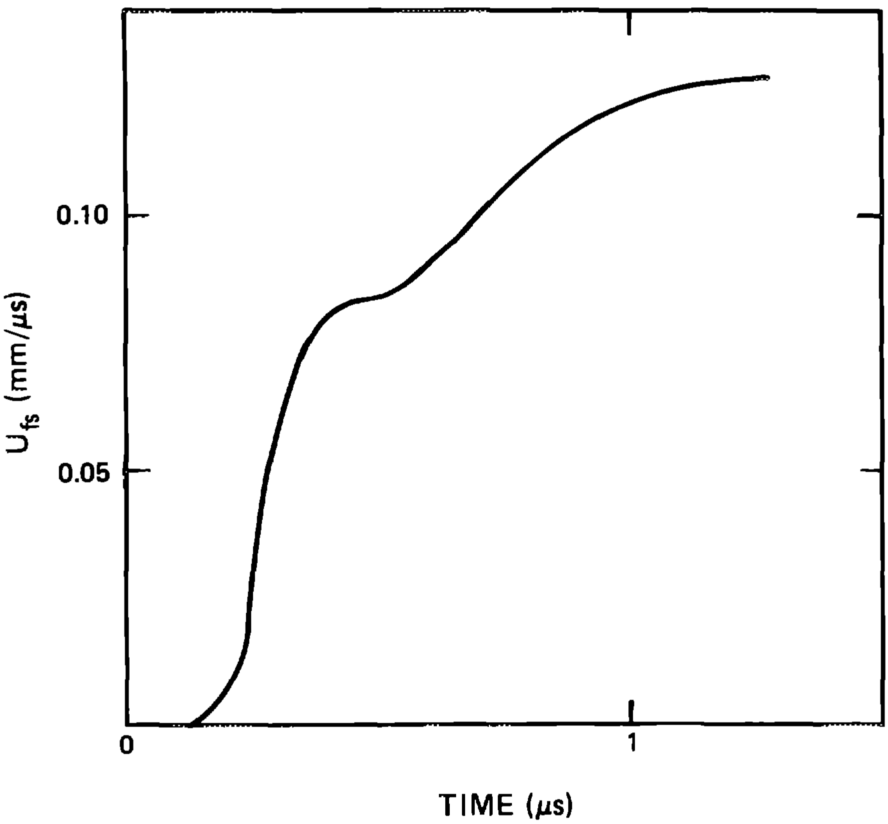
Free-surface capacitor
Time: Relative



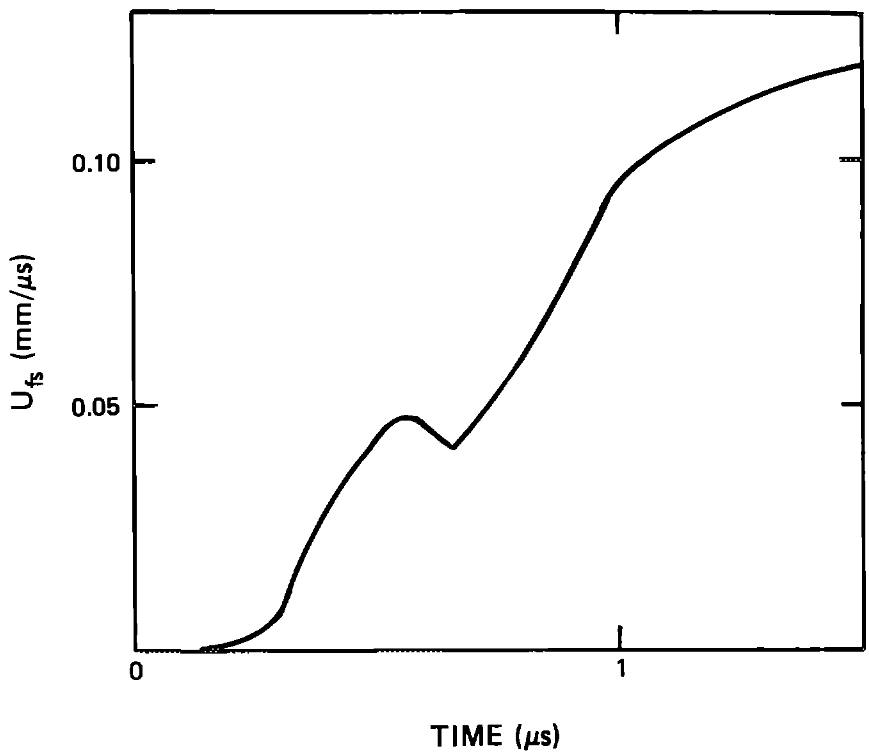
TARGET	Material: 301 stainless steel at 300 K Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Shot no.: 56-62-136 Date: July 12, 1965 Thickness: 12.70 mm Diameter: 38.1 mm
IMPACTOR	OFHC copper, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative
NOTES	Shots 56-62-136, 56-64-305, and 56-64-308 are a 301 stainless steel series with varied ambient temperatures.



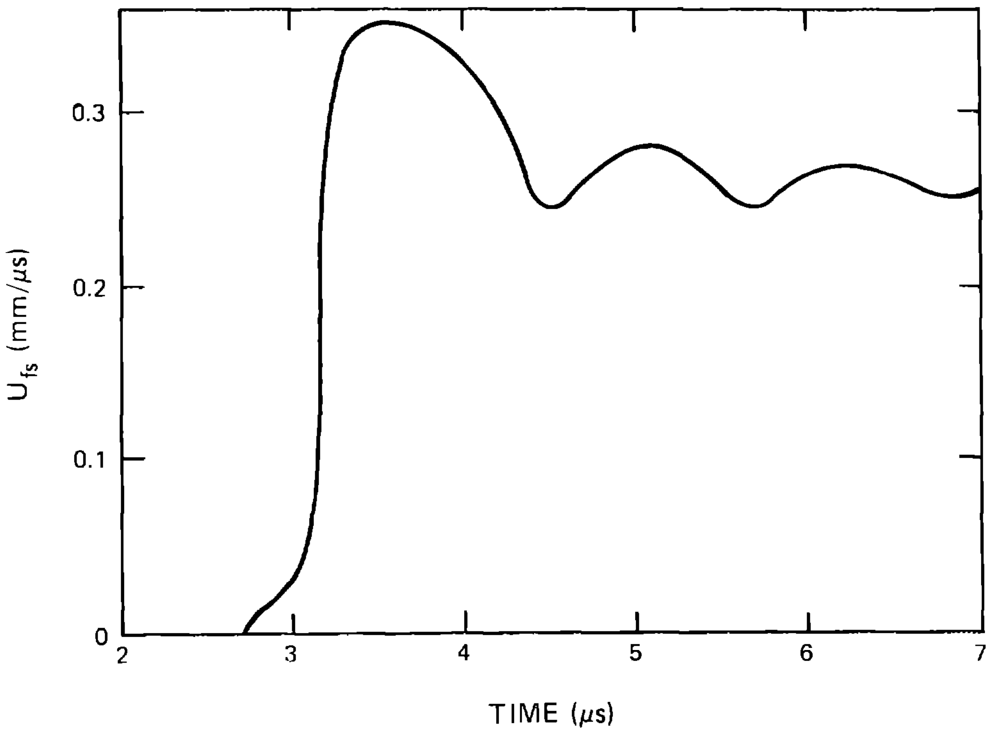
TARGET	Material: 301 stainless steel at 560 K Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Shot no.: 56-64-305 Date: July 14, 1964 Thickness: 12.70 mm Diameter: 38.1 mm
IMPACTOR	OFHC copper, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative
NOTES	Shots 56-62-136, 56-64-305, and 56-64-308 are a 301 stainless steel series with varied ambient temperatures.



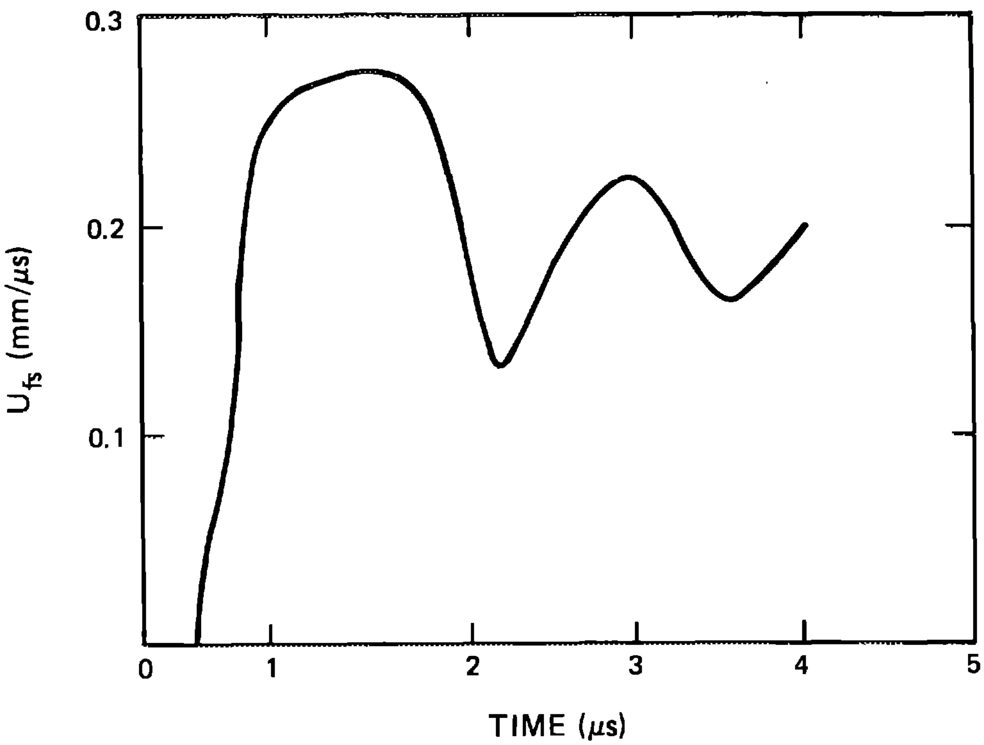
TARGET	Material: 301 stainless steel at 690 K Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Shot no.: 56-64-308 Date: July 17, 1964 Thickness: 12.70 mm Diameter: 38.1 mm
IMPACTOR	OFHC copper, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative
NOTES	Shots 56-62-136, 56-64-305, and 56-64-308 are a 301 stainless steel series with varied ambient temperatures.



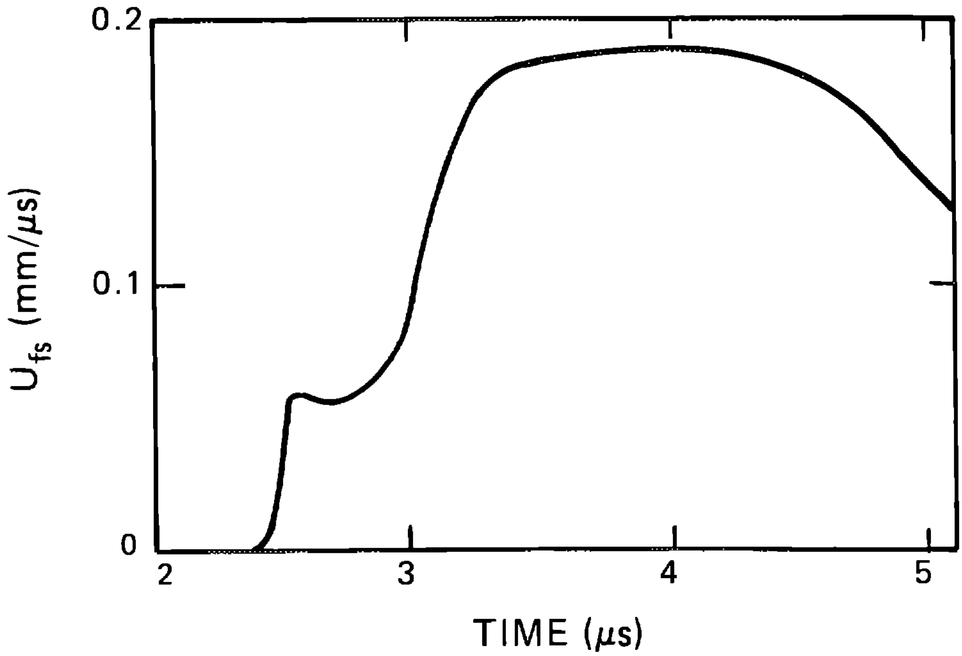
TARGET	**Material:** 304 stainless steel **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-66-401 **Date:** May 16, 1966 **Thickness:** 11.39 mm **Diameter:** 38.1 mm **Density:** 7.89 g/cm^3 $C_L = 5.77$ mm/μs $C_S = 3.12$ mm/μs
IMPACTOR	304 stainless steel, 3.18 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative



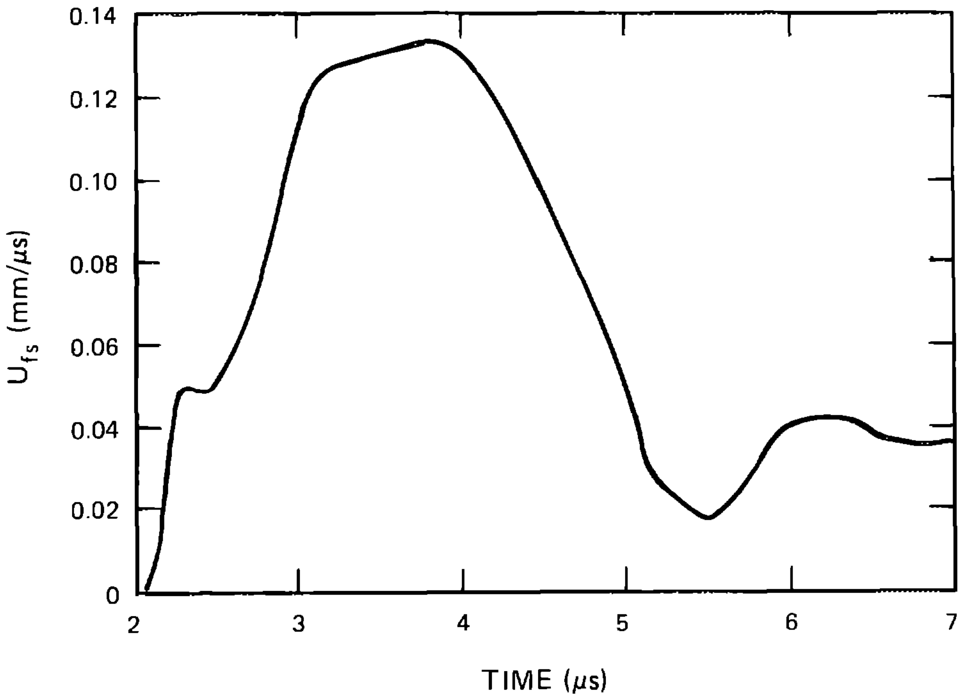
TARGET	**Material:** 21-6-9 stainless steel **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-73-10 **Date:** February 20, 1973 **Thickness:** 6.63 mm **Diameter:** 38.1 mm **Density:** 7.81 g/cm^3 $C_L = 5.72$ mm/μs $C_s = 3.14$ mm/μs **Heat treatment:** Annealed
IMPACTOR	OFHC copper, 3.18 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.284 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



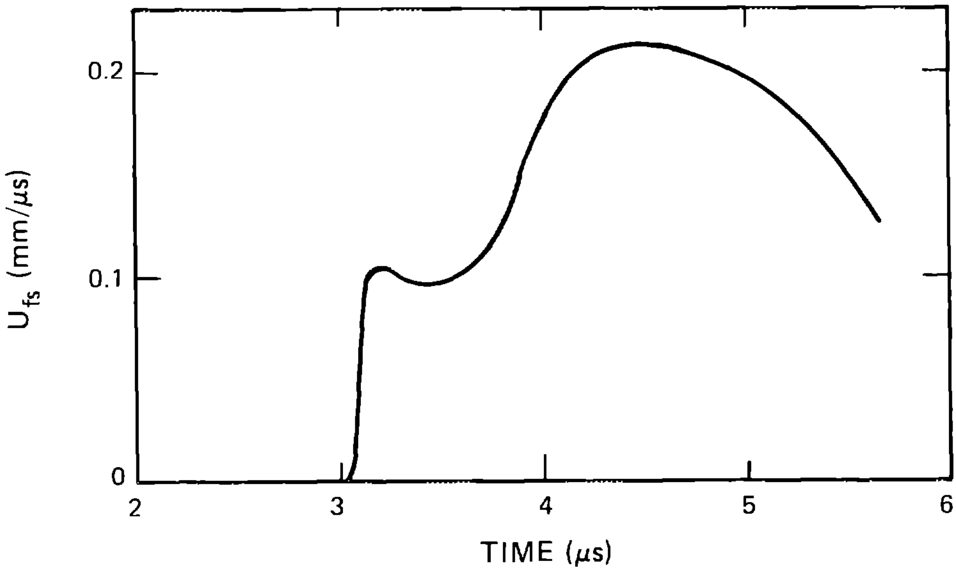
TARGET	**Material:** 1018 steel **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-63-218 **Date:** April 24, 1963 **Thickness:** 12.72 mm **Diameter:** 38.1 mm **Density:** 7.861 g/cm^3 $C_L = 5.92$ mm/µs $C_S = 3.19$ mm/µs
IMPACTOR	Iron, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.191 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative



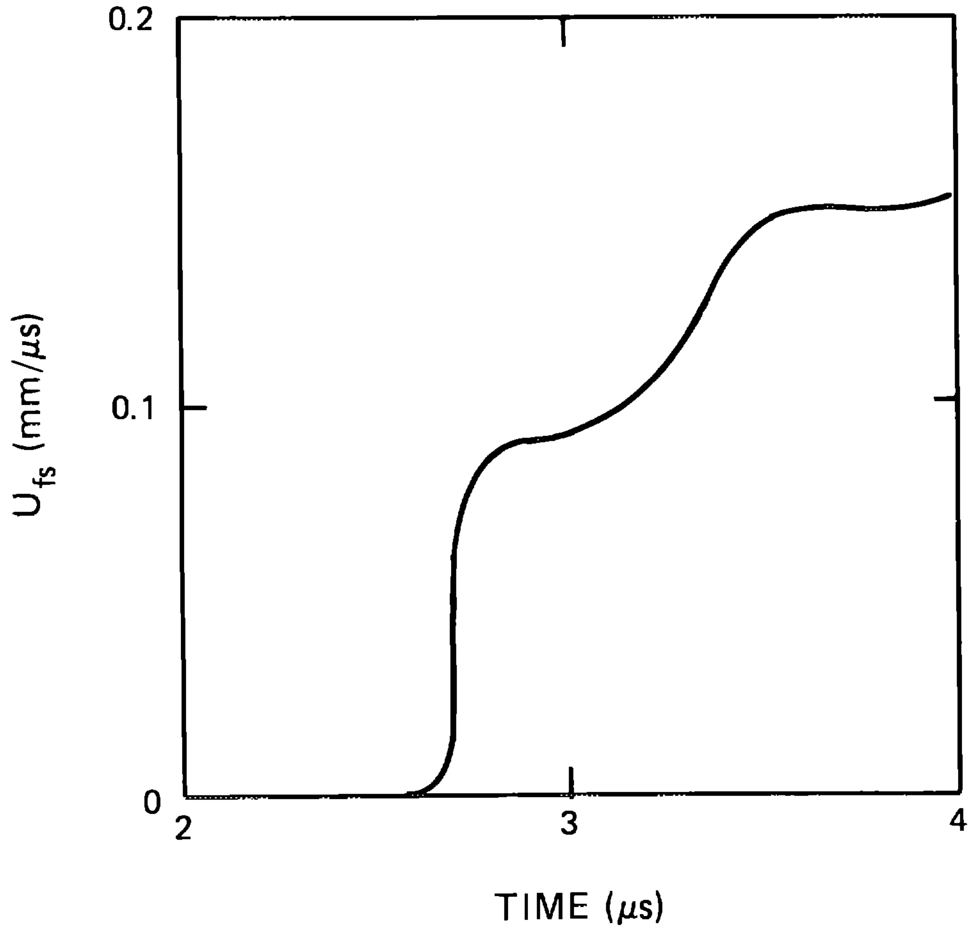
TARGET	**Material:** 1018 steel at 101°C **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-66-368 **Date:** January 5, 1966 **Thickness:** 12.70 mm **Diameter:** 38.1 mm **Density:** 7.861 g/cm^3 $C_L = 5.92$ mm/µs $C_s = 3.19$ mm/µs
IMPACTOR	Steel disk, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET	Material: 1045 carbon steel Experiment type: Free-surface capacitor Experimenter: J. W. Taylor Shot no.: 56-63-206 Date: April 8, 1963 Thickness: 18.42 mm Diameter: 152 mm Heat treatment: Annealed
IMPACTOR	Iron, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET	**Material:** 1095 carbon steel **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-63-207 **Date:** April 8, 1963 **Thickness:** 15.57 mm **Diameter:** 38.1 mm **Density:** 7.86 g/cm^3 C_L = 5.90 mm/µs C_s = 3.21 mm/µs
IMPACTOR	Iron, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET

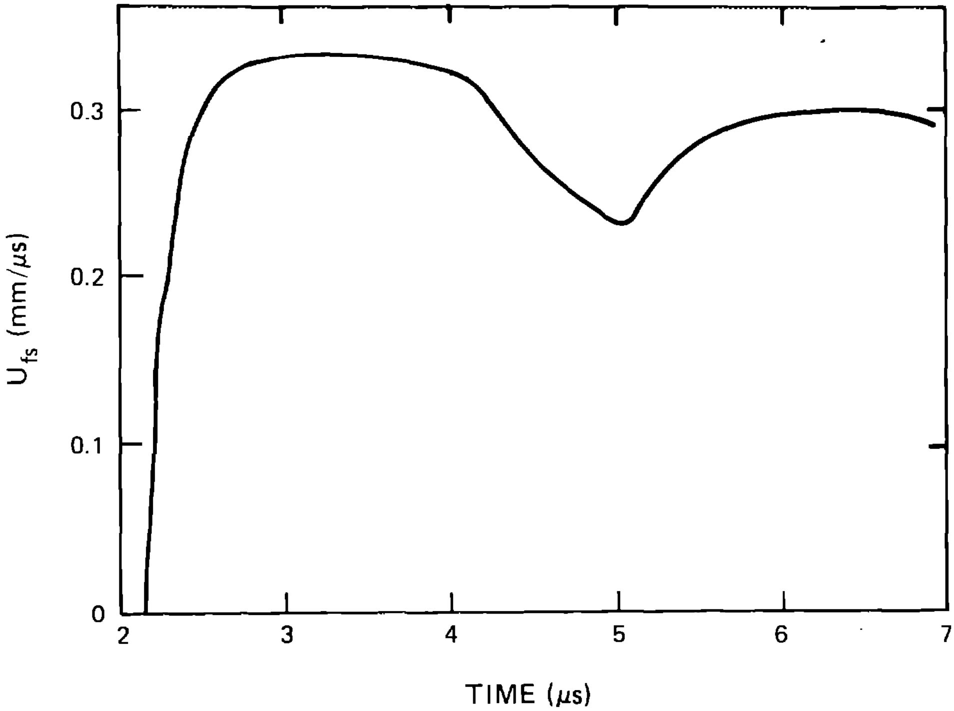
Material: 4150 steel
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970)
Shot no.: 56-67-448 Date: October 13, 1967
Thickness: 12.7 mm Diameter: 38.1 mm
Density: 7.785 g/cm^3
$C_L = 5.89$ mm/µs $C_S = 3.20$ mm/µs
Hardness: Rc 62

IMPACTOR

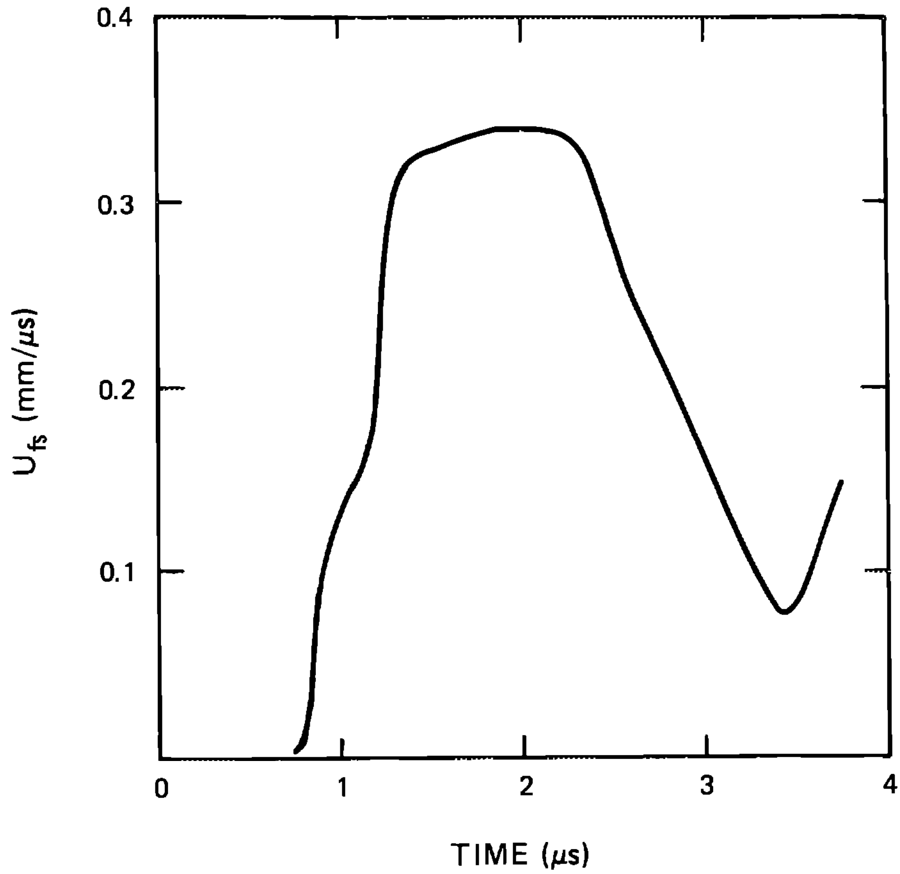
1018 steel, 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.340 mm/µs

TRANSDUCER

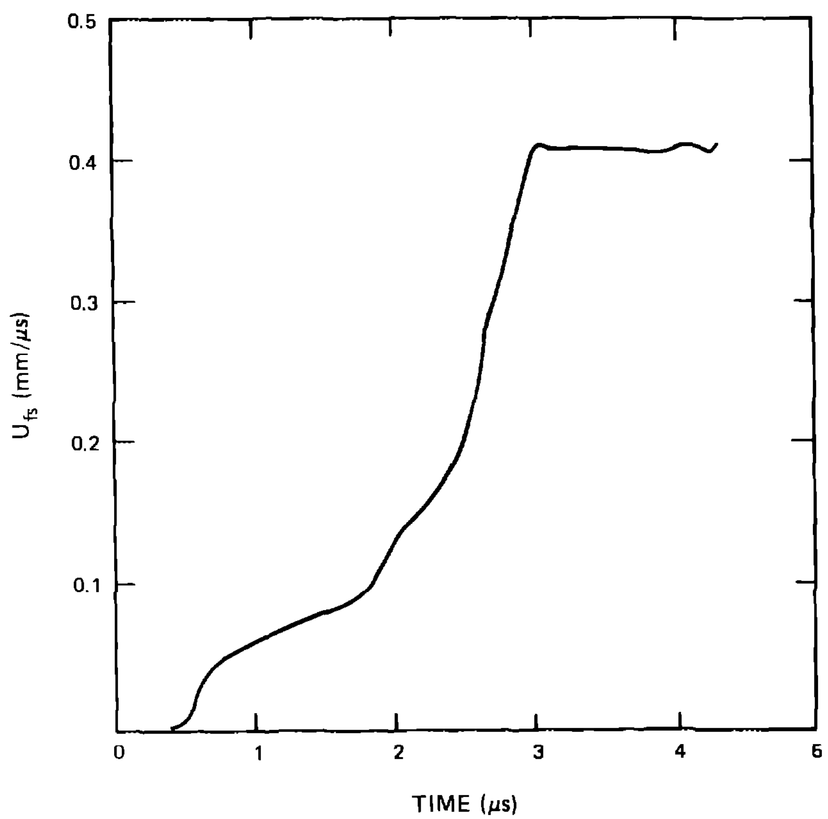
Free-surface capacitor
Time: Relative



TARGET	**Material:** Vascomax 250 steel **Experiment type:** Free-surface capacitor **Experimenters:** J. W. Hopson and J. W. Taylor **Shot no.:** 56-71-35 **Date:** October 27, 1971 **Thickness:** 13.23 mm **Diameter:** 38.1 mm **Density:** 8.0 g/cm^3 $C_L = 5.54$ mm/µs $C_s = 2.96$ mm/µs
IMPACTOR	Steel disk, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.321 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	**Material:** Sintered Vascomax 250 steel **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-73-13 **Date:** February 21, 1973 **Thickness:** 7.14 mm **Diameter:** 38.1 mm **Density:** 6.17 g/cm^3 $C_L = 4.17$ mm/μs $C_S = 2.30$ mm/μs
IMPACTOR	Steel disk, 6.12 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	The wave profile of the sintered Vascomax 250 sample was recorded after traveling through 7.52 mm of OFHC copper.



TARGET

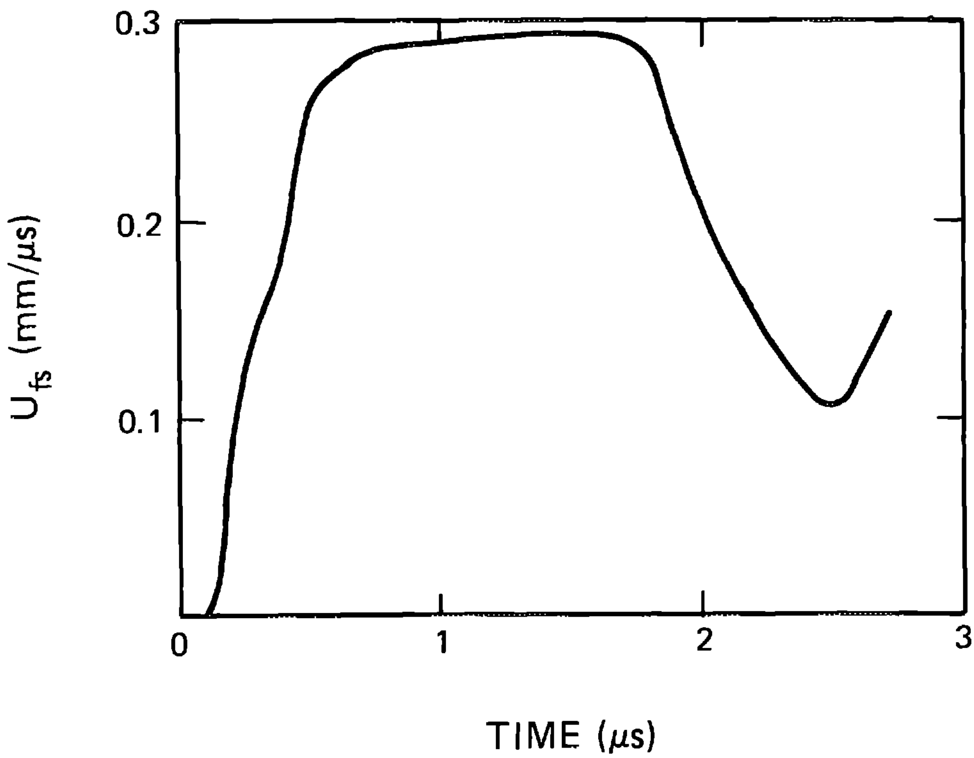
Material: Vascomax 300 steel
Experiment type: Free-surface capacitor
Experimenters: J. W. Hopson and J. W. Taylor
Shot no.: 56-71-33 Date: October 18, 1971
Thickness: 9.35 mm Diameter: 38.1 mm
Density: 8.0 g/cm^3
$C_L = 5.54$ mm/µs $C_S = 2.96$ mm/µs

IMPACTOR

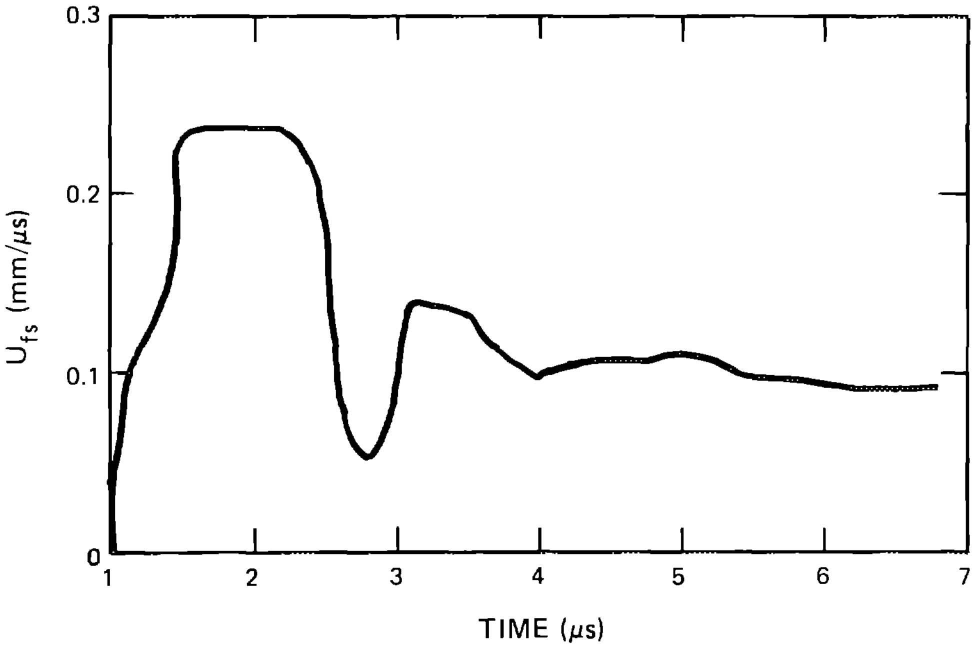
Steel disk, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.285 mm/µs

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET	**Material:** 90 wt% tantalum with 10 wt% tungsten **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-73-7 **Date:** February 14, 1973 **Thickness:** 6.09 mm **Diameter:** 38.1 mm **Density:** 16.93 g/cm^3 C_L = 4.20 mm/μs C_s = 2.12 mm/μs **Heat treatment:** Annealed at 1450°C for 2 hours
IMPACTOR	OFHC copper, 2.97 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.261 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET

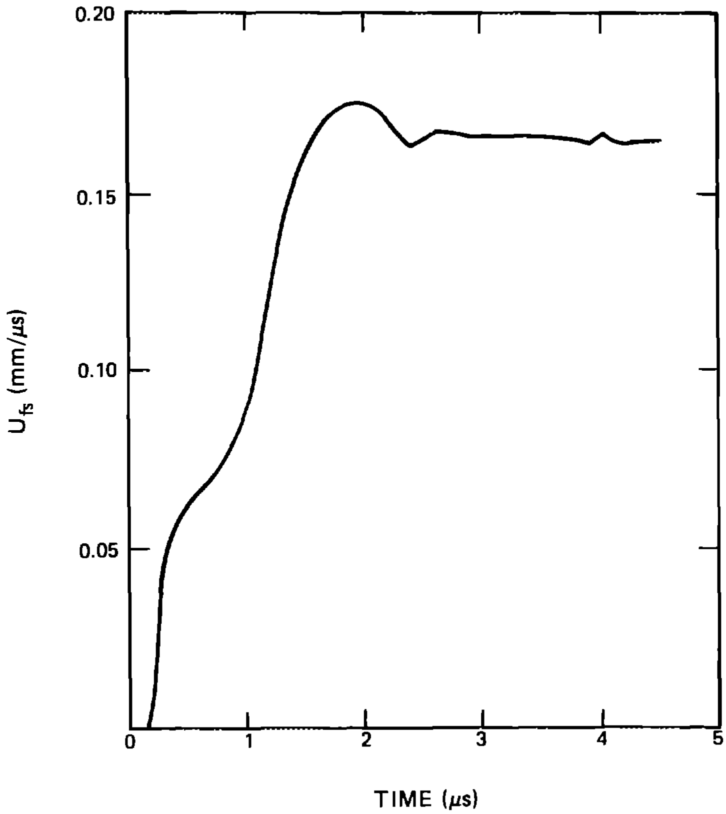
Material: 98.5 wt% tungsten with 0.5 wt% nickel and 1 wt% iron alloy
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-71 Date: December 12, 1973
Thickness: 12.71 mm Diameter: 41.3 mm
Density: 18.69 g/cm^3
$C_L = 5.14$ mm/μs $C_S = 2.85$ mm/μs
Heat treatment: Sintered at 1460°C

IMPACTOR

OFHC copper, 4.95 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET

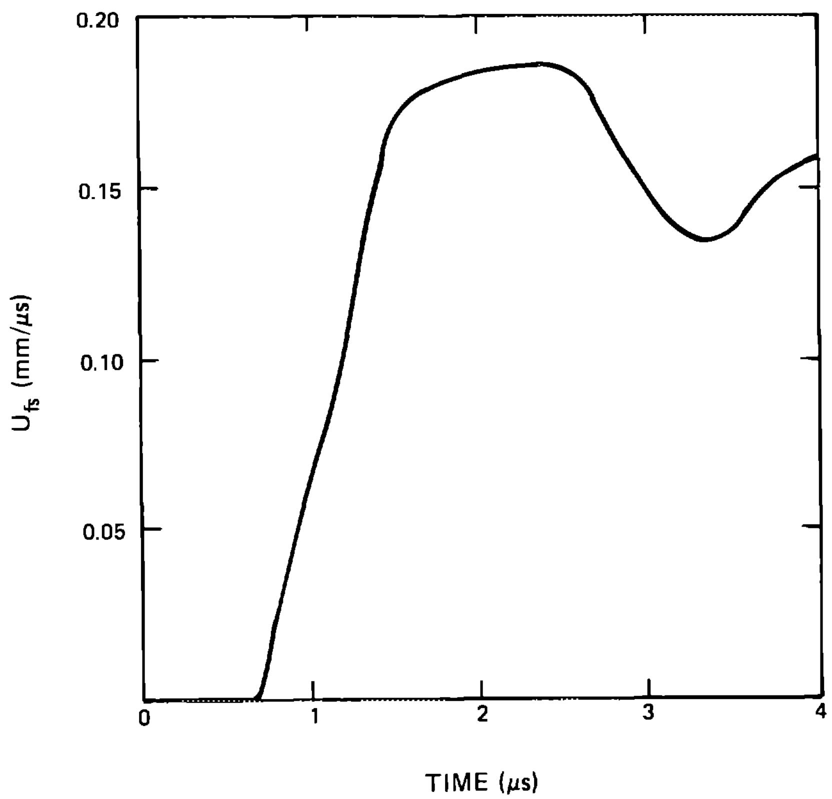
Material: 95 wt% tungsten with 2.1 wt% nickel, 1.4 wt% iron, and 1.5 wt% cobalt alloy
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-72   Date: December 13, 1973
Thickness: 12.72 mm   Diameter: 41.4 mm
Density: 17.94 g/cm^3
$C_L = 5.17$ mm/µs $C_S = 2.85$ mm/µs
Heat treatment: Sintered at 1460°C

IMPACTOR

OFHC copper, 4.95 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET

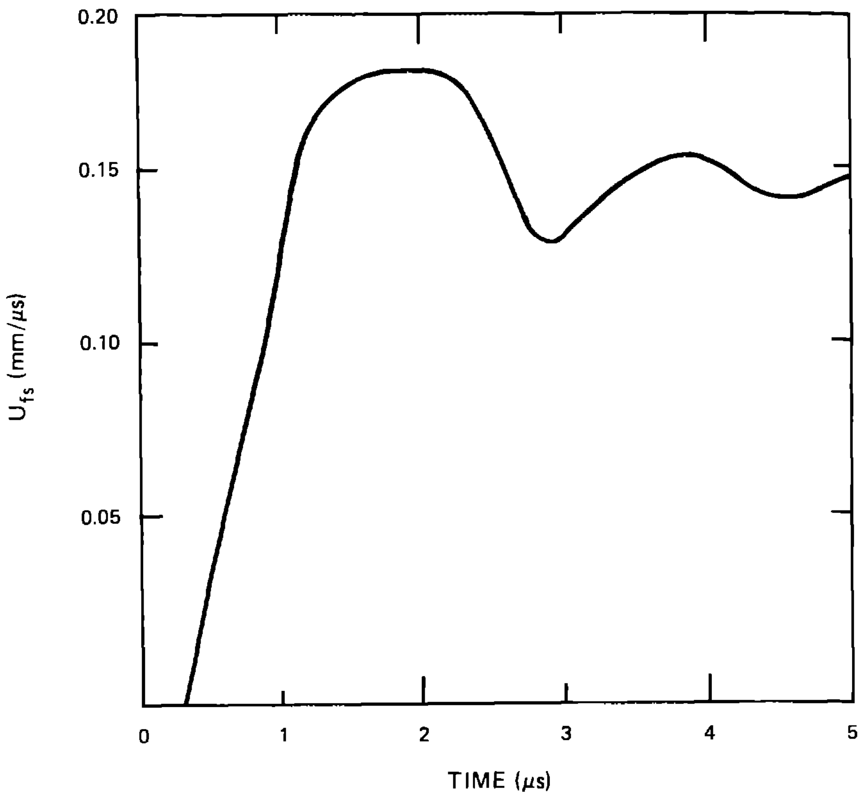
Material: 95 wt% tungsten with 3.5 wt% nickel and 1.5 wt% iron alloy
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-5 **Date:** February 12, 1973
Thickness: 12.87 mm **Diameter:** 41.4 mm
Density: 18.06 g/cm^3
$C_L = 5.19$ mm/μs $C_S = 2.85$ mm/μs

IMPACTOR

OFHC copper, 4.93 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.288 mm/μs

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET

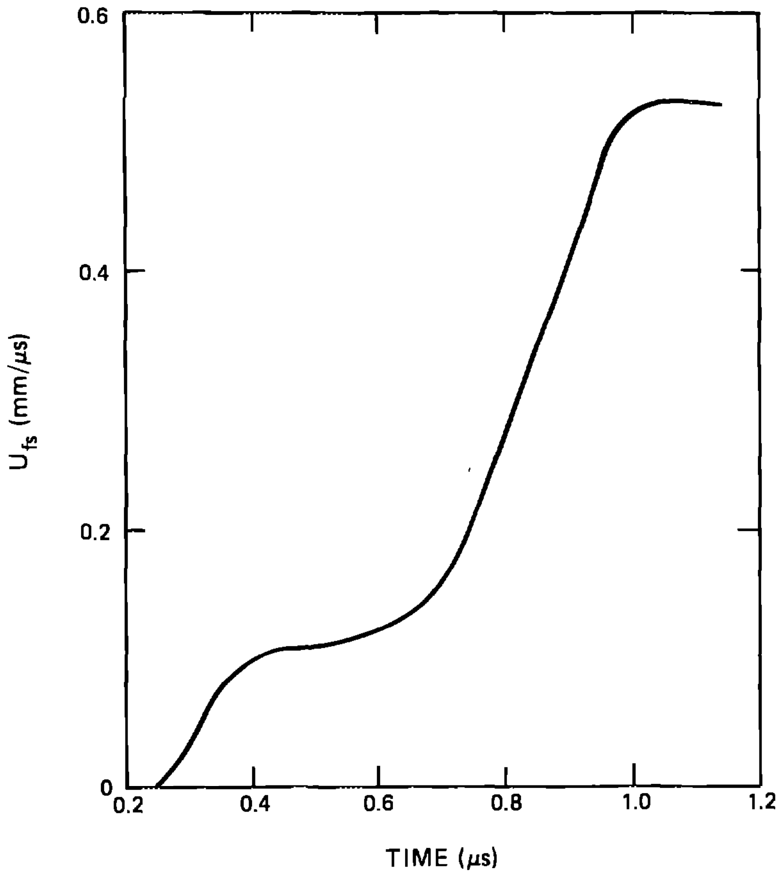
Material: 75 wt% tungsten with 25 wt% rhenium alloy
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-6 **Date:** February 13, 1973
Thickness: 11.24 mm **Diameter:** 41.3 mm
Density: 19.66 g/cm^3
$C_L = 5.18$ mm/µs $C_S = 2.91$ mm/µs

IMPACTOR

OFHC copper, 4.93 mm thick, backed with low-density polyfoam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.297 mm/µs

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET

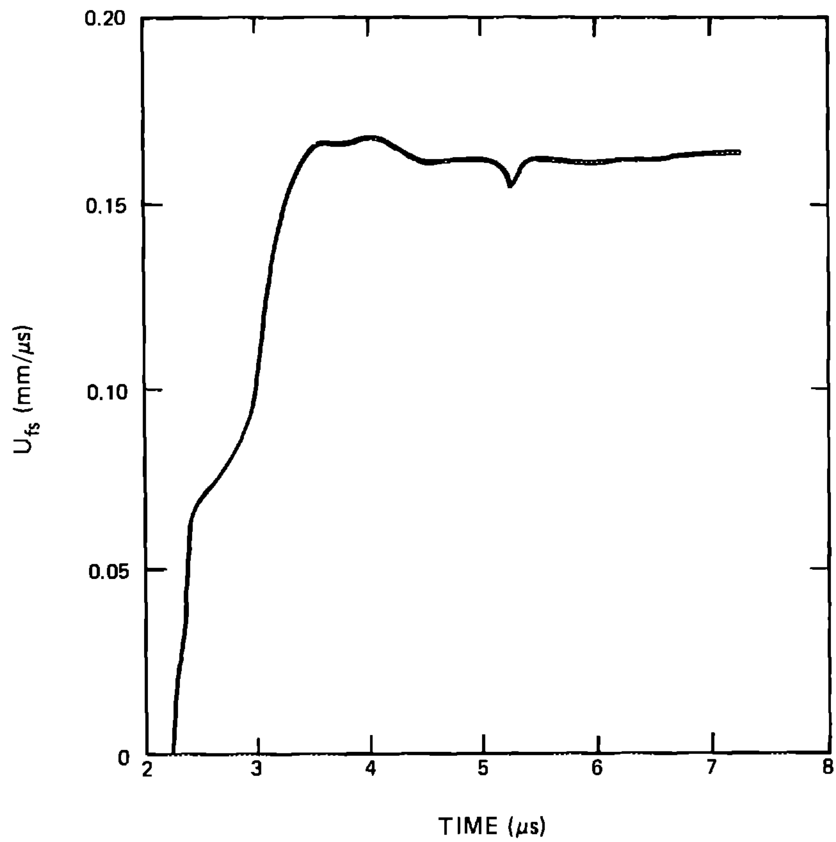
Material: 91 wt% tungsten with 5 wt% rhenium, 1.4 wt% platinum, 1.4 wt% nickel, and 1.2 wt% iron alloy
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-72-43 Date: May 19, 1972
Thickness: 12.83 mm Diameter: 41.3 mm
Density: 18.85 g/cm^3
$C_L = 5.13$ mm/μs $C_S = 2.77$ mm/μs

IMPACTOR

OFHC copper, 4.95 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.294 mm/μs

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET

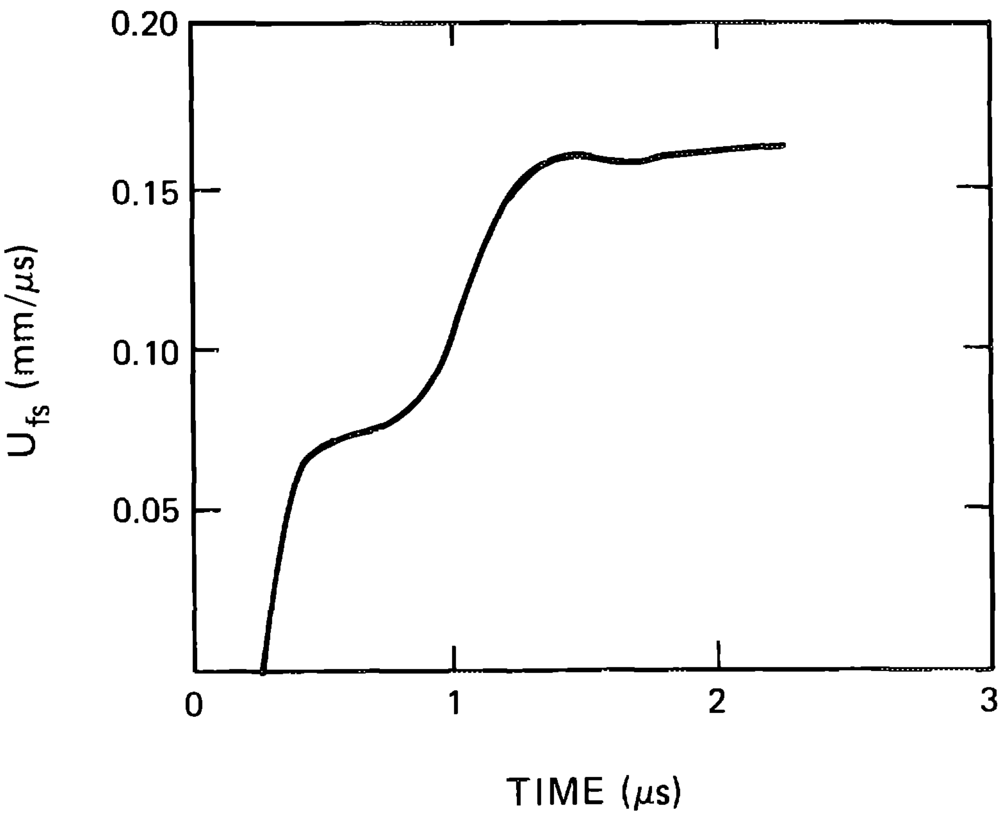
Material: 91 wt% tungsten with 5 wt% rhenium, 1.4 wt% platinum, 1.4 wt% nickel, and 1.2 wt% iron alloy
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-73-1 Date: February 2, 1973
Thickness: 12.85 mm Diameter: 41.3 mm
Density: 18.84 g/cm^3
$C_L = 5.13$ mm/µs $C_S = 2.77$ mm/µs

IMPACTOR

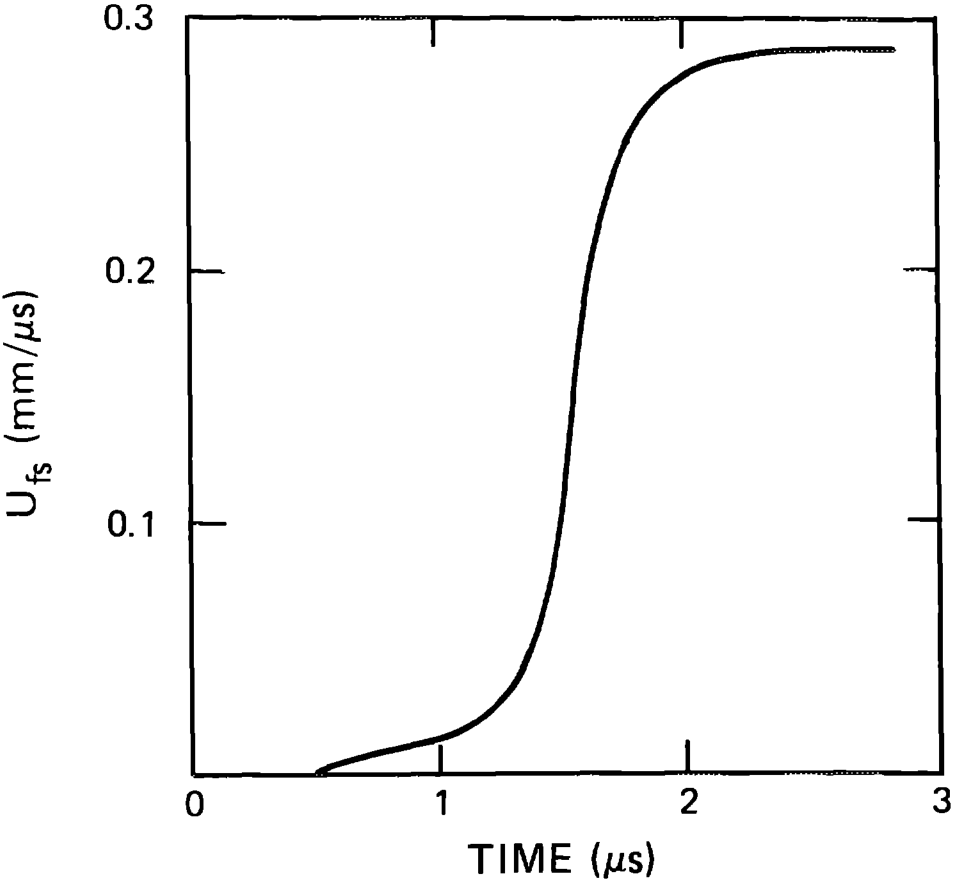
OFHC copper, 4.93 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET	Material: 99.5 wt% uranium with 0.5 wt% molybdenum Experiment type: Free-surface capacitor Experimenter: J. W. Hopson Shot no.: 56-71-41 Date: November 4, 1971 Thickness: 12.7 mm Diameter: 38.1 mm Density: 18.6 g/cm^3 C_L = 3.3 mm/μs C_S = 1.8 mm/μs Heat treatment: Gamma-quenched in water
IMPACTOR	OFHC copper, 5.82 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.300 mm/μs
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET

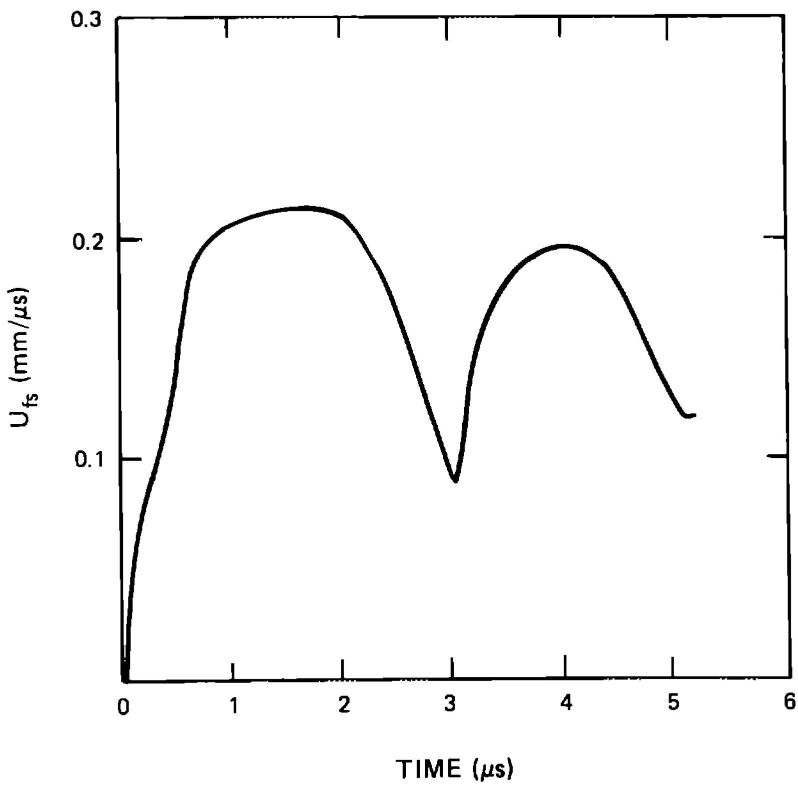
Material: 98 wt% uranium with 2 wt% molybdenum
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-72-4 Date: January 6, 1972
Thickness: 9.63 mm Diameter: 38.1 mm
Density: 18.6 g/cm^3
$C_L = 3.26$ mm/µs $C_S = 1.84$ mm/µs
Heat treatment: Gamma-quenched from 850°C, aged at 300°C
Hardness: Rc 45.8

IMPACTOR

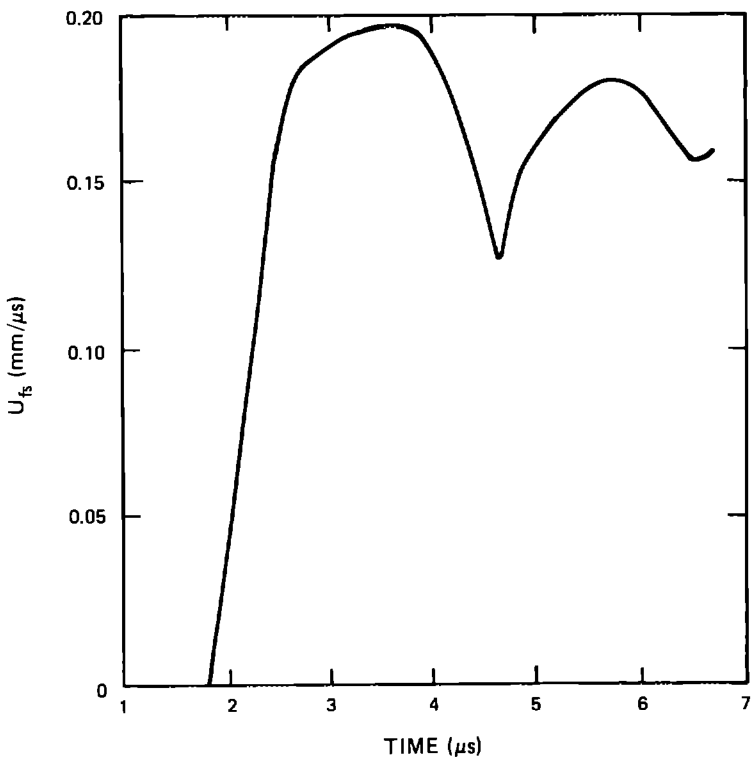
OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.264 mm/µs

TRANSDUCER

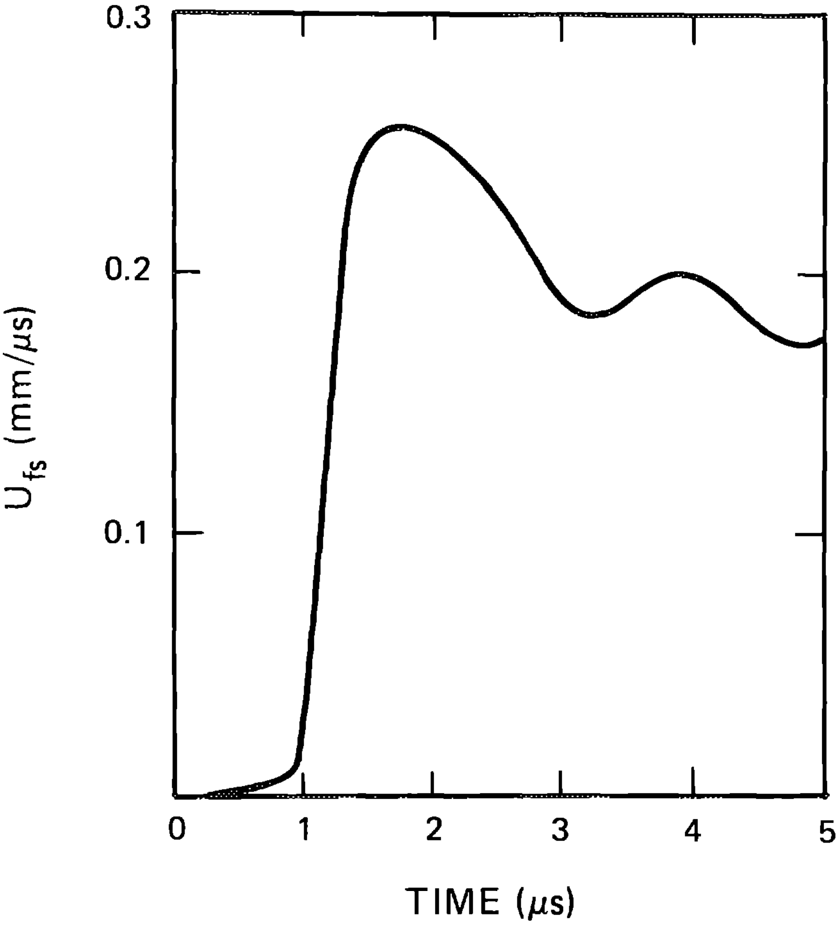
Free-surface capacitor
Time: Relative



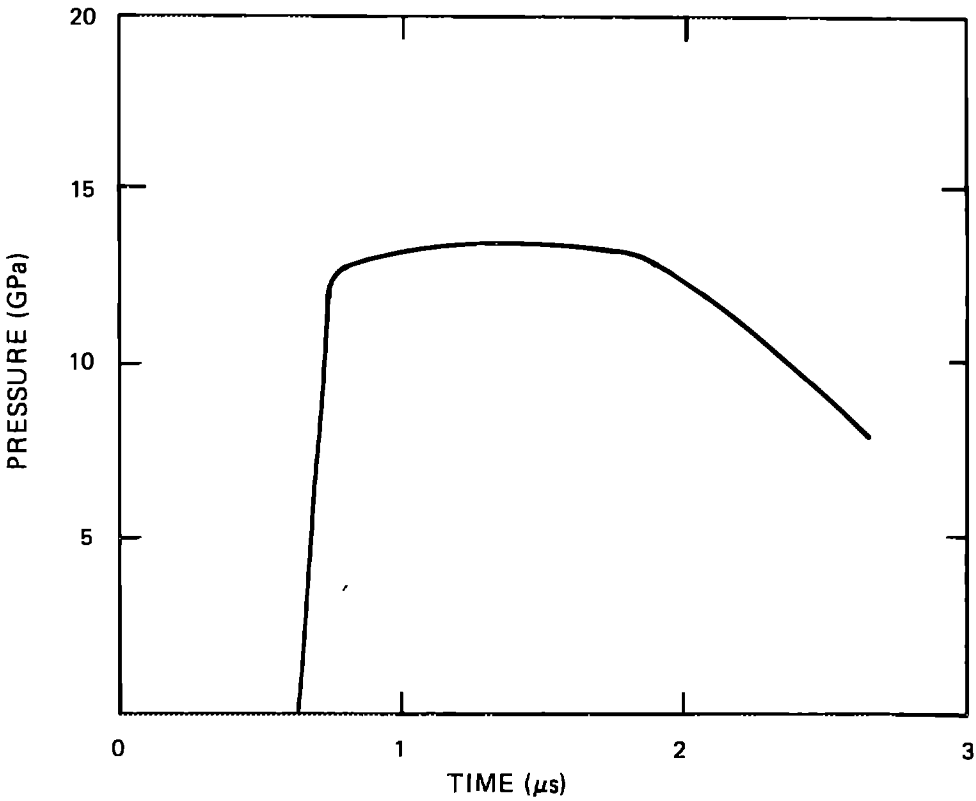
TARGET	**Material:** 97.96 wt% uranium with 2.04 wt% molybdenum **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-72-36 **Date:** April 26, 1972 **Thickness:** 12.75 mm **Diameter:** 49.3 mm **Density:** 18.6 g/cm^3 $C_L = 3.26$ mm/μs $C_s = 1.84$ mm/μs **Heat treatment:** Gamma-quenched from 850°C in H_2O, aged at 450°C **Hardness:** Rc 46.0
IMPACTOR	OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.259 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



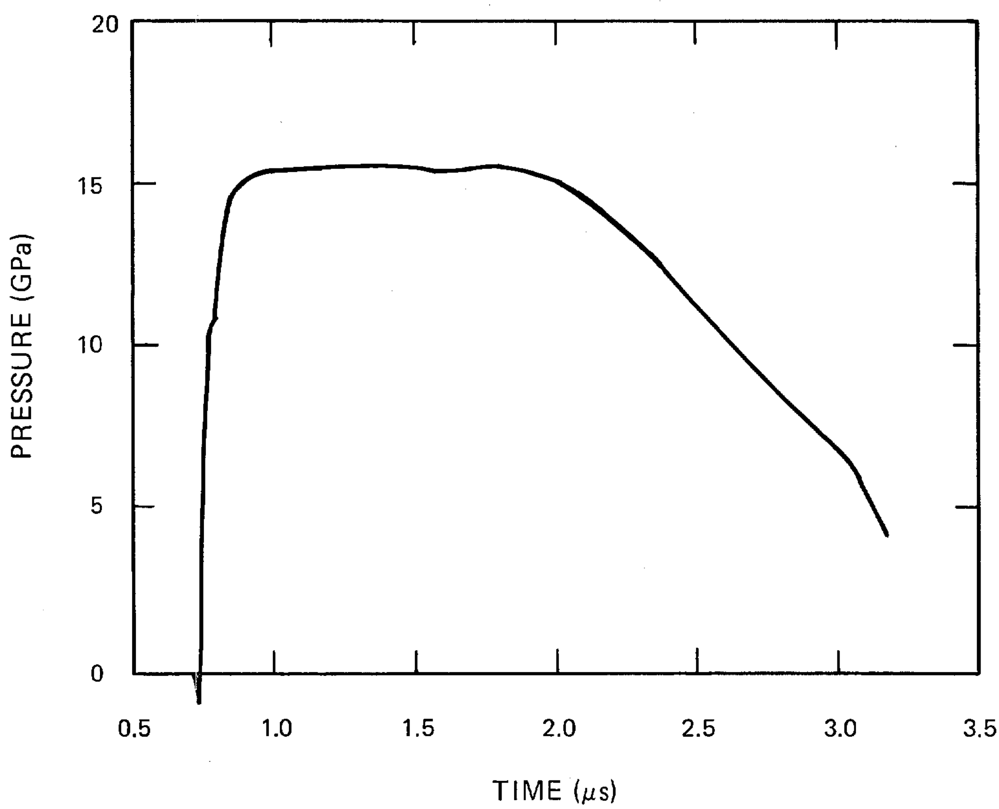
TARGET	**Material:** 94 wt% uranium with 6 wt% niobium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-75-20 **Date:** June 27, 1975 **Thickness:** 12.6 mm **Diameter:** 41.3 mm **Density:** 17.47 g/cm^3 C_L = 2.96 mm/μs C_S = 1.28 mm/μs
IMPACTOR	OFHC copper, 4.24 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET	Material: 94 wt% uranium with 6 wt% niobium Experiment type: Embedded Manganin gage Experimenter: C. E. Morris Shot no.: 56-79-4 Date: January 17, 1979 Thickness: 16.625 mm Diameter: 39.7 mm Density: 17.390 g/cm^3 $C_L = 2.90$ mm/μs $C_s = 1.23$ mm/μs
IMPACTOR	94 wt% uranium/6 wt% niobium, 2.997 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.528 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Location from impact surface: 10.808 mm Heat treatment: Annealed Encapsulation: 0.39 mm Al_2O_3 [$1\bar{1}02$] on both sides Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


20
15
10
5
PRESSURE (GPa)
0
1
2
3
TIME (μs)

TARGET	**Material:** 94 wt% uranium with 6 wt% niobium **Experiment type:** Embedded Manganin gage **Experimenter:** C. E. Morris **Shot no.:** 56-79-8 **Date:** February 9, 1979 **Thickness:** 15.110 mm **Diameter:** 39.7 mm **Density:** 17.390 g/cm^3 $C_L = 2.90$ mm/µs $C_S = 1.23$ mm/µs
IMPACTOR	94 wt% uranium/6 wt% niobium, 3.061 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.540 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Location from impact surface:** 9.619 mm **Heat treatment:** Annealed **Encapsulation:** 0.12 mm Al_2O_3 $[1\bar{1}02]$ on both sides **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative



PRESSURE (GPa)
20
15
10
5
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
TIME (μs)

TARGET

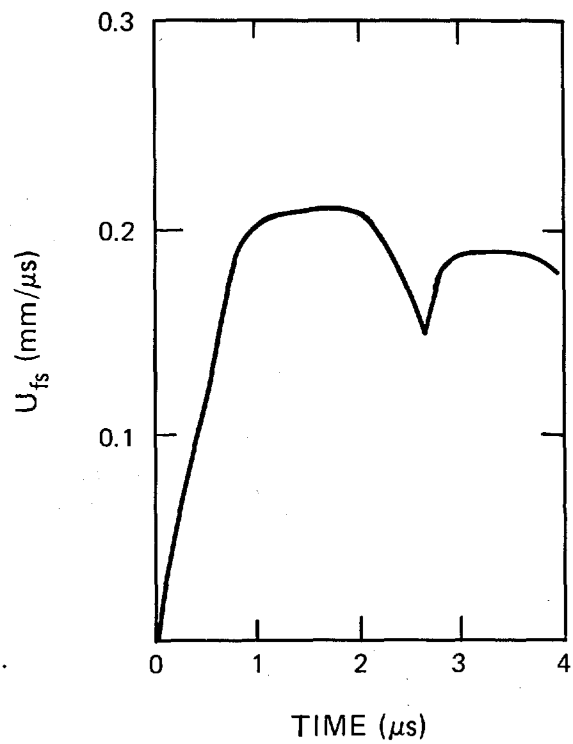
Material: 97.03 wt% uranium with 1.16 wt% niobium and 1.81 wt% titanium
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-72-10 **Date:** January 12, 1972
Thickness: 9.72 mm **Diameter:** 38.1 mm
Density: 17.9 g/cm^3
$C_L = 3.45$ mm/µs $C_S = 2.08$ mm/µs
Heat treatment: Gamma-quenched from 850°C in water, aged at 450°C
Hardness: Rc 53.9

IMPACTOR

OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.266 mm/µs

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET

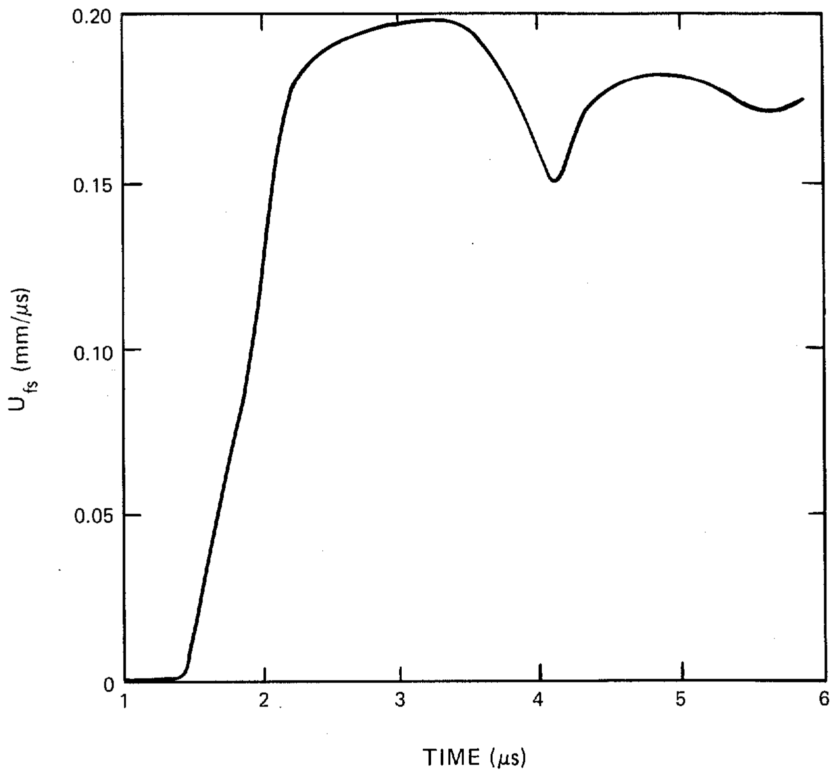
Material: 96.19 wt% uranium with 2.53 wt% niobium and 1.28 wt% titanium
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-72-40 **Date:** April 28, 1972
Thickness: 9.53 mm **Diameter:** 38.1 mm
Density: 18.0 g/cm^3
$C_L = 3.51$ mm/μs $C_S = 2.12$ mm/μs
Heat treatment: Gamma-quenched from 850°C, aged at 550°C
Hardness: Rc 48.9

IMPACTOR

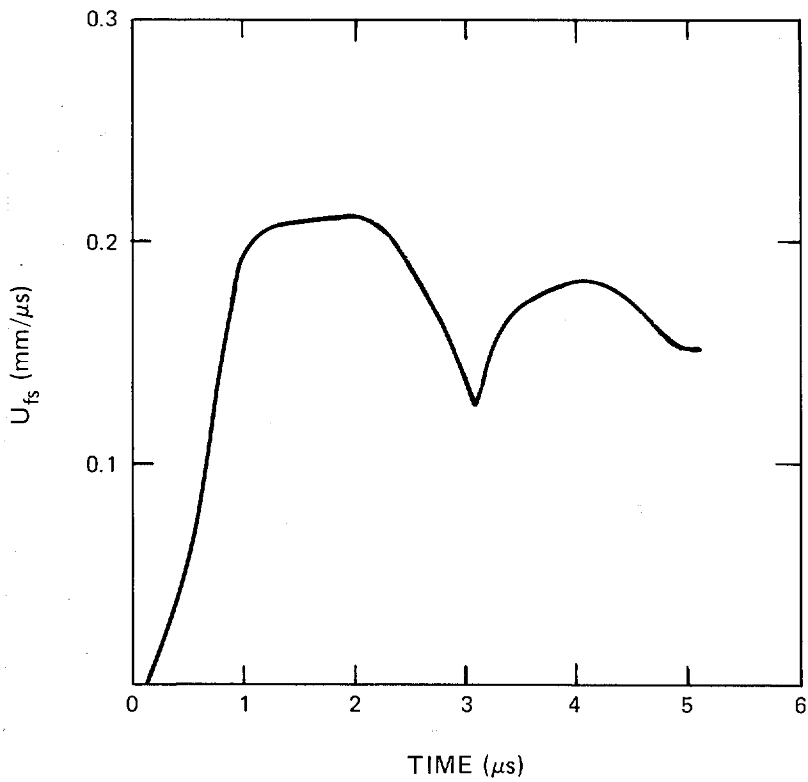
OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.260 mm/μs

TRANSDUCER

Free-surface capacitor
Time: Relative



TARGET	**Material:** 99.38 wt% uranium with 0.62 wt% titanium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-71-51 **Date:** December 9, 1971 **Thickness:** 9.72 mm **Diameter:** 38.1 mm **Density:** 18.6 g/cm^3 C_L = 3.42 mm/µs C_S = 2.07 mm/µs **Heat treatment:** Gamma-quenched from 850°C, aged at 500°C **Hardness:** Rc 50.0	
IMPACTOR	OFHC copper, 4.97 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.262 mm/µs	
TRANSDUCER	Free-surface capacitor **Time:** Relative	



TARGET

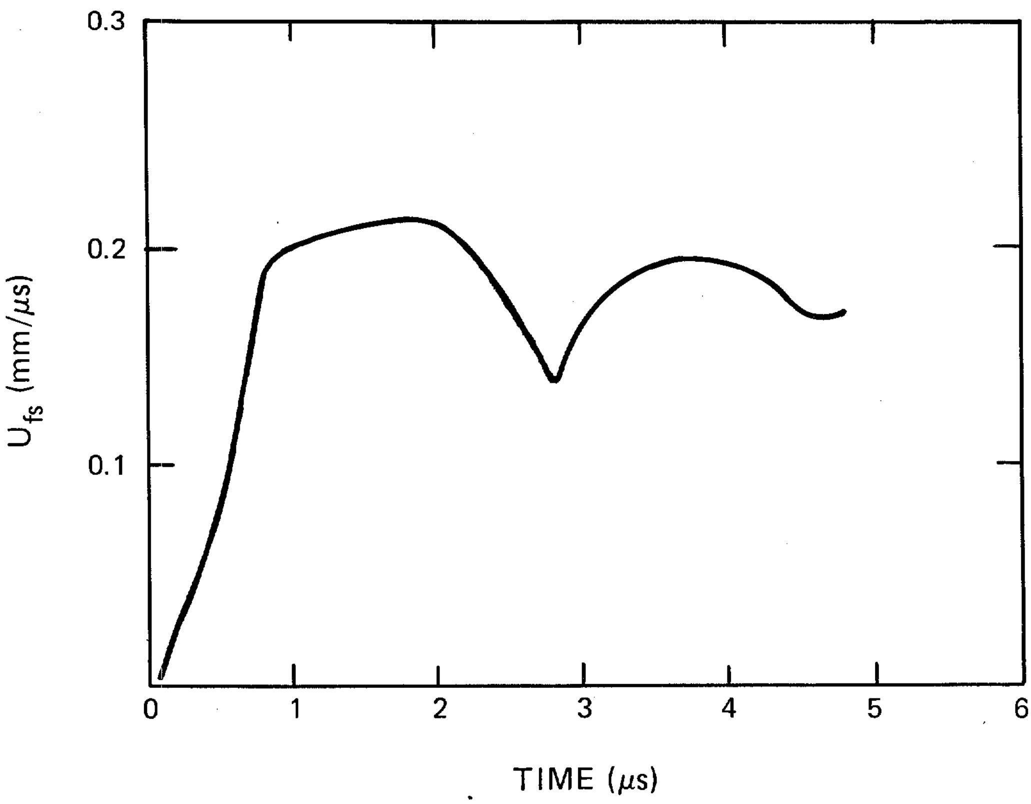
Material: 99.23 wt% uranium with 0.77 wt% titanium
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-72-7 Date: January 11, 1972
Thickness: 9.08 mm Diameter: 38.1 mm
Density: 18.5 g/cm^3
$C_L = 3.44$ mm/μs $C_S = 2.10$ mm/μs
Heat treatment: Gamma-quenched from 850°C to 500°C, aged at 500°C
Hardness: Rc 49.1

IMPACTOR

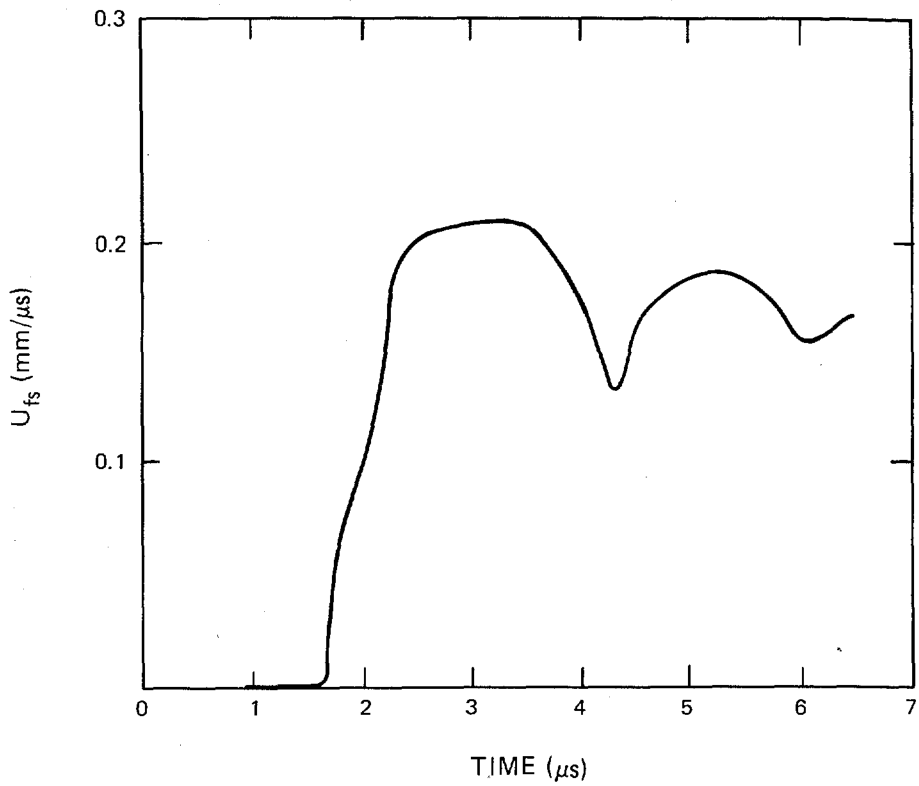
OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.276 mm/μs

TRANSDUCER

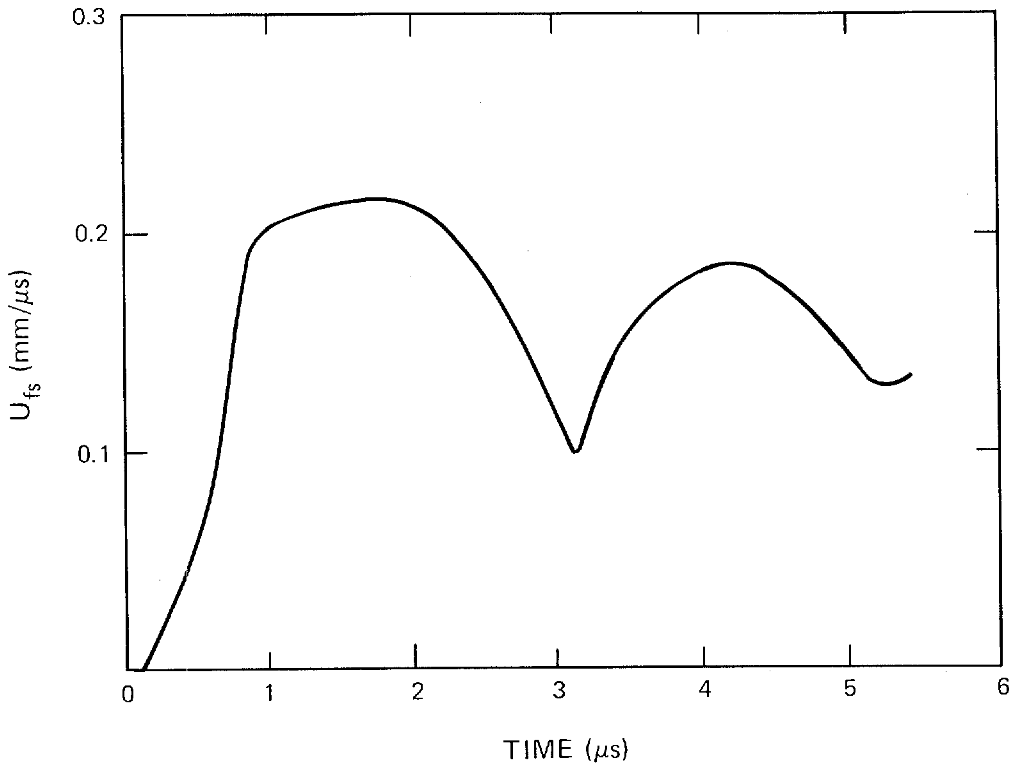
Free-surface capacitor
Time: Relative



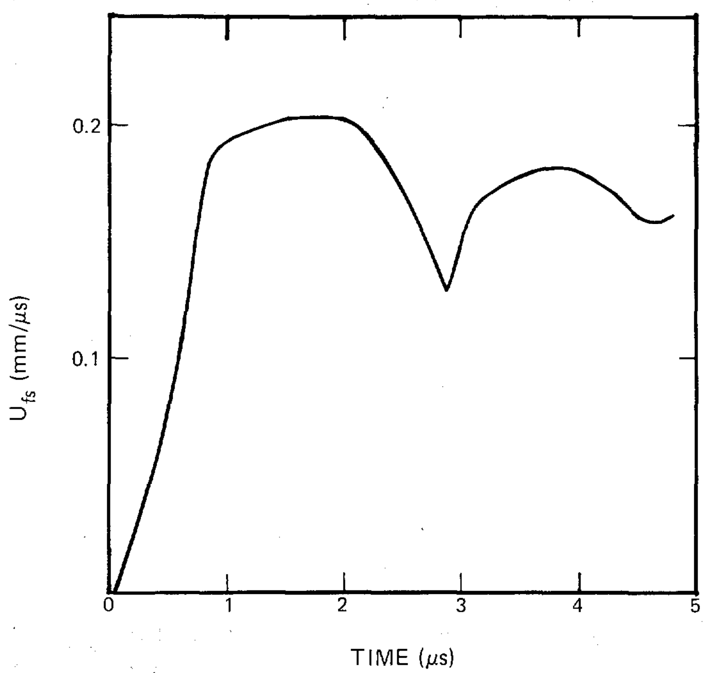
TARGET	**Material:** 99.16 wt% uranium with 0.84 wt% titanium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-72-33 **Date:** April 21, 1972 **Thickness:** 3.44 mm **Diameter:** 2.10 mm **Density:** 18.5 g/cm^3 $C_L = 3.44$ mm/μs $C_S = 2.10$ mm/μs **Heat treatment:** Gamma-quenched in water from 850°C, then aged at 450°C **Hardness:** Rc 54.5
IMPACTOR	OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.263 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	**Material:** 99.17 wt% uranium with 0.83 wt% titanium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-71-49 **Date:** December 7, 1971 **Thickness:** 9.70 mm **Diameter:** 38.1 mm **Density:** 18.46 g/cm^3 $C_L = 3.44$ mm/µs $C_S = 2.10$ mm/µs **Heat treatment:** Gamma-quenched in water from 850°C **Hardness:** Rc 40.4
IMPACTOR	OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.262 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	**Material:** 98.83 wt% uranium with 1.17 wt% titanium **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-72-3 **Date:** January 5, 1972 **Thickness:** 9.70 mm **Diameter:** 38.1 mm **Density:** 18.4 g/cm^3 $C_L = 3.45$ mm/µs $C_S = 2.10$ mm/µs **Heat treatment:** Gamma-quenched from 850°C to 500°C, aged at 500°C **Hardness:** Rc 49.8
IMPACTOR	OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.259 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET

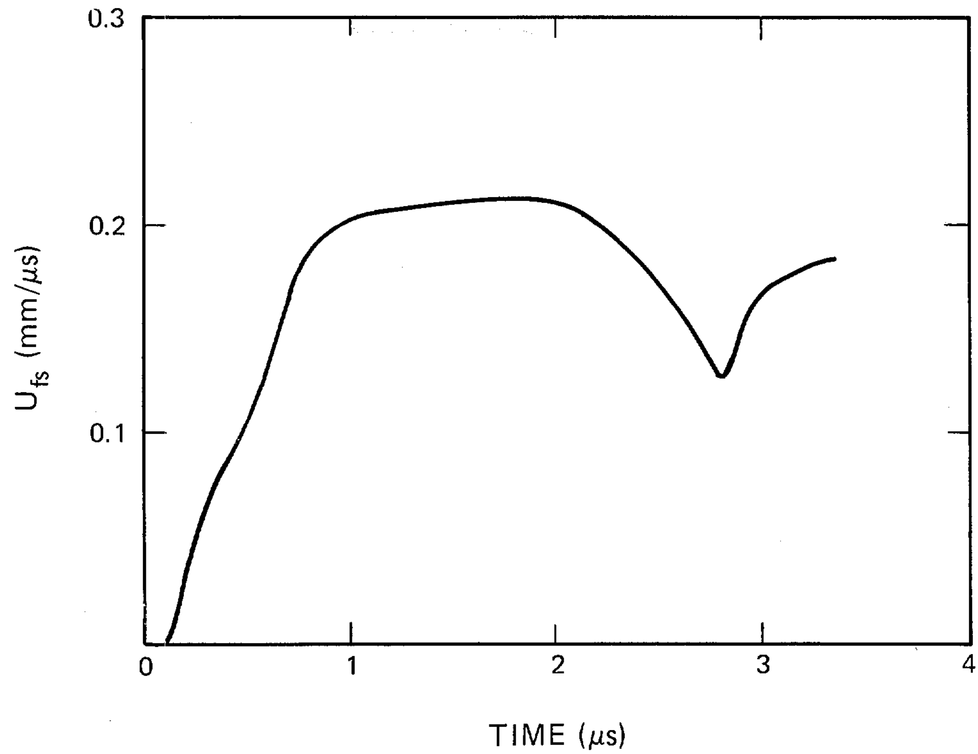
Material: 98.82 wt% uranium with 1.18 wt% titanium
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-72-17 Date: February 8, 1972
Thickness: 9.32 mm Diameter: 38.1 mm
Density: 18.4 g/cm^3
$C_L = 3.45$ mm/μs $C_S = 2.10$ mm/μs
Heat treatment: Gamma-quenched from 850°C in water, aged at 450°C
Hardness: Rc 49.8

IMPACTOR

OFHC copper, 5.0 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.262 mm/μs

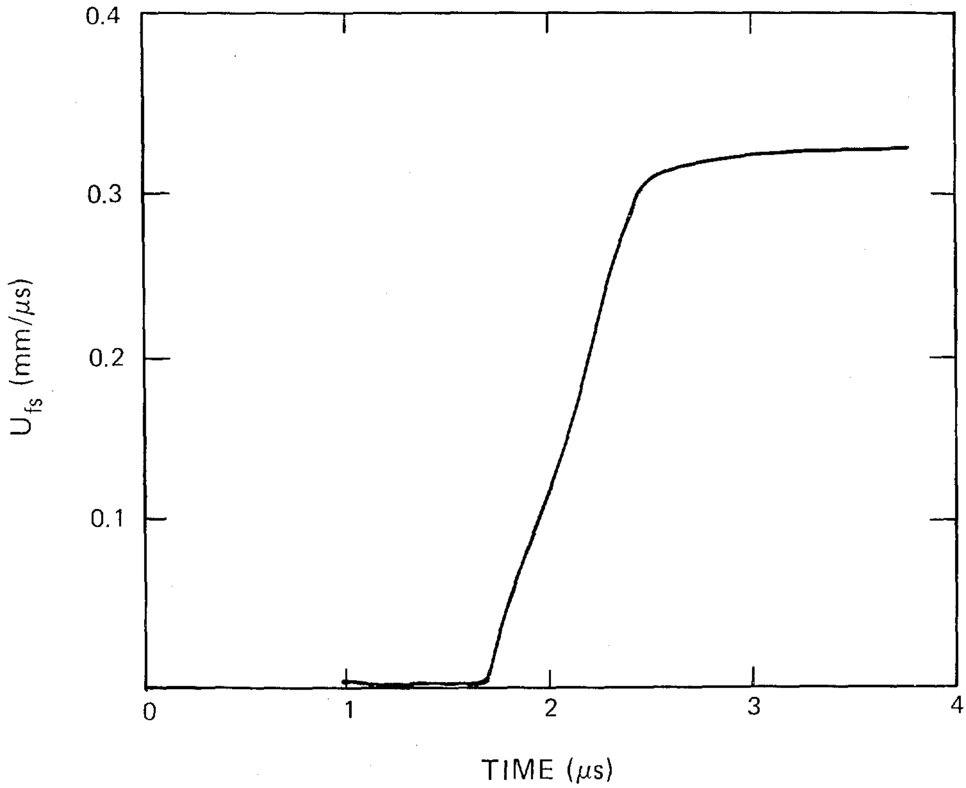
TRANSDUCER

Free-surface capacitor
Time: Relative



MINERALS AND COMPOUNDS

TARGET	**Material:** Alumina, Al_2O_3 (XA15) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 56-70-23 **Date:** March 5, 1970 **Thickness:** 9.53 mm **Diameter:** 38.1 mm **Density:** 3.12 g/cm^3 $C_L = 6.77$ mm/μs $C_S = 4.28$ mm/μs
IMPACTOR	Alumina (XA15), 4.54 mm thick, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.424 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative

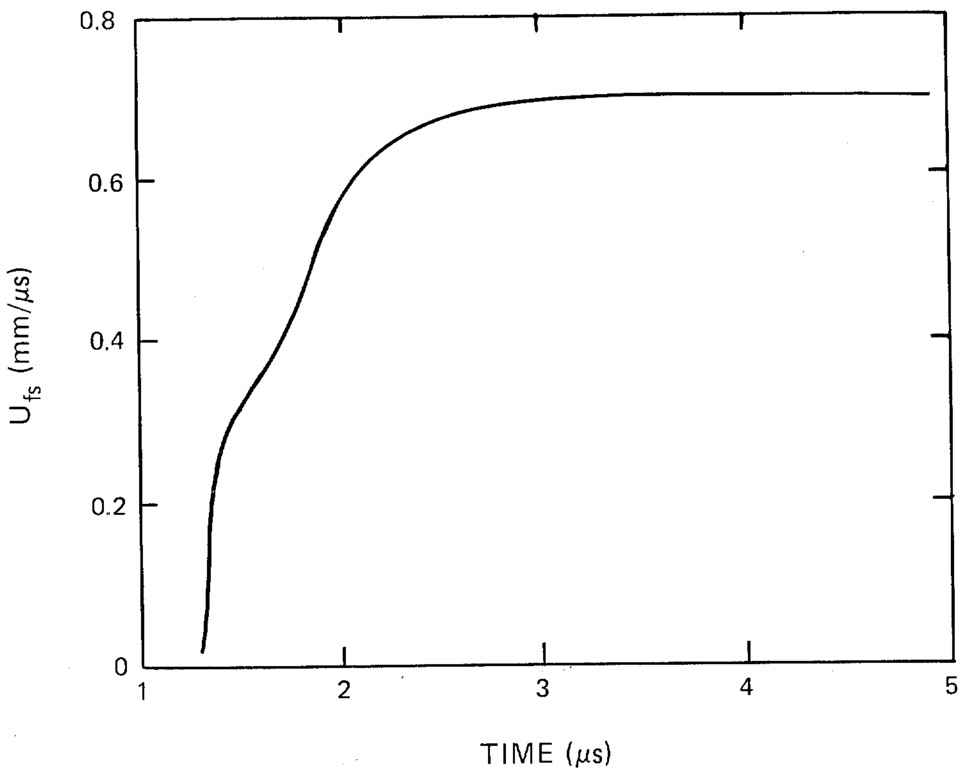


TARGET

Material: Alumina, Al_2O_3
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970)
Shot no.: 56-67-440 **Date:** January 24, 1967
Thickness: 12.7 mm
Density: 3.39 g/cm^3
$C_L = 8.72$ mm/μs $C_S = 5.15$ mm/μs

IMPACTOR 2024 aluminum, 6.35 mm thick, mounted on aluminum alloy projectile

TRANSDUCER Free-surface capacitor
Time: Relative



TARGET

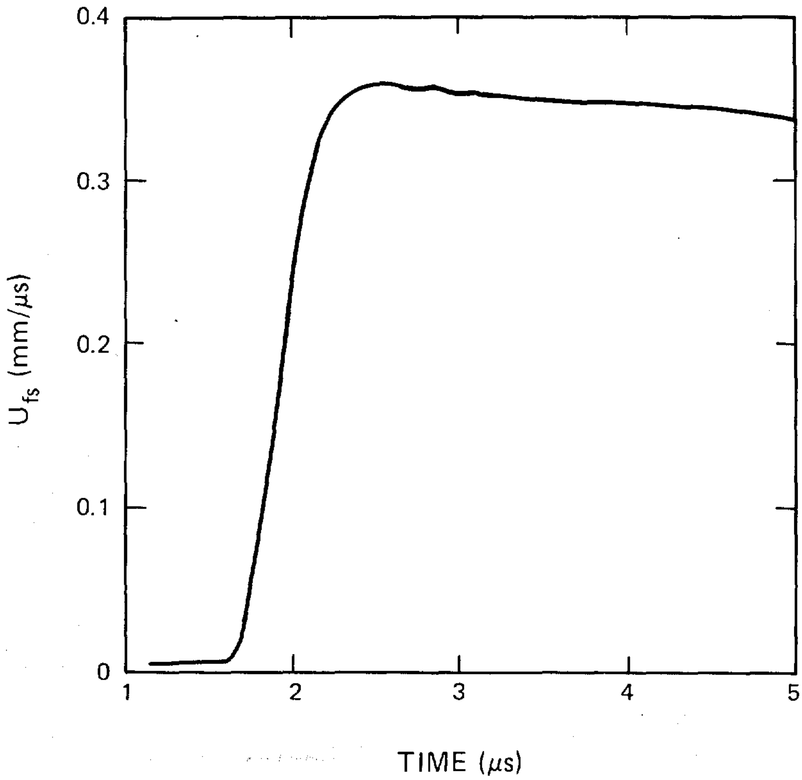
Material: Alumina, Al_2O_3 (A1-8)
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56A01 Date: July 31, 1968
Thickness: 12.95 mm Diameter: 38.1 mm
Density: 3.50 g/cm^3
$C_L = 8.94$ mm/μs

IMPACTOR

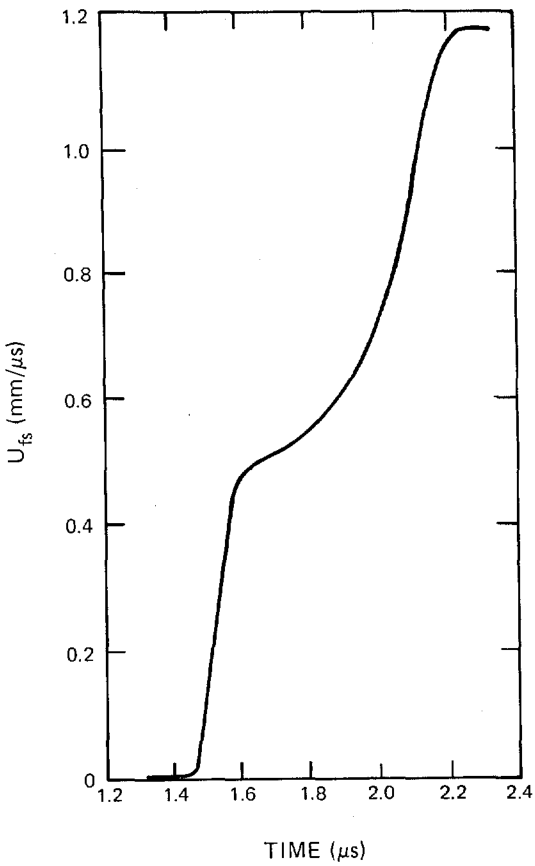
Alumina (Al-8), 6.35 mm thick, mounted on 51-mm-diam aluminum alloy
projectile
Impact velocity: 0.386 mm/μs

TRANSDUCER

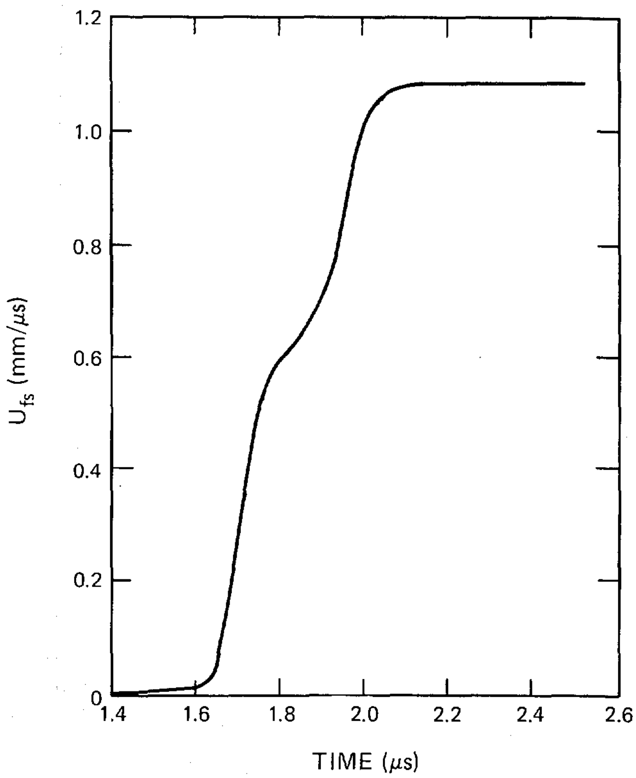
Free-surface capacitor
Time: Relative



TARGET	**Material:** Alumina, Al_2O^3 (Al-8) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80A02 **Date:** August 9, 1968
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate/ 12.71 mm alumina
SHOT COMPONENTS	Alumina, Al_2O^3 **Density:** 3.50 g/cm^3 C_L = 8.94 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET	**Material:** Beryllium oxide, BeO (Oak Ridge) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80205 **Date:** July 11, 1968
HE SHOT GEOMETRY	P-080 lens/51 mm baratol/2024 aluminum base plate/ 12.67 mm beryllium oxide
SHOT COMPONENTS	Beryllium oxide, BeO **Density:** 2.99 g/cm^3 $C_L = 11.90$ mm/µs $C_S = 7.28$ mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 80205, 80211, and 80212 are a series with varied impact stress.



TARGET

Material: Beryllium oxide, BeO (Oak Ridge)
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 80211 **Date:** August 8, 1968

HE SHOT GEOMETRY

P-080 lens/102 mm TNT/2024 aluminum base plate/ 12.96 mm beryllium oxide

SHOT COMPONENTS

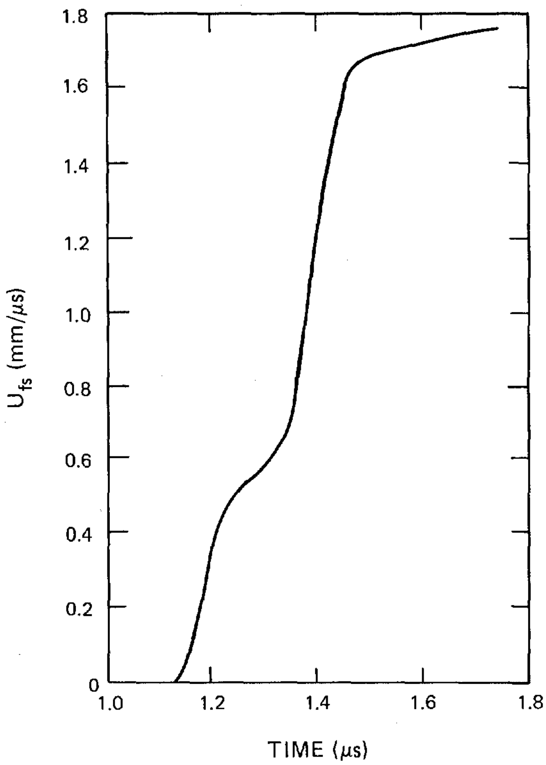
Beryllium oxide, BeO
Density: 2.99 g/cm^3
$C_L = 11.90$ mm/µs $C_S = 7.28$ mm/µs

TRANSDUCER

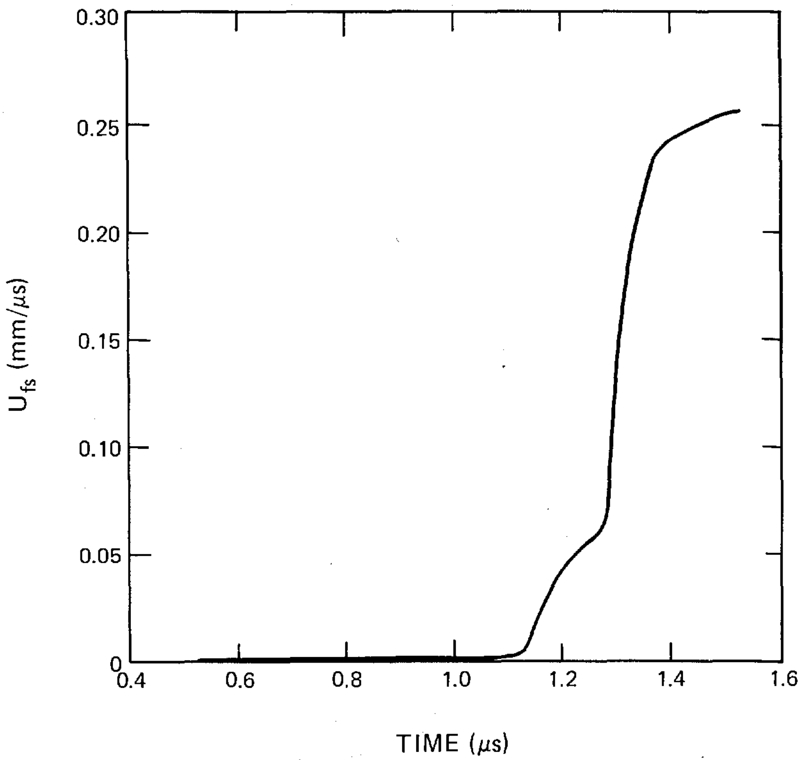
Free-surface capacitor
Time: Relative

NOTES

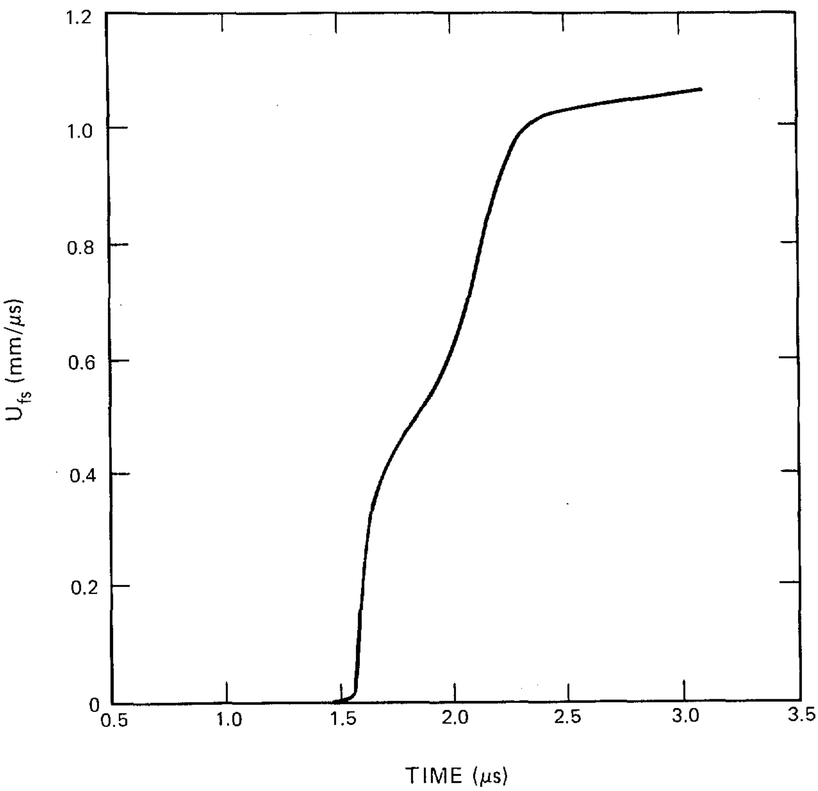
Shots 80205, 80211, and 80212 are a series with varied impact stress.



TARGET	**Material:** Beryllium oxide, BeO (Oak Ridge) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80212 **Date:** August 8, 1968
HE SHOT GEOMETRY	P-080 lens/102 mm Comp B/2024 aluminum base plate/ 12.95 mm beryllium oxide
SHOT COMPONENTS	Beryllium oxide, BeO **Density:** 2.99 g/cm^3 $C_L = 11.90$ mm/μs $C_S = 7.28$ mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 80205, 80211, and 80212 are a series with varied impact stress.



TARGET	**Material:** Beryllium oxide, BeO (Coors') **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80209 **Date:** July 2, 1968
HE SHOT GEOMETRY	P-080 lens/51 mm baratol/2024 aluminum base plate/ 12.34 mm beryllium oxide
SHOT COMPONENTS	Beryllium oxide, BeO **Density:** 2.86 g/cm^3 C_L = 11.45 mm/μs C_S = 7.02 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 80209 and 80210 are a series with varied impact stress.



TARGET

Material: Beryllium oxide, BeO (Coors')
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 80210 Date: July 3, 1968

HE SHOT GEOMETRY

P-080 lens/102 mm TNT/2024 aluminum base plate/ 12.36 mm beryllium oxide

SHOT COMPONENTS

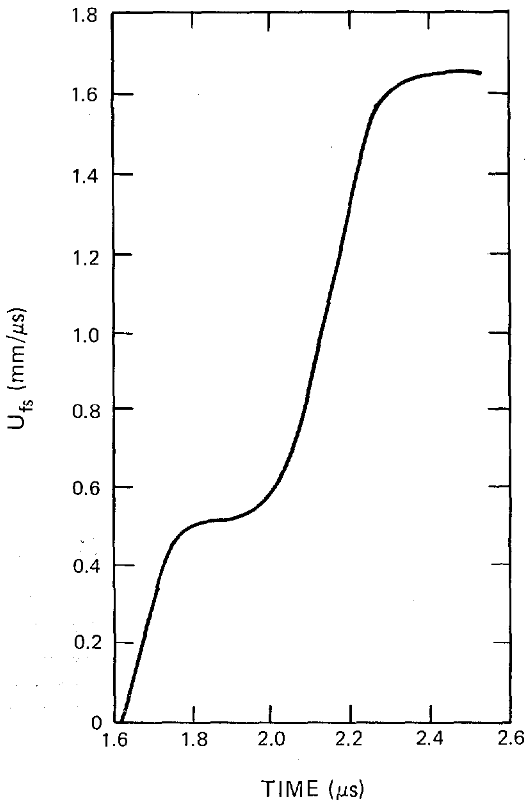
Beryllium oxide, BeO
Density: 2.86 g/cm^3
$C_L = 11.45$ mm/μs $C_S = 7.02$ mm/μs

TRANSDUCER

Free-surface capacitor
Time: Relative

NOTES

Shots 80209 and 80210 are a series with varied impact stress.



TARGET

Material: Boron carbide, B_4C
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 8BC01 **Date:** August 16, 1968

HE SHOT GEOMETRY

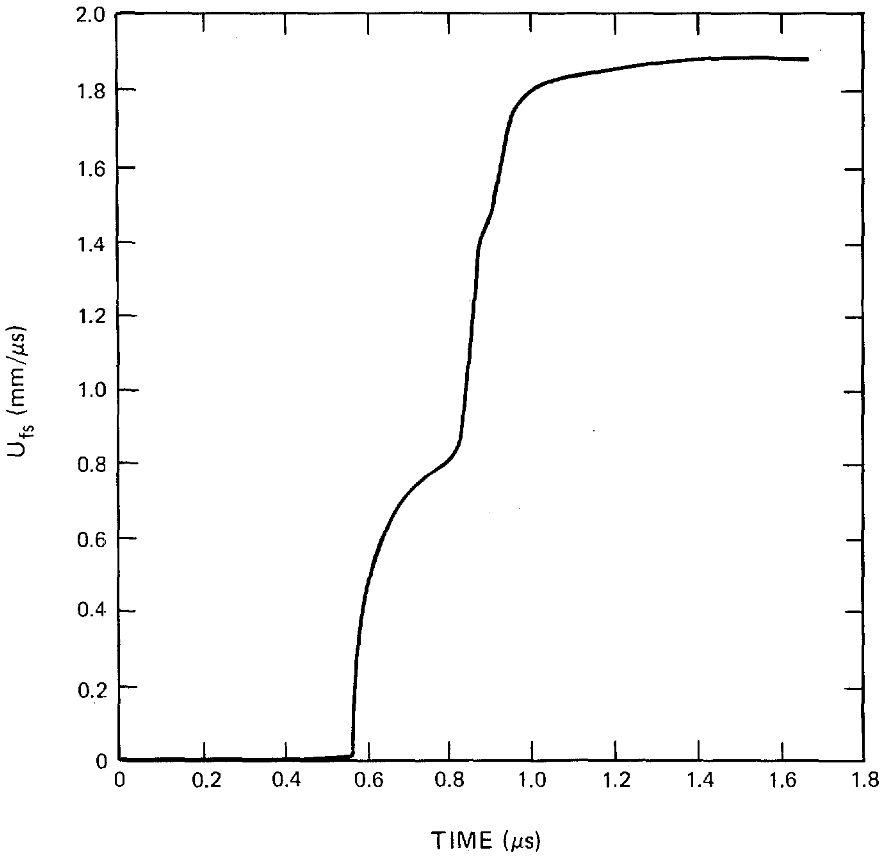
P-080 lens/102 mm TNT/2024 aluminum base plate/ 7.75 mm boron carbide

SHOT COMPONENTS

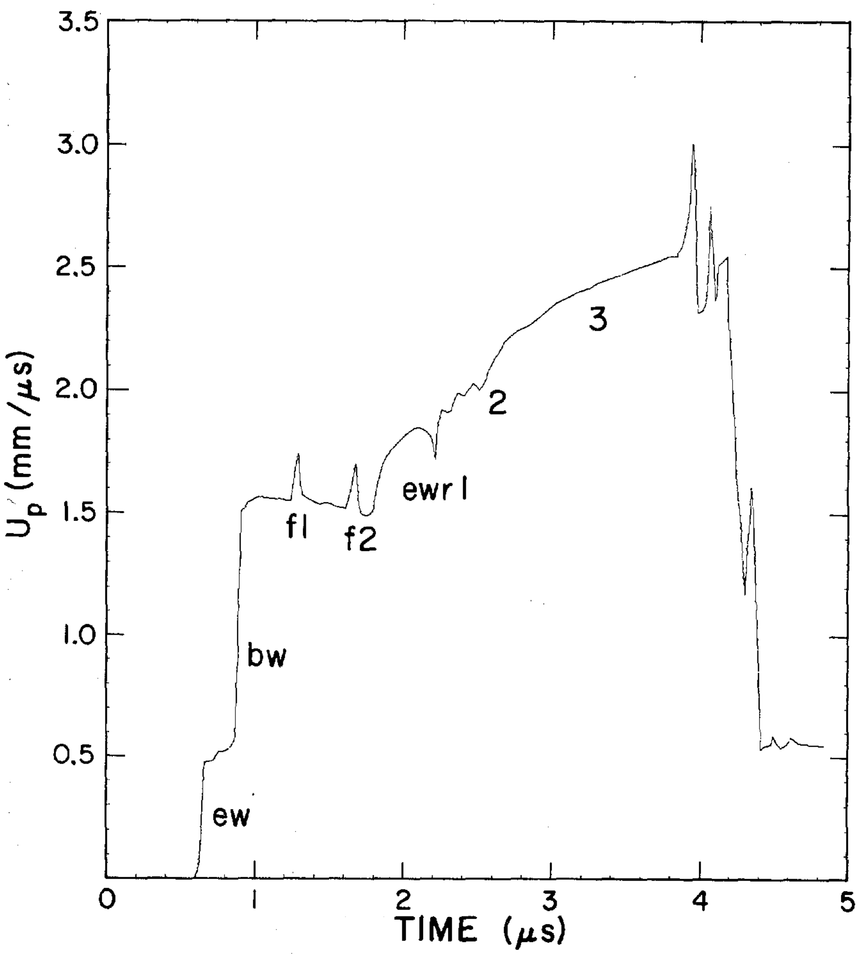
Boron carbide
Density: 2.45 g/cm^3
$C_L = 13.5$ mm/μs $C_S = 8.5$ mm/μs

TRANSDUCER

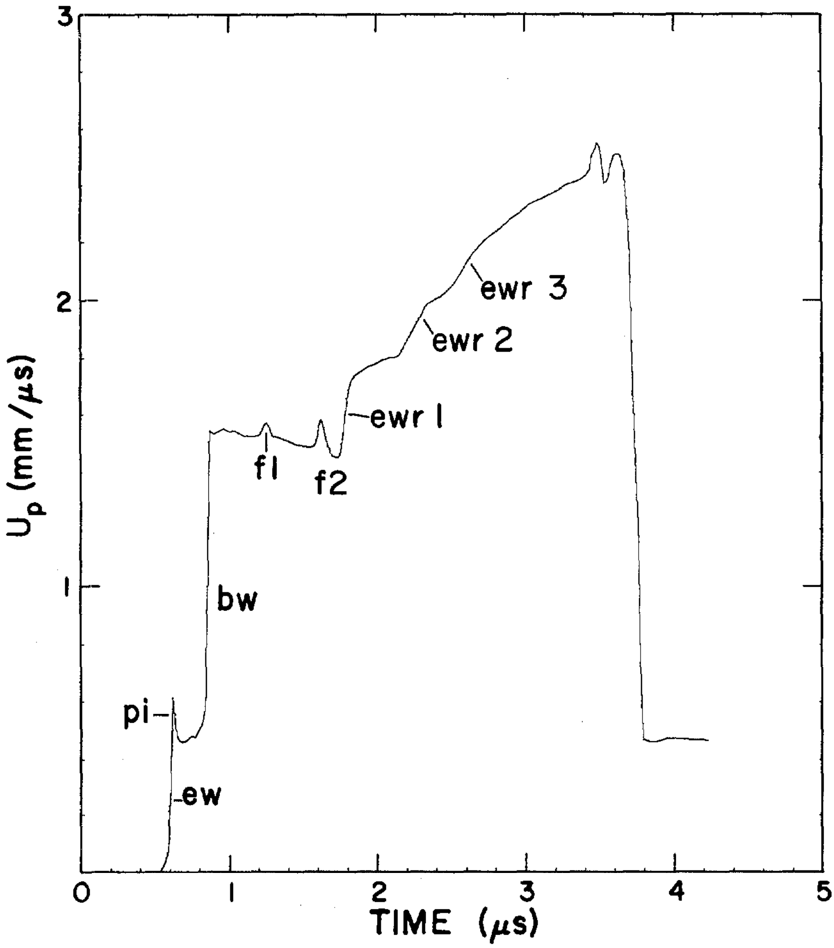
Free-surface capacitor
Time: Relative



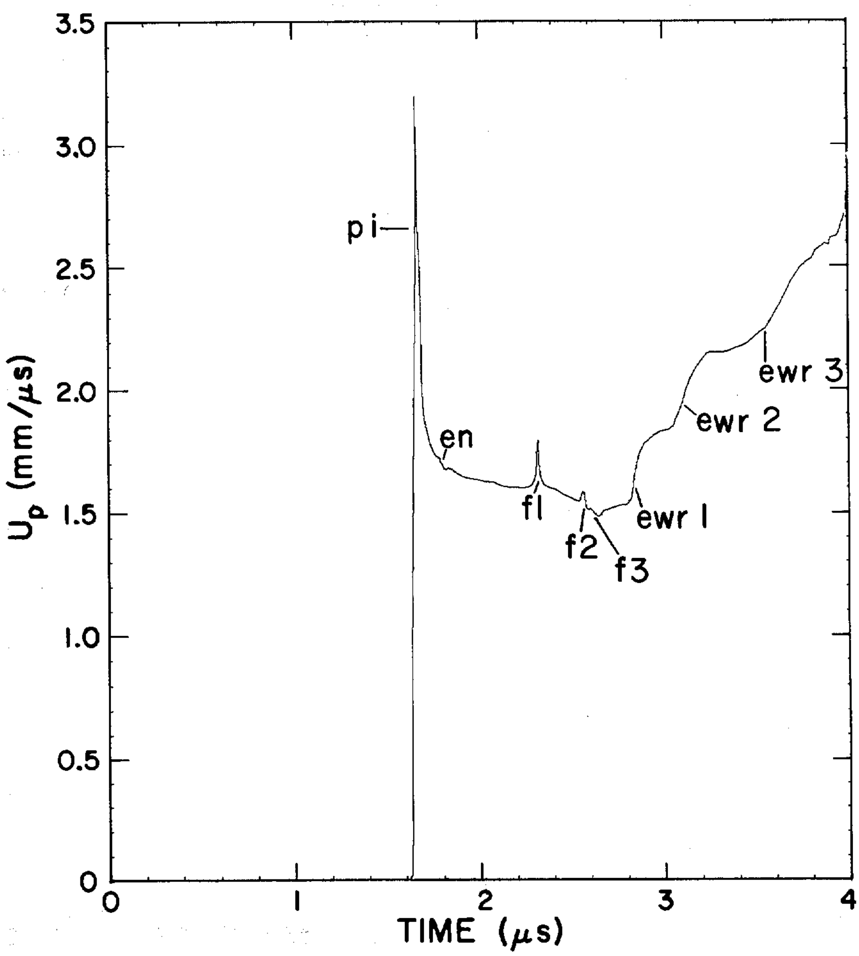
TARGET	Material: Boron carbide, B_4C Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 88 Date: September 13, 1973
HE SHOT GEOMETRY	P-081 lens/203 mm Comp B/8.32 mm boron carbide/ epoxy/0.03 mm aluminum//epoxy/8.31 mm boron carbide -f/ 7.71 mm air//
TRANSDUCER	ASM probe Coil radius: 28.64 mm Initial coil spacing: 16.02 mm Time: Relative



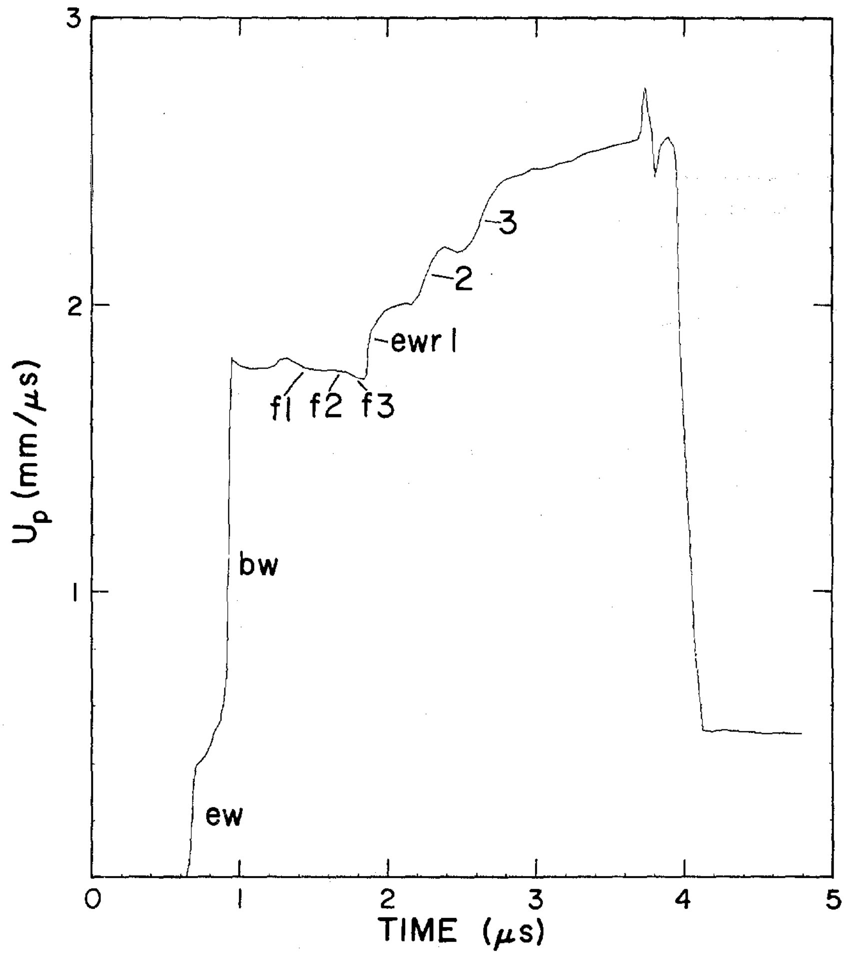
TARGET	Material: Boron carbide, B_4C Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 70 Date: August 30, 1972
HE SHOT GEOMETRY	P-081 lens/203 mm Comp B/8.257 mm boron carbide/ 0.03 mm aluminum, 0.025 mm air//8.312 mm boron carbide -f/6.38 mm air//
TRANSDUCER	ASM probe Coil radius: 28.64 mm, Initial coil spacing: 14.72 mm Time: Relative



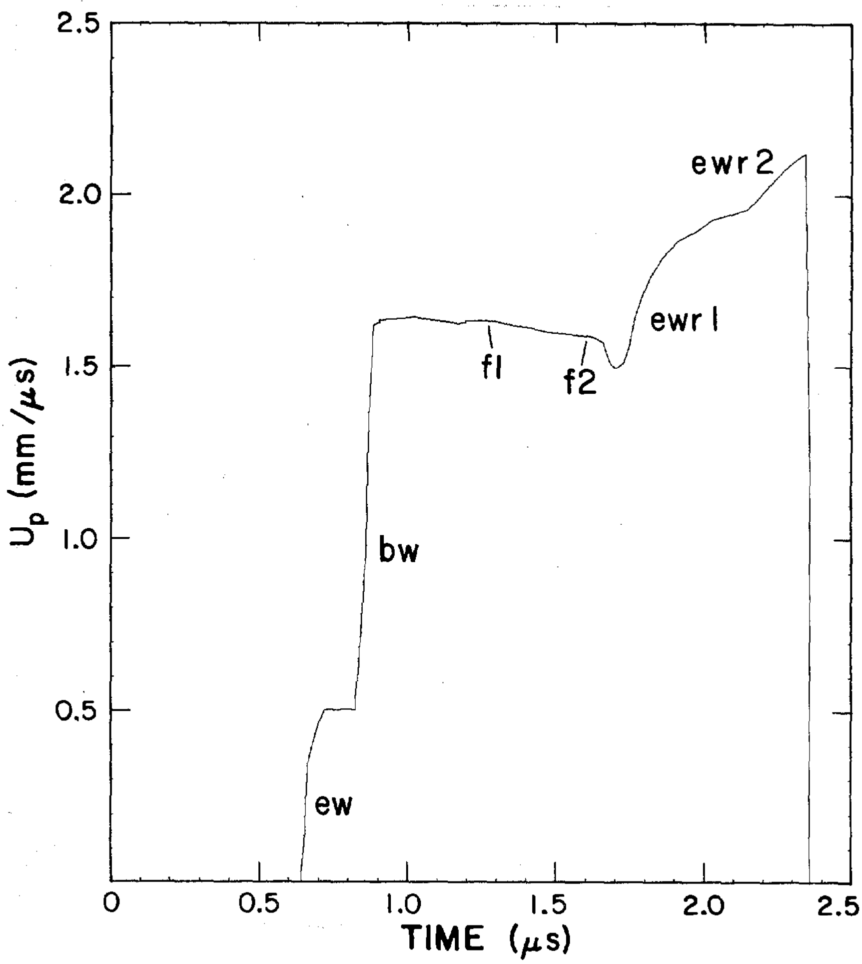
TARGET	**Material:** Boron carbide, B_4C **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 68 **Date:** July 7, 1972
HE SHOT GEOMETRY	P-081 lens/203 mm Comp B/12.78 mm 2024 aluminum// 8.43 mm boron carbide -f/5.02 mm air//
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 13.45 mm **Time:** Relative



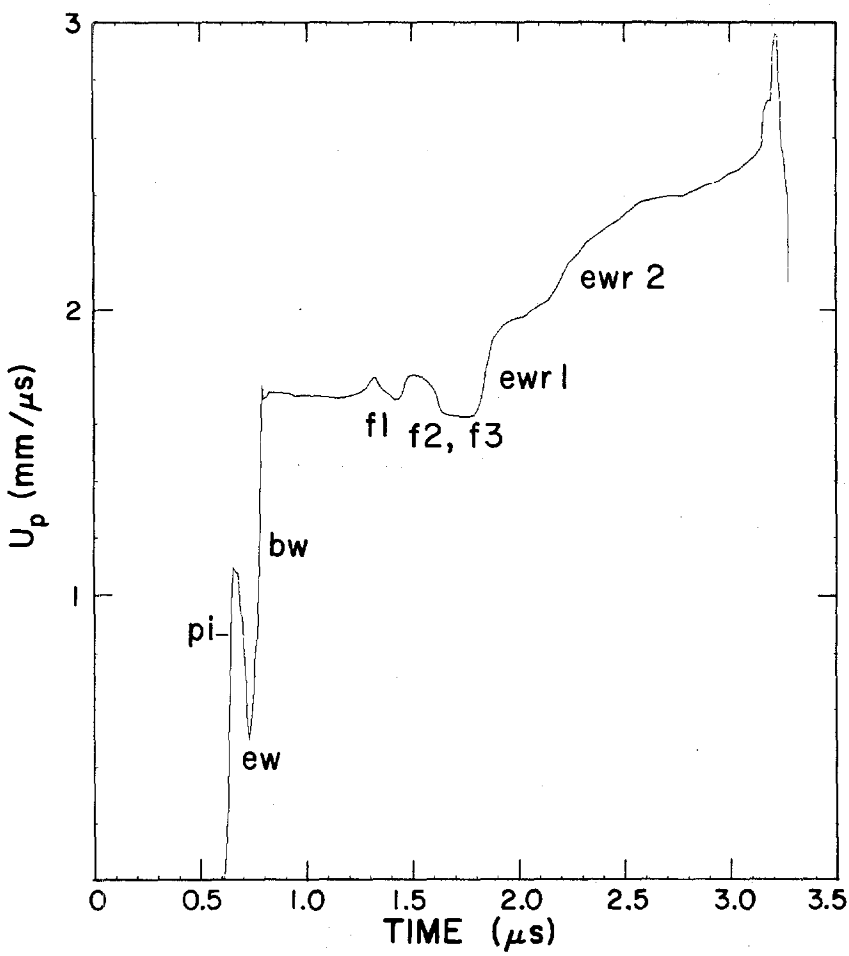
TARGET	**Material:** Boron carbide, B_4C **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 84 **Date:** May 1, 1973
HE SHOT GEOMETRY	P-081 lens/229 mm octol/8.23 mm boron carbide/epoxy/ 0.03 mm aluminum//epoxy/8.29 mm boron carbide -f/ 7.71 mm air//
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 16.00 mm **Time:** Relative



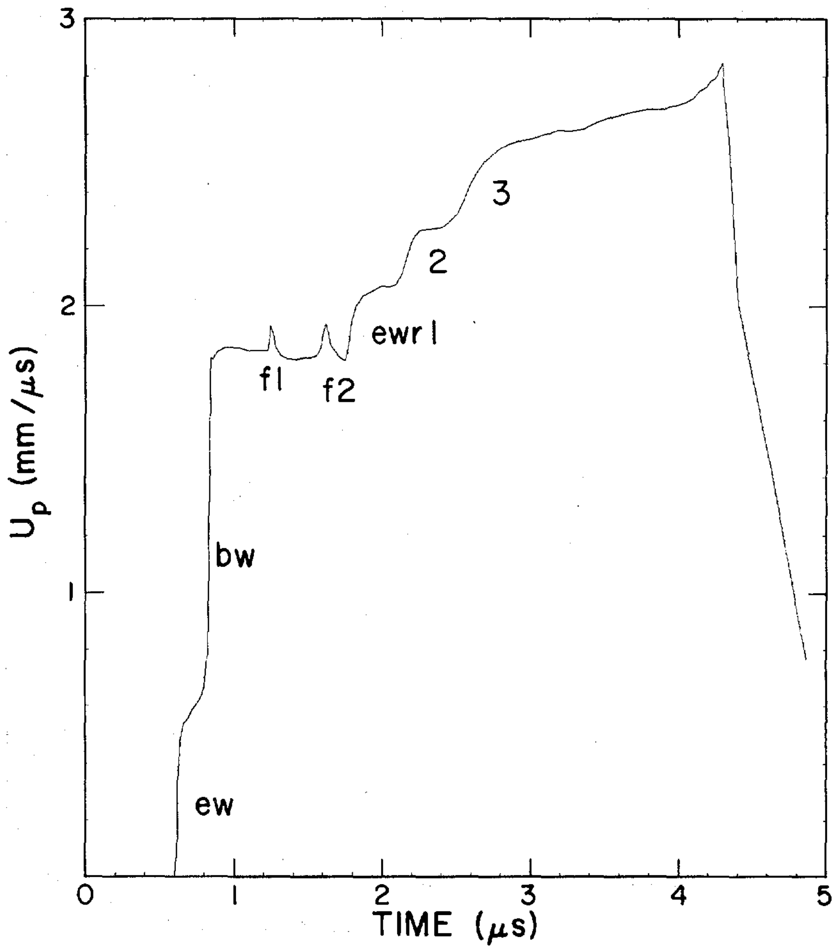
TARGET	Material: Boron carbide, B_4C Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 83 Date: April 30, 1973
HE SHOT GEOMETRY	P-081 lens/229 mm octol/8.27 mm boron carbide/epoxy/ 0.03 mm aluminum//epoxy/8.43 mm boron carbide -f/ 7.71 mm air//
TRANSDUCER	ASM probe Coil radius: 28.64 mm Initial coil spacing: 16.14 mm Time: Relative



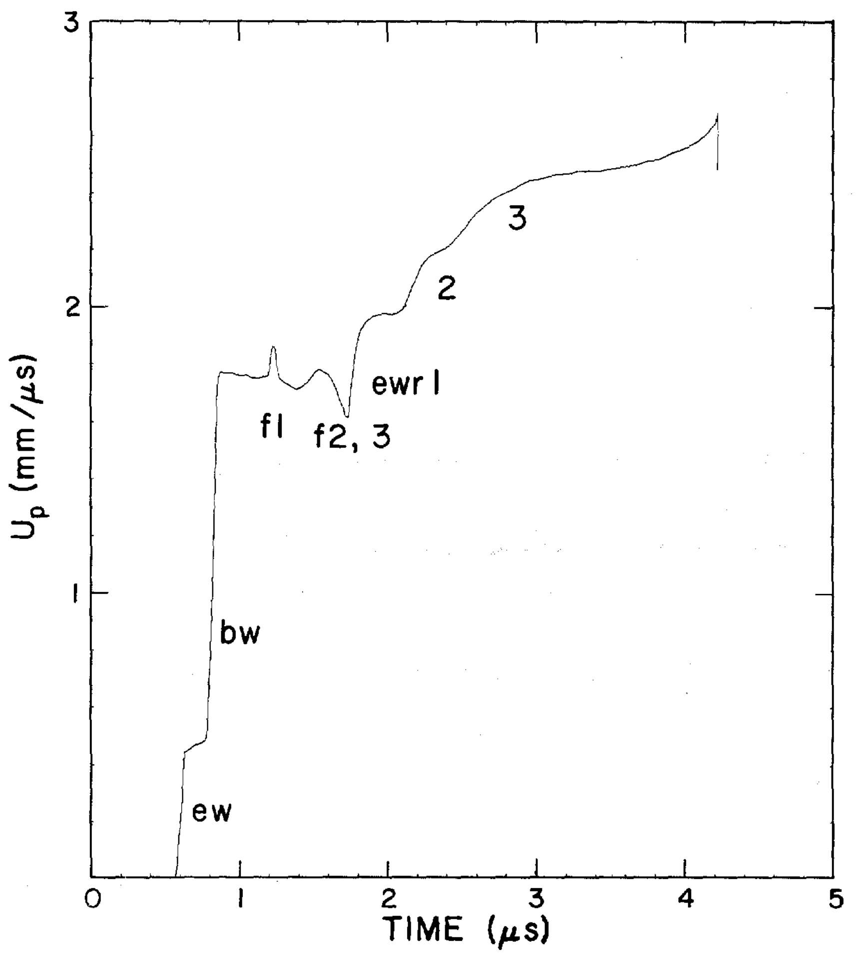
TARGET	**Material:** Boron carbide, B_4C
	Experiment type: ASM probe
	Experimenters: J. N. Fritz and J. A. Morgan
	Shot no.: M 74 **Date:** August 31, 1972
HE SHOT GEOMETRY	P-081 lens/229 mm octol/7.51 mm boron carbide/0.03 mm aluminum, 0.046 mm air//8.42 mm boron carbide -f/ 6.41 mm air//
TRANSDUCER	ASM probe
	Coil radius: 28.64 mm **Initial coil spacing:** 14.88 mm
	Time: Relative



TARGET	Material: Boron carbide, B_4C Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 89 Date: September 26, 1973
HE SHOT GEOMETRY	P-081 lens/229 mm octol/8.26 mm boron carbide/ epoxy/0.03 mm aluminum//epoxy/8.27 mm boron carbide -f/ 10.12 mm air//
TRANSDUCER	ASM probe Coil radius: 28.64 mm Initial coil spacing: 18.39 mm Time: Relative



TARGET	Material: Boron carbide, B_4C Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 90 Date: September 27, 1973
HE SHOT GEOMETRY	P-081 lens/152 mm PBX 9404/7.90 mm boron carbide/ epoxy/0.03 mm aluminum//epoxy/8.20 mm boron carbide -f/ 10.15 air//
TRANSDUCER	ASM probe Coil radius: 28.64 mm Initial coil spacing: 18.35 mm Time: Relative



TARGET

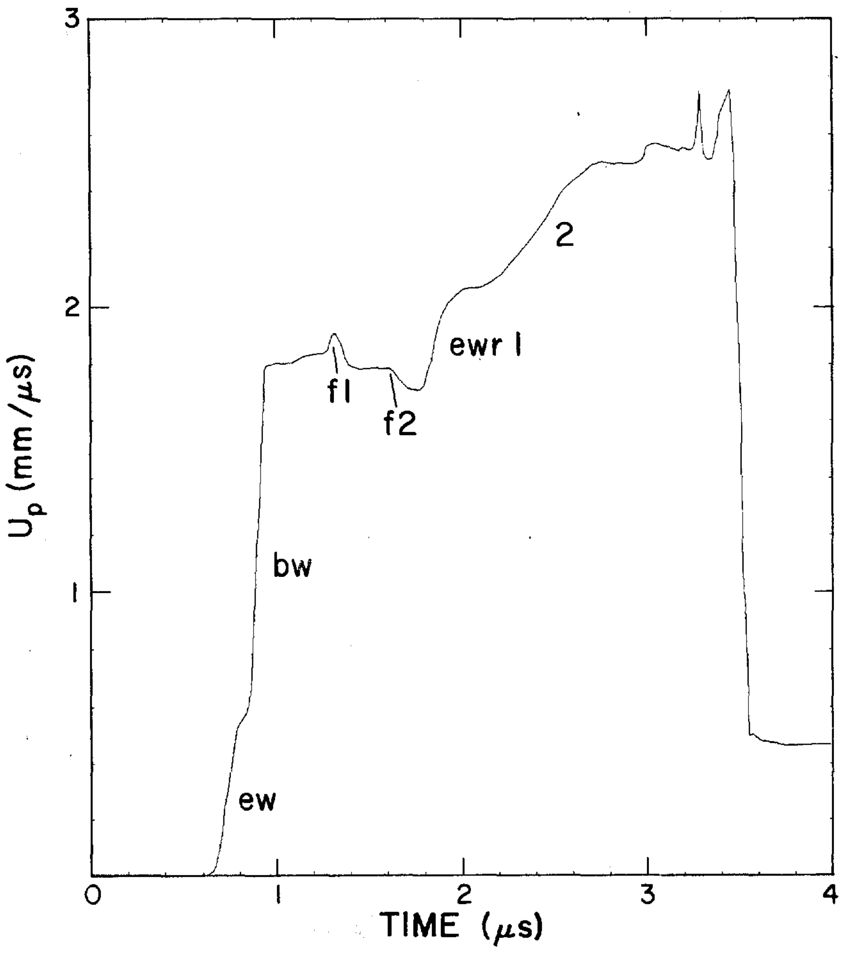
Material: Boron carbide, B_4C
Experiment type: ASM probe
Experimenters: J. N. Fritz and J. A. Morgan
Shot no.: M 86 Date: June 14, 1973

HE SHOT GEOMETRY

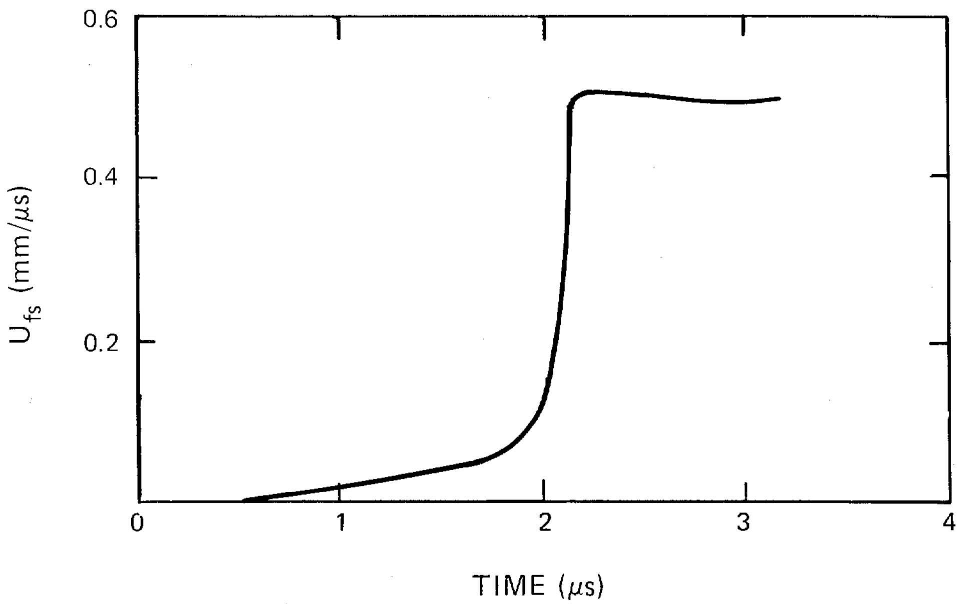
P-081 lens/152 mm PBX 9404/8.25 mm boron carbide/epoxy/0.03 mm aluminum//epoxy/8.30 mm boron carbide -f/6.38 mm air//

TRANSDUCER

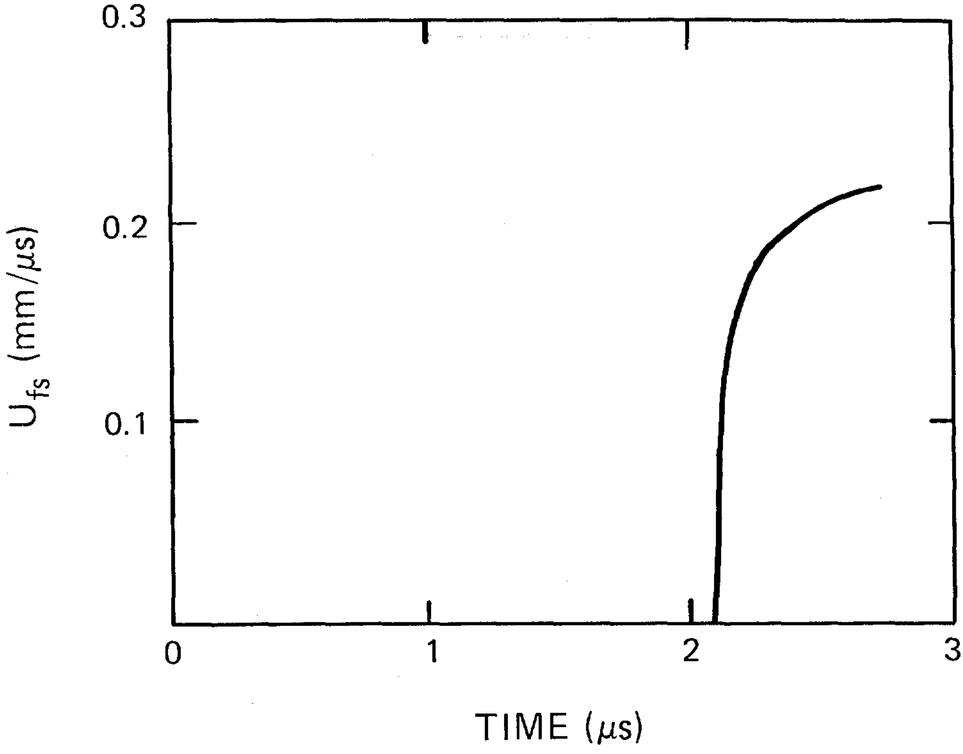
ASM probe
Coil radius: 28.64 mm Initial coil spacing: 14.68 mm
Time: Relative



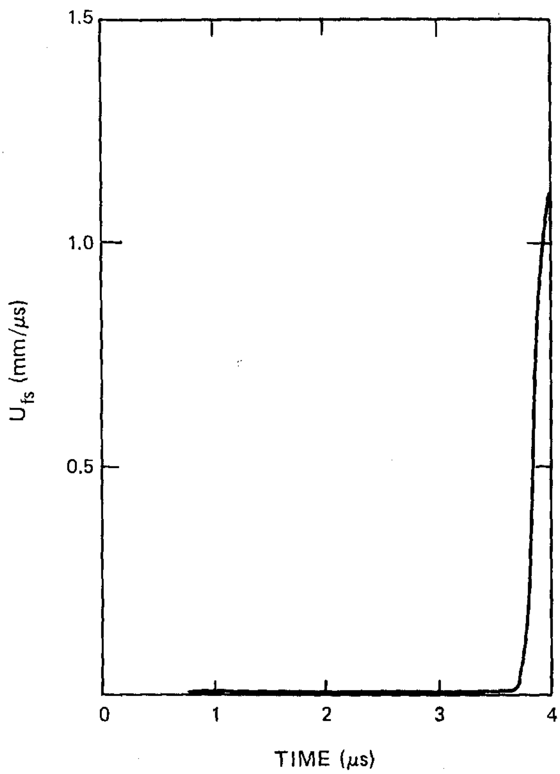
TARGET	**Material:** Boron nitride, BN **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-66-408 **Date:** December 22, 1966 **Thickness:** 12.70 mm **Density:** 2.02 g/cm^3
IMPACTOR	2024 aluminum mounted on aluminum alloy projectile **Impact velocity:** 0.301 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



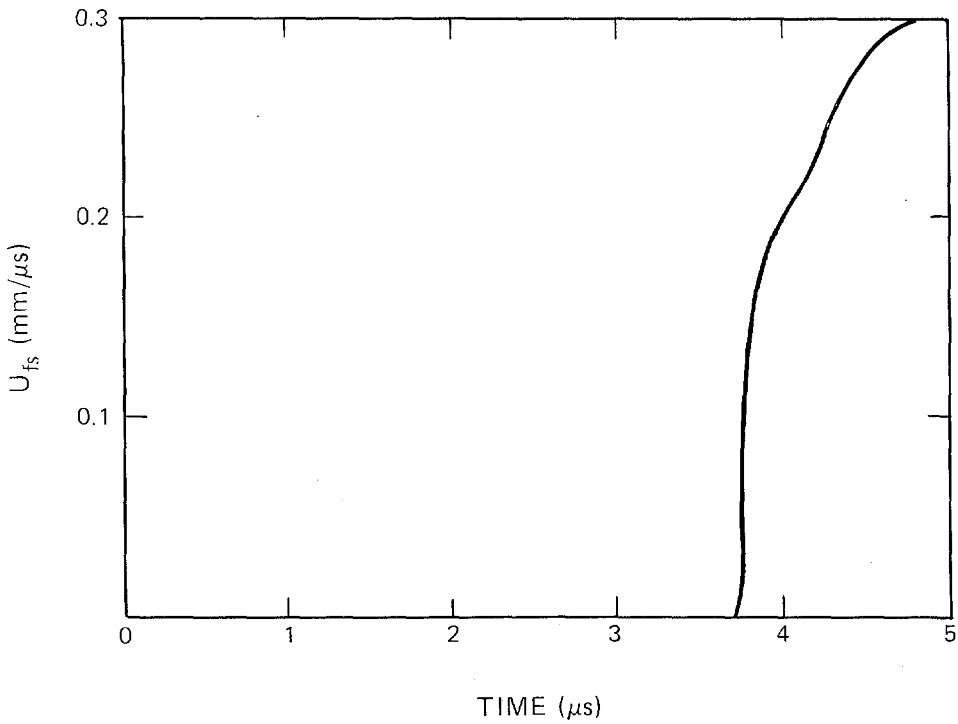
TARGET	**Material:** Calcium carbonate, $CaCO_3$ **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 8B690 **Date:** April 6, 1970
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate/ 8.74 mm calcium carbonate
SHOT COMPONENTS	Calcium carbonate **Density:** 2.63 g/cm^3
TRANSDUCER	Free-surface capacitor Time: Relative



TARGET	Material: Hafnium titanate, $HfTiO_3$ Experiment type: Free-surface capacitor Experimenter: J. W. Hopson Shot no.: 8B625 Date: May 14, 1969
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate/ 12.71 mm hafnium titanate
SHOT COMPONENTS	Hafnium titanate Density: 6.97 g/cm^3 C_L = 2.28 mm/μs
TRANSDUCER	Free-surface capacitor Time: Relative
NOTES	Shots 50-70-22 and 8B625 are a series with varied impact stress.



TARGET	**Material:** Hafnium titanate, $HfTiO_3$ **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 50-70-22 **Date:** February 27, 1970 **Thickness:** 12.72 mm **Density:** 6.96 g/cm^3 $C_L = 2.28$ mm/μs
IMPACTOR	2024 aluminum, 6.35 mm thick, mounted on aluminum alloy projectile **Impact velocity:** 0.39 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 50-70-22 and 8B625 are a series with varied impact stress.



TARGET

Material: Lithium hydride, ^6LiH
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Shot no.: 56-63-276 Date: October 10, 1963
Thickness: 12.7 mm
Density: 0.669 g/cm^3
C_L = 11.1 mm/μs

IMPACTOR

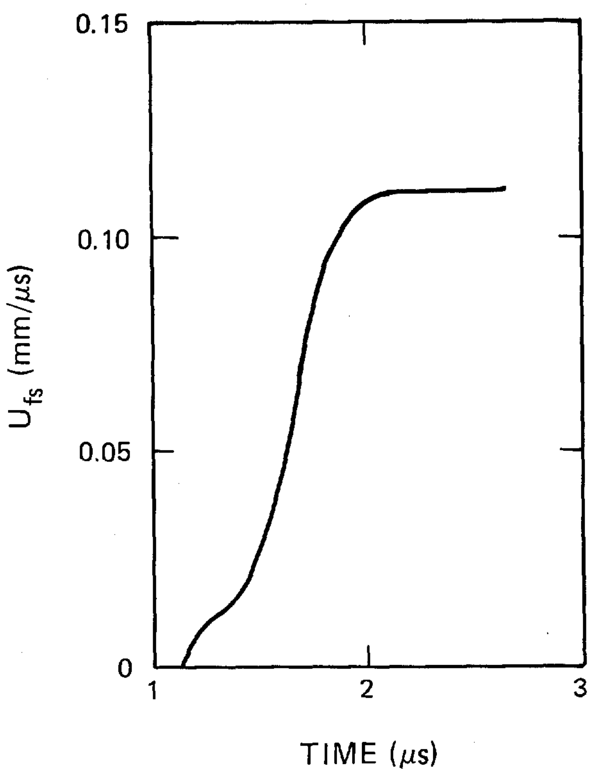
Lithium hydride, 6.35 mm thick, mounted on aluminum alloy projectile
Impact velocity: 0.138 mm/μs

TRANSDUCER

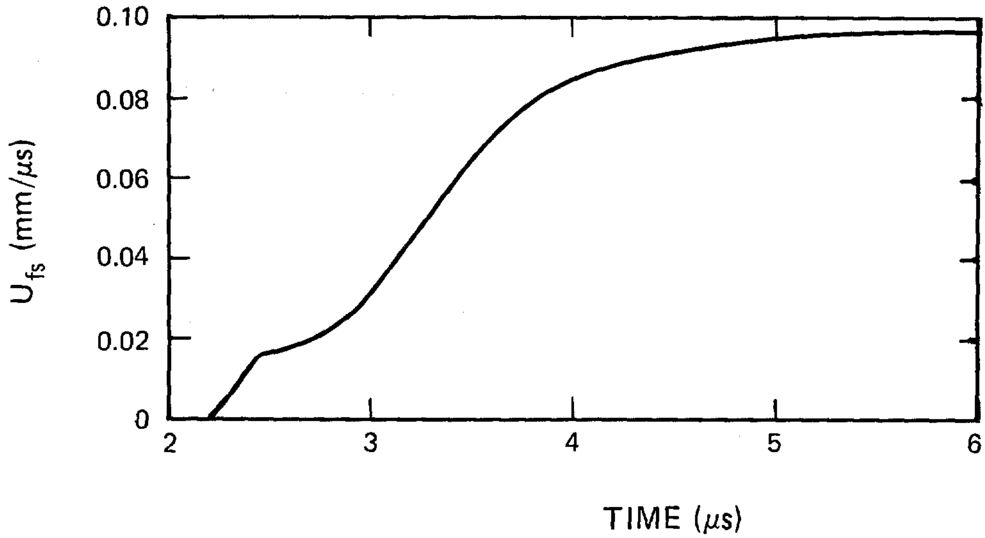
Free-surface capacitor
Time: Relative

NOTES

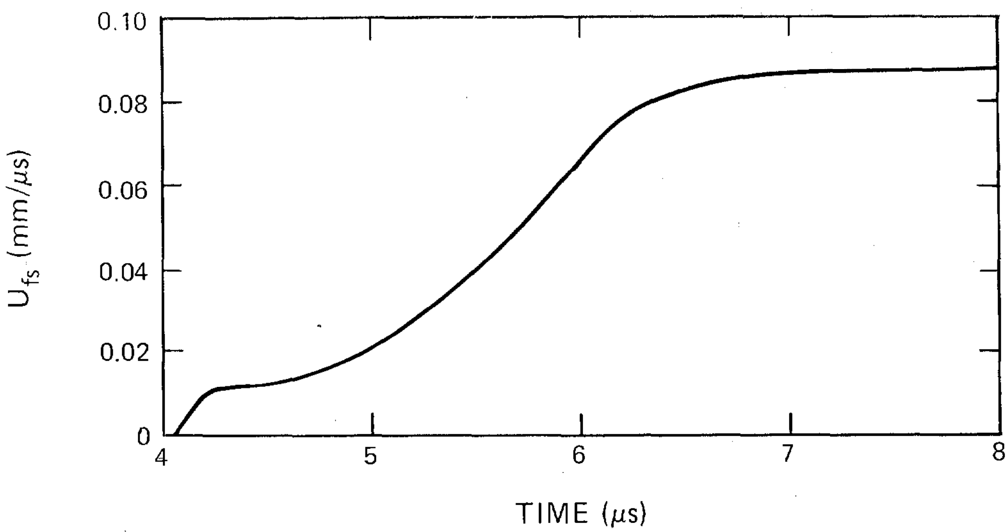
Shots 56-63-276, 56-64-315, and 56-64-316 are a series with varied target thickness.



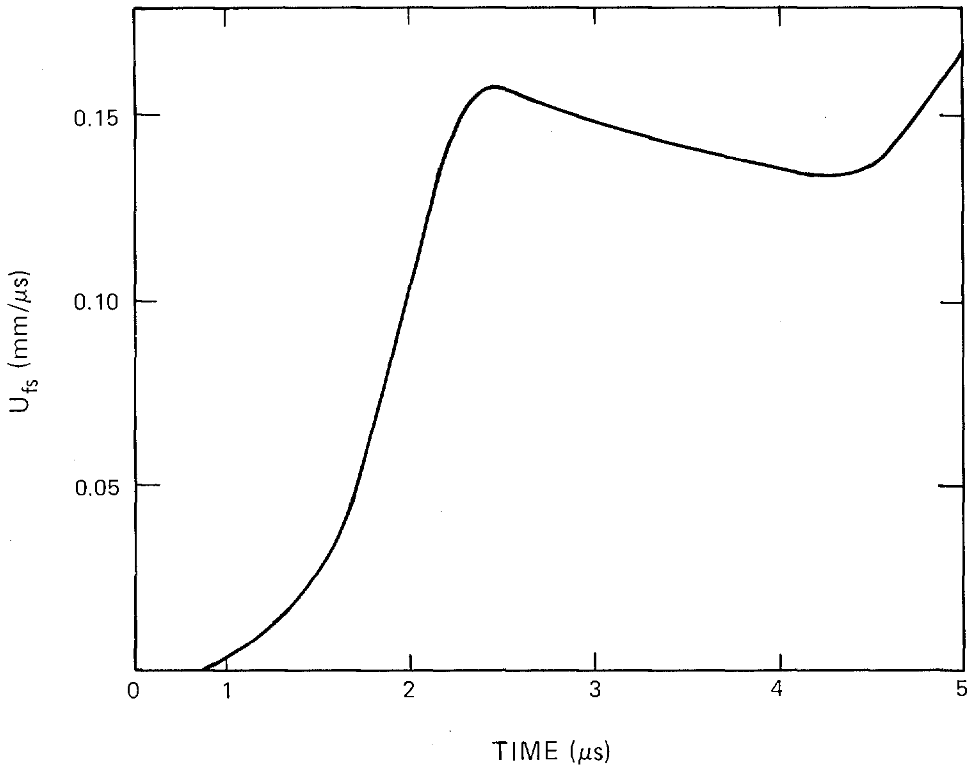
TARGET	**Material:** Lithium hydride, ^6LiH **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-64-315 **Date:** August 11, 1964 **Thickness:** 25.4 mm **Diameter:** 153 mm **Density:** 0.666 g/cm^3 $C_L = 10.4$ mm/μs $C_S = 6.86$ mm/μs
IMPACTOR	OFHC copper, mounted on 165-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-63-276, 56-64-315, and 56-64-316 are a series with varied target thickness.



TARGET	**Material:** Lithium hydride, ^6LiH **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-64-316 **Date:** August 13, 1964 **Thickness:** 50.80 mm **Diameter:** 153 mm **Density:** 0.66 g/cm^3 $C_L = 10.4$ mm/µs $C_S = 6.86$ mm/µs
IMPACTOR	OFHC copper, mounted on 165-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-63-276, 56-64-315, and 56-64-316 are a series with varied target thickness.



TARGET	**Material:** Lithium hydride, ^{6}LiH, at 115 °C **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Shot no.:** 56-64-292 **Date:** May 11, 1964 **Thickness:** 12.70 mm **Diameter:** 153 mm **Density:** 0.666 g/cm^3 $C_L = 10.4$ mm/μs $C_S = 6.86$ mm/μs
IMPACTOR	OFHC copper, mounted on 165-mm-diam aluminum alloy projectile
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 56-64-292, 56-64-309, and 56-64-314 are a series with varied ambient temperatures.



TARGET

Material: Lithium hydride, ^6LiH, at 210°C
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Shot no.: 56-64-309 **Date:** July 28, 1964
Thickness: 12.70 mm
Density: 0.666 g/cm^3
$C_L = 10.4$ mm/µs $C_S = 6.86$ mm/µs

IMPACTOR

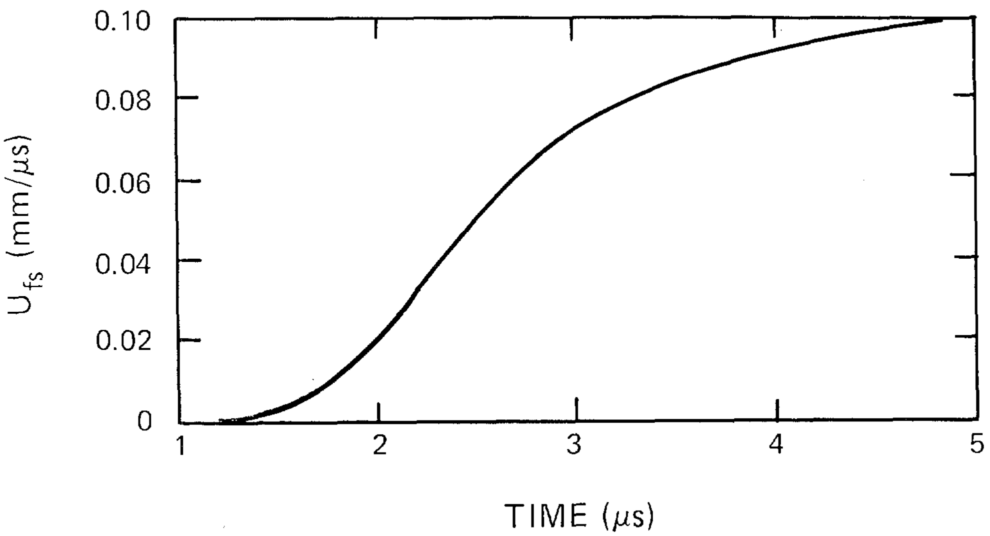
OFHC copper, mounted on 165-mm-diam aluminum alloy projectile

TRANSDUCER

Free-surface capacitor
Time: Relative

NOTES

Shots 56-64-292, 56-64-309, and 56-64-314 are a series with varied ambient temperatures.

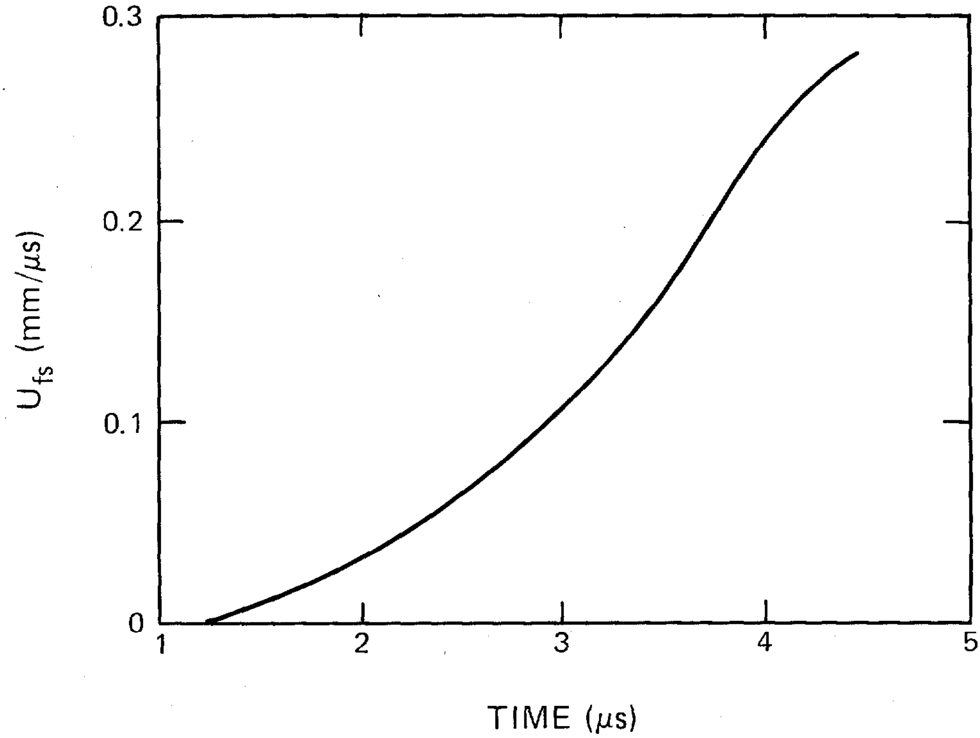


TARGET — Material: Lithium hydride, ^6LiH, at 360°C
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Shot no.: 56-64-314 Date: August 13, 1964
Thickness: 12.7 mm Diameter: 153 mm
Density: 6.66 g/cm^3
C_L = 10.4 mm/μs C_S = 6.86 mm/μs

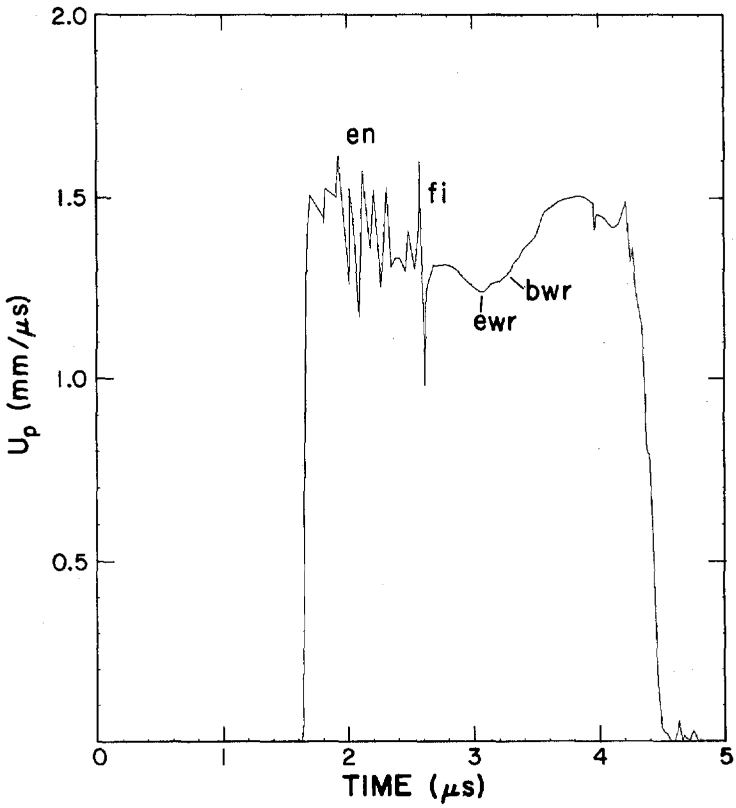
IMPACTOR — OFHC copper disk, mounted on aluminum alloy projectile

TRANSDUCER — Free-surface capacitor
Time: Relative

NOTES — Shots 56-64-292, 56-64-309, and 56-64-314 are a series with varied target thickness.



TARGET	**Material:** Sodium chloride, NaCl (pressed polycrystalline sample) **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 63 **Date:** April 19, 1972
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/8.944 mm OFHC copper// 5.03 mm sodium chloride -f/5.06 mm air//
SHOT COMPONENTS	OFHC copper **Density:** 8.93 g/cm^3 C_L = 4.76 mm/μs C_S = 2.33 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.09 mm **Time:** Relative



TARGET

Material: Sodium chloride, NaCl (pressed polycrystalline sample)
Experiment type: ASM probe
Experimenters: J. N. Fritz and J. A. Morgan
Shot no.: M 65 **Date:** April 21, 1972

HE SHOT GEOMETRY

P-081 lens/102 mm TNT/12.76 mm 2024 aluminum//
f- 5.01 mm sodium chloride -f/5.05 mm air//

SHOT COMPONENTS

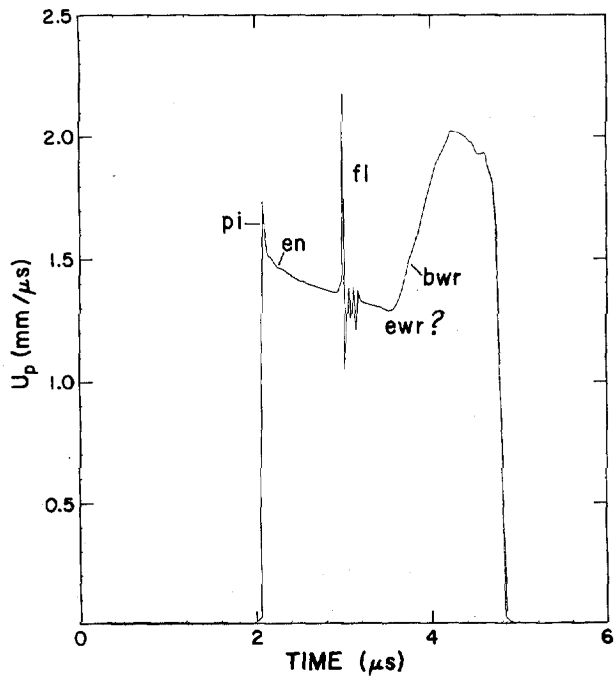
2024 aluminum
Density: 2.785 g/cm^3
$C_L = 6.36$ mm/μs $C_s = 3.16$ mm/μs

TRANSDUCER

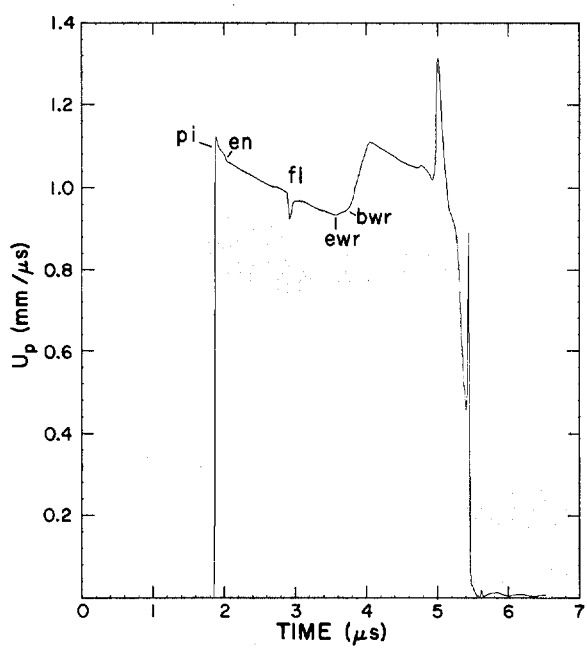
ASM probe
Coil radius: 28.64 mm **Initial coil spacing:** 10.06 mm
Time: Relative

NOTES

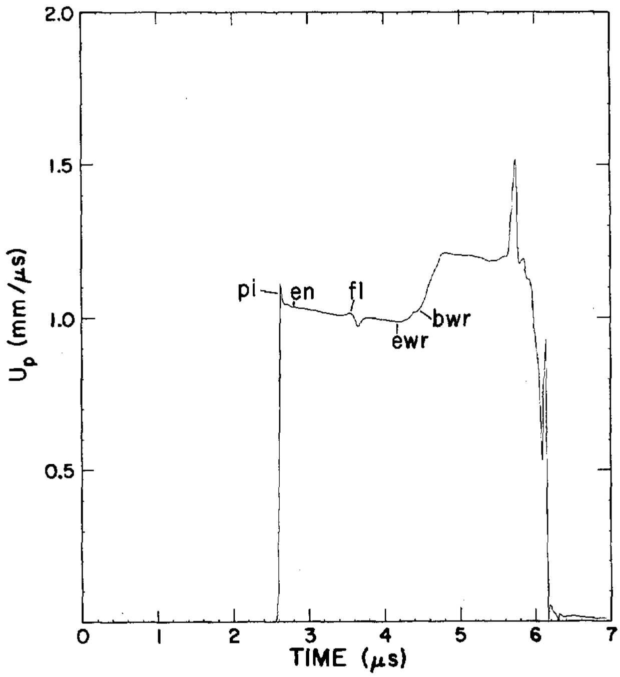
For shielding, a 75-nm aluminum film was deposited on both faces of the sodium chloride sample and was grounded to the aluminum base plate.



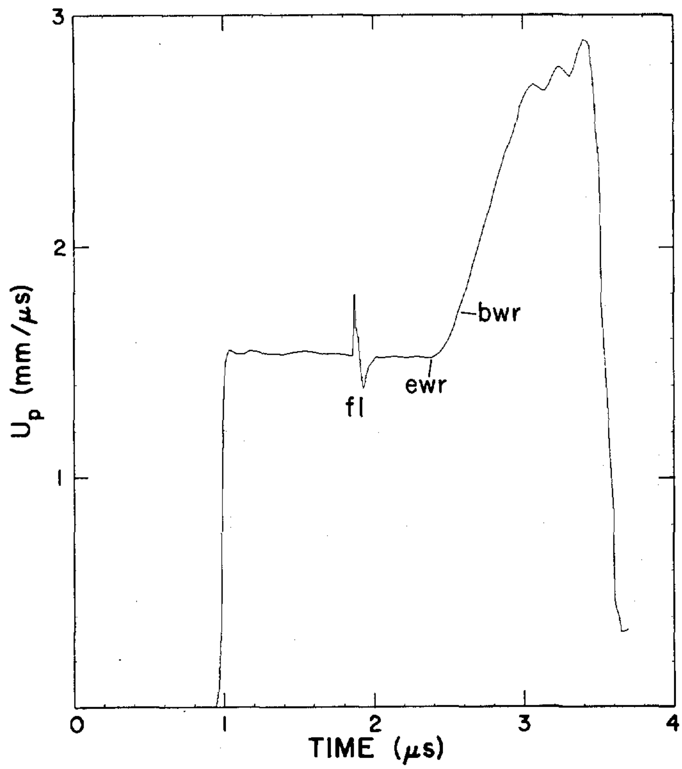
TARGET	**Material:** Sodium chloride, NaCl (pressed polycrystalline sample) **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Reference:** J. N. Fritz and J. A. Morgan (1973) **Shot no.:** M 66 **Date:** May 1, 1972
HE SHOT GEOMETRY	P-081 lens/102 mm TNT/9.38 mm OFHC copper// f- 5.04 mm sodium chloride -f/5.04 mm air//
SHOT COMPONENTS	OFHC copper **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_S = 2.33$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.09 mm **Time:** Relative
NOTES	For shielding, a 75-nm aluminum film was deposited on both faces of the sodium chloride sample and was grounded to the aluminum base plate.



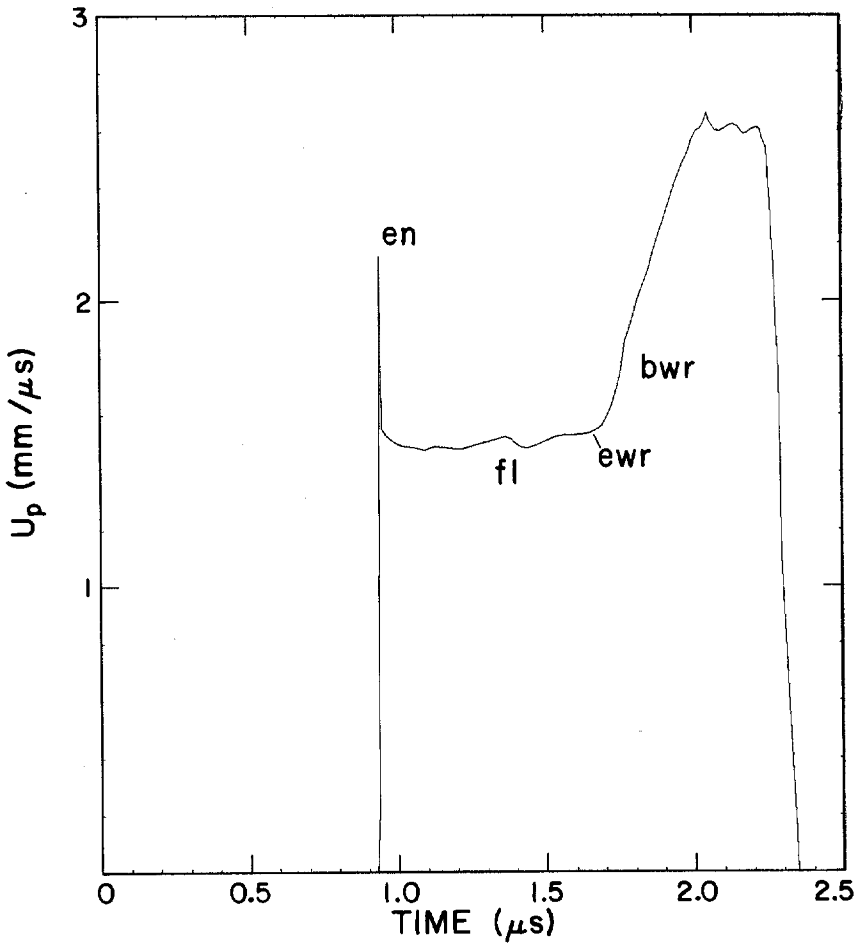
TARGET	**Material:** Sodium chloride, NaCl (pressed polycrystalline sample) **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 67 **Date:** May 5, 1972
HE SHOT GEOMETRY	P-081 lens/203 mm TNT/12.67 mm OFHC copper// f- 5.04 mm sodium chloride -f/5.04 mm air//
SHOT COMPONENTS	OFHC copper **Density:** 8.93 g/cm^3 C_L = 4.76 mm/μs C_S = 2.33 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.09 mm **Time:** Relative
NOTES	For shielding, a 75-nm aluminum film was deposited on both faces of the sodium chloride sample and was grounded to the aluminum base plate.



TARGET	**Material:** Sodium chloride, NaCl (pressed polycrystalline sample) **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 79 **Date:** February 13, 1973
HE SHOT GEOMETRY	P-081 lens/203 mm TNT/5.00 mm sodium chloride/ 0.03 mm aluminum//f- 5.01 mm sodium chloride -f/5.02 mm air//
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.03 mm **Time:** Relative
NOTES	For shielding, a 75-nm aluminum film was deposited on both faces of the sodium chloride sample and was grounded to the aluminum base plate.



TARGET	**Material:** Sodium chloride, NaCl (pressed polycrystalline sample) **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 81 **Date:** February 15, 1973
HE SHOT GEOMETRY	P-081 lens/203 mm TNT/12.78 mm 2024 aluminum// f- 5.00 mm sodium chloride -f/5.01 mm air//
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.01 mm **Time:** Relative



TARGET

Material: Spinel, $MgAl_2O_4$
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 8B572 **Date:** January 21, 1969

HE SHOT GEOMETRY

P-081 lens/102 mm TNT/2024 aluminum base plate/ 7.75 mm spinel

SHOT COMPONENTS

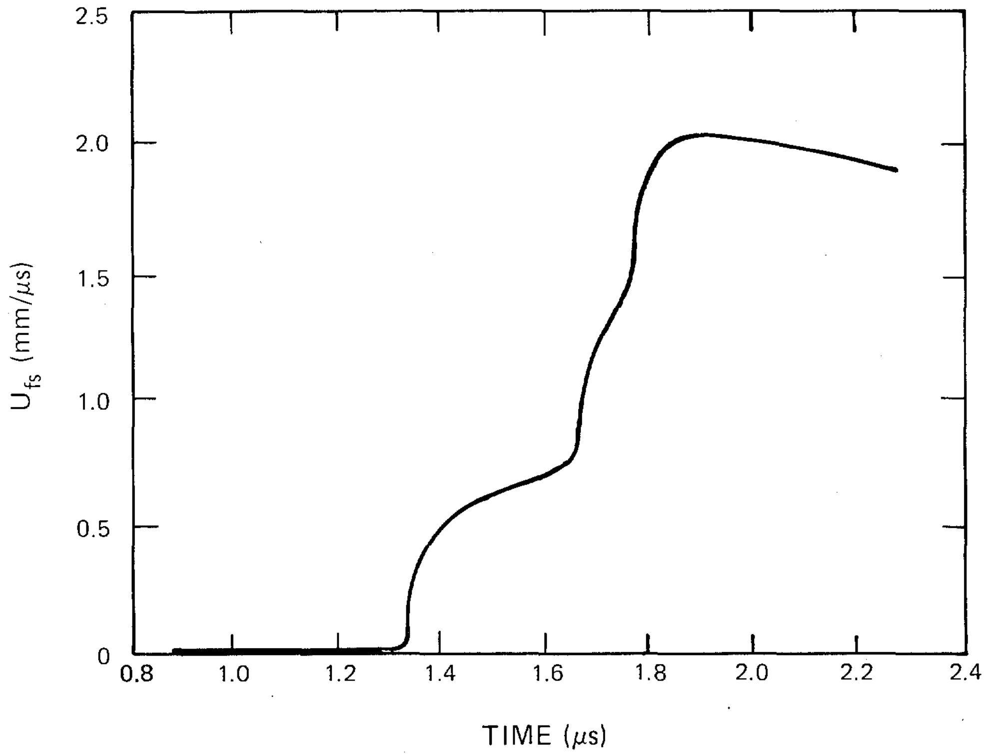
Spinel
Density: 3.27 g/cm^3
$C_L = 9.02$ mm/μs $C_S = 5.15$ mm/μs

TRANSDUCER

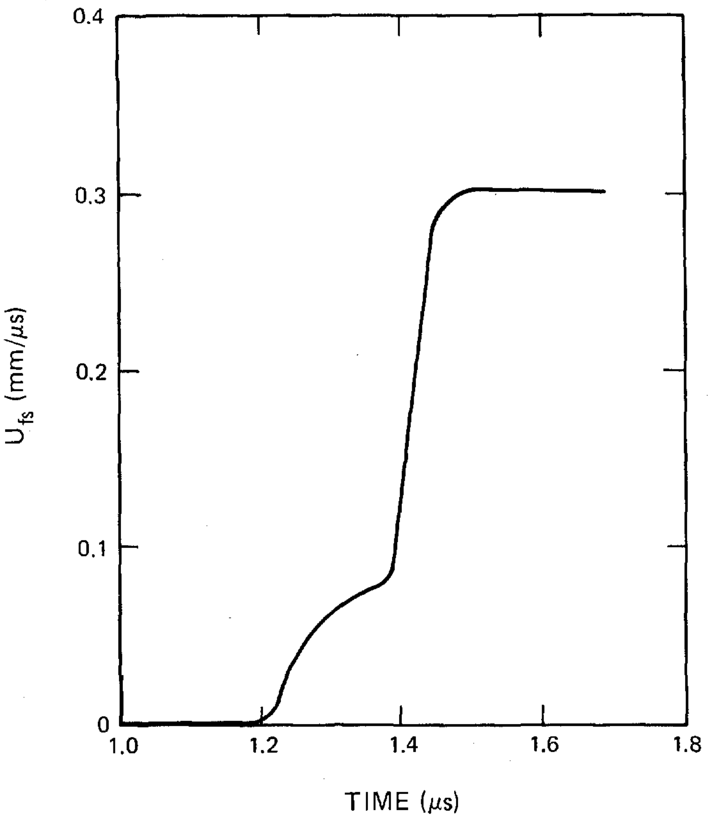
Free-surface capacitor
Time: Relative

NOTES

Shots 8B572, 8B573, and 8B575 are a series with varied impact stress.



TARGET	**Material:** Spinel, $MgAl_2O_4$ **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 8B573 **Date:** January 21, 1969
HE SHOT GEOMETRY	102 mm Comp B/2024 aluminum base plate/6.47 mm spinel
SHOT COMPONENTS	Spinel **Density:** 3.27 g/cm^3 $C_L = 9.02$ mm/µs $C_S = 5.15$ mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 8B572, 8B573, and 8B575 are a series with varied impact stress.



TARGET

Material: Spinel, $MgAl_2O_4$
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 8B575 Date: January 21, 1969

HE SHOT GEOMETRY

102 mm baratol/2024 aluminum base plate/7.75 mm spinel

SHOT COMPONENTS

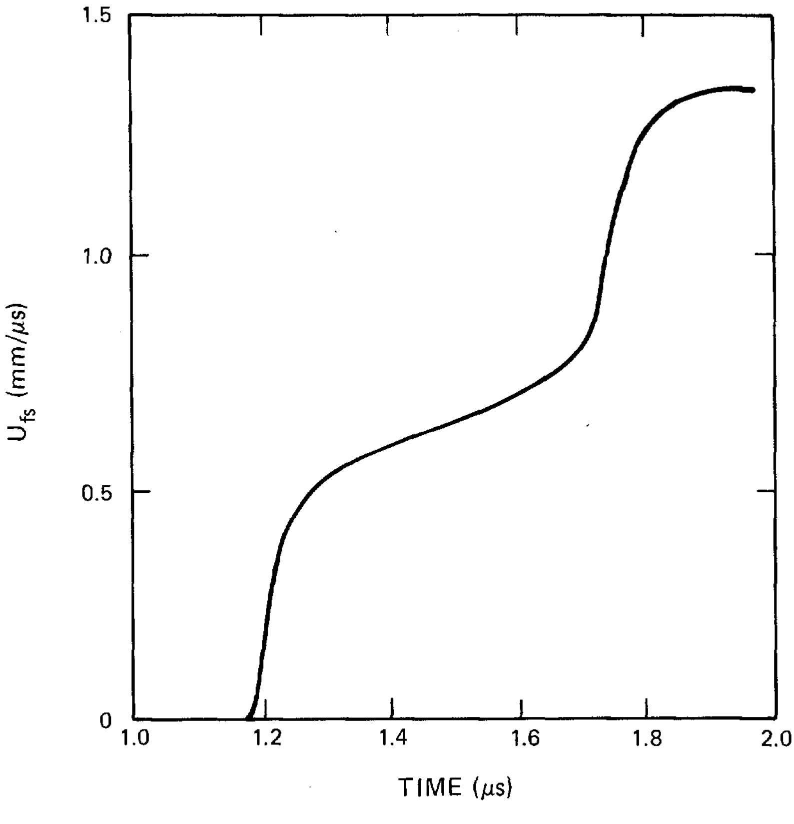
Spinel
Density: 3.27 g/cm^3
C_L = 9.02 mm/μs C_S = 5.15 mm/μs

TRANSDUCER

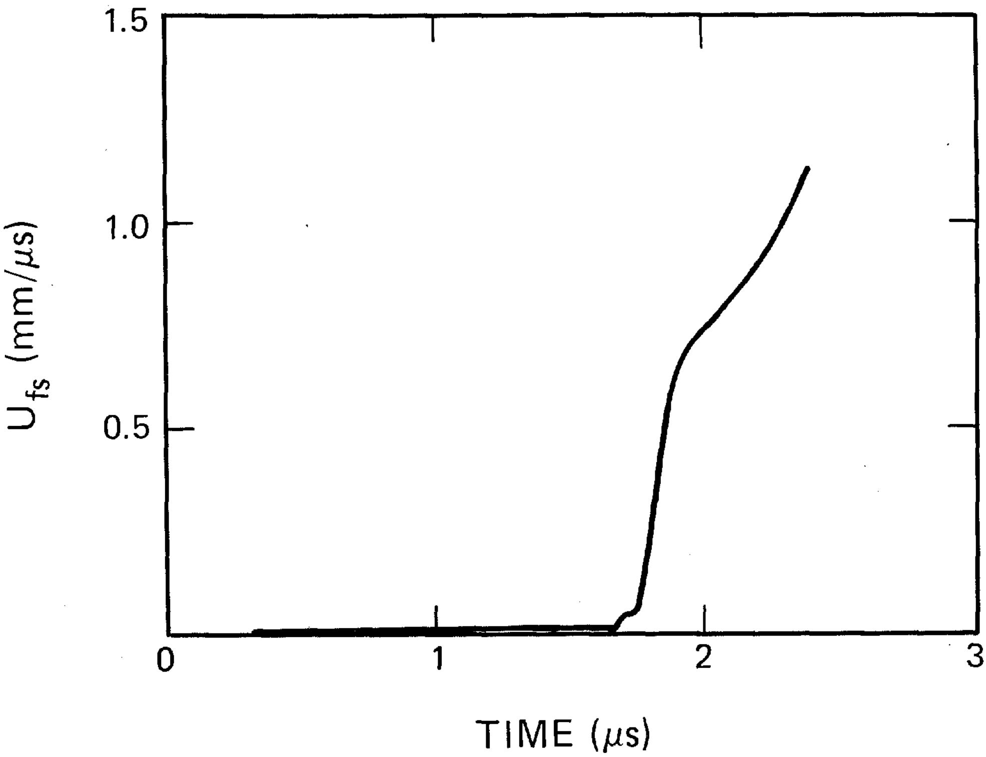
Free-surface capacitor
Time: Relative

NOTES

Shots 8B572, 8B573, and 8B575 are a series with varied impact stress.



TARGET	**Material:** Tantalum carbide, $TaC_{0.50}$ **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 8B624 **Date:** May 14, 1969
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate/ 5.31 mm tantalum carbide
SHOT COMPONENTS	Tantalum carbide **Density:** 15.60 g/cm^3 $C_L = 4.94$ mm/μs $C_S = 2.63$ mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



TARGET

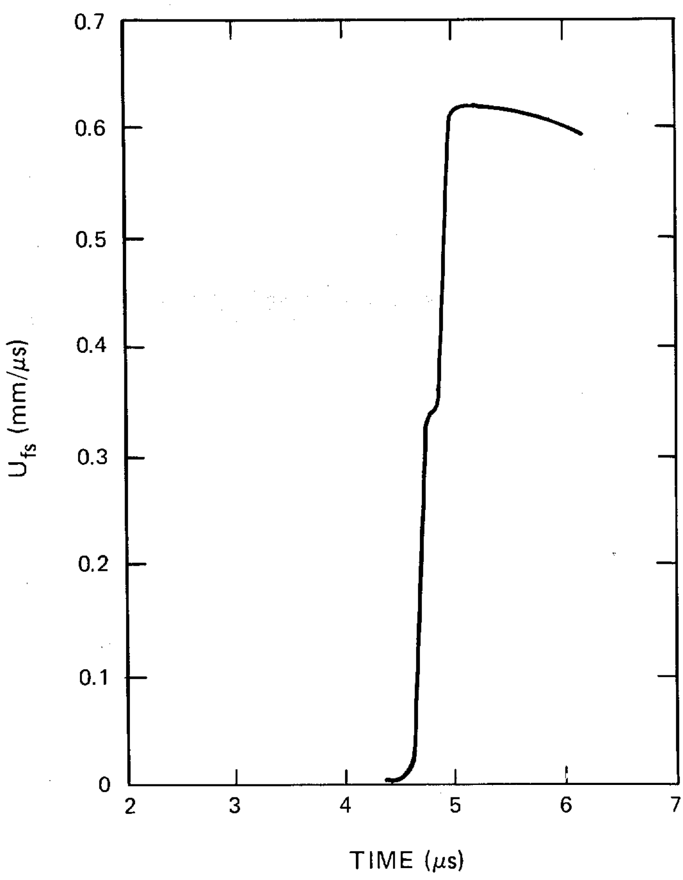
Material: Tantalum carbide carbon, TaCC-90, 10% porosity
Experiment type: Free-surface capacitor
Experimenter: J. W. Hopson
Shot no.: 56-70-36 Date: April 3, 1970
Thickness: 6.34 mm
Density: 3.00 g/cm^3
C_L = 1.80 mm/μs

IMPACTOR

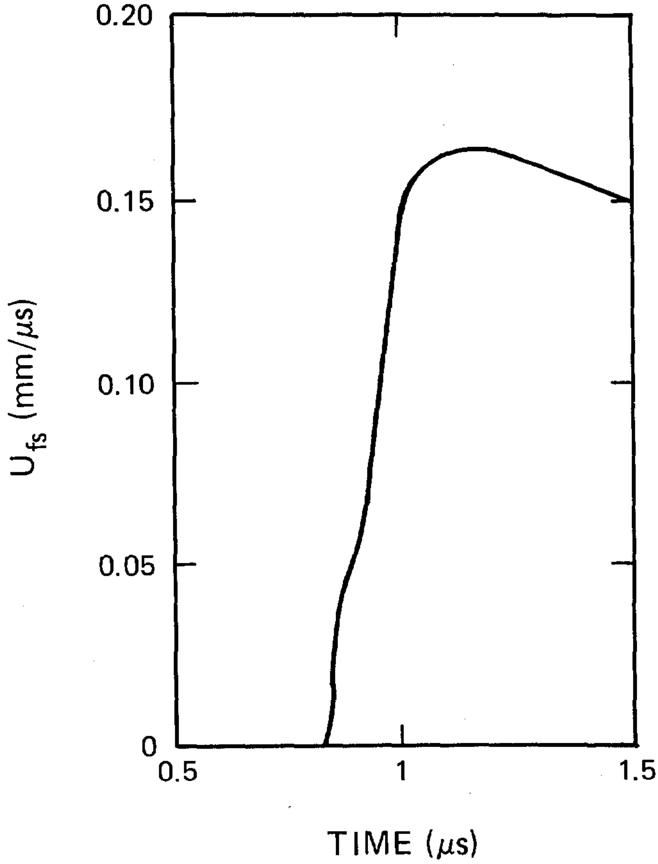
3.16 mm tantalum carbide backed with 3.04 mm steel, mounted on aluminum alloy projectile

TRANSDUCER

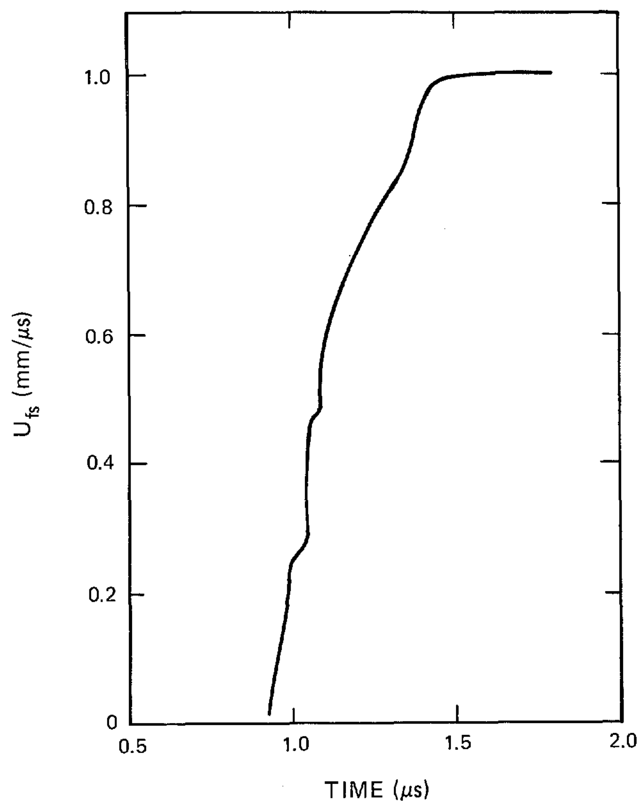
Free-surface capacitor
Time: Relative



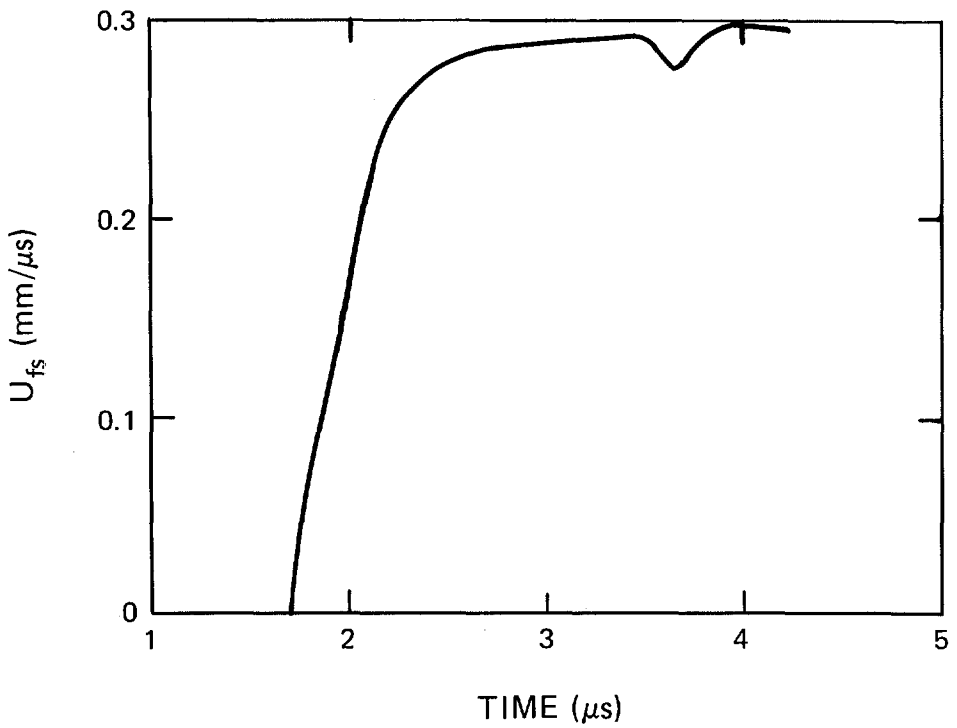
TARGET	**Material:** Titanium boride, TiB_2 (Union Carbide) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 8B604 **Date:** February 25, 1969
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate/ 9.53 mm titanium boride
SHOT COMPONENTS	Titanium boride **Density:** 4.50 g/cm^3 $C_L = 10.94$ mm/μs $C_S = 6.85$ mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



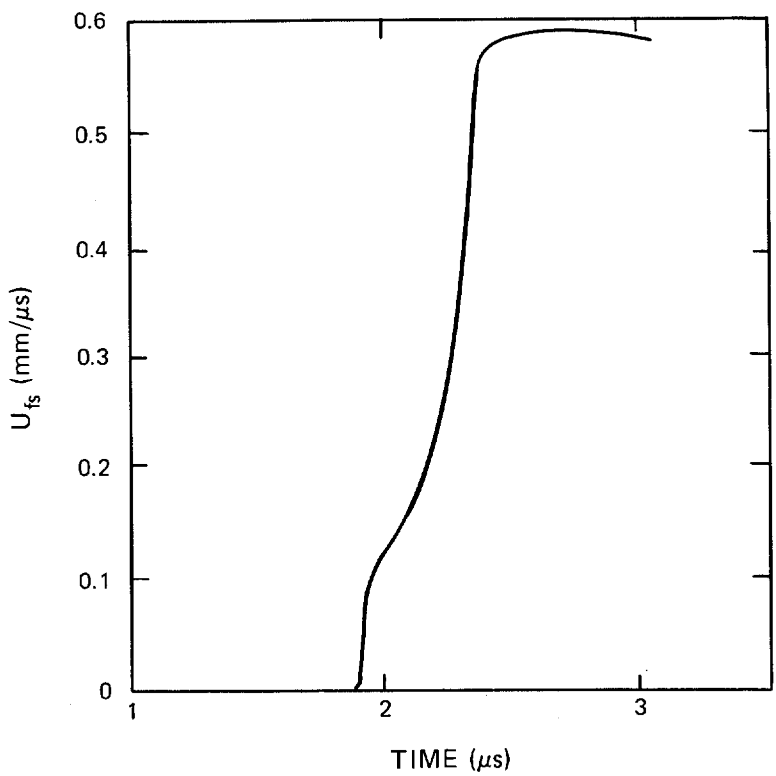
TARGET	**Material:** Titanium boride, TiB_2 **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 8B612 **Date:** March 14, 1969
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate/ 10.16 mm titanium boride
SHOT COMPONENTS	Titanium boride **Density:** 4.30 g/cm^3 C_L = 10.97 mm/μs C_S = 7.30 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



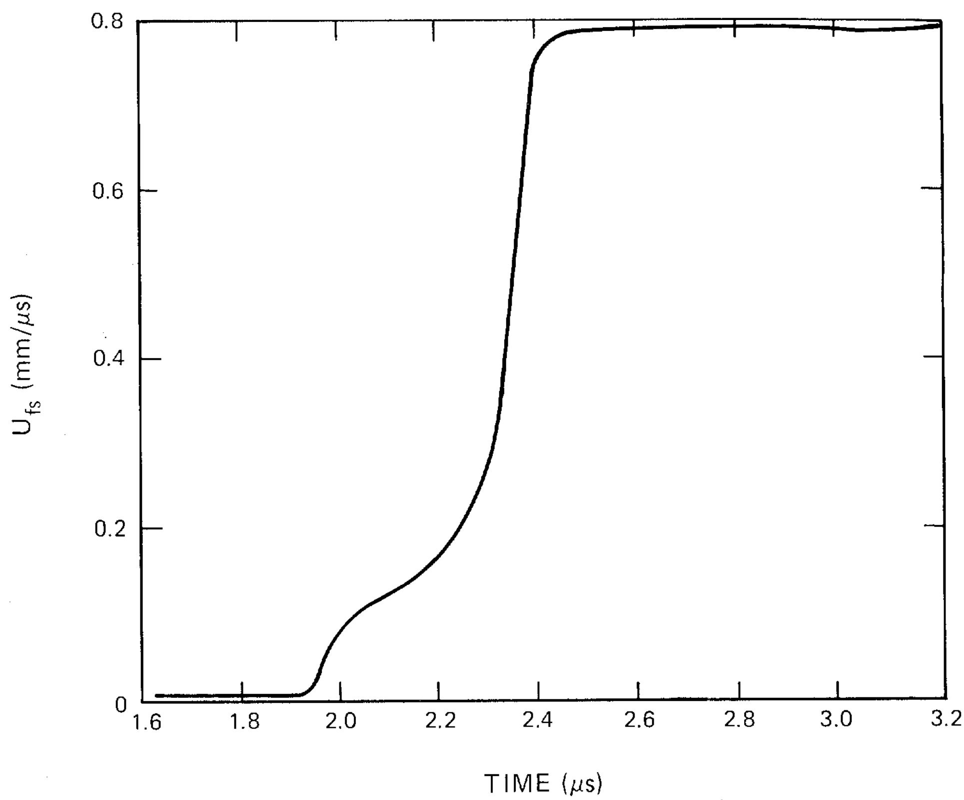
TARGET	**Material:** Tungsten carbide, WC (Metalwerke Plansee, Grade 850) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Taylor **Reference:** R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970) **Shot no.:** 56-63-277 **Date:** October 10, 1963 **Thickness:** 12.7 mm **Diameter:** 38.1 mm **Density:** 15.00 g/cm^3
IMPACTOR	Tungsten carbide (Metalwerke Plansee, Grade 850), 6.35 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.300 mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative



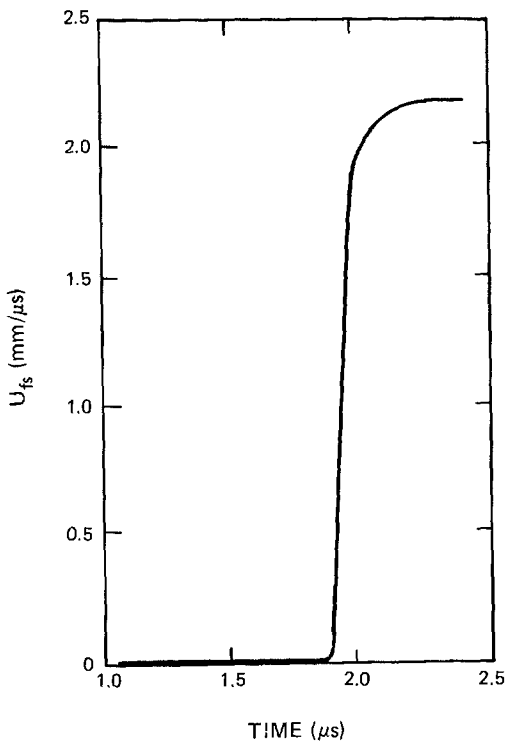
TARGET	**Material:** Tungsten carbide, WC (Kennametal, Grade K8) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80305 **Date:** August 8, 1968
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate/ 13.04 mm tungsten carbide
SHOT COMPONENTS	Tungsten carbide **Density:** 15.01 g/cm^3 $C_L = 6.75$ mm/μs $C_S = 3.95$ mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 80305, 80306, and 80308 are a series with varied impact stress.



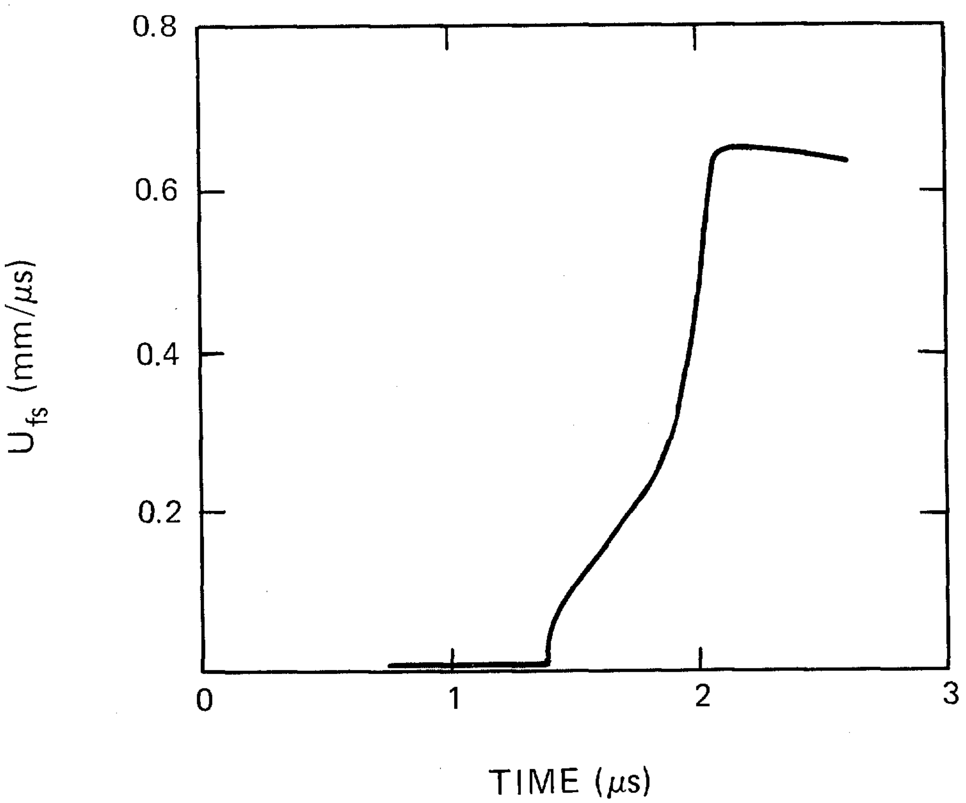
TARGET	**Material:** Tungsten carbide, WC (Kennametal, Grade K-8) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80306 **Date:** August 8, 1968
HE SHOT GEOMETRY	P-080 lens/102 mm TNT/2024 aluminum base plate/ 13.04 mm tungsten carbide
SHOT COMPONENTS	Tungsten carbide **Density:** 15.01 g/cm^3 C_L = 6.75 mm/µs C_S = 3.95 mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 80305, 80306, and 80308 are a series with varied impact stress.



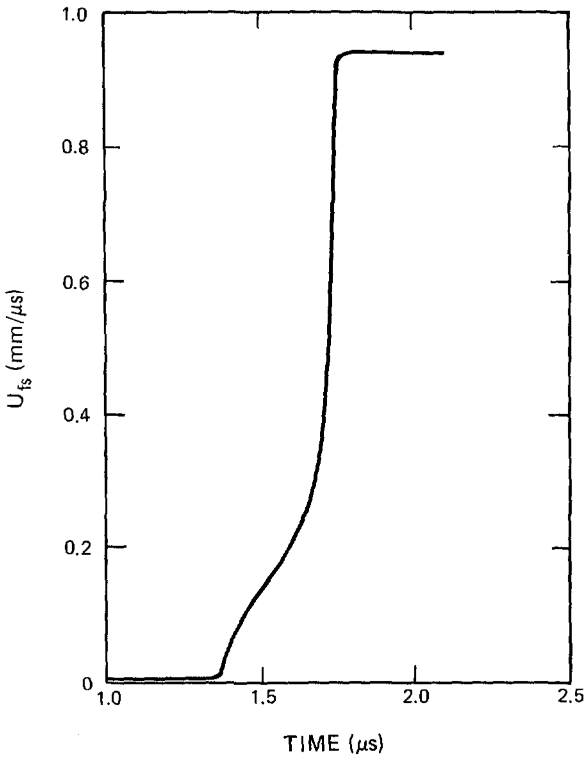
TARGET	**Material:** Tungsten carbide, WC (Kennametal, Grade K8) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 80308 **Date:** October 9, 1968
HE SHOT GEOMETRY	P-120 lens/102 mm Comp B/1.6 mm air/5.0 mm stainless steel driver plate/50 mm free run/6.35 mm 2024 aluminum base plate/13.0 mm tungsten carbide
SHOT COMPONENTS	Tungsten carbide **Density:** 15.01 g/cm³ $C_L = 6.75$ mm/μs $C_S = 3.95$ mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 80305, 80306, and 80308 are a series with varied impact stress.



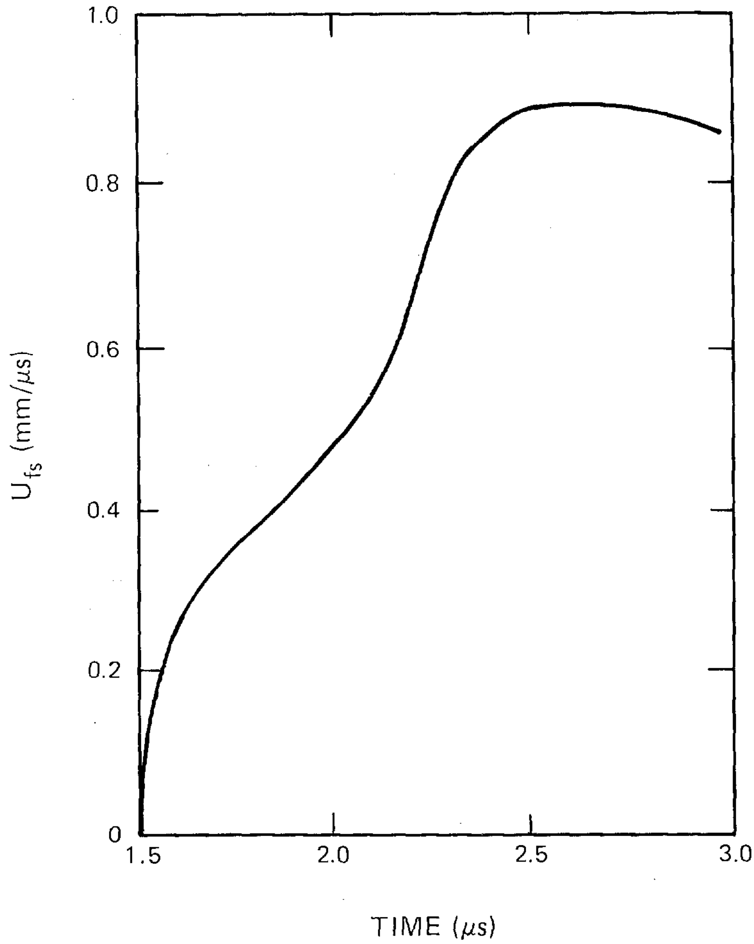
TARGET	**Material:** Tungsten carbide, WC (2A-S) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 8B551 **Date:** December 10, 1968
HE SHOT GEOMETRY	102 mm baratol/1.31 mm 2024 aluminum base plate/ 9.14 mm tungsten carbide
SHOT COMPONENTS	Tungsten carbide **Density:** 14.75 g/cm^3 $C_L = 6.72$ mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 8B551 and 8B553 are a series with varied impact stress.



TARGET	**Material:** Tungsten carbide, WC (2A-S) **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 8B553 **Date:** December 10, 1968
HE SHOT GEOMETRY	P-080 lens/102 mm TNT/2024 aluminum base plate/ 9.14 mm tungsten carbide
SHOT COMPONENTS	Tungsten carbide **Density:** 14.75 g/cm^3 $C_L = 6.72$ mm/μs
TRANSDUCER	Free-surface capacitor **Time:** Relative
NOTES	Shots 8B551 and 8B553 are a series with varied impact stress.

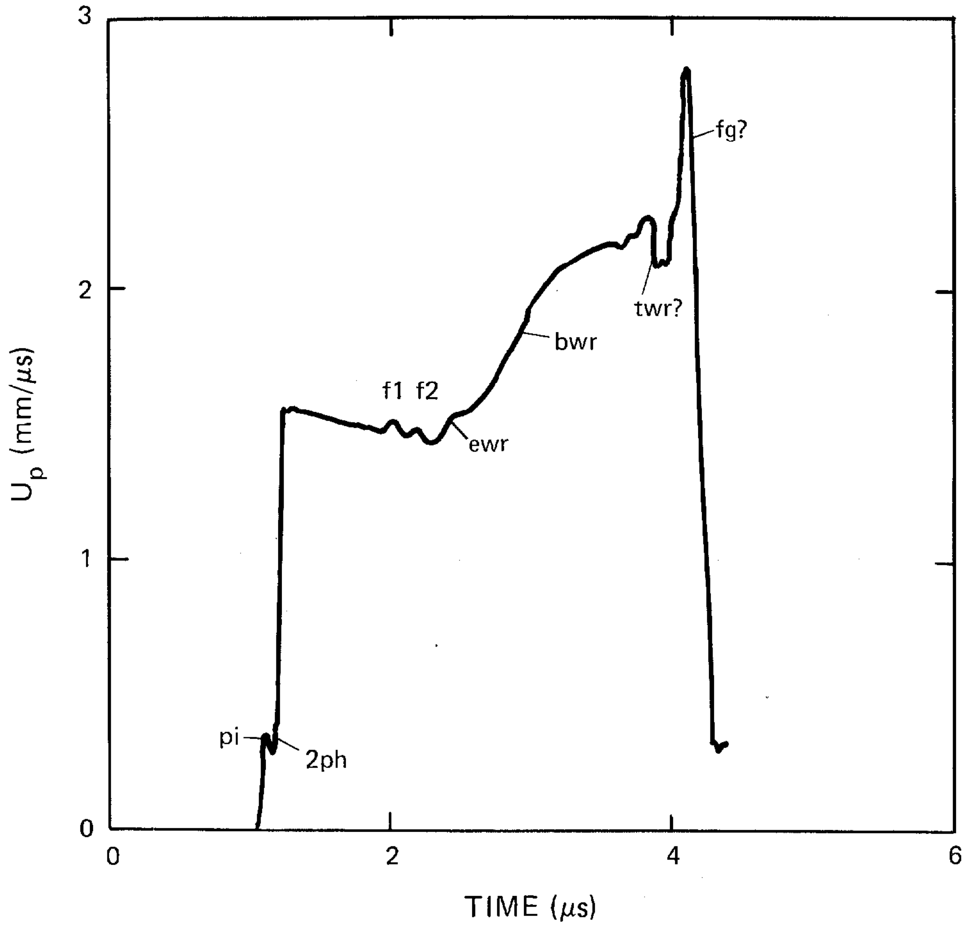


TARGET	**Material:** Zirconium boride, ZrB_2 **Experiment type:** Free-surface capacitor **Experimenter:** J. W. Hopson **Shot no.:** 8ZB01 **Date:** August 16, 1968 **Thickness:** 9.53 mm
HE SHOT GEOMETRY	P-080 lens/102 mm baratol/2024 aluminum base plate
SHOT COMPONENT	Zirconium boride **Density:** 5.67 g/cm^3 $C_L = 9.28$ mm/µs $C_s = 5.91$ mm/µs
TRANSDUCER	Free-surface capacitor **Time:** Relative



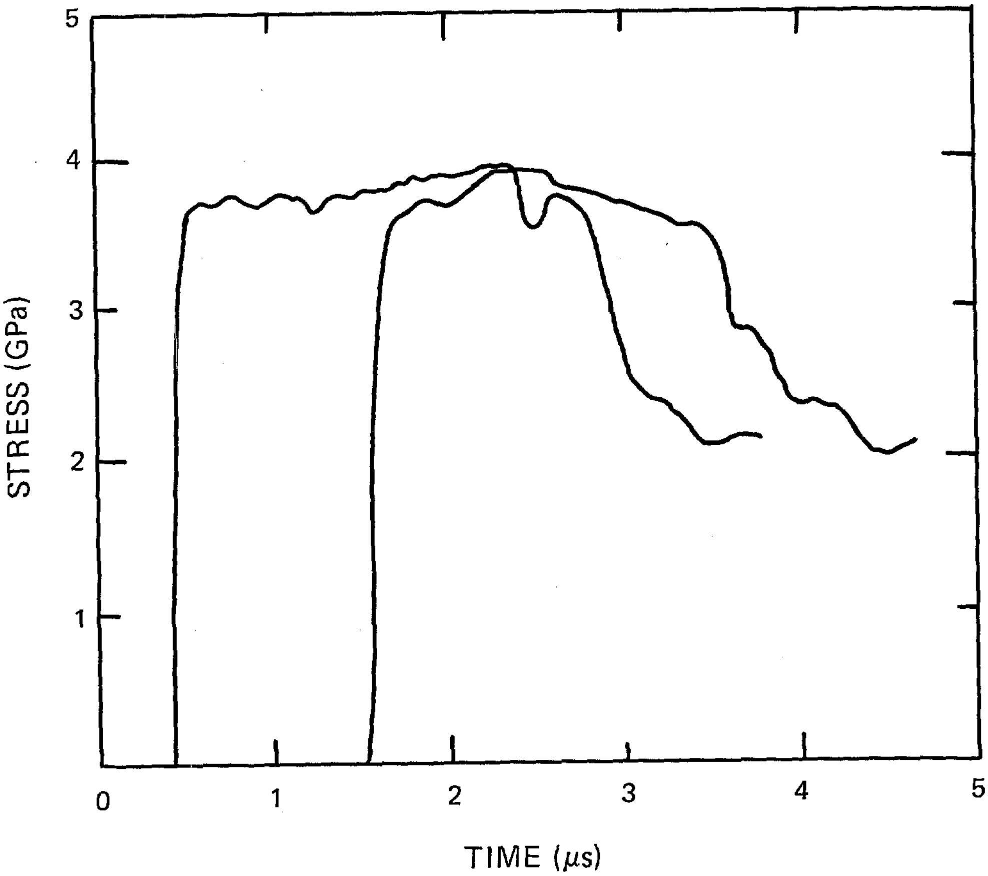
ROCKS AND
MIXTURES OF MINERALS

TARGET	**Material:** Corundum mixture—85.2 wt% aluminum oxide, Al_2O_3/9.7 wt% silicon dioxide, SiO_2/2.7 wt% magnesium oxide, MgO/2.4 wt% calcium oxide-barium oxide, CaO-BaO **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 54 **Date:** December 27, 1971
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/6.344 mm corundum mixture/ 0.03 mm aluminum//6.334 mm corundum mixture -f/ 5.00 mm air//
SHOT COMPONENTS	Corundum mixture **Density:** 3.389 g/cm^3 $C_L = 8.94$ mm/μs $C_S = 5.25$ mm/μs Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 11.334 mm

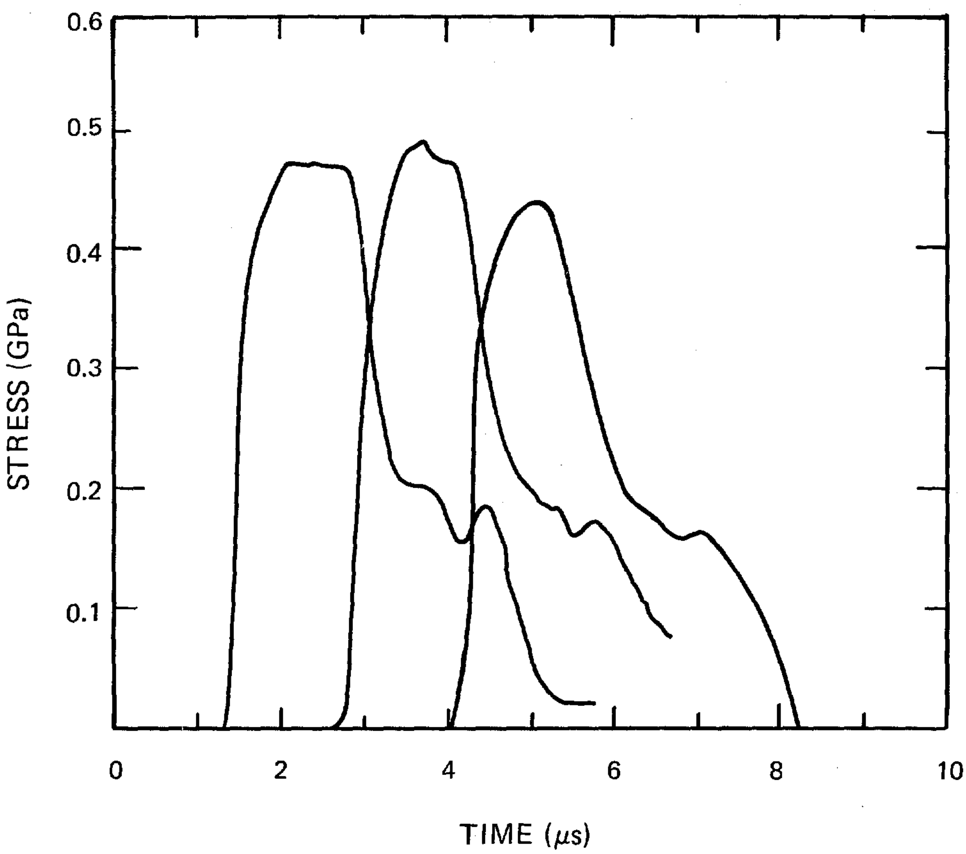


3
2
1
0
U_p (mm/μs)
0
2
4
6
TIME (μs)
pi
2ph
f1 f2
ewr
bwr
twr?
fg?

TARGET	**Material:** Devonian gas shale (shock direction normal to bedding plane), Lincoln County, West Virginia **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-77-47 **Date:** April 11, 1977 **Diameter:** 40.0 mm **Density:** 2.44 g/cm^3 $C_L = 3.36$ mm/μs
IMPACTOR	OFHC copper, 5.30 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.435 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.21 mm and 6.82 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative

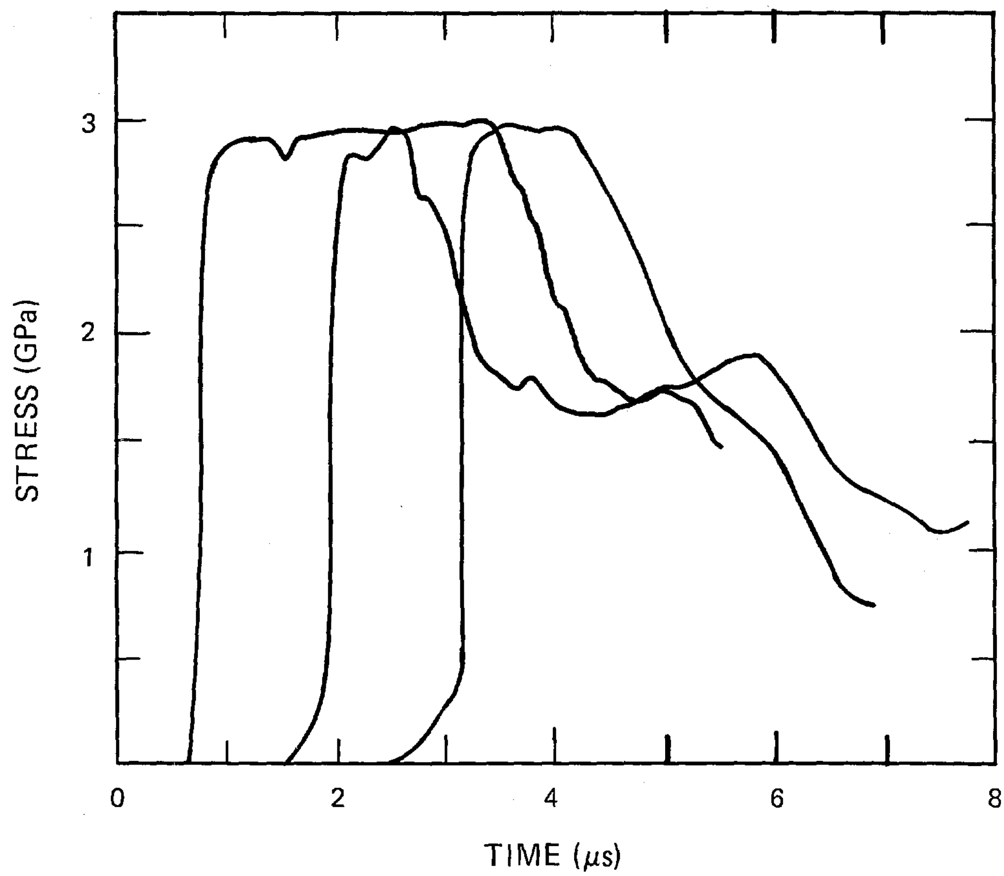

5
4
3
2
1
STRESS (GPa)
0
1
2
3
4
5
TIME (μs)

TARGET	**Material:** Devonian gas shale (shock direction normal to bedding plane), Lincoln County, West Virginia **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-77-48 **Date:** April 11, 1977 **Diameter:** 40.0 mm **Density:** 2.44 g/cm^3 $C_L = 3.33$ mm/μs
IMPACTOR	6061 aluminum, 5.30 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.095 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.24 mm, 6.82 mm, and 11.40 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative



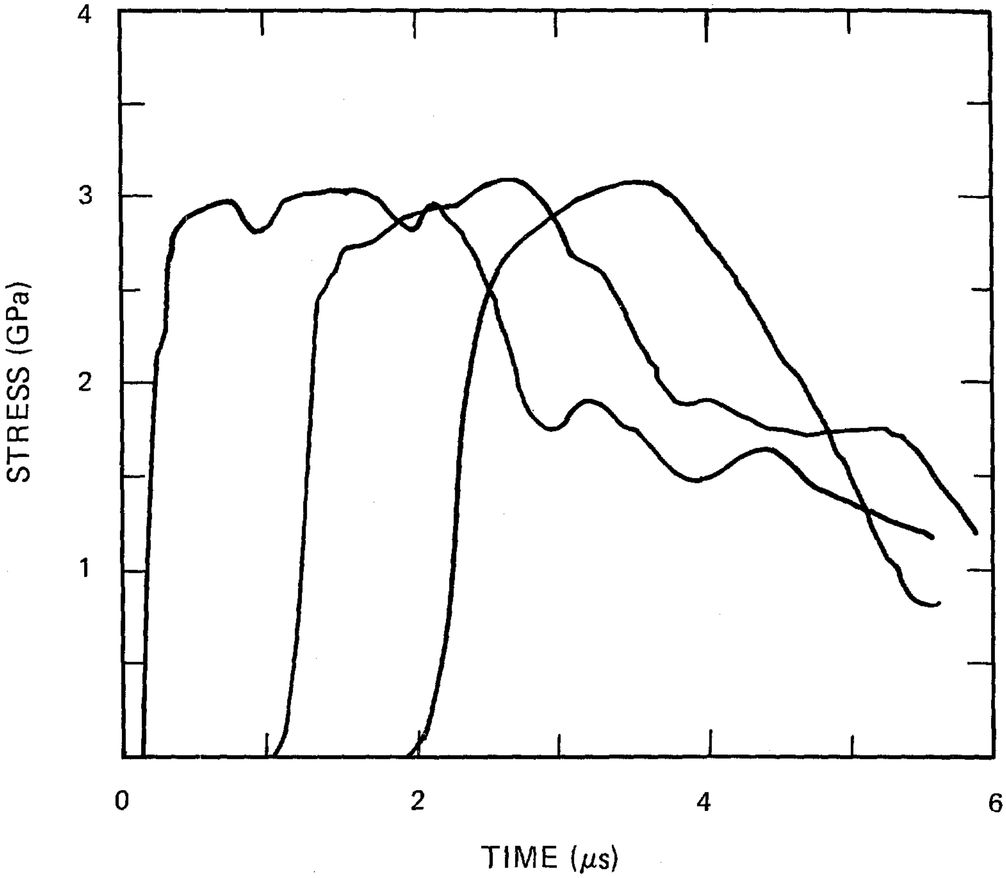
0.6
0.5
0.4
0.3
0.2
0.1
STRESS (GPa)
0
2
4
6
8
10
TIME (μs)

TARGET	**Material:** Devonian gas shale (shock direction parallel to bedding plane), Lincoln County, West Virginia **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-77-49 **Date:** April 11, 1977 **Diameter:** 40.0 mm **Density:** 2.43 g/cm^3 $C_L = 4.70$ mm/μs
IMPACTOR	OFHC copper, 5.20 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.350 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.18 mm, 6.73 mm, and 11.27 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative

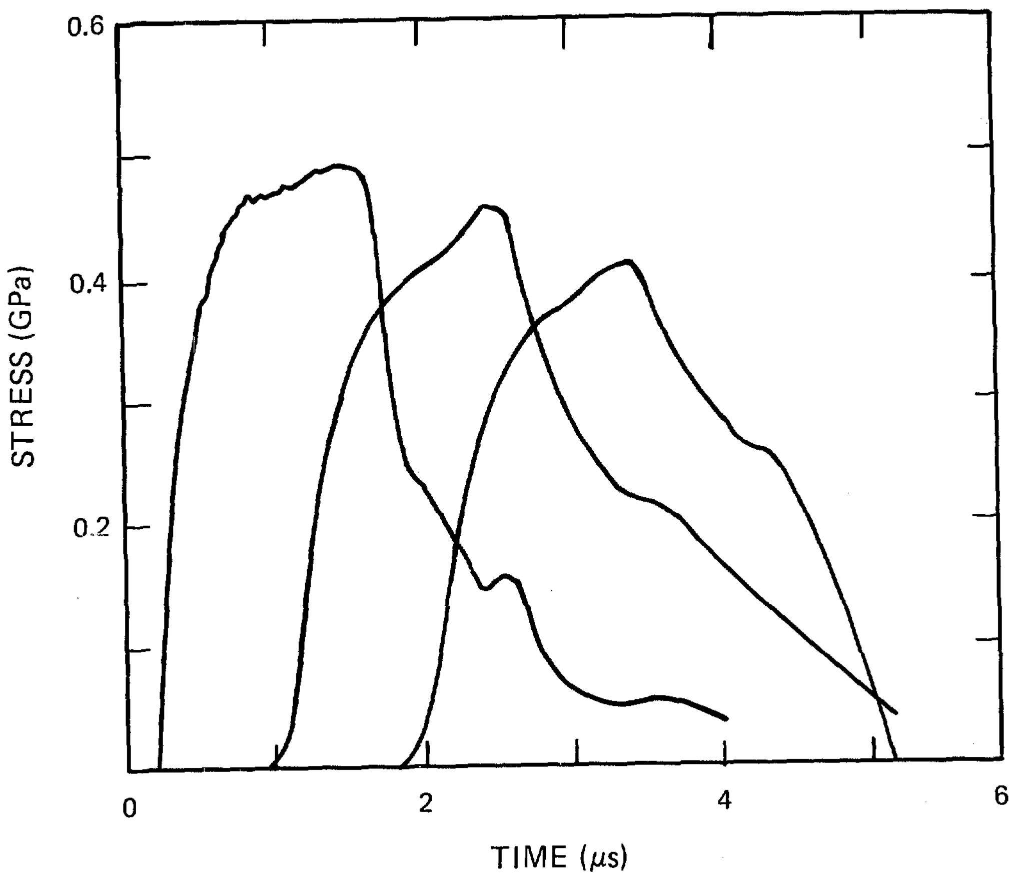


STRESS (GPa)
1
2
3
0
2
4
6
8
TIME (μs)

TARGET	Material: Devonian gas shale (shock direction parallel to bedding plane), Lincoln County, West Virginia Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-77-50 Date: April 13, 1977 Diameter: 40.0 mm Density: 2.72 g/cm^3 $C_L = 5.01$ mm/μs
IMPACTOR	OFHC copper, 5.20 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.290 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 6.49 mm, and 10.94 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


4
3
2
1
STRESS (GPa)
0
2
4
6
TIME (μs)

TARGET	**Material:** Devonian gas shale (shock direction parallel to bedding plane), Lincoln County, West Virginia **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-77-51 **Date:** April 15, 1977 **Diameter:** 40.0 mm **Density:** 2.72 g/cm^3 $C_L = 5.32$ mm/μs
IMPACTOR	6061 aluminum, 5.20 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.065 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 1.94 mm, 6.40 mm, and 10.83 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative


0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
TIME (μs)

TARGET

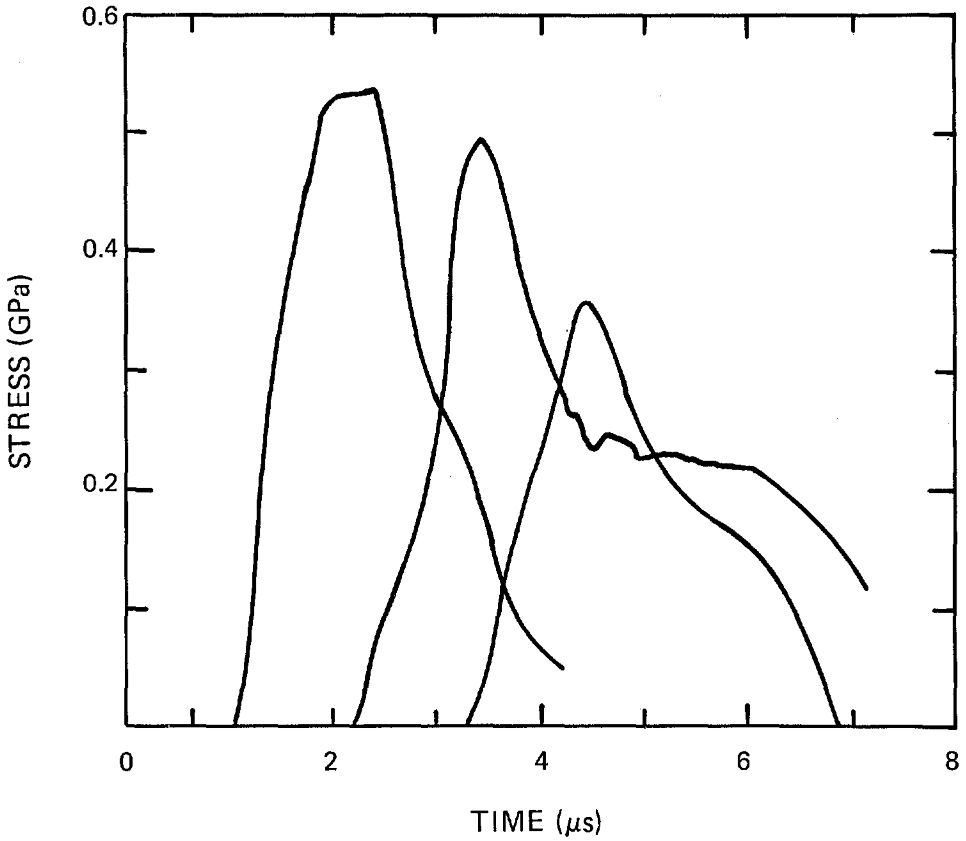
Material: Devonian gas shale (shock direction normal to bedding plane), Lincoln County, West Virginia
Experiment type: Embedded Manganin gage
Experimenter: Bart Olinger
Shot no.: 56-77-52 **Date:** April 13, 1977
Diameter: 40.0 mm
Density: 2.71 g/cm^3
$C_L = 3.97$ mm/μs

IMPACTOR

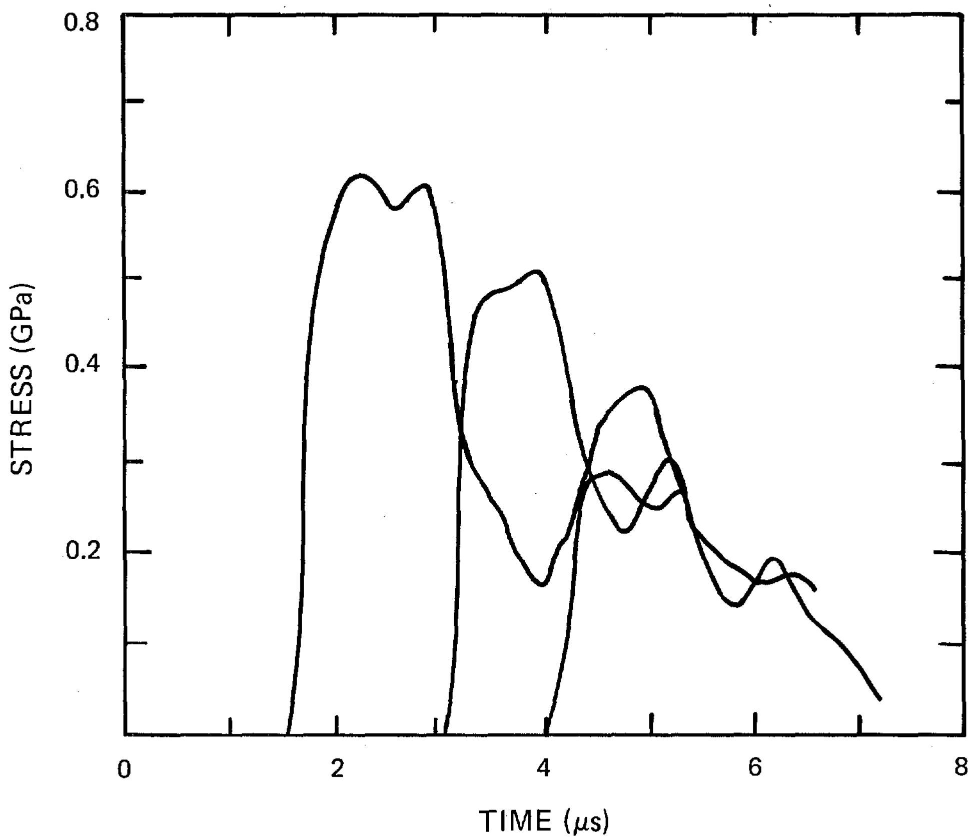
6061 aluminum, 5.10 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.080 mm/μs

TRANSDUCER

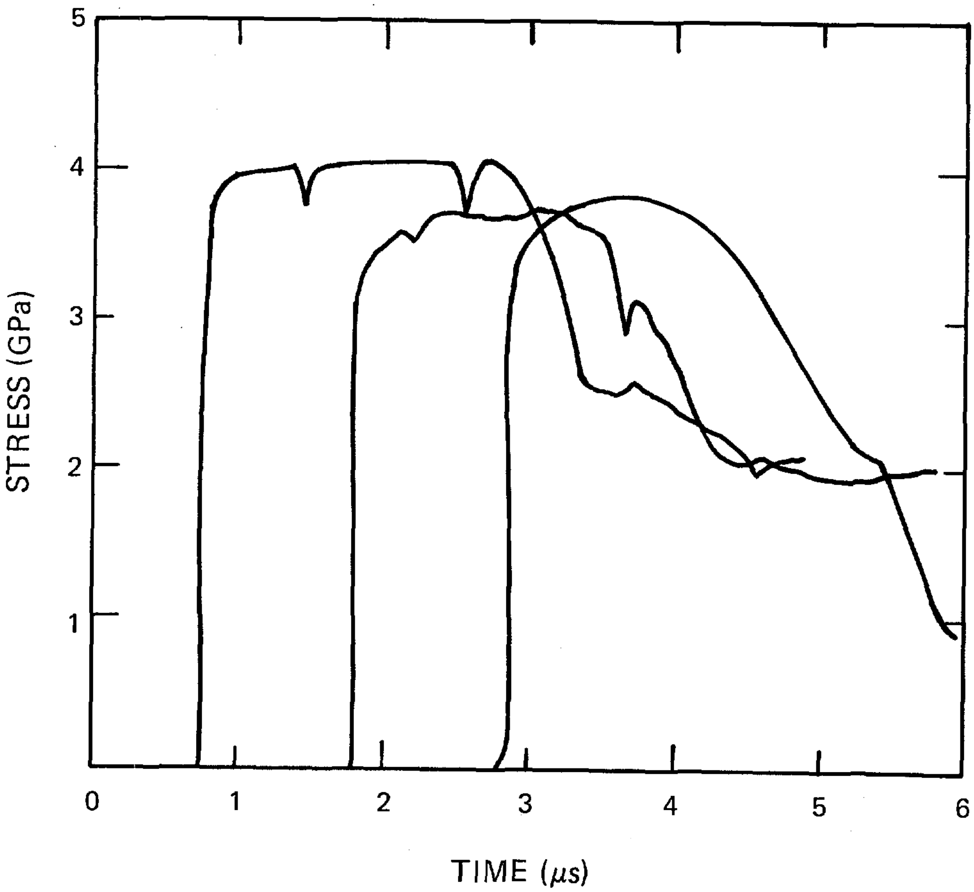
Two-terminal, 50-Ω Manganin gage
Locations from impact surface: 2.06 mm, 6.46 mm, and 10.10 mm
Heat treatment: Annealed
Encapsulation: None
Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages
$\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$,
$\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$,
where $x = \Delta R/R$.
$a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$
$a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$
Time: Relative


0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

TARGET	**Material:** Devonian gas shale (shock direction parallel to bedding plane), Lincoln County, West Virginia **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-77-53 **Date:** April 19, 1977 **Diameter:** 40.0 mm **Density:** 2.40 g/cm^3 $C_L = 4.57$ mm/μs
IMPACTOR	6061 aluminum, 5.10 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.075 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.21 mm, 6.75 mm, and 11.26 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative


0.8
0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

TARGET	**Material:** Devonian gas shale (shock direction normal to bedding plane), Lincoln County, West Virginia **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-77-54 **Date:** April 18, 1977 **Diameter:** 40.0 mm **Density:** 2.73 g/cm^3 $C_L = 3.79$ mm/μs
IMPACTOR	OFHC copper, 5.10 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.409 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.02 mm, 6.84 mm, and 10.93 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative


5
4
3
2
1
0
1
2
3
4
5
6
STRESS (GPa)
TIME (μs)

TARGET

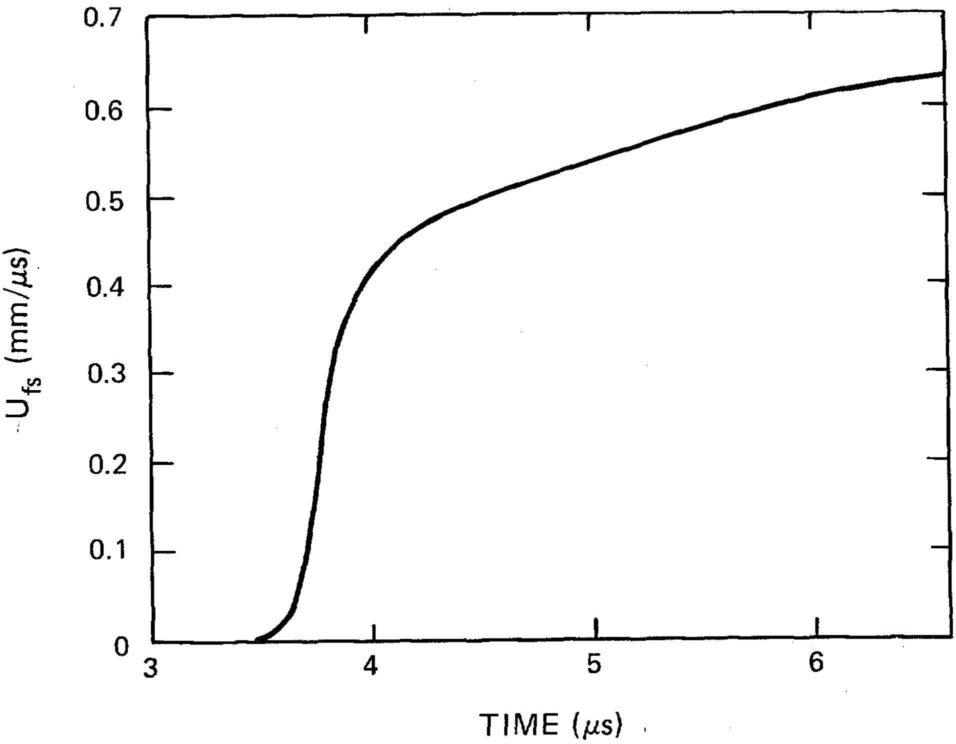
Material: Diabase
Experiment type: Free-surface capacitor
Experimenter: J. W. Taylor
Reference: R. G. McQueen, S. P. Marsh, J. W. Taylor, J. N. Fritz, and W. J. Carter (1970)
Shot no.: 56-64-297 **Date:** June 10, 1964
Thickness: 22.15 mm **Diameter:** 152 mm
Density: 3.01 g/cm^3
$C_L = 6.88$ mm/µs $C_S = 3.81$ mm/µs

IMPACTOR

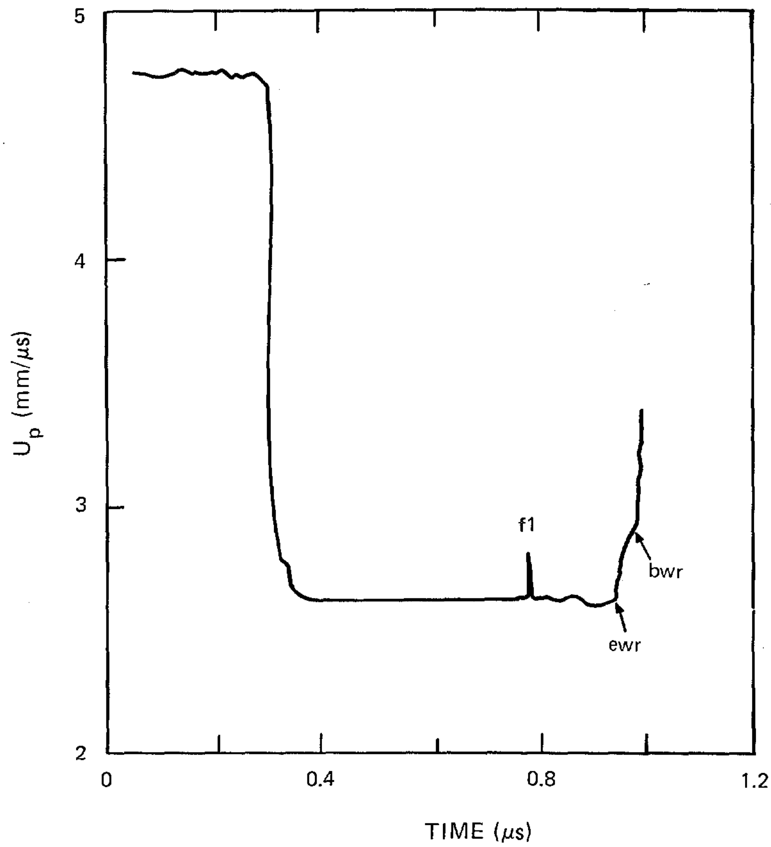
Diabase, 22.15 mm thick, mounted on 165-mm-diam aluminum alloy projectile
Impact velocity: 0.864 mm/µs

TRANSDUCER

Free-surface capacitor
Time: Relative

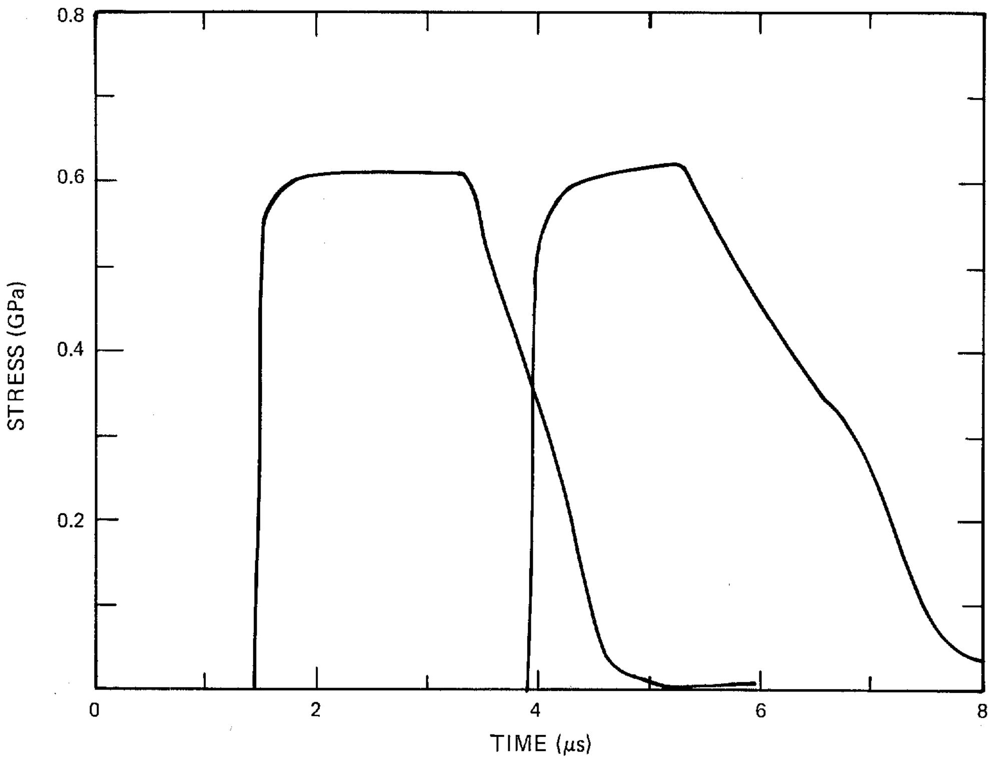


TARGET	Material: Silicon dioxide, SiO_2; gray Arkansas novaculite Experiment type: ASM probe Experimenter: J. A. Morgan and J. N. Fritz Reference: Timmerhaus and Barber (1979) Shot no.: M 103 Date: August 12, 1976 Thickness: 3.00 mm Diameter: 28 mm Density: 2.655 g/cm^3
IMPACTOR	2024 aluminum, 6.35 mm thick, mounted on 29-mm-diam polycarbonate projectile Impact velocity: 4.75 mm/μs
TRANSDUCER	ASM probe Coil radius: 6.93 mm Initial coil spacing: 4.27 mm

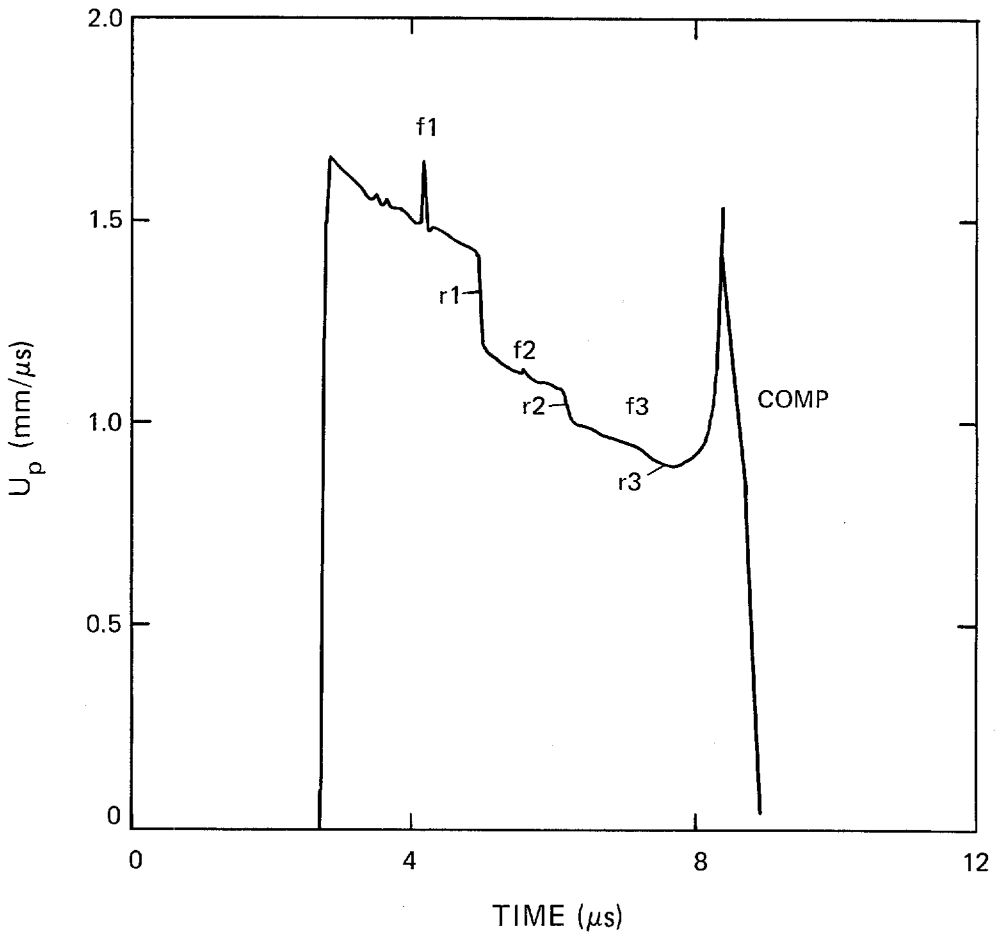


PLASTICS

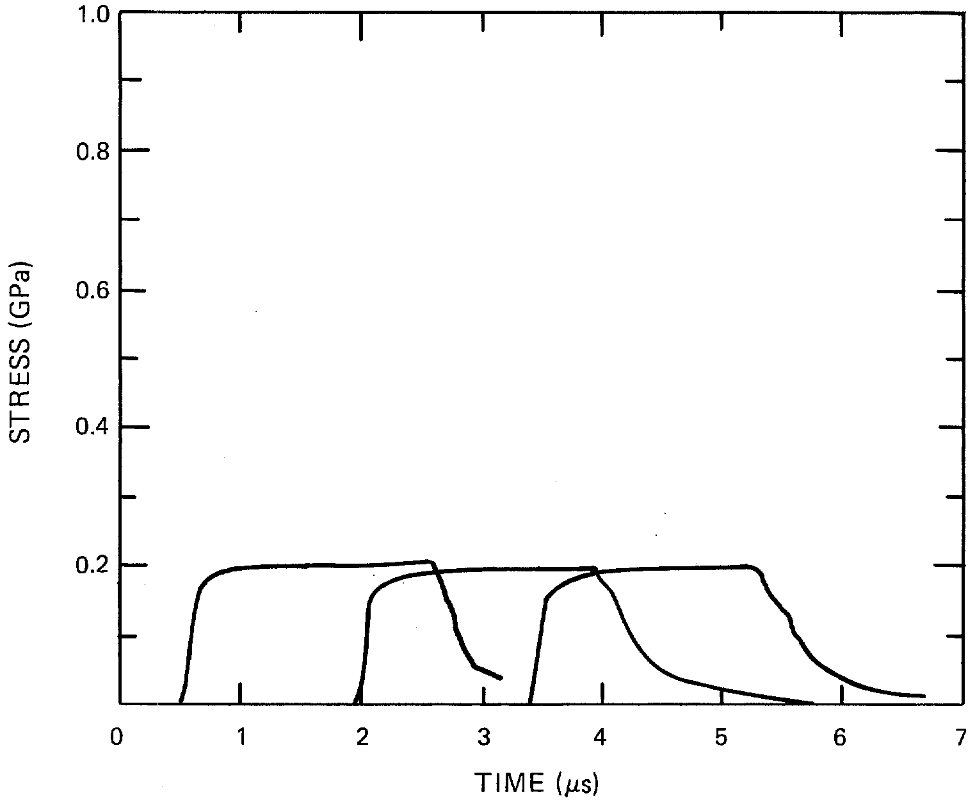
TARGET	Material: Lexan Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-79-23 Date: May 17, 1979 Diameter: 38.1 mm Density: 1.197 g/cm^3 $C_L = 2.30$ mm/µs $C_S = 0.97$ mm/µs
IMPACTOR	Lexan, 3.1 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.409 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 3.1 mm and 9.2 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


0.8
0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

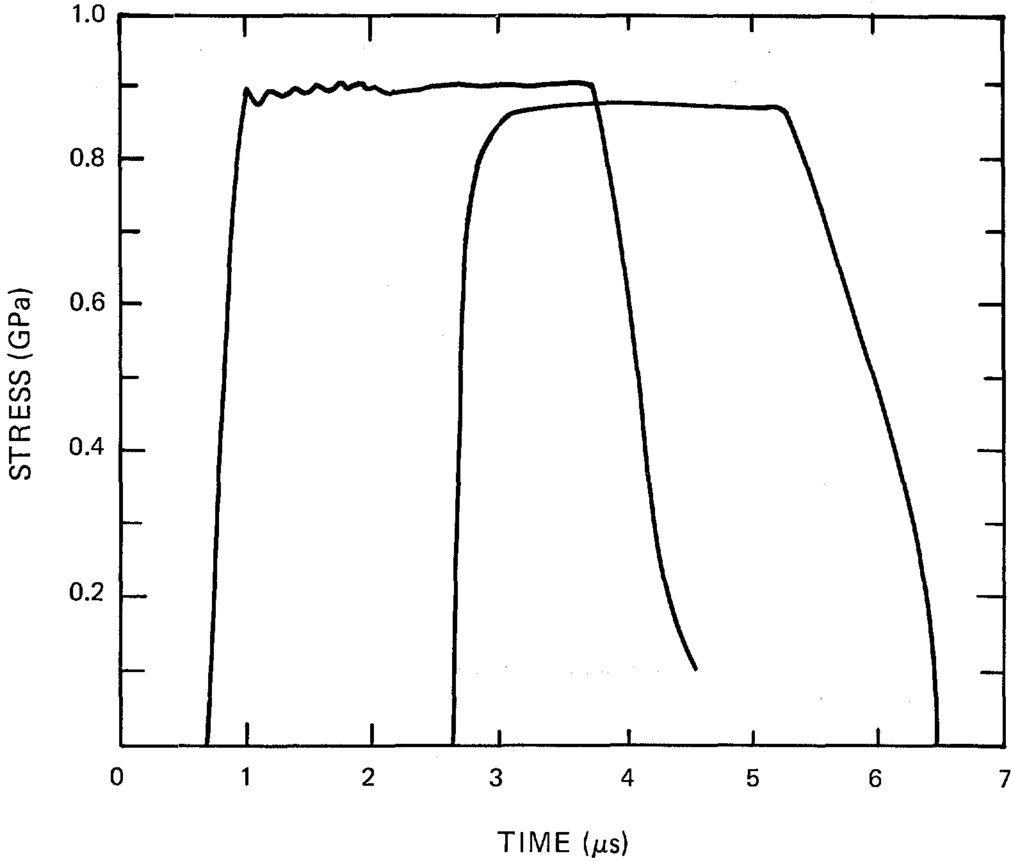
TARGET	**Material:** Polyethylene **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 93 **Date:** June 12, 1974
HE SHOT GEOMETRY	P-081 lens/203 mm Comp B/14.46 mm OFHC copper// 7.89 mm polyethylene/f- 8.99 mm lead glass/3.53 mm air//
SHOT COMPONENTS	Polyethylene **Density:** 0.916 g/cm^3 $C_L = 2.04$ mm/μs $C_S = 0.66$ mm/μs OFHC copper **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/μs $C_S = 2.33$ mm/μs Lead glass **Density:** 5.085 g/cm^3 $C_L = 3.62$ mm/μs $C_S = 2.10$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 20.41 mm


2.0
1.5
1.0
0.5
0
U_p (mm/μs)
0
4
8
12
TIME (μs)
f1
r1
f2
r2
f3
r3
COMP

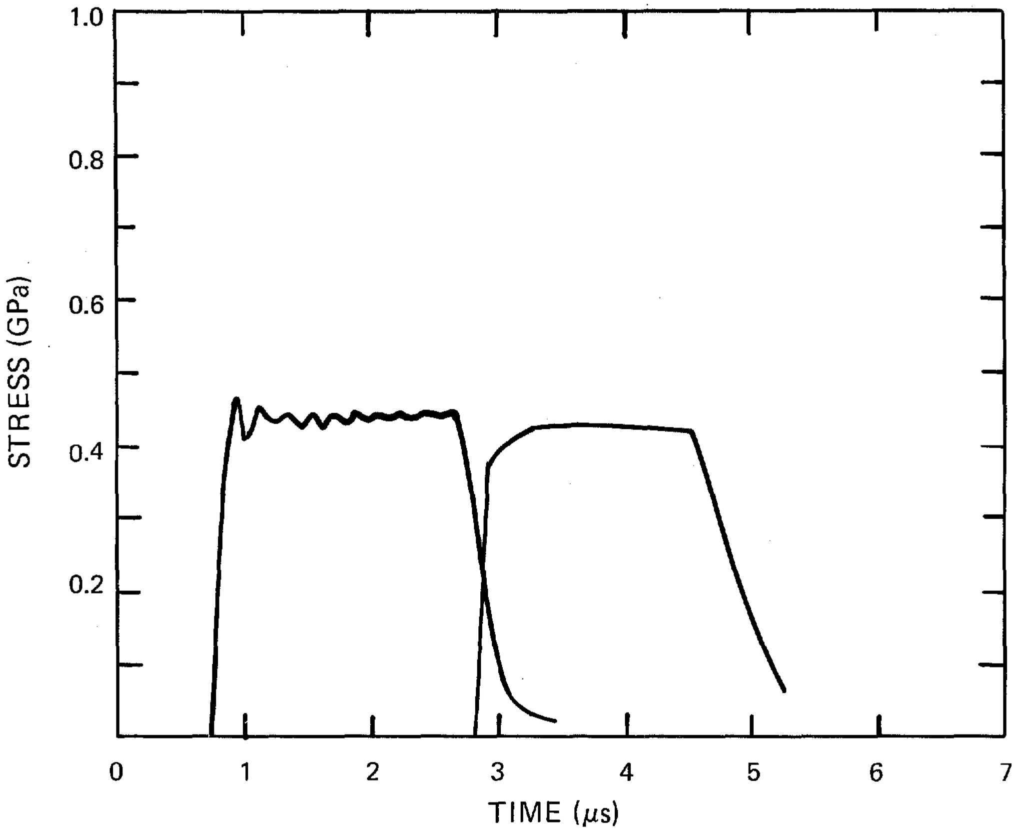
TARGET	**Material:** Polymethyl methacrylate (PMMA) **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-78-28 **Date:** June 26, 1978 **Diameter:** 38.1 mm **Density:** 1.187 g/cm^3 $C_L = 2.76$ mm/μs $C_S = 1.38$ mm/μs
IMPACTOR	PMMA, 3.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.12 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 1.05 mm, 5.17 mm, and 9.27 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative


1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
TIME (μs)

TARGET	**Material:** Polymethyl methacrylate (PMMA) **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-78-29 **Date:** June 26, 1978 **Diameter:** 38.1 mm **Density:** 1.187 g/cm^3 $C_L = 2.76$ mm/µs $C_S = 1.38$ mm/µs
IMPACTOR	PMMA, 3.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.47 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.05 mm and 8.16 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative

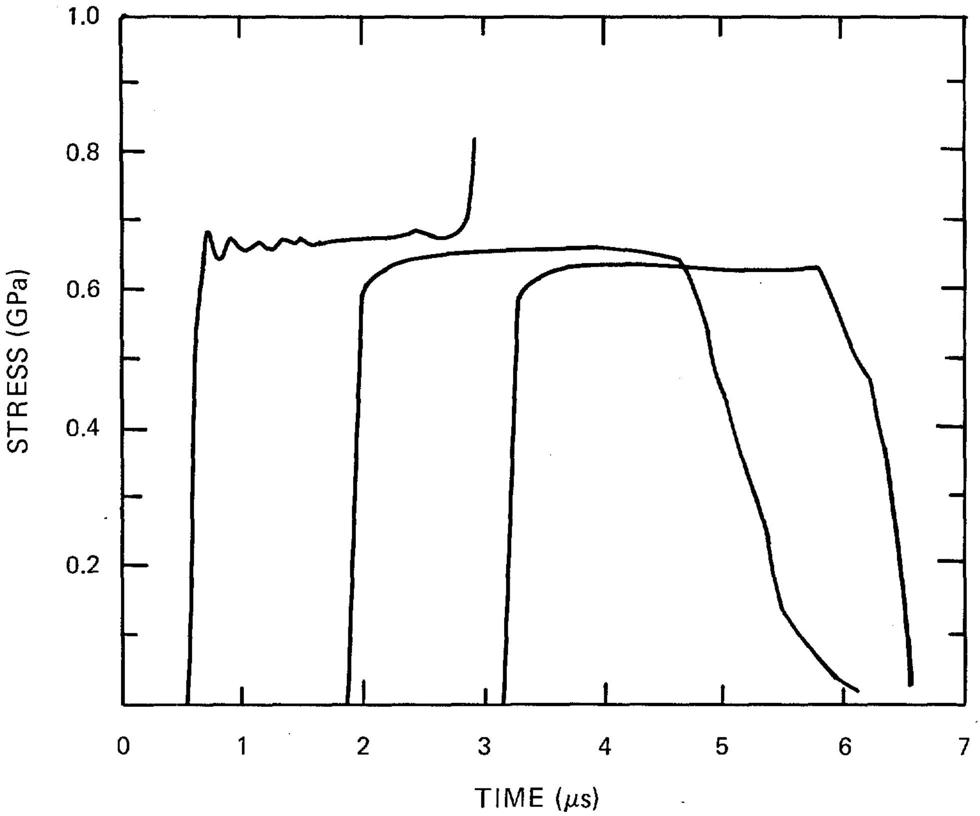

1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
TIME (μs)

TARGET	**Material:** Polymethyl methacrylate (PMMA) **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-78-30 **Date:** June 27, 1978 **Diameter:** 38.1 mm **Density:** 1.187 g/cm^3 $C_L = 2.76$ mm/μs $C_S = 1.38$ mm/μs
IMPACTOR	PMMA, 3.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.25 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 1.05 mm and 7.15 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative



1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
TIME (μs)

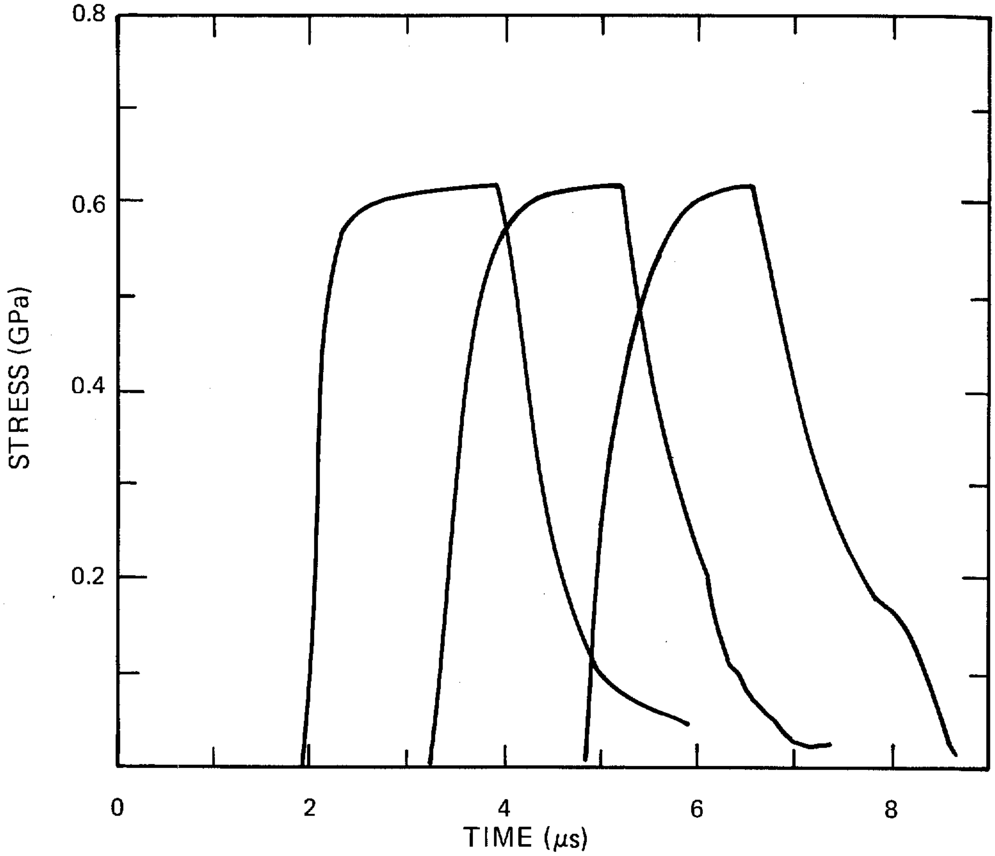
TARGET	Material: Polymethyl methacrylate (PMMA) Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-31 Date: June 27, 1978 Diameter: 38.1 mm Density: 1.187 g/cm^3 $C_L = 2.76$ mm/μs $C_S = 1.38$ mm/μs
IMPACTOR	PMMA, 3.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.37 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.05 mm, 6.14 mm, and 10.25 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative



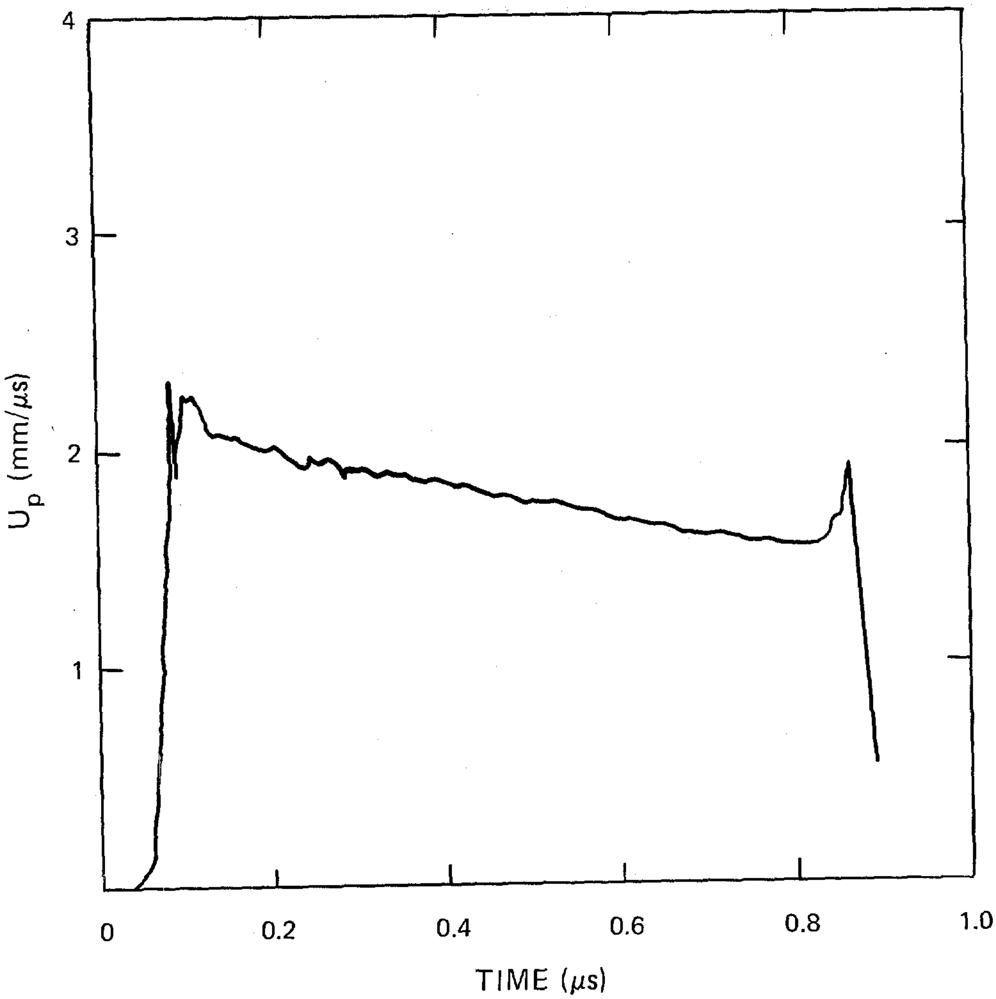
1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
TIME (μs)

HIGH EXPLOSIVES, HIGH-EXPLOSIVE SIMULANTS, AND PROPELLANTS

TARGET	Material: Baratol, 76 wt% barium nitrate/24 wt% TNT Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-77-98 Date: October 20, 1977 Diameter: 38.1 mm Density: 2.61 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.54$ mm/μs
IMPACTOR	Baratol, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.176 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 6.11 mm, and 10.18 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative

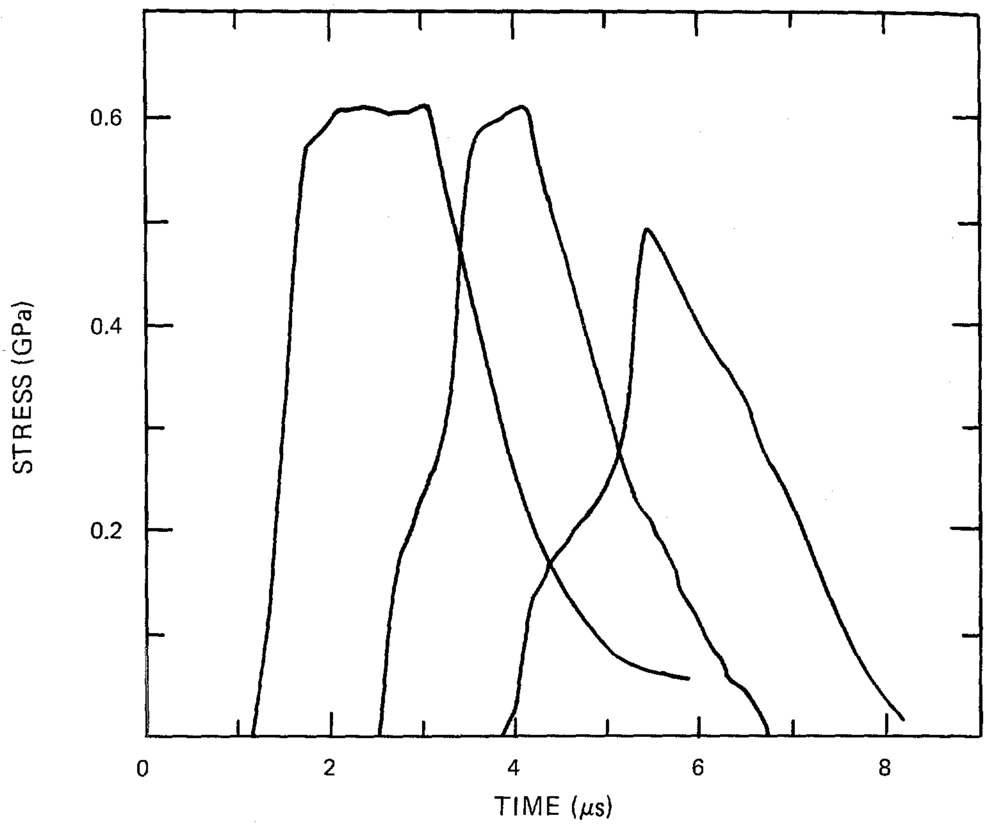

0.8
0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

TARGET	**Material:** Comp B **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** C 4152 **Date:** October 23, 1974
HE SHOT GEOMETRY	P-080 lens/25.4 mm Comp B/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	Comp B **Density:** 1.73 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs Teflon **Density:** 2.14 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.78 mm



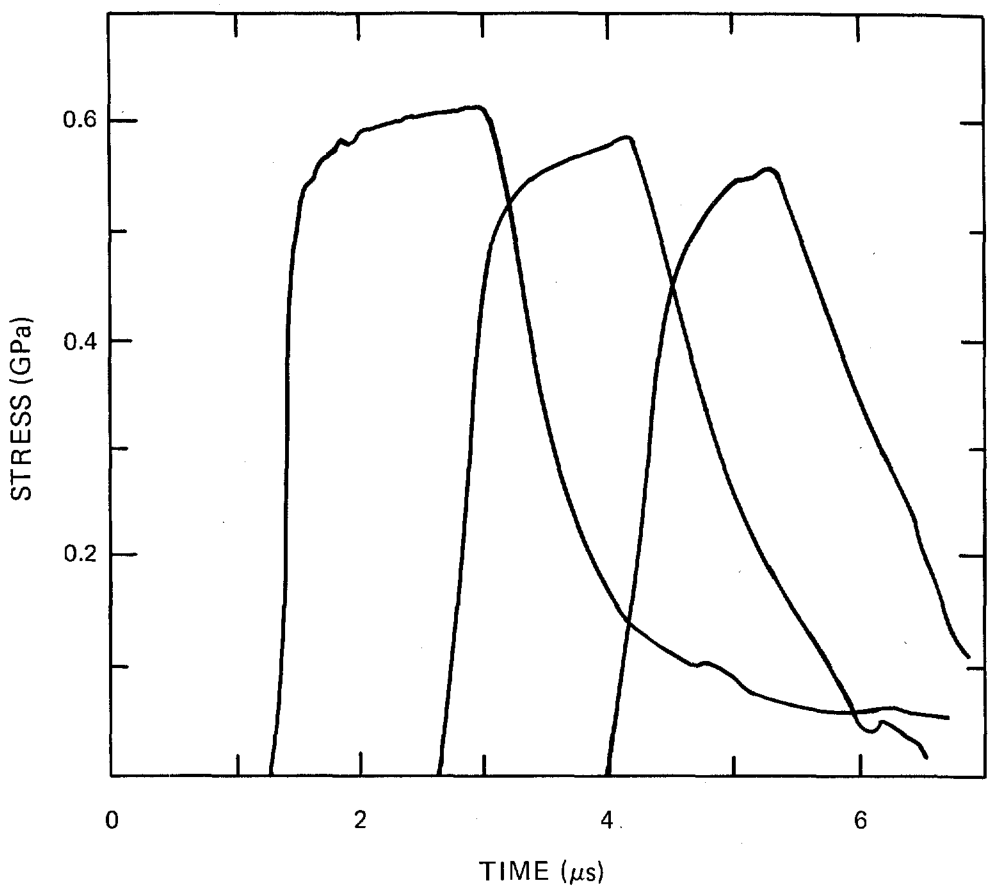
4
3
2
1
U_p (mm/μs)
0
0.2
0.4
0.6
0.8
1.0
TIME (μs)

TARGET	Material: Comp B-3, 60 wt% RDX/40 wt% TNT Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-77-104 Date: October 26, 1977 Diameter: 38.1 mm Density: 1.70 g/cm^3 $C_L = 3.00$ mm/µs $C_S = 1.61$ mm/µs
IMPACTOR	Comp B-3, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.266 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 6.11 mm, and 10.18 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative

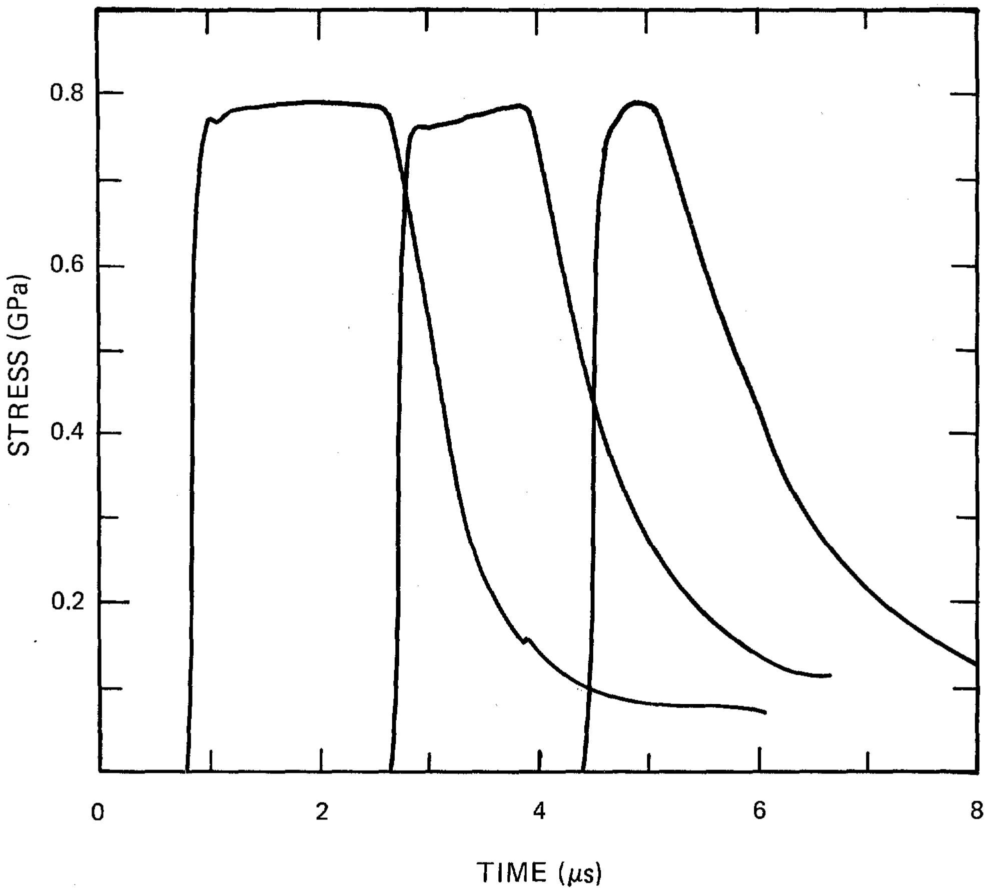


0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

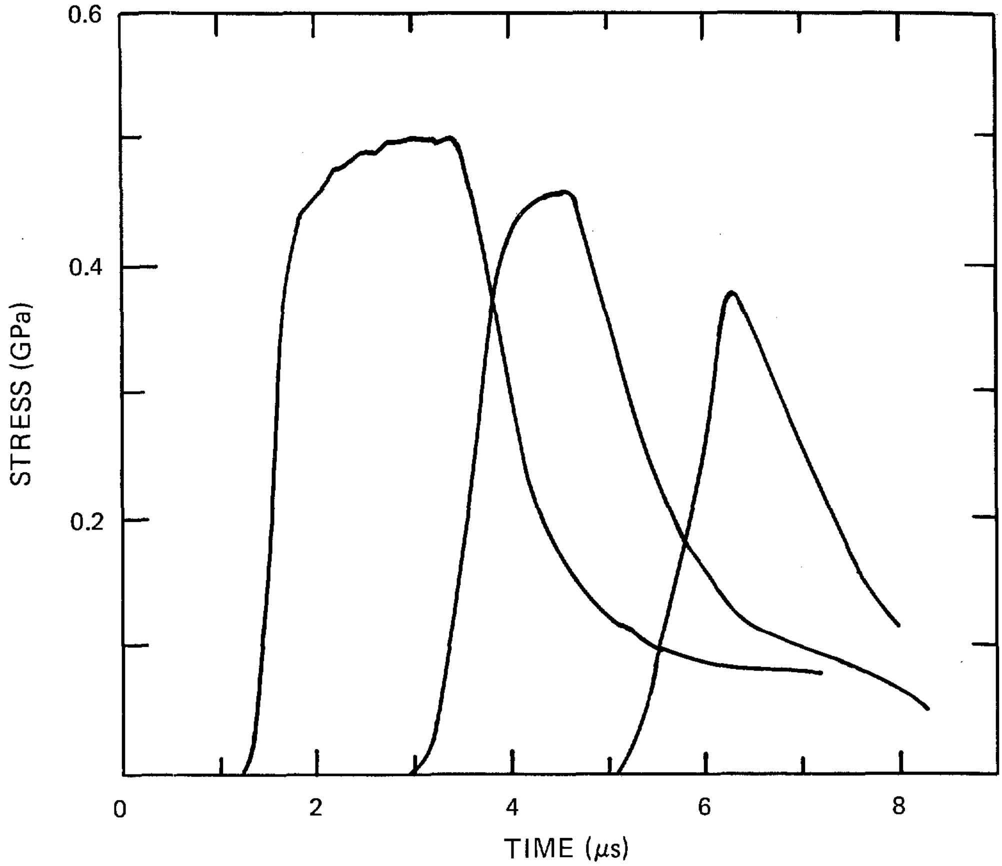
TARGET	Material: Inert 900-10, 48 wt% Pentek/46 wt% barium nitrate, $Ba(NO_3)_2$/2.8 wt% nitrocellulose (NC), 3.2 wt% tris-beta chloroethyl-phosphate (CEF) Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-77-88 Date: September 8, 1977 Diameter: 38.1 mm Density: 1.88 g/cm^3 $C_L = 3.21$ mm/μs $C_S = 1.57$ mm/μs
IMPACTOR	Inert 900-10, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.210 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 6.11 mm, and 10.18 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
TIME (μs)

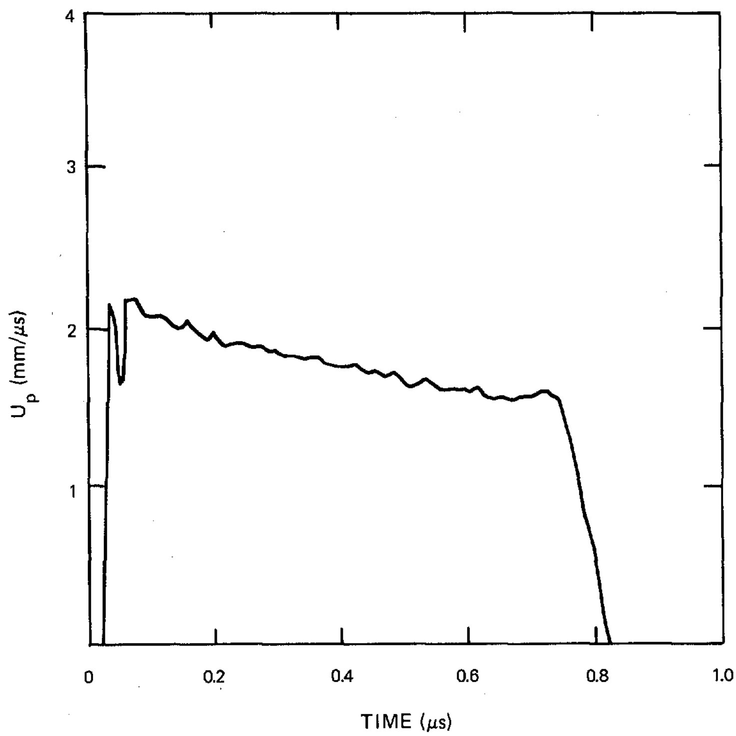
TARGET	**Material:** Inert 905-03, 60 wt% cyanuric acid/32 wt% melamine/ 4 wt% NC/4 wt% CEF **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-77-89 **Date:** September 9, 1977 **Diameter:** 38.1 mm **Density:** 1.60 g/cm^3 $C_L = 2.22$ mm/μs $C_S = 0.90$ mm/μs
IMPACTOR	Inert 905-03, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.416 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.04 mm, 6.11 mm, and 10.18 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative


0.8
0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

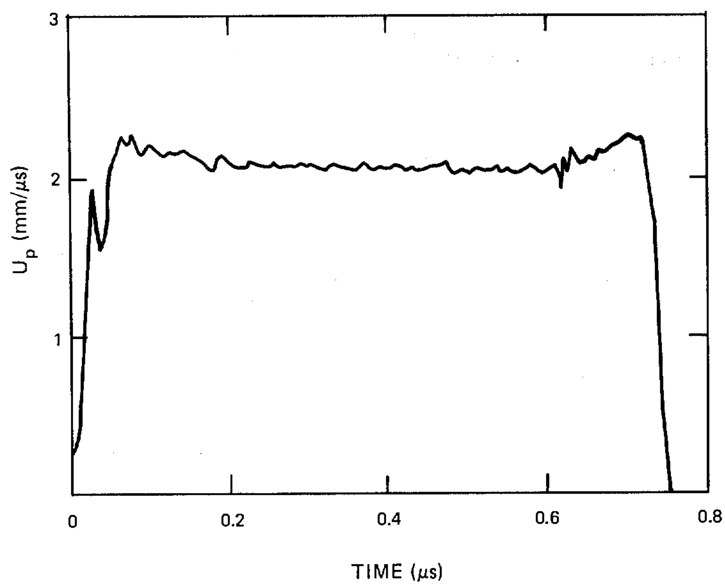
TARGET	Material: Inert 900-19, 95 wt% cyanuric acid/ 5 wt% Kel-F 800 Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-77-90 Date: September 9, 1977 Diameter: 38.1 mm Density: 1.64 g/cm^3 $C_L = 2.59$ mm/μs $C_S = 1.29$ mm/μs
IMPACTOR	Inert 900-19, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.298 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 6.11 mm, and 10.18 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

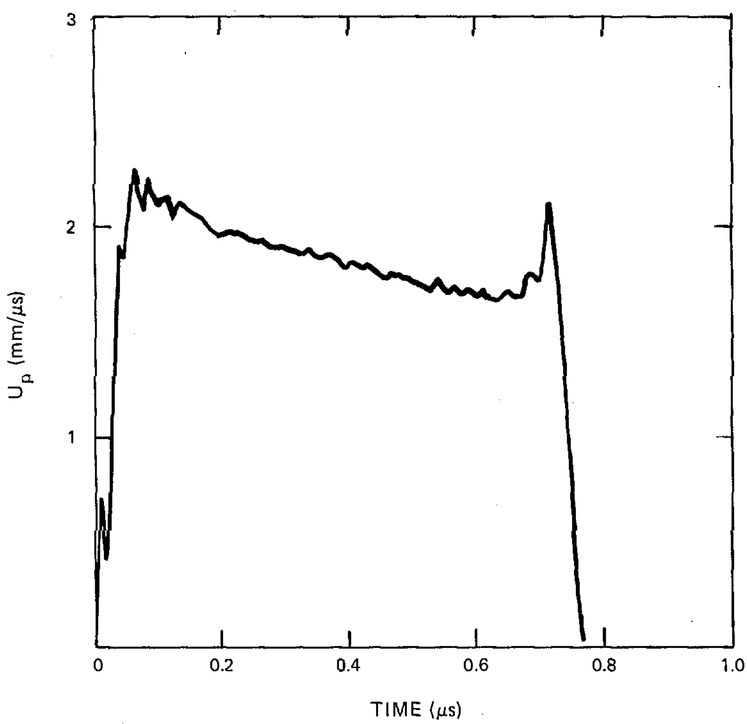
TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3603 **Date:** December 16, 1974
HE SHOT GEOMETRY	P-080 lens/2.54 mm PBX 9404/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs Teflon **Density:** 2.14 g/cm^3 C_L = 1.23 mm/μs C_S = 0.41 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.78 mm



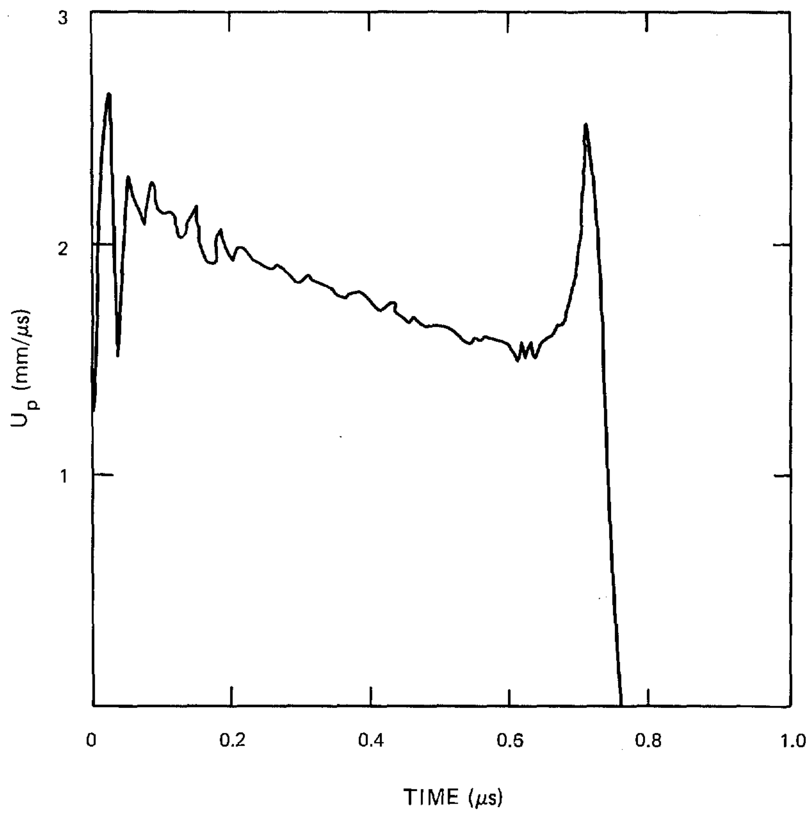
TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3608 **Date:** December 18, 1974
HE SHOT GEOMETRY	P-080 lens/101.6 mm PBX 9404/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 $C_L = 2.90$ mm/µs $C_S = 1.57$ mm/µs Teflon **Density:** 2.14 g/cm^3 $C_L = 1.23$ mm/µs $C_S = 0.41$ mm/µs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.78 mm



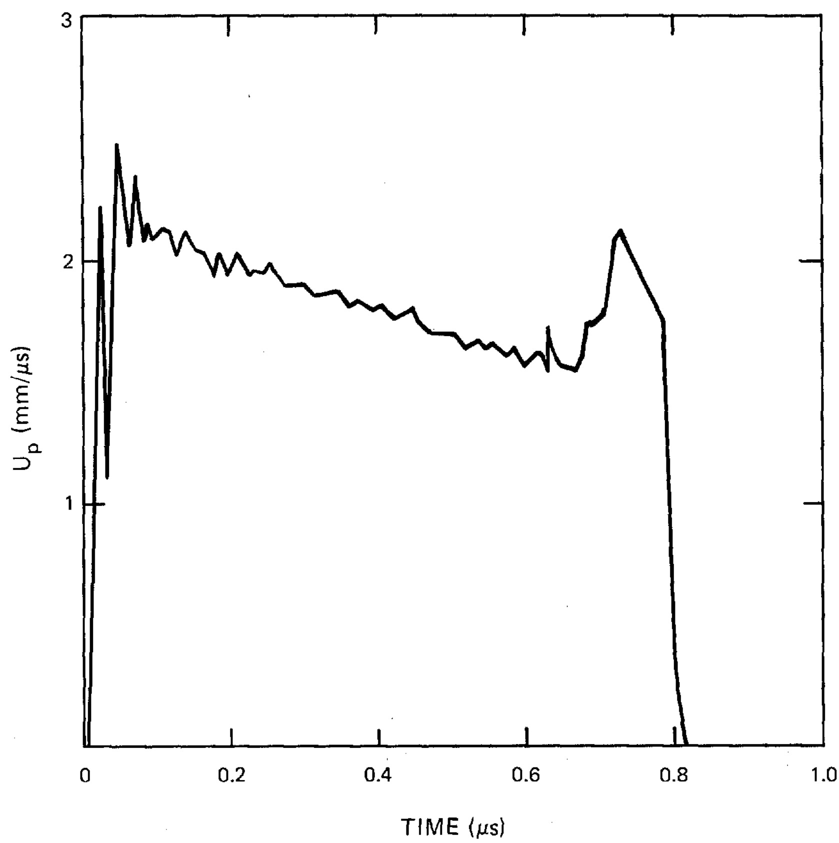
TARGET	Material: PBX 9404 Experiment type: ASM probe Experimenter: W. C. Davis Reference: Davis (1976) Shot no.: F 3609 Date: December 19, 1974
HE SHOT GEOMETRY	P-080 lens/25.4 mm PBX 9404/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	PBX 9404 Density: 1.84 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs Teflon Density: 2.14 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe Coil radius: 18.62 mm Initial coil spacing: 6.78 mm



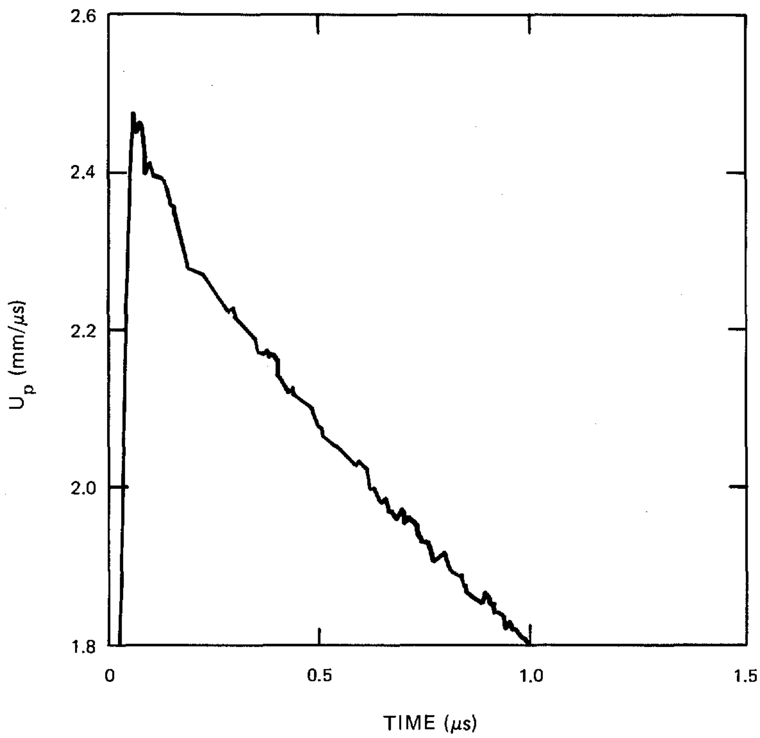
TARGET	Material: PBX 9404 Experiment type: ASM probe Experimenter: W. C. Davis Reference: Davis (1976) Shot no.: F 3652 Date: February 26, 1975
HE SHOT GEOMETRY	P-080 lens/6.35 mm PBX 9404/0.025 mm copper// 6.35 mm PBX 9404//
SHOT COMPONENTS	PBX 9404 Density: 1.84 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs
TRANSDUCER	ASM probe Coil radius: 18.62 mm Initial coil spacing: 6.78 mm



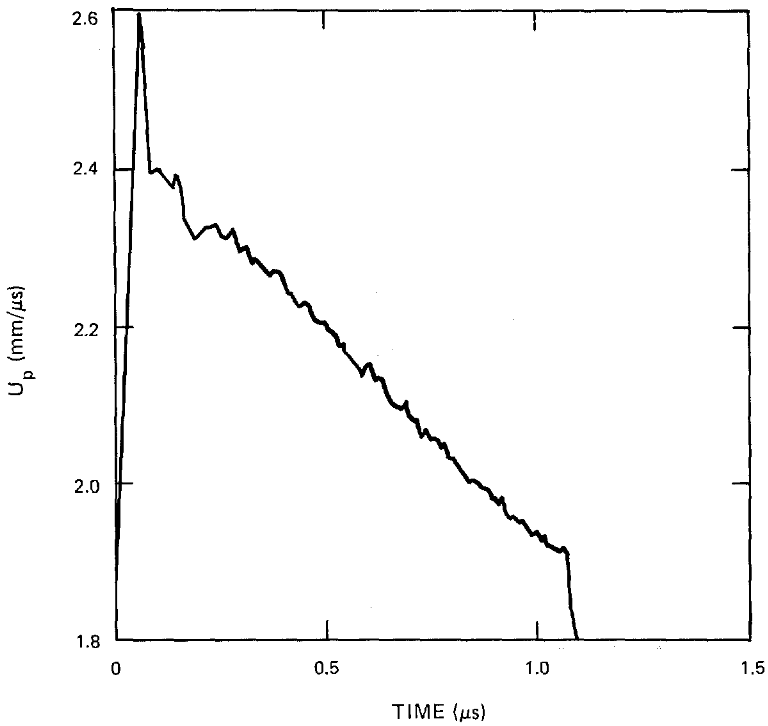
TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3653 **Date:** February 26, 1975
HE SHOT GEOMETRY	P-080 lens/25.4 mm PBX 9404/0.075 mm magnesium// 6.35 mm PBX 9404//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.78 mm



TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3669 **Date:** May 12, 1975
HE SHOT GEOMETRY	P-080 lens/25.4 mm PBX 9404/0.075 mm aluminum// 6.34 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs Teflon **Density:** 2.14 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.77 mm



TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3788 **Date:** August 7, 1975
HE SHOT GEOMETRY	P-080 lens/50.8 mm PBX 9404/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.51$ mm/μs Teflon **Density:** 2.14 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.78 mm



TARGET

Material: PBX 9404
Experiment type: ASM probe
Experimenter: W. C. Davis
Reference: Davis (1976)
Shot no.: F 3789 **Date:** August 7, 1975

HE SHOT GEOMETRY

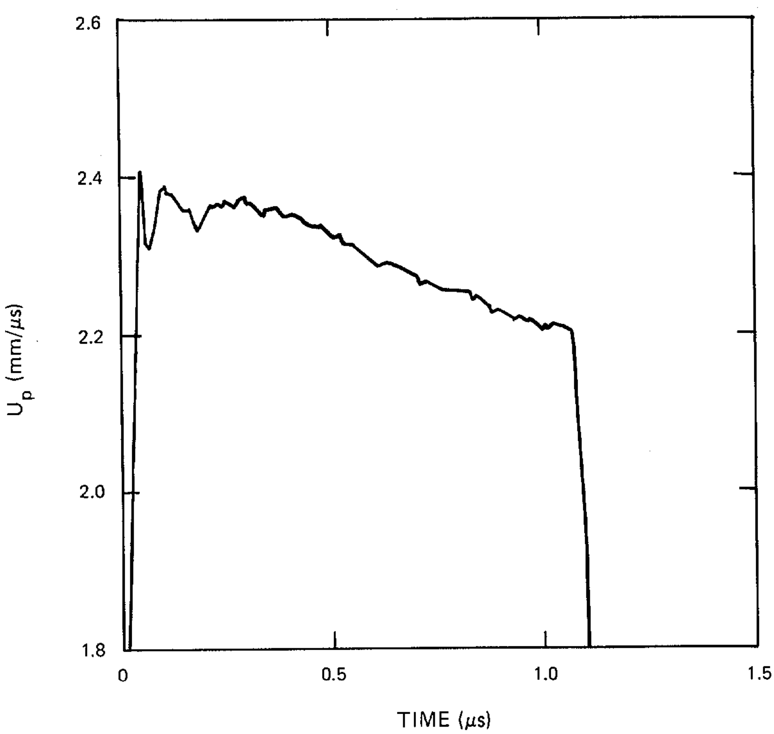
P-080 lens/101.6 mm PBX 9404/0.075 mm aluminum//
6.35 mm Teflon//

SHOT COMPONENTS

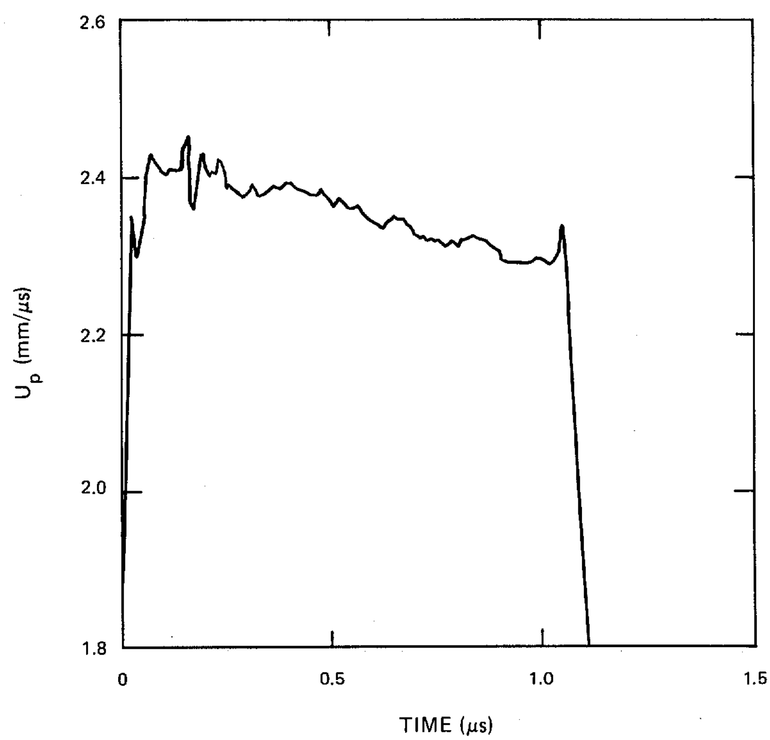
PBX 9404
Density: 1.84 g/cm^3
$C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs
Teflon
Density: 2.14 g/cm^3
$C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs

TRANSDUCER

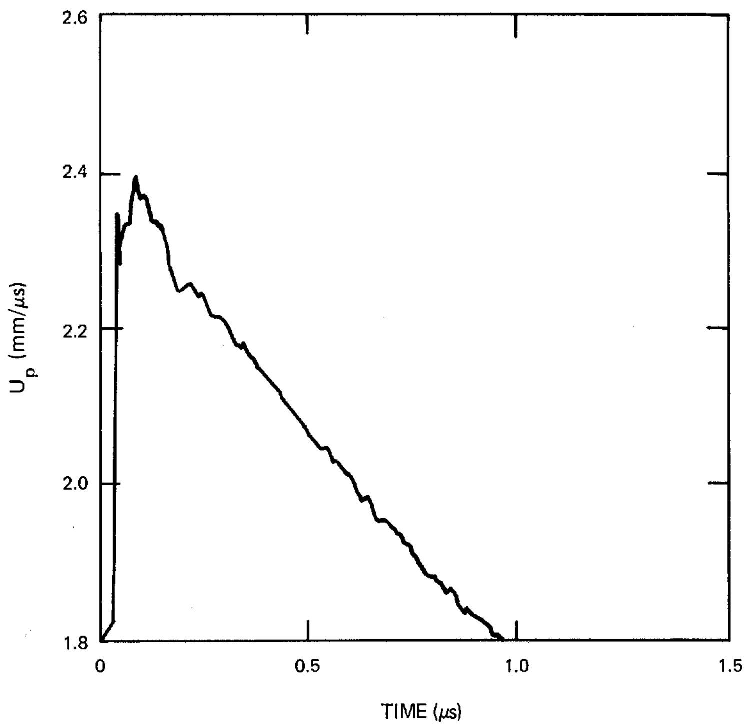
ASM probe
Coil radius: 18.62 mm **Initial coil spacing:** 6.78 mm



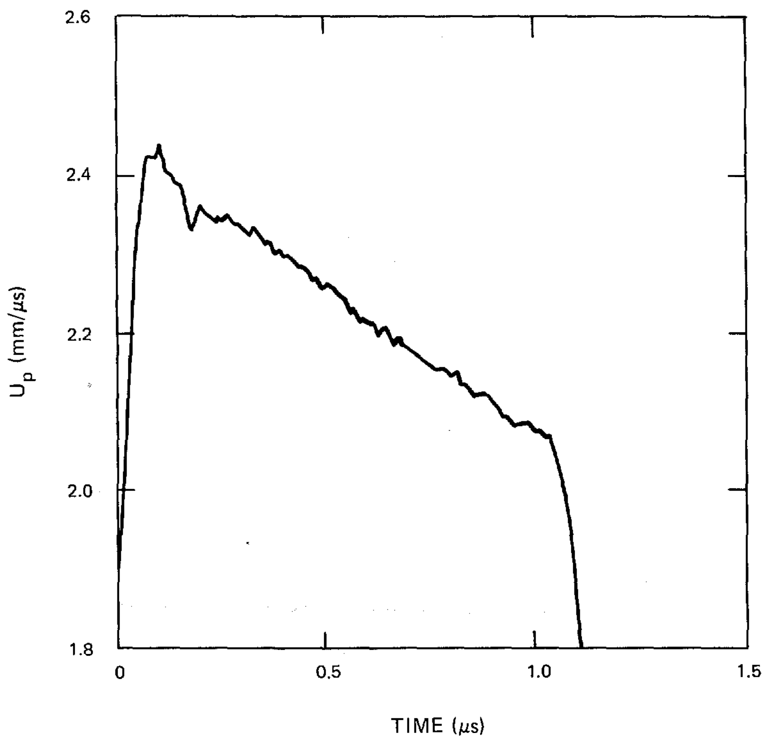
TARGET	Material: PBX 9404 Experiment type: ASM probe Experimenter: W. C. Davis Reference: Davis (1976) Shot no.: F 3790 Date: August 8, 1975
HE SHOT GEOMETRY	P-080 lens/203.2 mm PBX 9404/0.075 mm aluminum// 6.36 mm Teflon//
SHOT COMPONENTS	PBX 9404 Density: 1.84 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs Teflon Density: 2.14 g/cm^3 C_L = 1.23 mm/μs C_S = 0.41 mm/μs
TRANSDUCER	ASM probe Coil radius: 18.62 mm Initial coil spacing: 6.79 mm



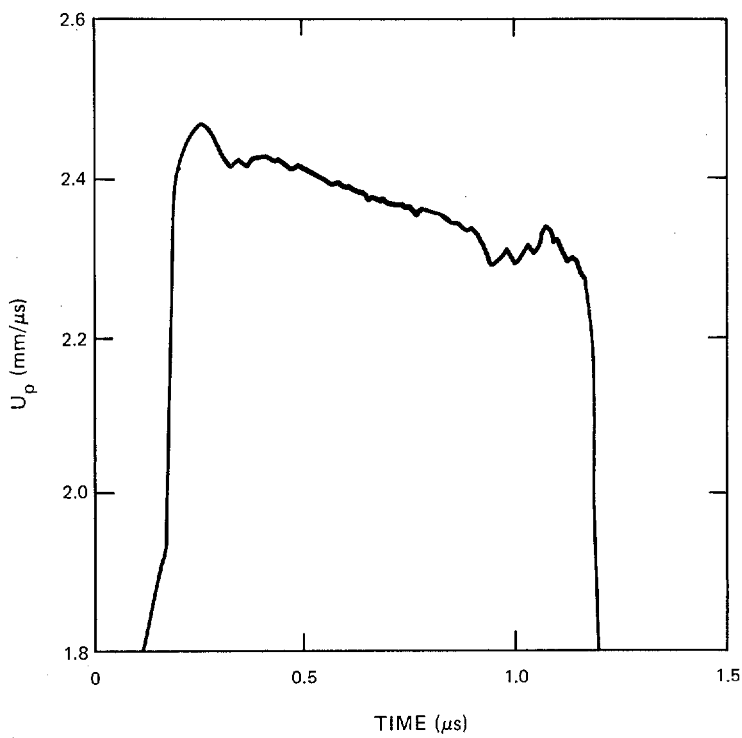
TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3796 **Date:** August 15, 1975
HE SHOT GEOMETRY	P-080 lens/25.4 mm PBX 9404/0.075 mm aluminum// 6.36 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs Teflon **Density:** 2.14 g/cm^3 C_L = 1.23 mm/μs C_S = 0.41 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.79 mm



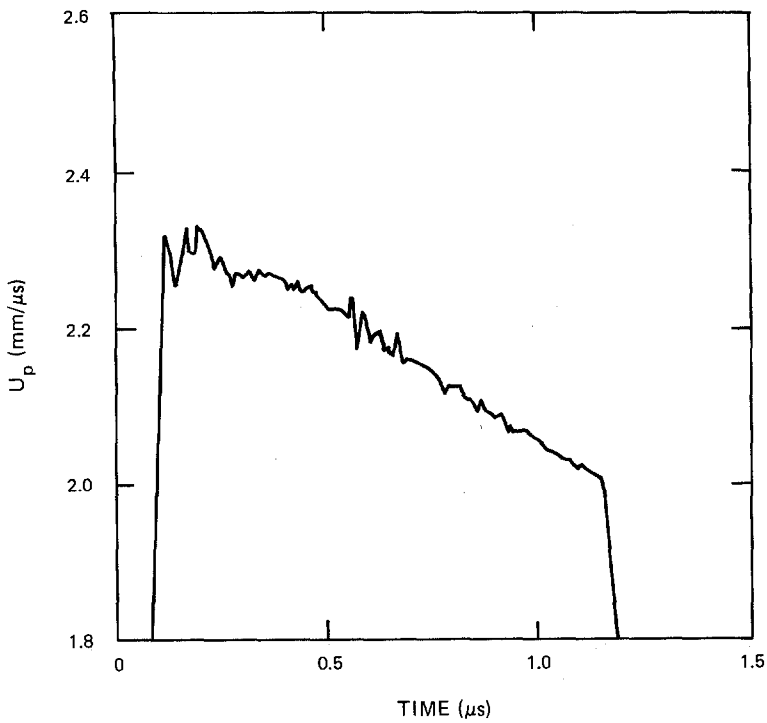
TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3799 **Date:** August 20, 1975
HE SHOT GEOMETRY	P-080 lens/50.8 mm PBX 9404/0.075 mm aluminum// 6.36 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs Teflon **Density:** 2.14 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.79 mm



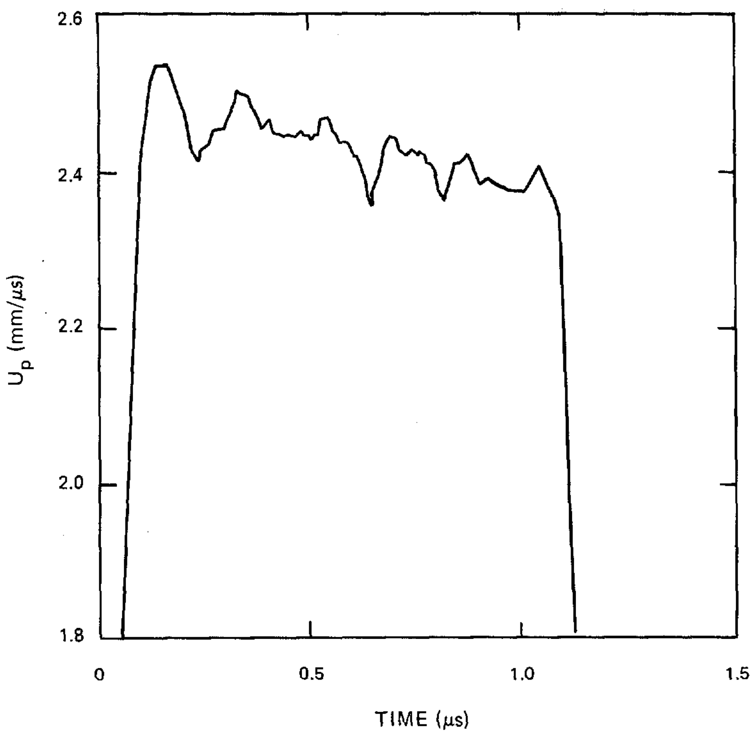
TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3808 **Date:** September 3, 1975
HE SHOT GEOMETRY	P-080 lens/101.6 mm PBX 9404/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs Teflon **Density:** 2.14 g/cm^3 C_L = 1.23 mm/μs C_S = 0.41 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.78 mm



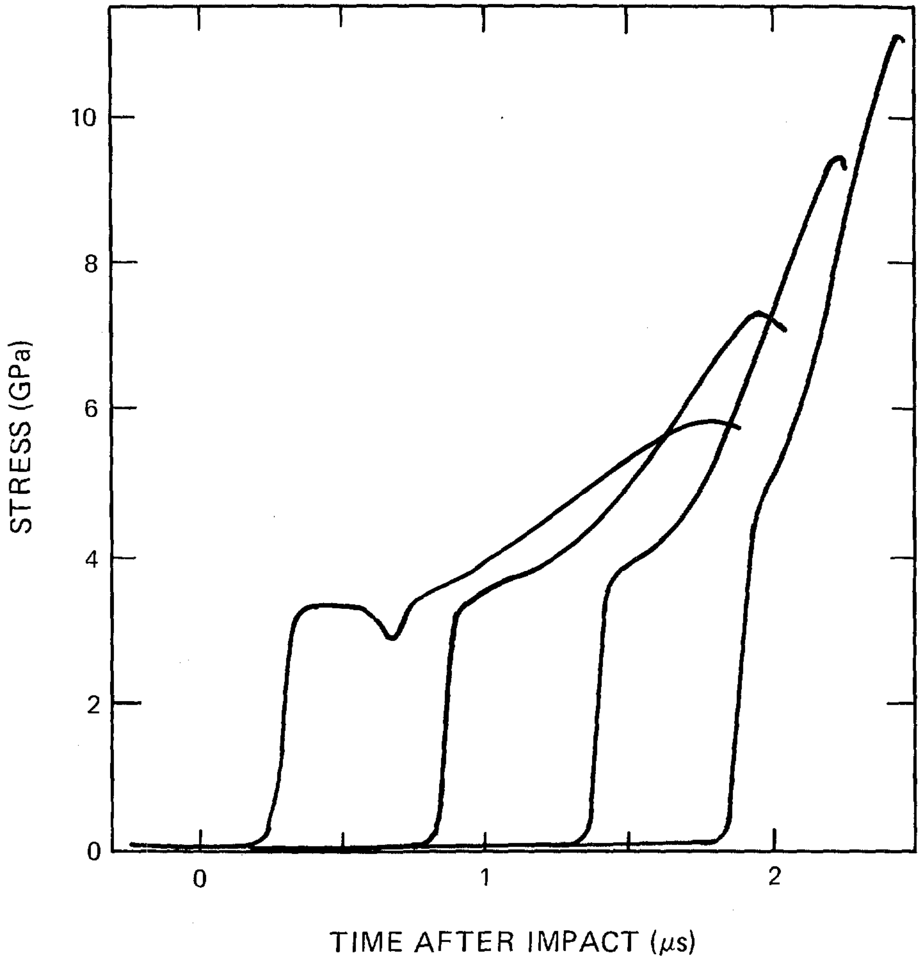
TARGET	**Material:** PBX 9404 **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3810 **Date:** September 3, 1975
HE SHOT GEOMETRY	P-080 lens/50.8 mm PBX 9404/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	PBX 9404 **Density:** 1.84 g/cm³ C_L = 2.90 mm/μs C_S = 1.57 mm/μs Teflon **Density:** 2.14 g/cm³ C_L = 1.23 mm/μs C_S = 0.41 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.78 mm



TARGET	Material: PBX 9404 Experiment type: ASM probe Experimenter: W. C. Davis Reference: Davis (1976) Shot no.: F 3811 Date: September 3, 1975
HE SHOT GEOMETRY	P-080 lens/203.2 mm PBX 9404/0.075 mm aluminum// 6.35 mm Teflon//
SHOT COMPONENTS	PBX 9404 Density: 1.84 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs Teflon Density: 2.14 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe Coil radius: 18.62 mm Initial coil spacing: 6.78 mm

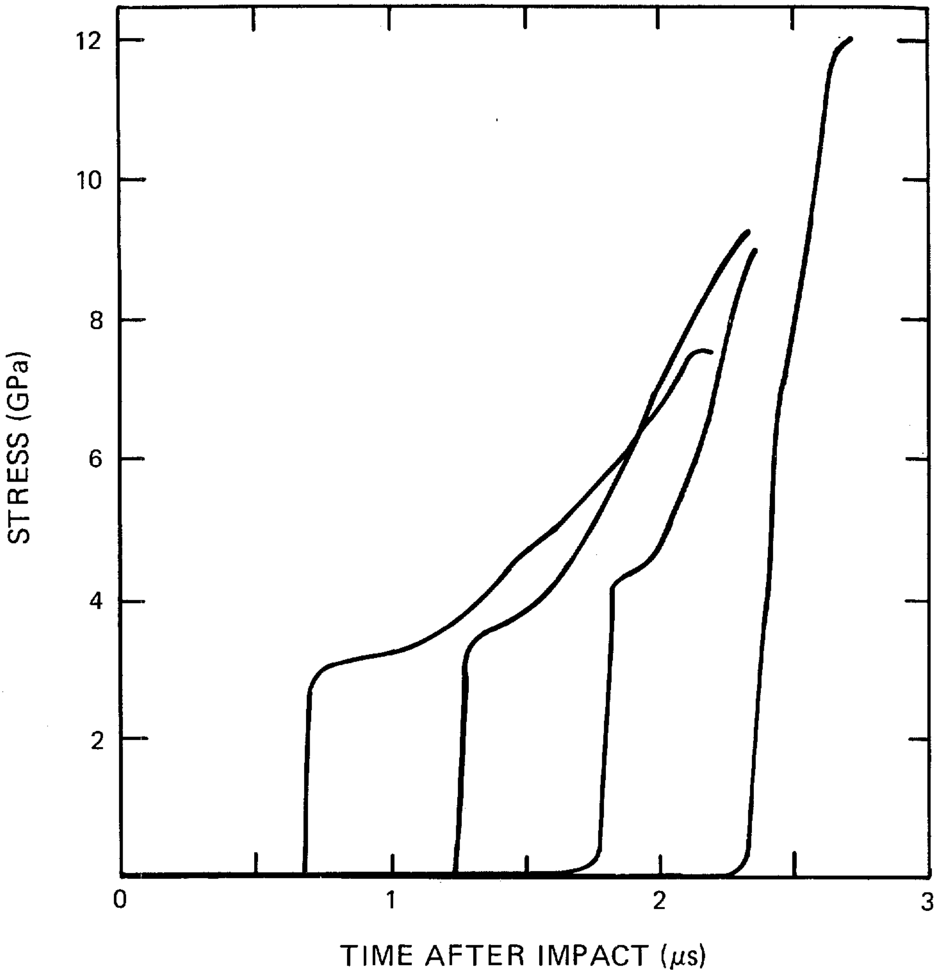


TARGET	Material: PBX 9404 (plastic-bonded HMX) Experiment type: Multiple embedded Manganin gage Impact stress: 2.9 GPa Experimenters: J. O. Johnson and Jerry Wackerle Reference: Wackerle, Rabie, Ginsberg, and Anderson (1978) Shot no.: 287 Series: M9404 Date: June 1976 Thickness: 15 mm Diameter: 65 mm Density: 1.844 g/cm^3 $C_L = 2.96$ mm/μs $C_S = 1.57$ mm/μs Fabrication: Machined from material pressed from plastic-coated HMX
IMPACTOR	Aluminum alloy projectile faced with copper, 8 mm thick Impact velocity: 0.56 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 0.95 mm, 2.95 mm, 5.0 mm, and 7.0 mm Encapsulation: 0.05-mm Kapton on each side Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact

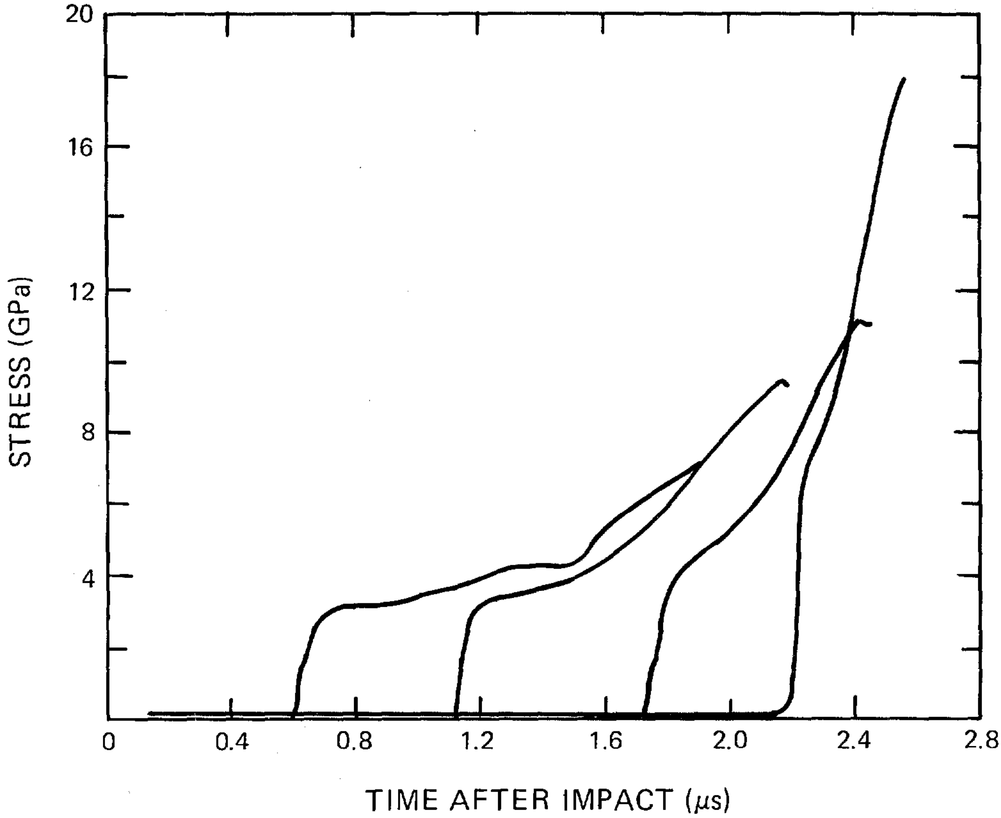


10
8
6
4
2
0
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

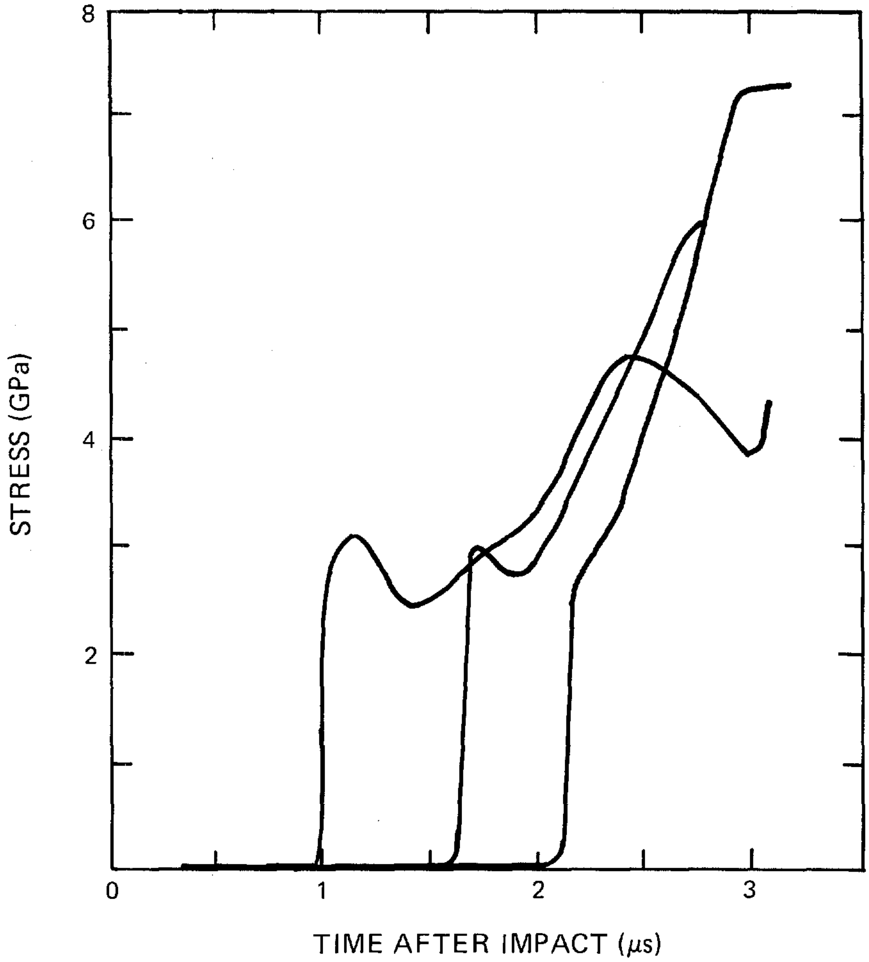
TARGET	Material: PBX 9404 Experiment type: Multiple embedded Manganin gage Impact stress: 2.9 GPa Experimenters: J. O. Johnson and Jerry Wackerle Reference: Wackerle, Rabie, Ginsberg, and Anderson (1978) Shot no.: 288 Series: M9404 Date: June 1976 Thickness: 15 mm Diameter: 65 mm Density: 1.844 g/cm^3 $C_L = 2.96$ mm/µs $C_S = 1.57$ mm/µs Fabrication: Machined from material pressed from plastic-coated HMX
IMPACTOR	Aluminum alloy projectile faced with copper, 8 mm thick Impact velocity: 0.56 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.4 mm, 4.5 mm, 6.5 mm, and 8.5 mm Encapsulation: 0.05-mm Kapton on each side Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact


12
10
8
6
4
2
0
1
2
3
STRESS (GPa)
TIME AFTER IMPACT (μs)

TARGET	**Material:** PBX 9404 **Experiment type:** Multiple embedded Manganin gage **Impact stress:** 2.9 GPa **Experimenters:** J. O. Johnson and Jerry Wackerle **Reference:** Wackerle, Rabie, Ginsberg, and Anderson (1978) **Shot no.:** *290* **Series:** *M9404* **Date:** July 7, 1976 **Thickness:** 15 mm **Diameter:** 65 mm **Density:** 1.844 g/cm^3 $C_L = 2.96$ mm/μs $C_S = 1.57$ mm/μs **Fabrication:** Machined from material pressed from plastic-coated HMX
IMPACTOR	Aluminum alloy projectile faced with copper, 8 mm thick **Impact velocity:** 0.553 mm/μs
TRANSDUCER	*Two-terminal, 50-Ω Manganin gage* **Locations from impact surface:** 2.01 mm, 3.99 mm, 5.99 mm, and 8.05 mm **Encapsulation:** 0.05-mm Kapton on each side **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**

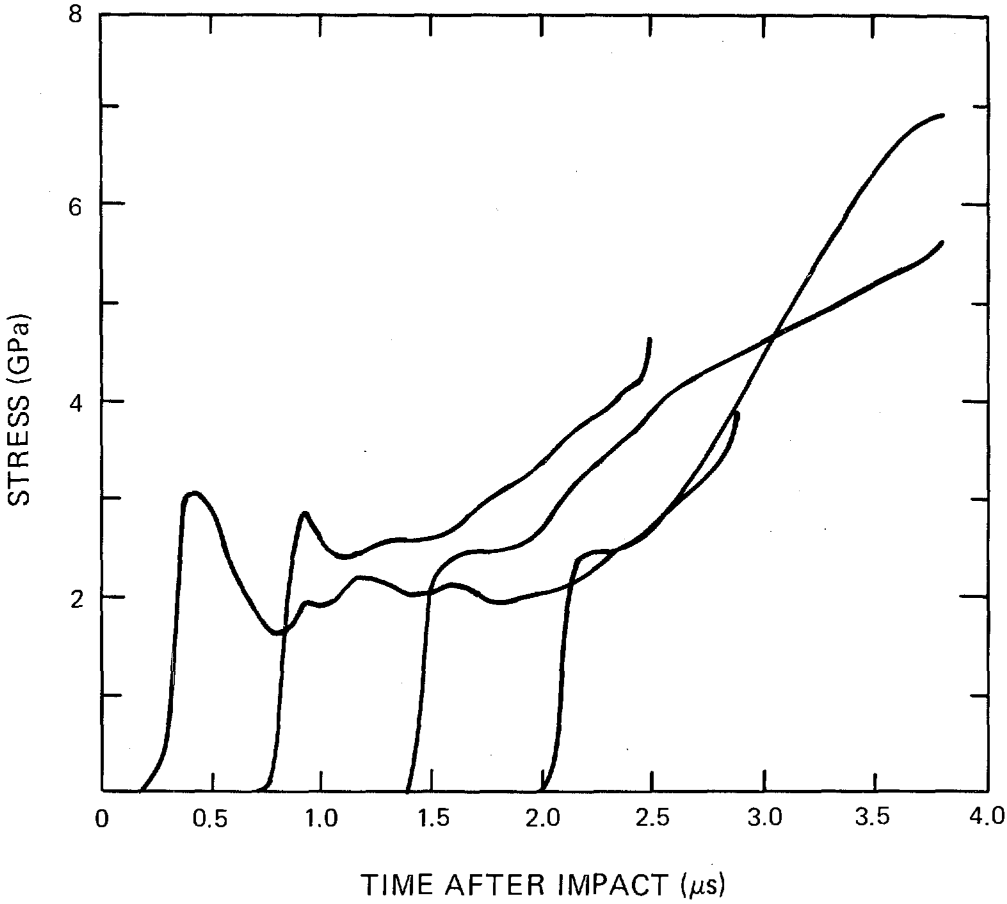

20
16
12
8
4
STRESS (GPa)
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
TIME AFTER IMPACT (μs)

TARGET	Material: PBX 9404 Experiment type: Multiple embedded Manganin gage Impact stress: 2.9 GPa Experimenters: J. O. Johnson and Jerry Wackerle Reference: Wackerle, Rabie, Ginsberg, and Anderson (1978) Shot no.: 292 Series: M9404 Date: July 13, 1976 Thickness: 15 mm Diameter: 65 mm Density: 1.844 g/cm^3 $C_L = 2.96$ mm/μs $C_S = 1.57$ mm/μs Fabrication: Machined from material pressed from plastic-coated HMX
IMPACTOR	Projectile faced with carbon foam and copper flyer, 1.0 mm thick Impact velocity: 0.56 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 3.0 mm, 5.0 mm, and 7.0 mm Encapsulation: 0.51-mm Kapton on each side Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact



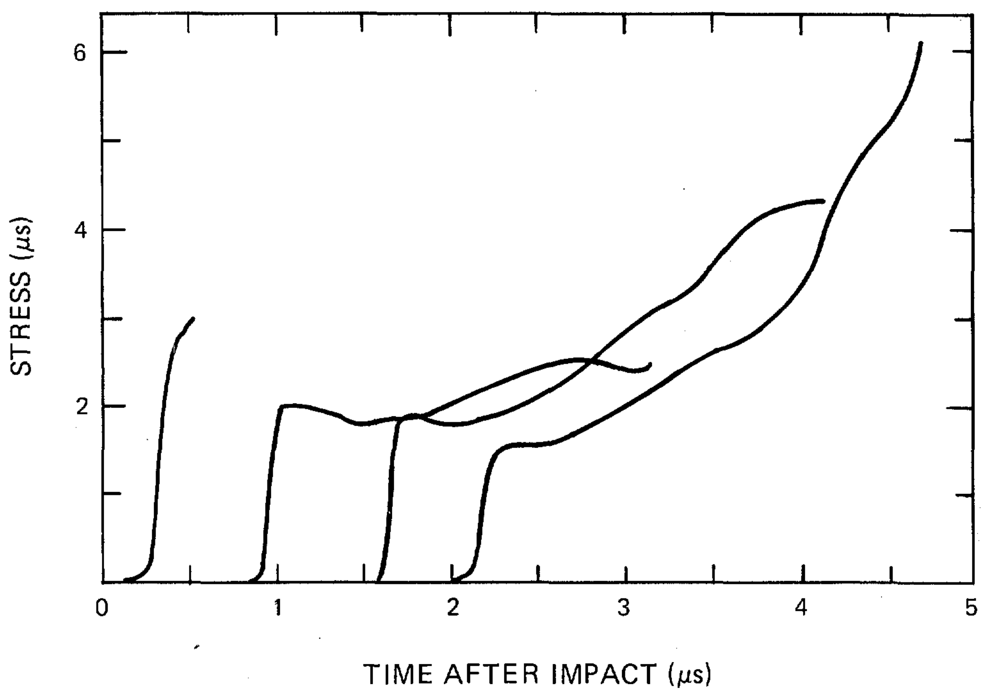
8
6
4
2
0
1
2
3
STRESS (GPa)
TIME AFTER IMPACT (μs)

TARGET	**Material:** PBX 9404 **Experiment type:** Multiple embedded Manganin gage **Impact stress:** 2.9 GPa **Experimenters:** J. O. Johnson and Jerry Wackerle **Reference:** Wackerle, Rabie, Ginsberg, and Anderson (1978) **Shot no.:** 294 **Series:** M9404 **Date:** July 23, 1976 **Thickness:** 15 mm **Diameter:** 65 mm **Density:** 1.844 g/cm^3 $C_L = 2.96$ mm/μs $C_S = 1.57$ mm/μs **Fabrication:** Machined from material pressed from plastic-coated HMX
IMPACTOR	Projectile faced with carbon foam and copper flyer, 0.76 mm thick **Impact velocity:** 0.557 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 1.02 mm, 3.07 mm, 5.11 mm, and 7.16 mm **Encapsulation:** 0.05-mm Kapton on each side **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**

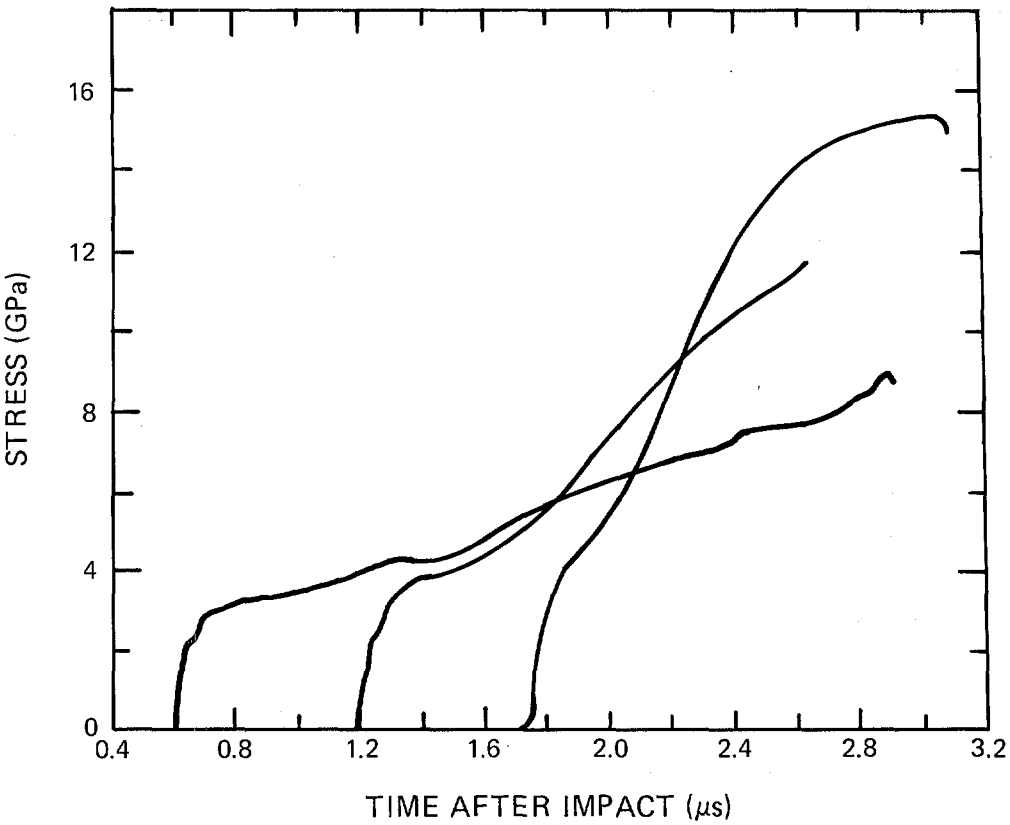


8
6
4
2
STRESS (GPa)
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
TIME AFTER IMPACT (μs)

TARGET	**Material:** PBX 9404
	Experiment type: Multiple embedded Manganin gage
	Impact stress: 2.9 GPa
	Experimenters: J. O. Johnson and Jerry Wackerle
	Reference: Wackerle, Rabie, Ginsberg, and Anderson (1978)
	Shot no.: 295 **Series:** M9404 **Date:** August 10, 1976
	Thickness: 15 mm **Diameter:** 65 mm
	Density: 1.844 g/cm^3
	$C_L = 2.96$ mm/μs $C_S = 1.57$ mm/μs
	Fabrication: Machined from material pressed from plastic-coated HMX
IMPACTOR	Projectile faced with carbon foam and copper flyer
	Impact velocity: 0.55 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage
	Locations from impact surface: 1.0 mm, 3.1 mm, 5.1 mm, and 7.2 mm
	Encapsulation: 0.05-mm Kapton on each side
	Reference: Wackerle, Johnson, and Halleck (1975a)
	Time after impact

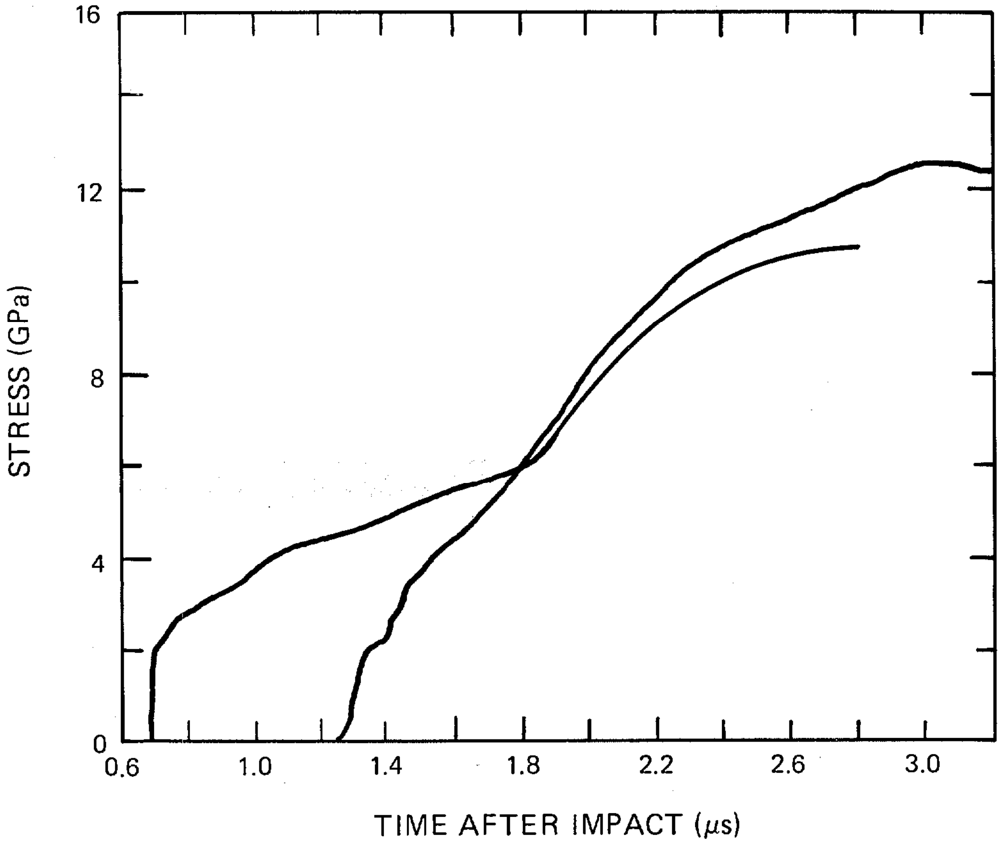

6
4
2
STRESS (μs)
0
1
2
3
4
5
TIME AFTER IMPACT (μs)

TARGET	Material: PBX 9404
	Experiment type: Multiple embedded Manganin gage
	Impact stress: 2.9 GPa
	Experimenters: J. O. Johnson and Jerry Wackerle
	Reference: Wackerle, Rabie, Ginsberg, and Anderson (1978)
	Shot no.: 308 Series: M9404 Date: December 16, 1976
	Thickness: 15 mm Diameter: 65 mm
	Density: 1.844 g/cm^3
	$C_L = 2.96$ mm/μs $C_S = 1.57$ mm/μs
	Fabrication: Machined from material pressed from plastic-coated HMX
IMPACTOR	Aluminum alloy faced with copper, 8 mm thick
	Impact velocity: 0.556 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage
	Locations from impact surface: 2.11 mm, 4.09 mm, and 6.12 mm
	Encapsulation: 0.1-mm Kapton on each side
	Reference: Wackerle, Johnson, and Halleck (1975a)
	Time after impact



16
12
8
4
0
STRESS (GPa)
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
TIME AFTER IMPACT (μs)

TARGET	Material: PBX 9404 Experiment type: Multiple embedded Manganin gage Impact stress: 2.9 GPa Experimenters: J. O. Johnson and Jerry Wackerle Reference: Wackerle, Rabie, Ginsberg, and Anderson (1978) Shot no.: 311 Series: M9404 Date: February 1, 1977 Thickness: 12 mm Diameter: 50 mm Density: 1.844 g/cm^3 $C_L = 2.96$ mm/μs $C_S = 1.57$ mm/μs Fabrication: Machined from material pressed from plastic-coated HMX
IMPACTOR	Aluminum alloy projectile faced with copper, 8 mm thick Impact velocity: 0.554 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.69 mm, and 4.65 mm Encapsulation: 0.1-mm Kapton on each side Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact



16
12
8
4
0
STRESS (GPa)
0.6
1.0
1.4
1.8
2.2
2.6
3.0
TIME AFTER IMPACT (μs)

TARGET

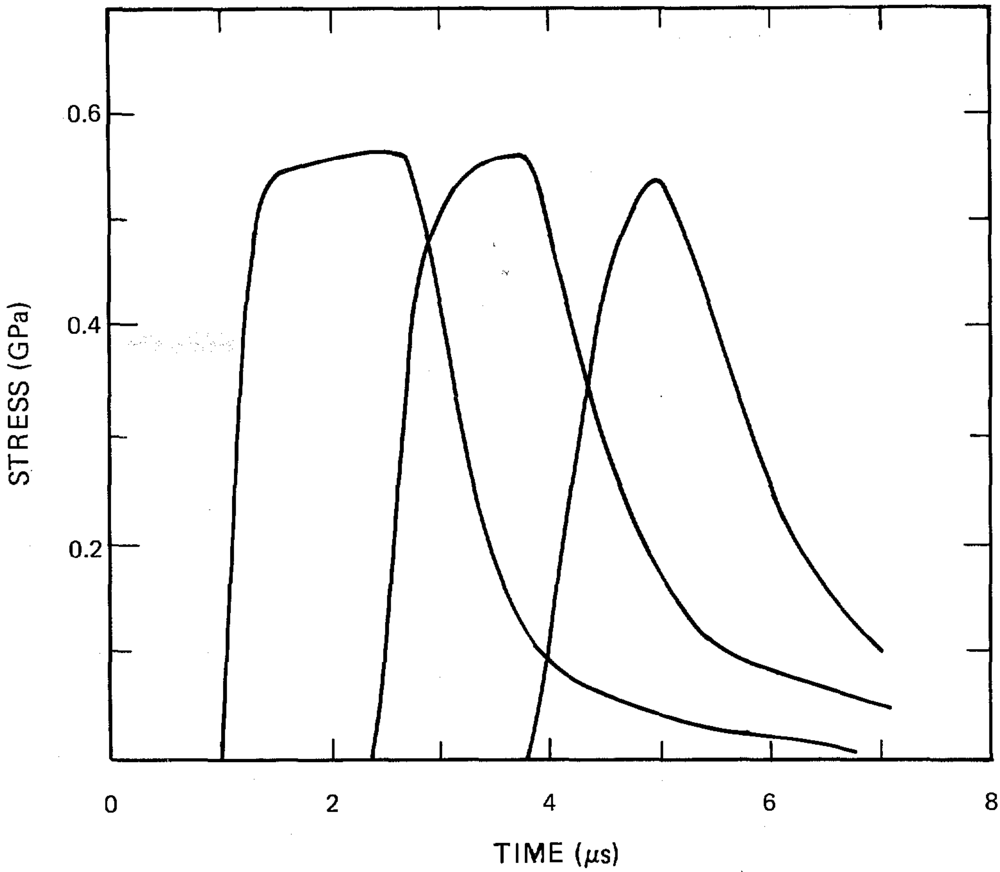
Material: PBX 9501, 95 wt% HMX/2.5 wt% Estane 5703 F1/2.5 wt% nitroplasticizer
Experiment type: Embedded Manganin gage
Experimenter: Bart Olinger
Shot no.: 56-77-103 **Date:** October 27, 1977
Diameter: 38.1 mm
Density: 1.82 g/cm^3
$C_L = 2.97$ mm/μs $C_S = 1.39$ mm/μs

IMPACTOR

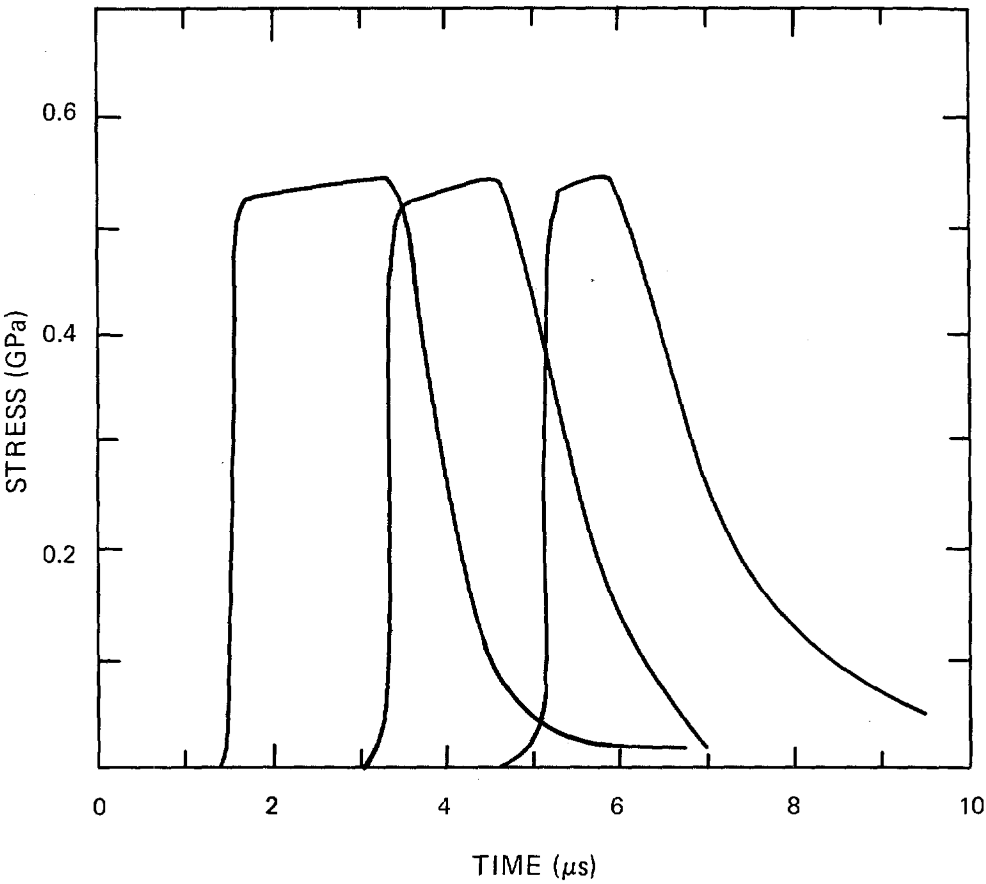
PBX 9501, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.248 mm/μs

TRANSDUCER

Two-terminal, 50-Ω Manganin gage
Locations from impact surface: 2.04 mm, 6.11 mm, and 10.18 mm
Heat treatment: Annealed
Encapsulation: None
Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages
$\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$,
$\sigma = a_2 + {}_2 x + c_2 x^2$ for $x > 0.1$,
where $x = \Delta R/R$.
$a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$
$a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$
Time: Relative

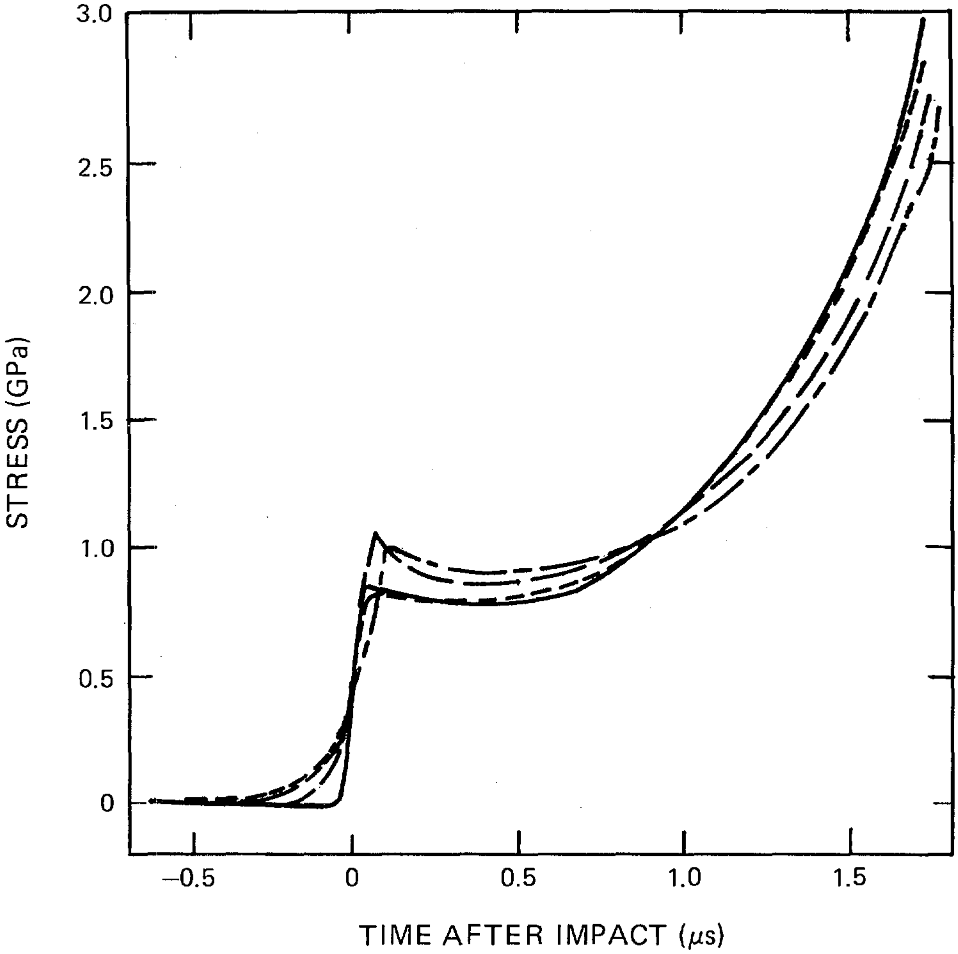

0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

TARGET	Material: PBX 9502, 95 wt% TATB/5 wt% Kel-F 800 Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-77-105 Date: October 27, 1977 Diameter: 38.1 mm Density: 1.88 g/cm^3 $C_L = 2.74$ mm/μs $C_S = 1.41$ mm/μs
IMPACTOR	PBX 9502, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.252 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 6.11 mm, and 10.18 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative



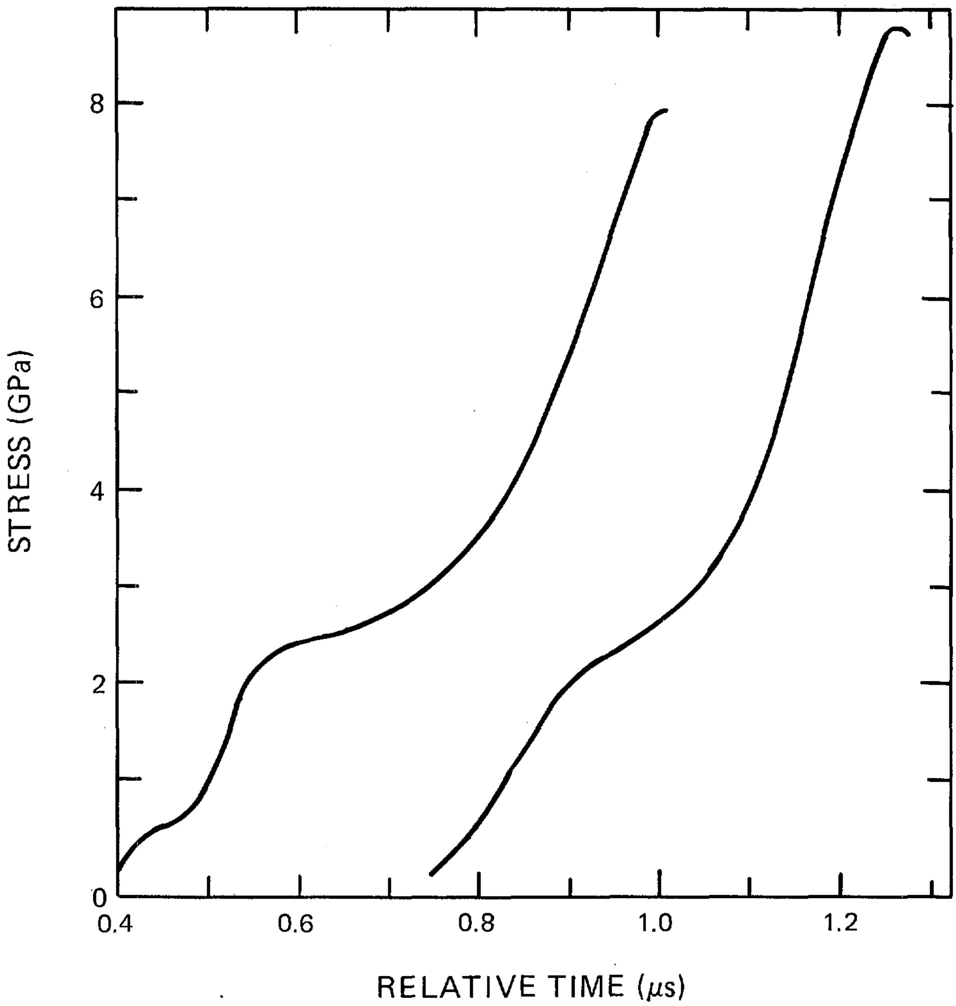
0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
10
TIME (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Manganin gage impact face **Impact stress:** 0.9 GPa **Experimenters:** P. M. Halleck, J. O. Johnson, and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), (1975b) **Shot no.:** 241 **Series:** LDPM **Date:** January 15, 1975 **Thickness:** 3 mm **Diameter:** 62 mm **Density:** 1.40 g/cm^3 **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	7075 Aluminum or brass projectile faced with explosive specimen **Impact velocity:** 0.406 mm/μs
TRANSDUCERS	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 0 mm, 0 mm, 0 mm, and 0 mm **Encapsulation:** 0.05-mm Kapton on each side **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**



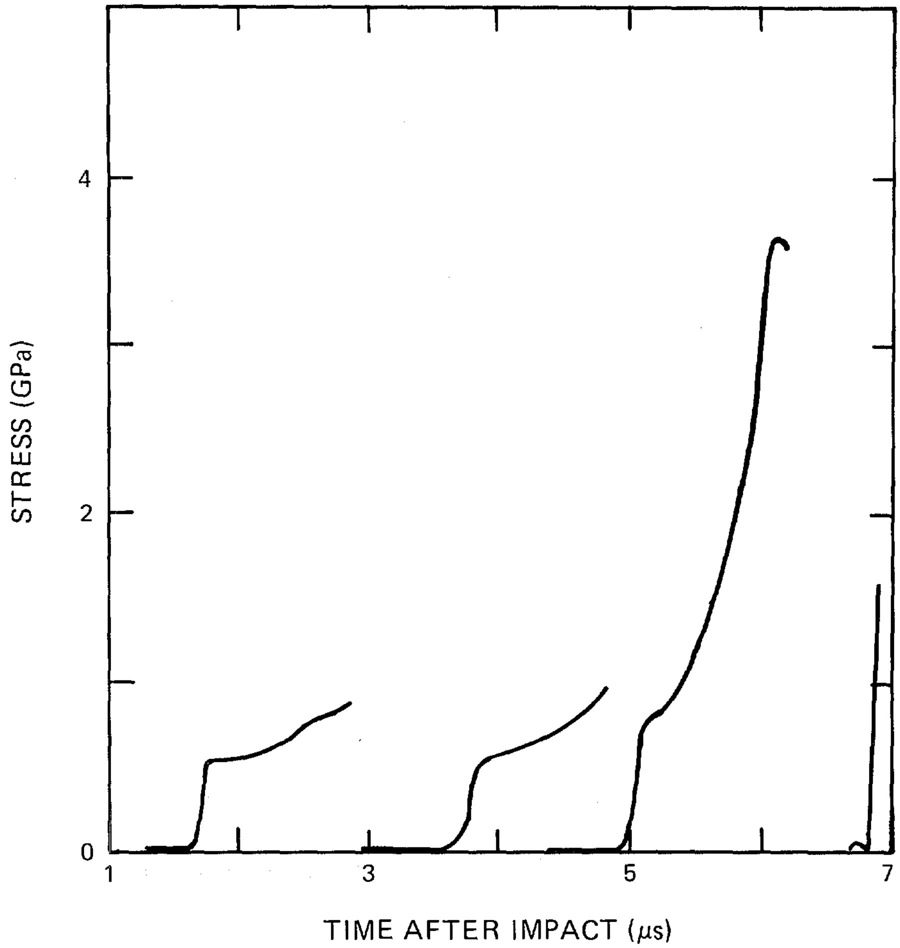
3.0
2.5
2.0
1.5
1.0
0.5
0
STRESS (GPa)
−0.5
0
0.5
1.0
1.5
TIME AFTER IMPACT (μs)

TARGET	Material: Pressed PETN Experiment type: Multiple embedded Manganin gage Impact stress: 1.9 GPa Experimenters: Jerry Wackerle, J. O. Johnson, and P. M. Halleck References: Wackerle, Johnson, and Halleck (1975a), (1976) Shot no.: 183 Series: HDPM Date: March 2, 1974 Thickness: 5.5 mm Diameter: 38 mm Density: 1.75 g/cm^3 $C_L = 2.98$ mm/μs $C_S = 1.64$ mm/μs
IMPACTOR	7075 Aluminum alloy projectile Impact velocity: 0.476 mm/μs
TRANSDUCERS	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.1 mm and 3.2 mm Encapsulation: 0.05-mm Kapton on each side Reference: Wackerle, Johnson, and Halleck (1975a) Time: Relative



STRESS (GPa)
8
6
4
2
0
0.4
0.6
0.8
1.0
1.2
RELATIVE TIME (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Multiple embedded Manganin gage **Impact stress:** 0.5 GPa **Experimenters:** P. M. Halleck, J. O. Johnson, and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), (1975b) **Shot no.:** 255 **Series:** LDPM **Date:** June 5, 1975 **Thickness:** 10 mm **Diameter:** 41 mm **Density:** 1.40 g/cm^3 **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	7075 Aluminum alloy projectile **Impact velocity:** 0.29 mm/μs
TRANSDUCERS	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2 mm, 4 mm, 6 mm, and 8 mm **Encapsulation:** 0.05-mm Kapton on each side **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**


4
2
0
STRESS (GPa)
1
3
5
7
TIME AFTER IMPACT (μs)

TARGET

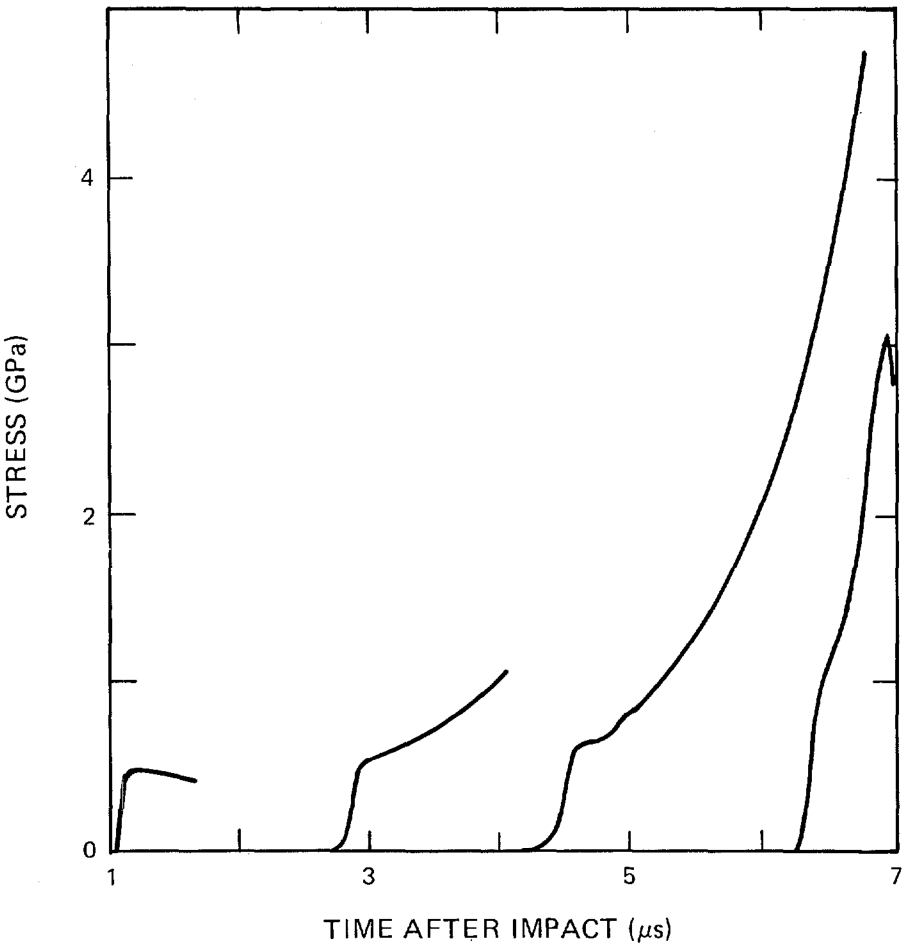
Material: Pressed PETN
Experiment type: Multiple embedded Manganin gage
Impact stress: 0.5 GPa
Experimenters: P. M. Halleck, J. O. Johnson, and Jerry Wackerle
References: Wackerle, Johnson, and Halleck (1975a), (1975b)
Shot no.: 256 Series: LDPM Date: June 10, 1975
Thickness: 9 mm Diameter: 41 mm
Density: 1.40 g/cm^3
Fabrication: Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks

IMPACTOR

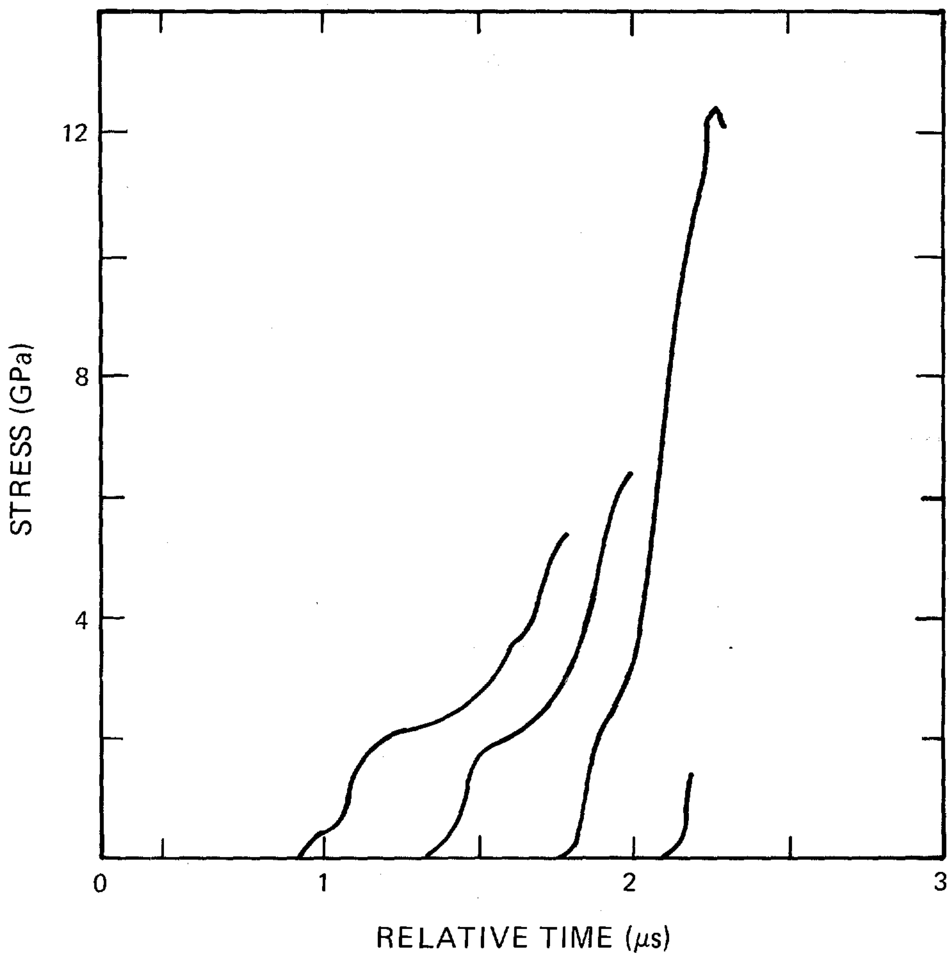
7075 Aluminum alloy projectile
Impact velocity: 0.489 mm/μs

TRANSDUCERS

Two-terminal, 50-Ω Manganin gage
Locations from impact surface: 1 mm, 3 mm, 5 mm, and 7 mm
Encapsulation: 0.05-mm Kapton on each side
Reference: Wackerle, Johnson, and Halleck (1975a)
Time after impact

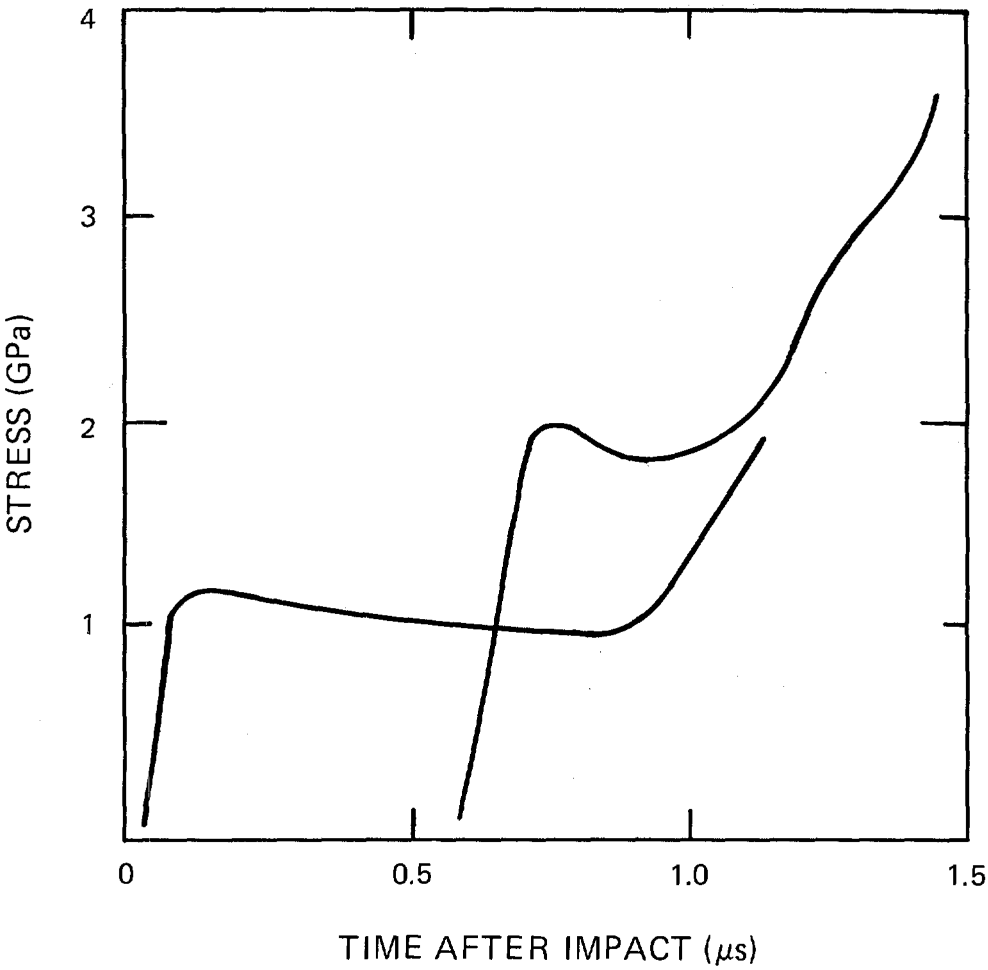

STRESS (GPa)
4
2
0
1
3
5
7
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Multiple embedded Manganin gage **Impact stress:** 2 GPa **Experimenters:** Jerry Wackerle, J. O. Johnson, and P. M. Halleck **References:** Wackerle, Johnson, and Halleck (1975a), (1976) **Shot no.:** 283 **Series:** HDPM **Date:** April 13, 1976 **Thickness:** 6.8 mm **Diameter:** 37 mm **Density:** 1.75 g/cm^3 $C_L = 2.98$ mm/μs $C_S = 1.64$ mm/μs **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	7075 Aluminum alloy projectile **Impact velocity:** 0.479 mm/μs
TRANSDUCERS	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 1.58 mm, 2.67 mm, 3.79 mm, and 4.87 mm **Encapsulation:** 0.05-mm Kapton on each side **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time:** Relative

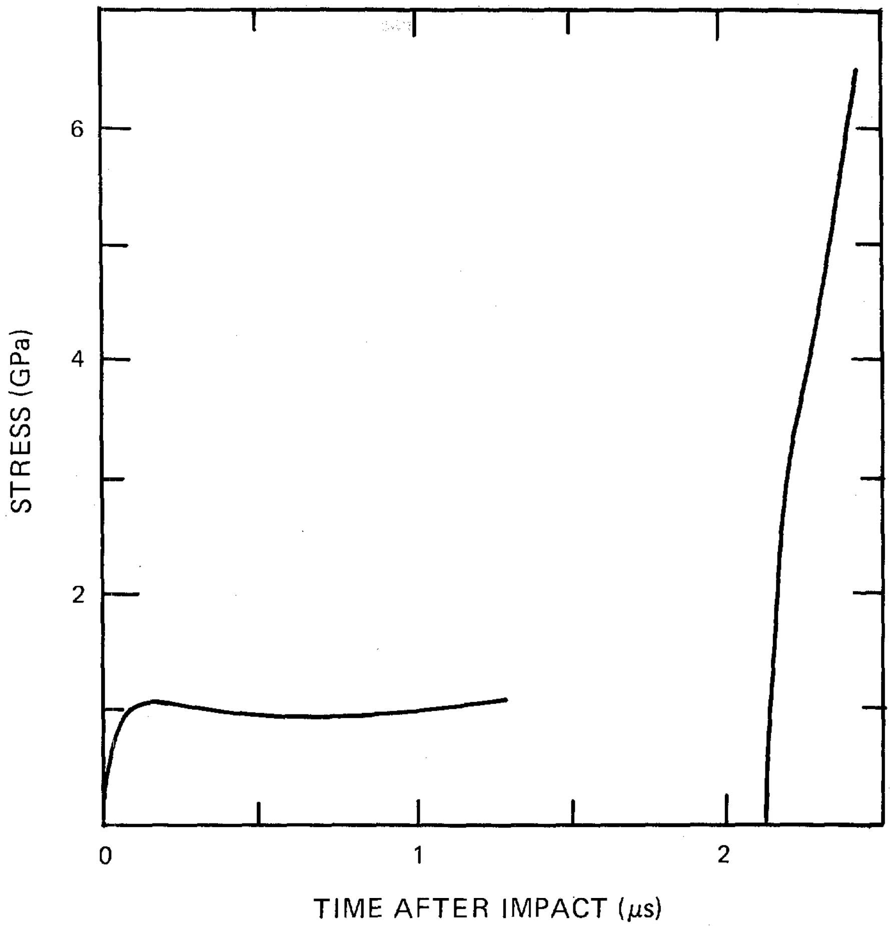


12
8
4
0
1
2
3
STRESS (GPa)
RELATIVE TIME (μs)

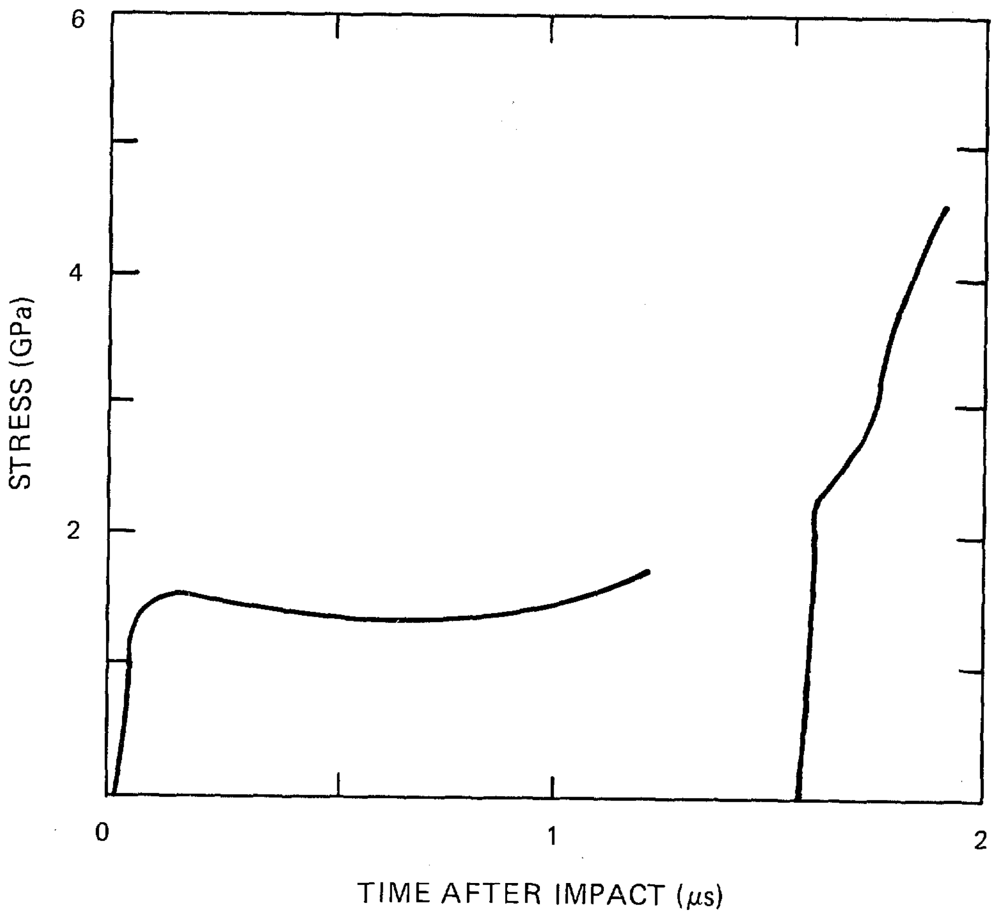
TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.0 GPa **Experimenters:** Jerry Wackerle and J. O. Johnson **Reference:** Wackerle and Johnson (1973) **Shot no.:** 6-3 **Series no.:** X67 **Date:** 1969 **Thickness:** 1.23 mm **Diameter:** 33 mm **Density:** 1.58 g/cm^3 **Fabrication:** Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below **Impact velocity:** 0.37 mm/μs
TRANSDUCERS	**Impact face:** Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode **Back face:** Shunted guard-ring quartz gage 22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode **Reference:** Graham, Neilson, and Benedick (1965) **Time after impact**


4
3
2
1
STRESS (GPa)
0
0.5
1.0
1.5
TIME AFTER IMPACT (μs)

TARGET	Material: Pressed PETN Experiment type: Quartz-gage front back Impact stress: 1.04 GPa Experimenters: Jerry Wackerle and J. O. Johnson Reference: Wackerle and Johnson (1973) Shot no.: 6-4 Series no.: X67 Date: 1969 Thickness: 4.23 mm Diameter: 33 mm Density: 1.59 g/cm^3 Fabrication: Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below Impact velocity: 0.375 mm/μs
TRANSDUCERS	Impact face: Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode Back face: Shunted guard-ring quartz gage 22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode Reference: Graham, Neilson, and Benedick (1965) Time after impact

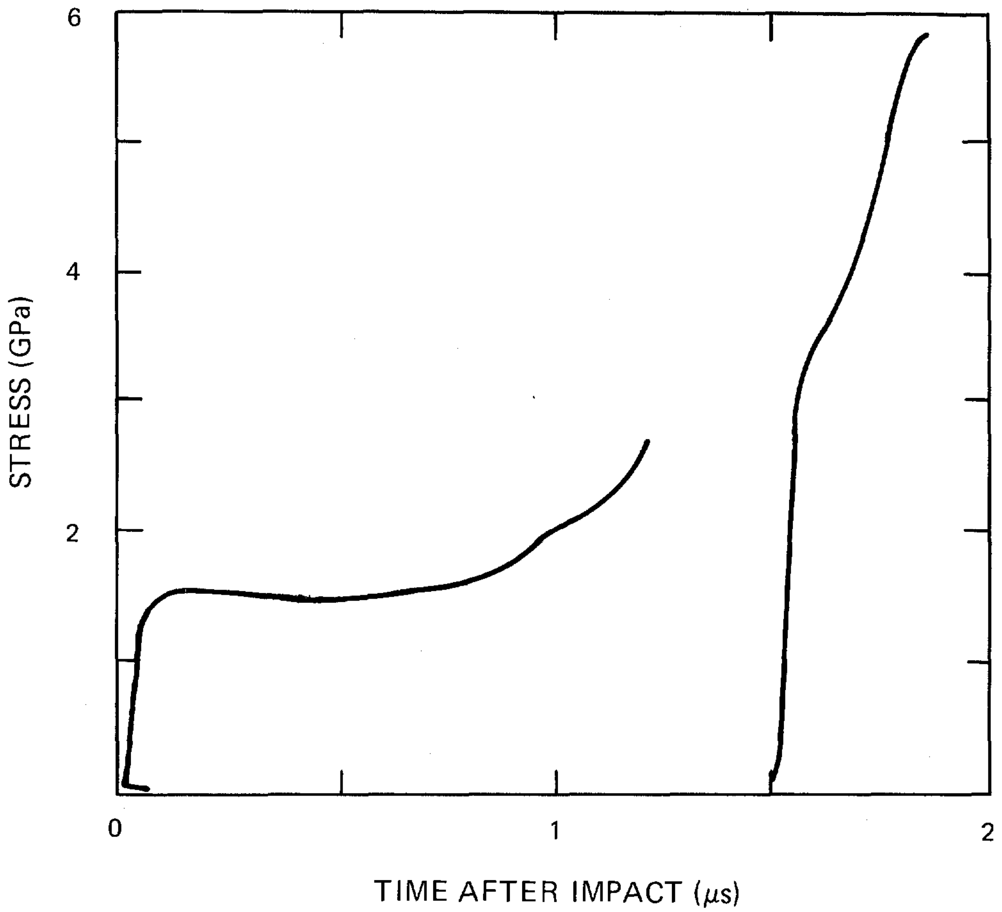

STRESS (GPa)
6
4
2
0
1
2
TIME AFTER IMPACT (μs)

TARGET	Material: Pressed PETN Experiment type: Quartz-gage front back IImpact stress: 1.50 GPa Experimenters: Jerry Wackerle and J. O. Johnson Reference: Wackerle and Johnson (1973) Shot no.: 7-2 Series no.: X67 Date: 1969 Thickness: 4.45 mm Diameter: 33 mm Density: 1.71 g/cm^3 $C_L = 2.9$ mm/μs $C_S = 1.5$ mm/μs Fabrication: Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below Impact velocity: 0.398 mm/μs
TRANSDUCERS	Impact face: Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode Back face: Shunted guard-ring quartz gage 22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode Reference: Graham, Neilson, and Benedick (1965) Time after impact

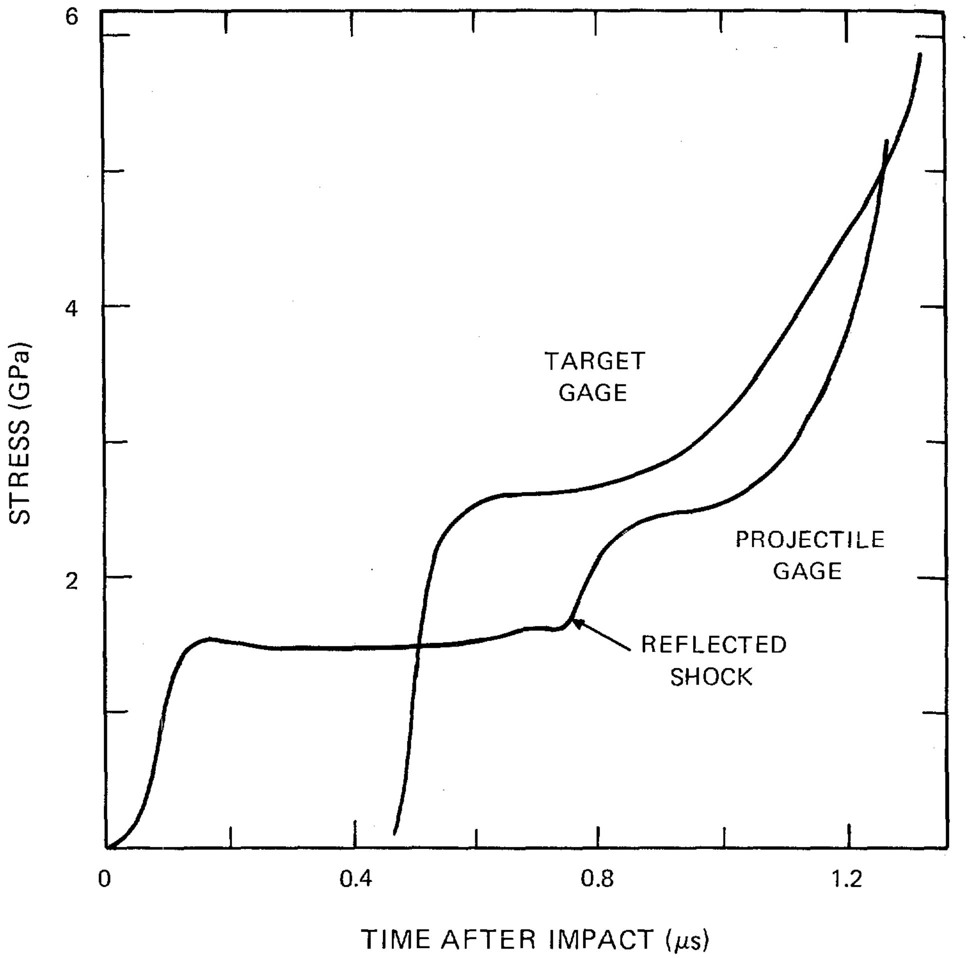


6
4
2
0
1
2
STRESS (GPa)
TIME AFTER IMPACT (μs)

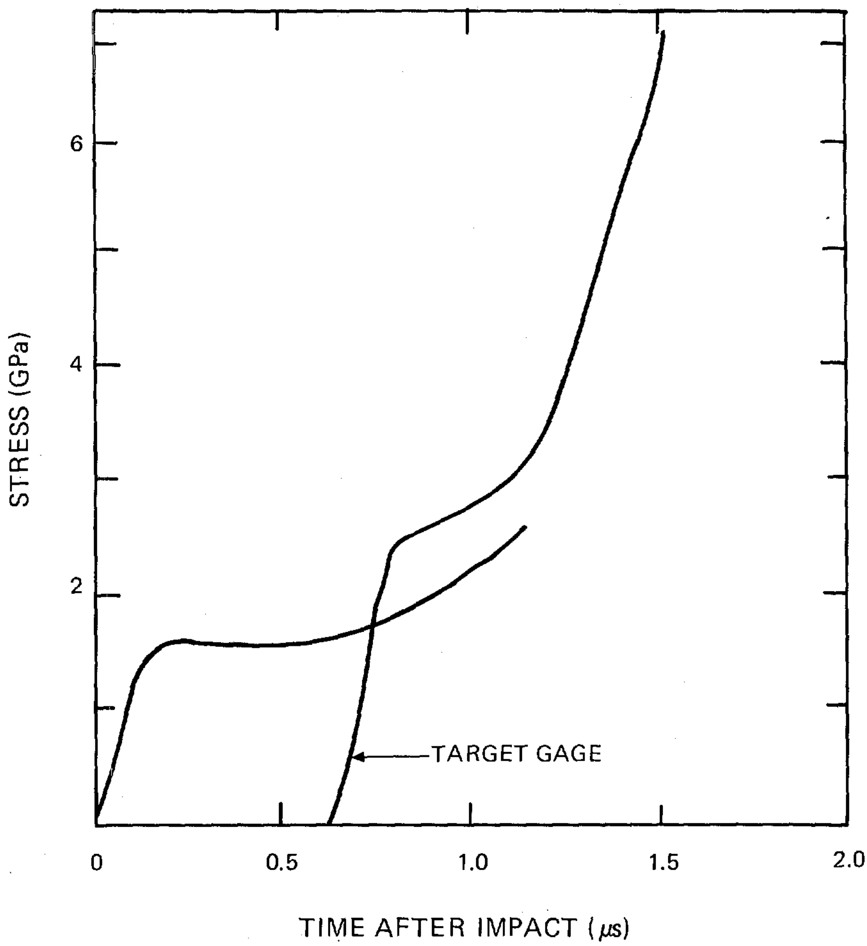
TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.68 GPa **Experimenters:** Jerry Wackerle and J. O. Johnson **Reference:** Wackerle and Johnson (1973) **Shot no.:** 7-3 **Series no.:** X67 **Date:** 1969 **Thickness:** 4.45 mm **Diameter:** 33 mm **Density:** 1.72 g/cm^3 $C_L = 2.93$ mm/μs $C_S = 1.55$ mm/μs **Fabrication:** Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below **Impact velocity:** 0.429 mm/μs
TRANSDUCERS	**Impact face:** Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode **Back face:** Shunted guard-ring quartz gage 22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode **Reference:** Graham, Neilson, and Benedick (1965) **Time after impact**


6
4
2
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

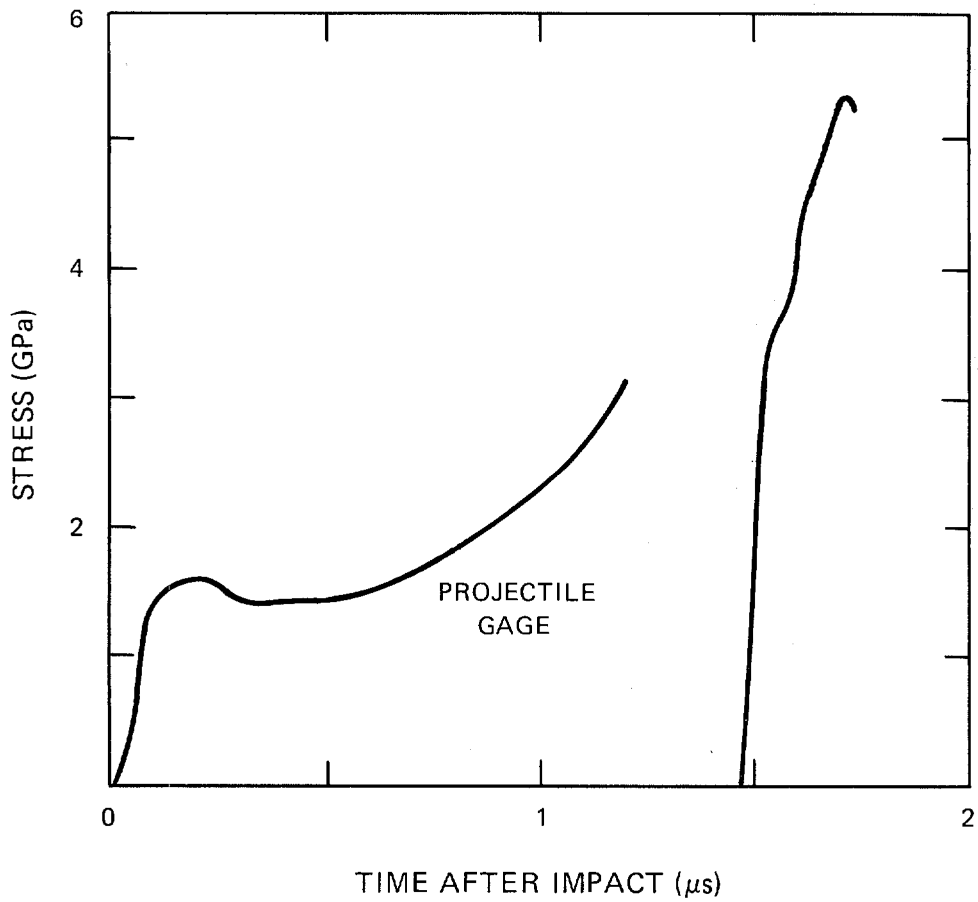
TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.67 GPa **Experimenters:** Jerry Wackerle and J. O. Johnson **Reference:** Wackerle and Johnson (1973) **Shot no.:** 7-7 **Series no.:** X67 **Date:** 1969 **Thickness:** 1.22 mm **Diameter:** 33 mm **Density:** 1.70 g/cm^3 $C_L = 2.9$ mm/μs $C_S = 1.5$ mm/μs **Fabrication:** Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below **Impact velocity:** 0.444 mm/μs
TRANSDUCERS	**Impact face:** Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode **Back face:** Shunted guard-ring quartz gage 22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode **Reference:** Graham, Neilson, and Benedick (1965) **Time after impact**


6
4
2
STRESS (GPa)
0
0.4
0.8
1.2
TIME AFTER IMPACT (μs)
TARGET GAGE
PROJECTILE GAGE
REFLECTED SHOCK

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.63 GPa **Experimenters:** Jerry Wackerle and J. O. Johnson **Reference:** Wackerle and Johnson (1973) **Shot no.:** 7-8 **Series no.:** X67 **Date:** 1969 **Thickness:** 1.91 mm **Diameter:** 33 mm **Density:** 1.71 g/cm^3 $C_L = 2.9$ mm/μs $C_S = 1.5$ mm/μs **Fabrication:** Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below **Impact velocity:** 0.444 mm/μs
TRANSDUCERS	**Impact face:** Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode **Back face:** Shunted guard-ring quartz gage 22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode **Reference:** Graham, Neilson, and Benedick (1965) **Time after impact**


STRESS (GPa)
6
4
2
0
0.5
1.0
1.5
2.0
TIME AFTER IMPACT (μs)
TARGET GAGE

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.63 GPa **Experimenters:** Jerry Wackerle and J. O. Johnson **Reference:** Wackerle and Johnson (1973) **Shot no.:** 7-9 **Series no.:** X67 **Date:** 1969 **Thickness:** 3.95 mm **Diameter:** 33 mm **Density:** 1.6 g/cm^3 $C_L = 2.9$ mm/μs $C_S = 1.5$ mm/μs **Fabrication:** Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below **Impact velocity:** 0.444 mm/μs
TRANSDUCERS	**Impact face:** Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode **Back face:** Shunted guard-ring quartz gage 22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode **Reference:** Graham, Neilson, and Benedick (1965) **Time after impact**



6
4
2
0
1
2
STRESS (GPa)
TIME AFTER IMPACT (μs)
PROJECTILE
GAGE

TARGET

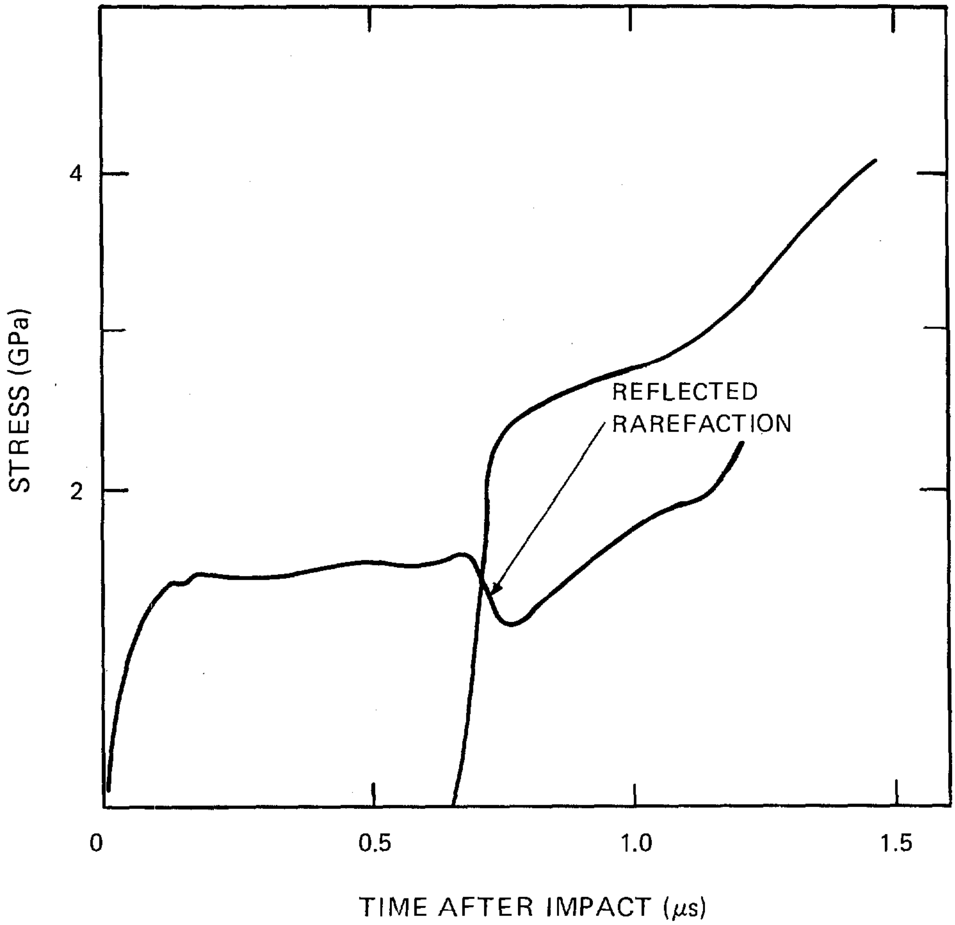
Material: Pressed PETN
Experiment type: Quartz-gage front back
Impact stress: 1.75 GPa
Experimenters: Jerry Wackerle and J. O. Johnson
Reference: Wackerle and Johnson (1973)
Shot no.: 7-10 **Series no.:** X67 **Date:** 1969
Thickness: 1.23 mm **Diameter:** 33 mm
Density: 1.71 g/cm^3
$C_L = 2.9$ mm/μs $C_S = 1.5$ mm/μs
Fabrication: Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN with an 0.82-mm Lucite buffer layer included between the explosive sample and the target gage

IMPACTOR

50-mm-diam aluminum alloy projectile faced with quartz gage described below
Impact velocity: 0.453 mm/μs

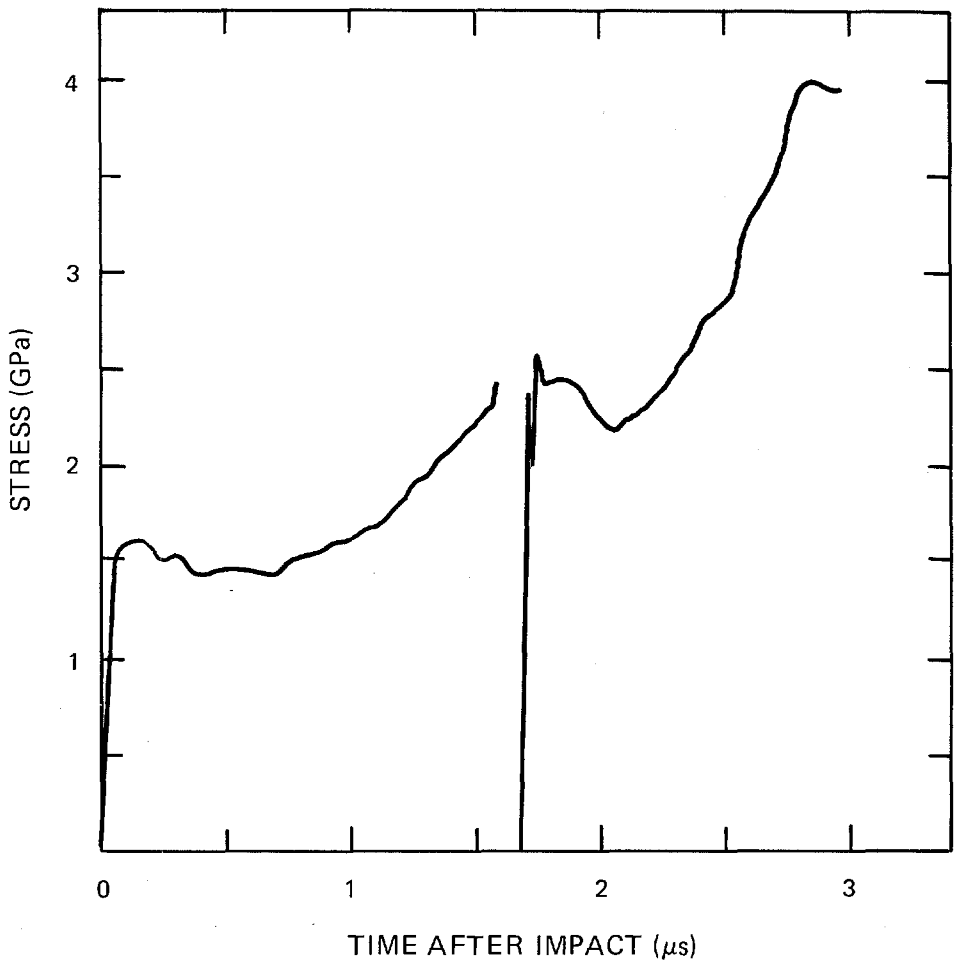
TRANSDUCERS

Impact face: Shunted guard-ring quartz gage
30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode
Back face: Shunted guard-ring quartz gage
22-mm diam by 4.8 mm thick; 9.4-mm-diam electrode
Reference: Graham, Neilson, and Benedick (1965)
Time after impact

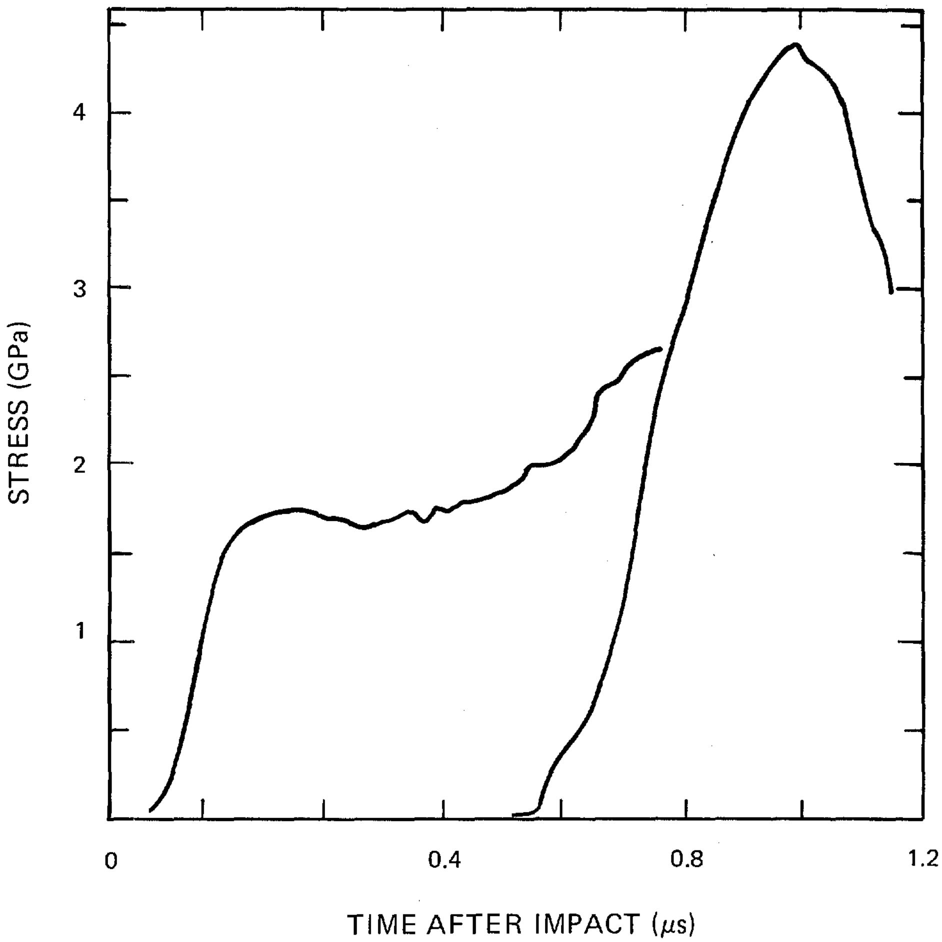


STRESS (GPa)
4
2
0
0.5
1.0
1.5
TIME AFTER IMPACT (μs)
REFLECTED
RAREFACTION

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.6 GPa **Experimenters:** Jerry Wackerle, P. M. Halleck, and J. O. Johnson **References:** Wackerle, Johnson, and Halleck (1975a), (1976) **Shot no.:** 26 **Series no.:** HDPQ **Date:** November 19, 1971 **Thickness:** 5.11 mm **Diameter:** 40 mm **Density:** 1.7 g/cm^3 $C_L = 2.98$ mm/μs $C_S = 1.64$ mm/μs **Fabrication:** Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below **Impact velocity:** 0.38 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 30-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 28-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**

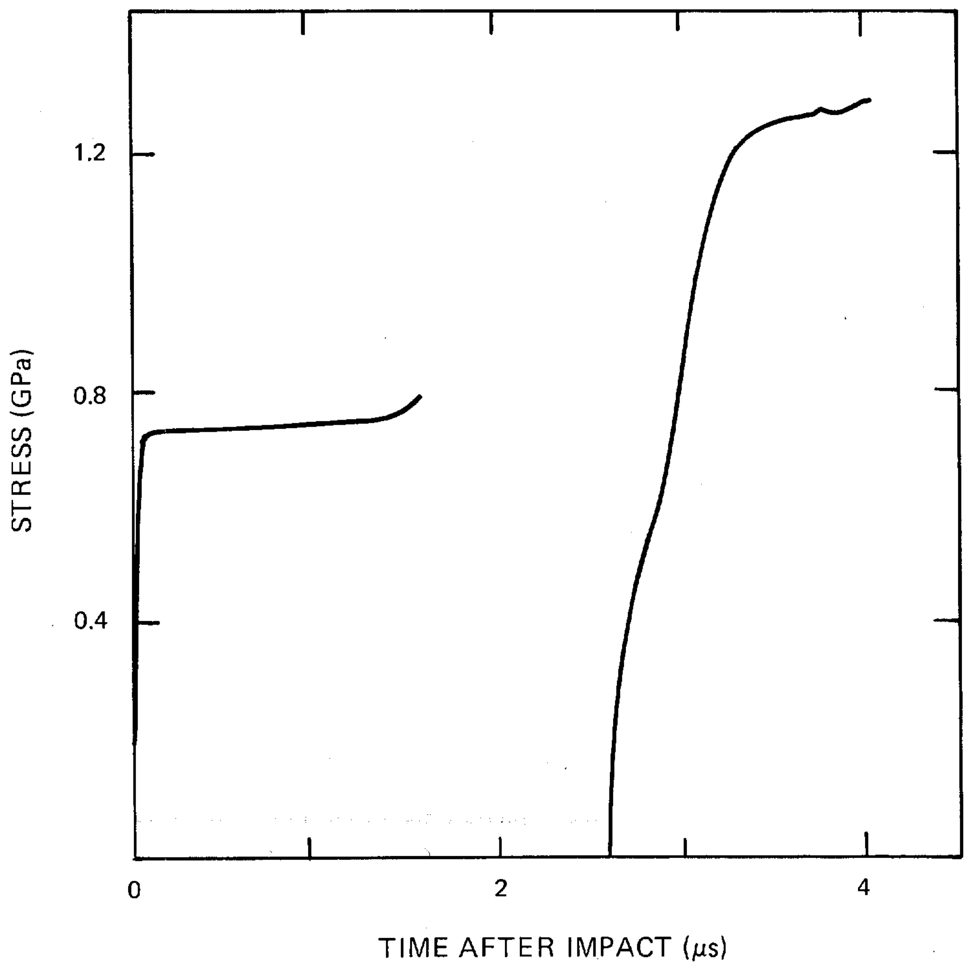

4
3
2
1
STRESS (GPa)
0
1
2
3
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.8 GPa **Experimenters:** Jerry Wackerle, P. M. Halleck, and J. O. Johnson **References:** Wackerle, Johnson, and Halleck (1975a), (1976) **Shot no.:** 28 **Series no.:** HDPQ **Date:** December 13, 1971 **Thickness:** 2.0 mm **Diameter:** 40 mm **Density:** 1.7 g/cm^3 $C_L = 2.98$ mm/μs $C_S = 1.64$ mm/μs **Fabrication:** Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below **Impact velocity:** 0.56 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 30-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 23-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**

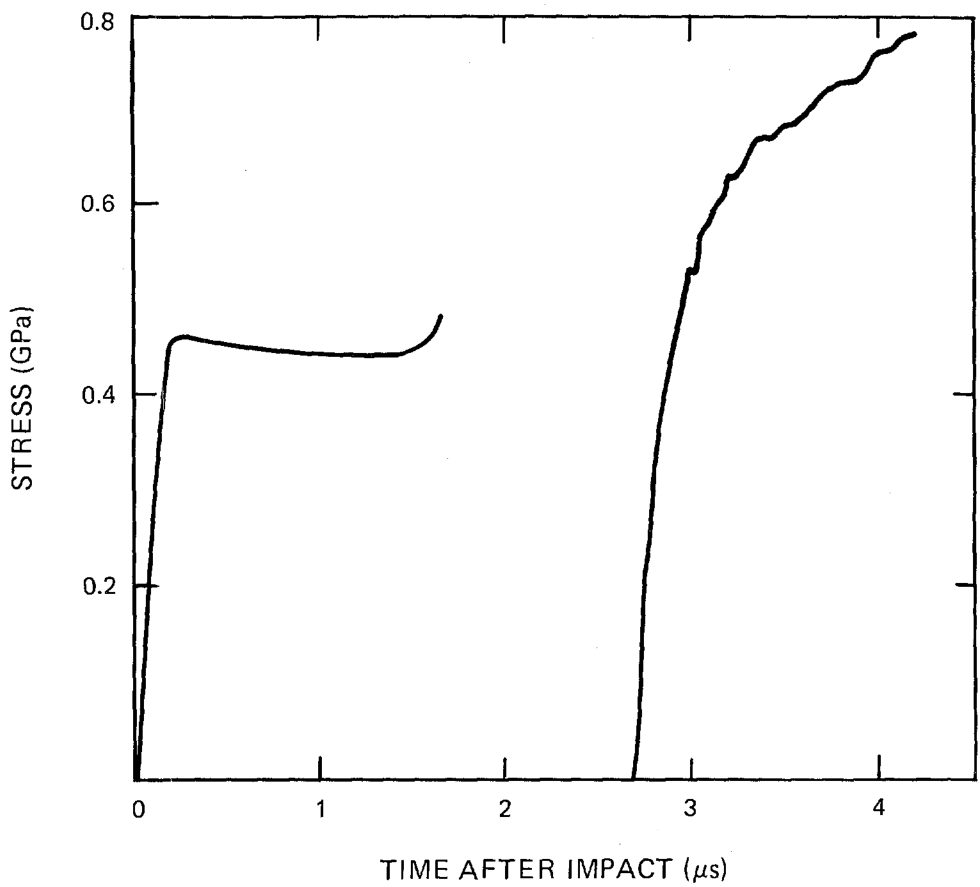


STRESS (GPa)
4
3
2
1
0
0.4
0.8
1.2
TIME AFTER IMPACT (μs)

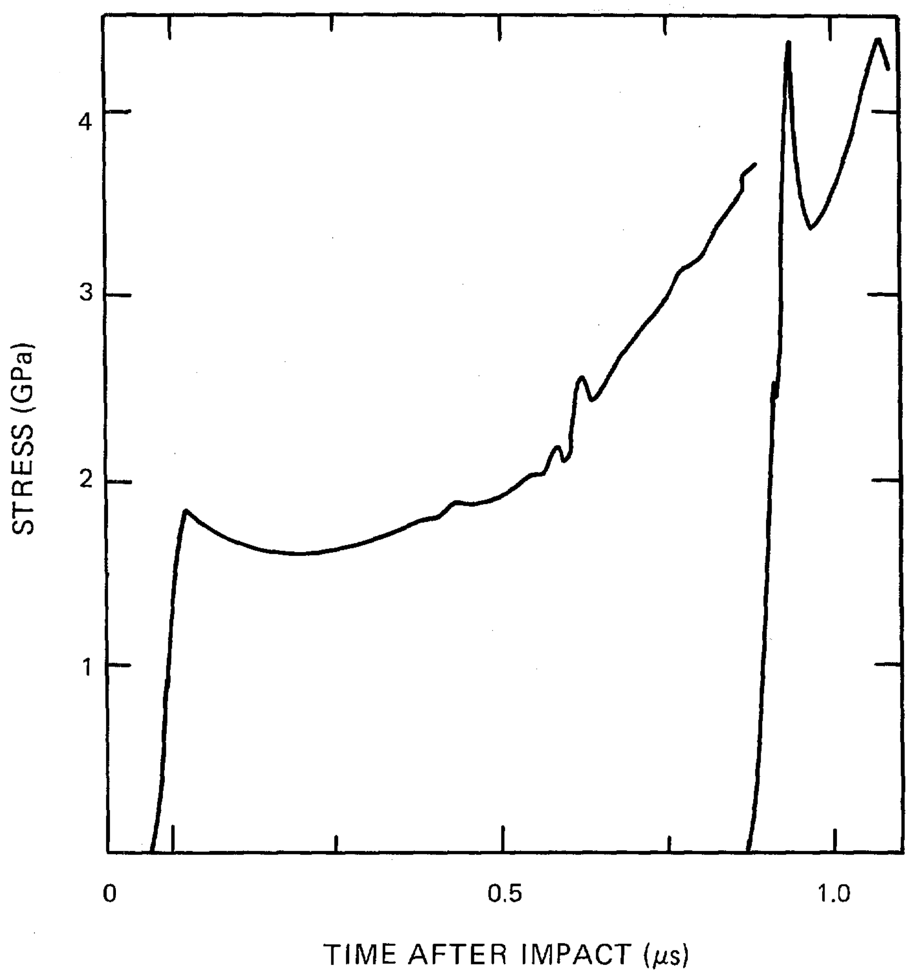
TARGET	Material: Pressed PETN Experiment type: Quartz-gage front back Impact stress: 0.72 GPa Experimenters: Jerry Wackerle, P. M. Halleck, and J. O. Johnson References: Wackerle, Johnson, and Halleck (1975a), (1976) Shot no.: 29 Series no.: HDPQ Date: December 15, 1971 Thickness: 8.1 mm Diameter: 40 mm Density: 1.750 g/cm^3 $C_L = 2.98$ mm/μs $C_S = 1.64$ mm/μs Fabrication: Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below Impact velocity: 0.202 mm/μs
TRANSDUCERS	Impact face: Grounded guard-ring quartz gage 30-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Back face: Grounded guard-ring quartz gage 23-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Calibration: Wackerle, with field-fringe correction Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact


STRESS (GPa)
1.2
0.8
0.4
0
2
4
TIME AFTER IMPACT (μs)

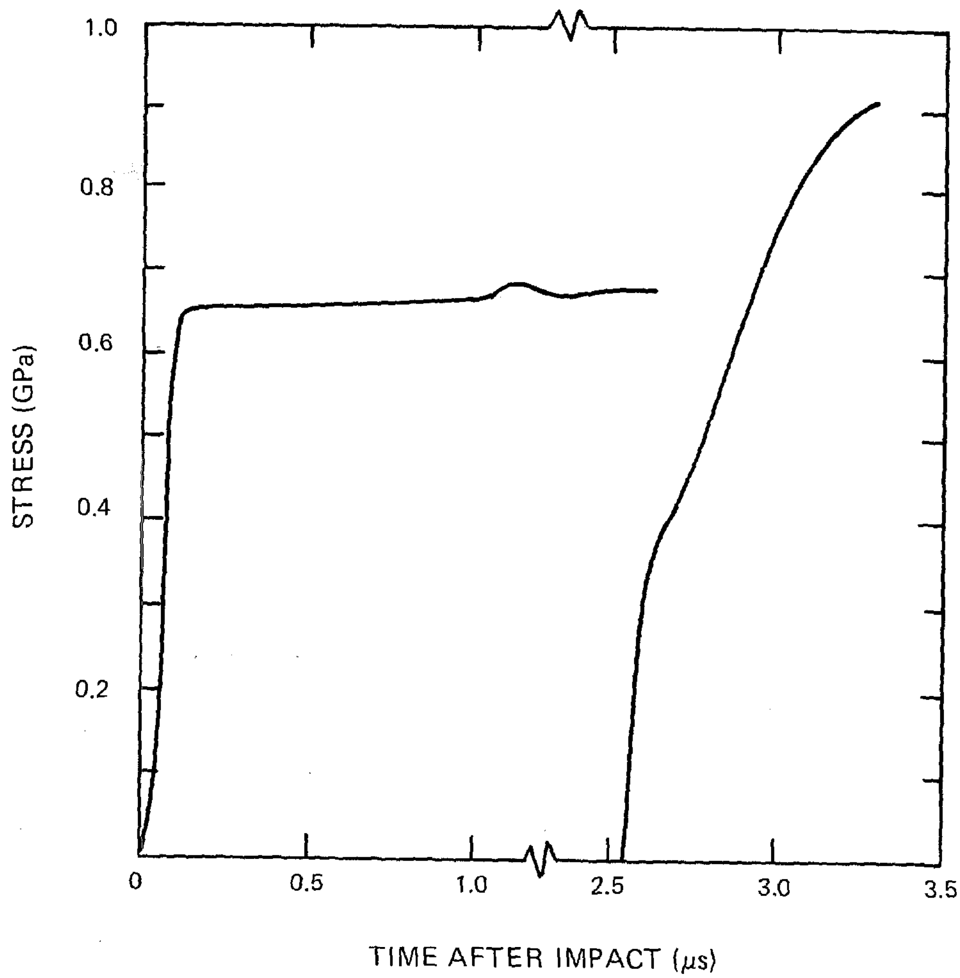
TARGET	Material: Pressed PETN Experiment type: Quartz-gage front back Impact stress: 0.46 GPa Experimenters: Jerry Wackerle, P. M. Halleck, and J. O. Johnson References: Wackerle, Johnson, and Halleck (1975a), (1976) Shot no.: 30 Series no.: HDPQ Date: December 17, 1971 Thickness: 8.11 mm Diameter: 40 mm Density: 1.752 g/cm^3 $C_L = 2.98$ mm/µs $C_S = 1.64$ mm/µs Fabrication: Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below Impact velocity: 0.121 mm/µs
TRANSDUCER	Impact face: Grounded guard-ring quartz gage 33-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Back face: Grounded guard-ring quartz gage 23-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Calibration: Wackerle, with field-fringe correction Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact


0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
TIME AFTER IMPACT (μs)

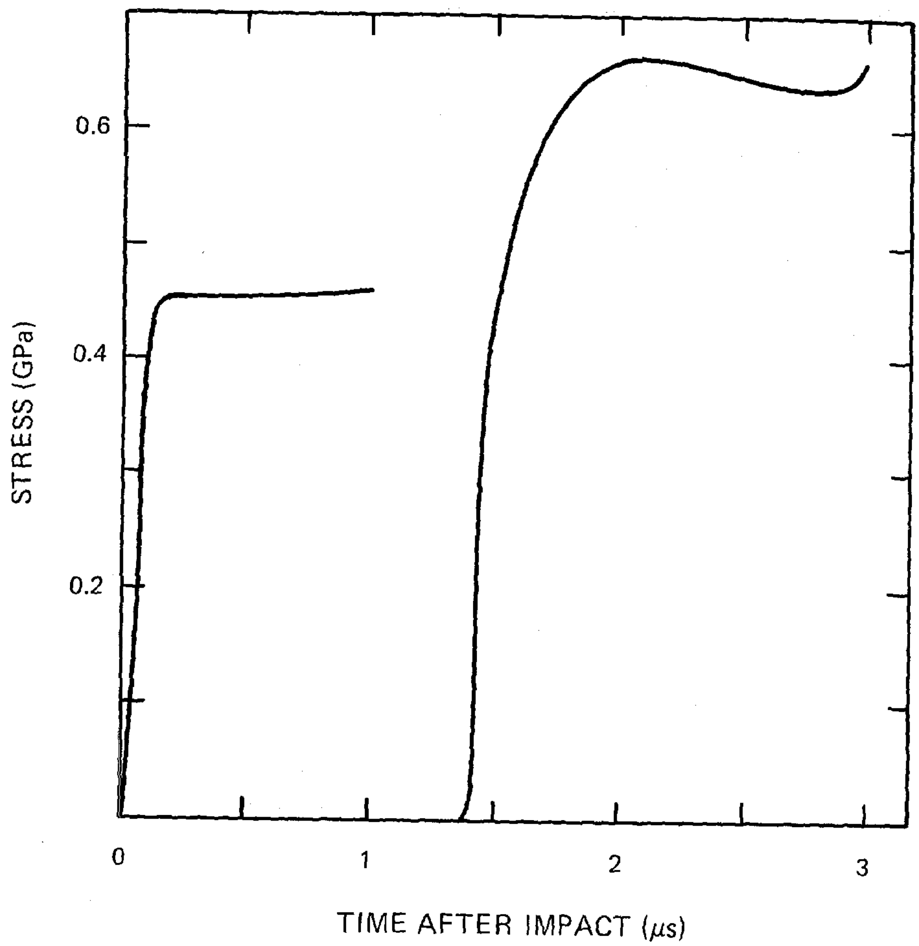
TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.7 GPa **Experimenters:** Jerry Wackerle, P. M. Halleck, and J. O. Johnson **References:** Wackerle, Johnson, and Halleck (1975a), (1976) **Shot no.:** 33 **Series no.:** HDPQ **Date:** January 3, 1972 **Thickness:** 3.05 mm **Diameter:** 40 mm **Density:** 1.7 g/cm^3 $C_L = 2.98$ mm/µs $C_S = 1.64$ mm/µs **Fabrication:** Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below **Impact velocity:** 0.504 mm/µs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 33-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 23-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**


STRESS (GPa)
1
2
3
4
0
0.5
1.0
TIME AFTER IMPACT (μs)

TARGET	Material: Pressed PETN Experiment type: Quartz-gage front back Impact stress: 0.66 GPa Experimenters: Jerry Wackerle, P. M. Halleck, and J. O. Johnson References: Wackerle, Johnson, and Halleck (1975a), (1976) Shot no.: 44 Series no.: HDPQ Date: February 29, 1972 Thickness: 8.12 mm Diameter: 40 mm Density: 1.750 g/cm^3 $C_L = 2.98$ mm/µs $C_S = 1.64$ mm/µs Fabrication: Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below Impact velocity: 0.184 mm/µs
TRANSDUCERS	Impact face: Grounded guard-ring quartz gage 33-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Back face: Grounded guard-ring quartz gage 23-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Calibration: Wackerle, with field-fringe correction Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact

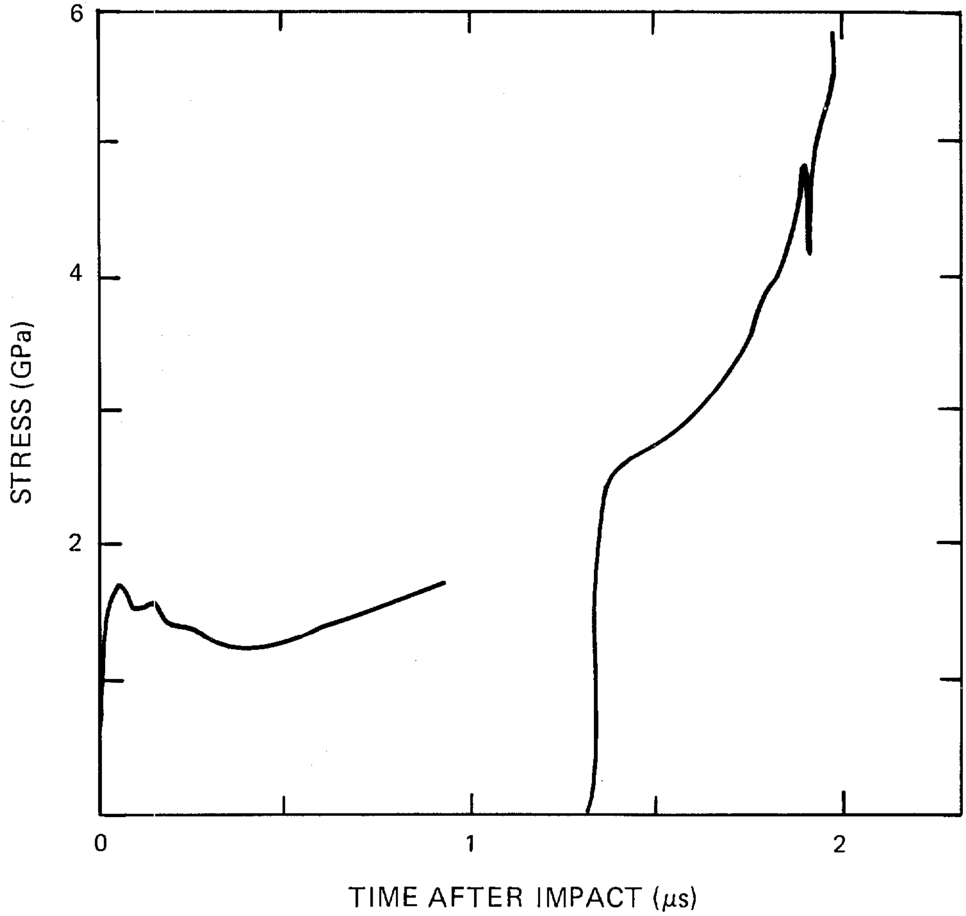

1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
0.5
1.0
2.5
3.0
3.5
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.45 GPa **Experimenters:** Jerry Wackerle, P. M. Halleck, and J. O. Johnson **References:** Wackerle, Johnson, and Halleck (1975a), (1976) **Shot no.:** 45 **Series no.:** HDPQ **Date:** March 1, 1972 **Thickness:** 4.04 mm **Diameter:** 40 mm **Density:** 1.750 g/cm^3 $C_L = 2.98$ mm/μs $C_S = 1.64$ mm/μs **Fabrication:** Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below **Impact velocity:** 0.121 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 33-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 23-mm diam by 9.2 mm thick; 9.6-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**

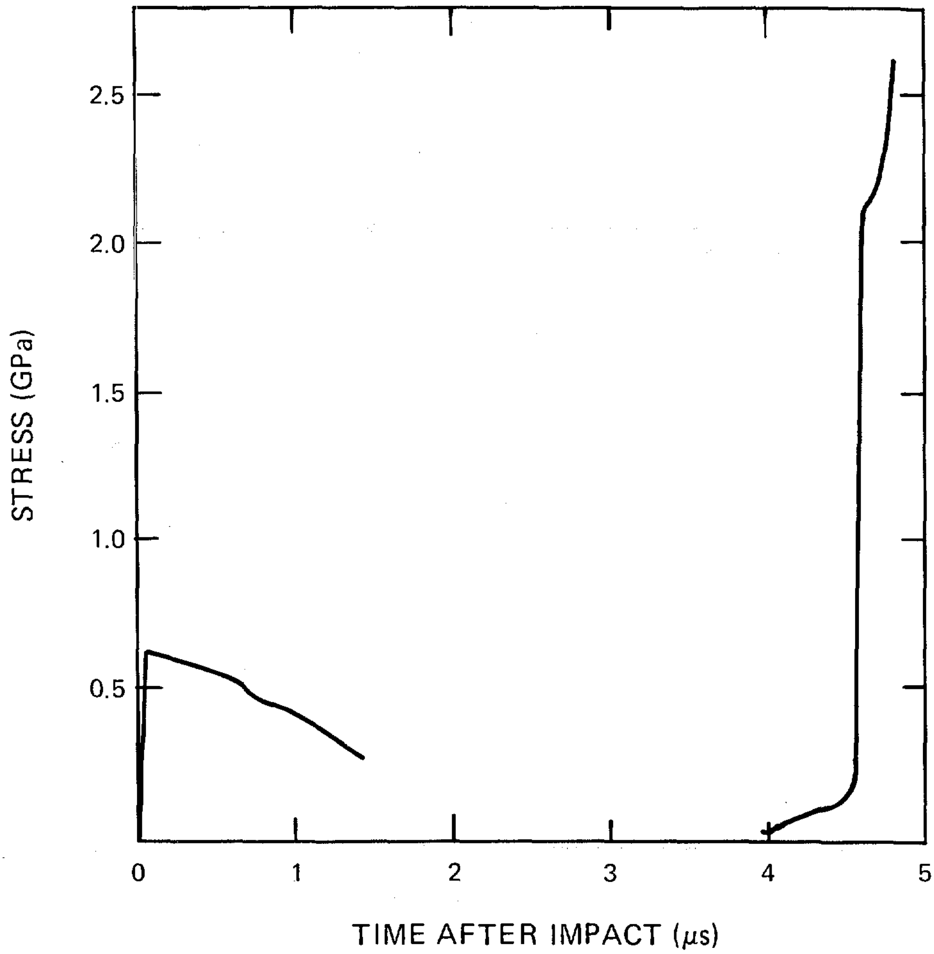


STRESS (GPa)
0.2
0.4
0.6
0
1
2
3
TIME AFTER IMPACT (μs)

TARGET	Material: Pressed PETN Experiment type: Quartz-gage front back Impact stress: 1.6 GPa Experimenters: Jerry Wackerle, P. M. Halleck, and J. O. Johnson References: Wackerle, Johnson, and Halleck (1975a), (1976) Shot no.: 97 Series no.: HDPQ Date: November 18, 1972 Thickness: 5.10 mm Diameter: 40 mm Density: 1.7 g/cm^3 $C_L = 2.98$ mm/μs $C_S = 1.64$ mm/μs Fabrication: Specimens were dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and were machined into disks
IMPACTOR	Aluminum alloy projectile faced with impact-face gage described below Impact velocity: 0.41 mm/μs
TRANSDUCERS	Impact face: Grounded guard-ring quartz gage 33-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Back face: Grounded guard-ring quartz gage 23-mm diam by 9.2 mm thick; 9.6-mm-diam electrode Calibration: Wackerle, with field-fringe correction Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact

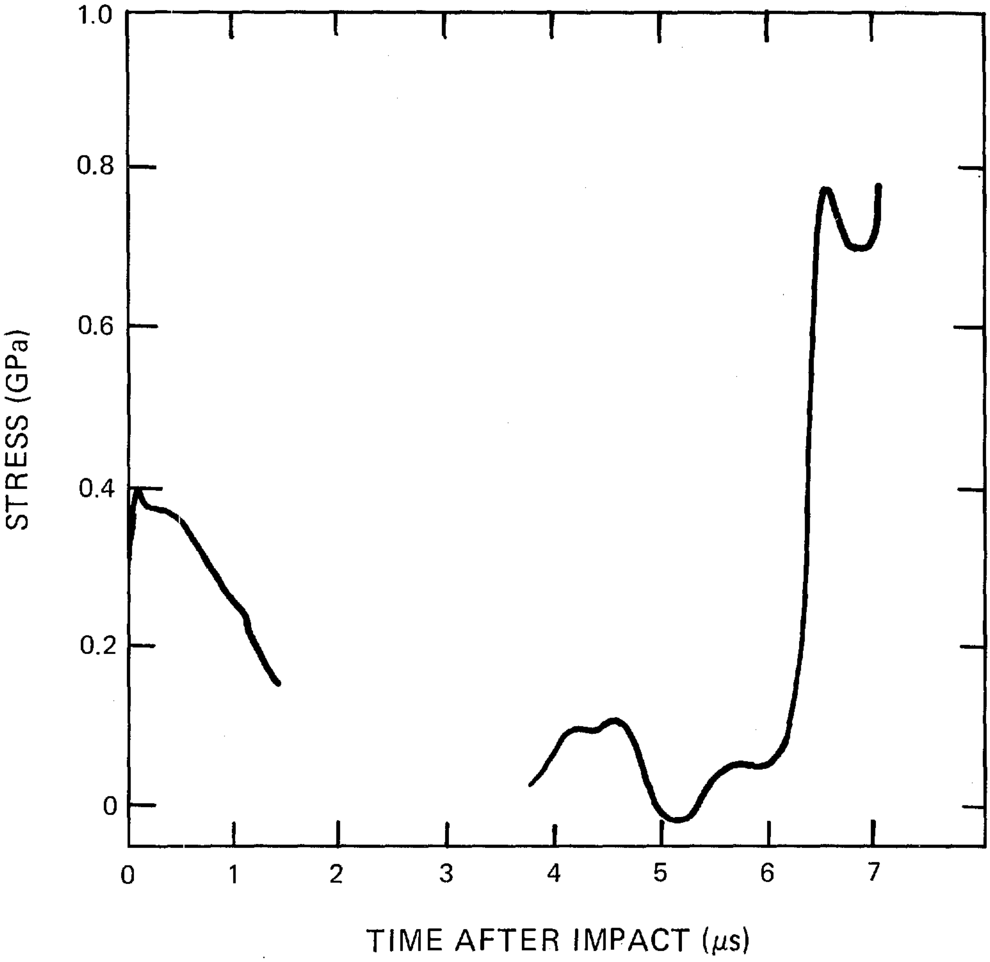

6
4
2
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.64 GPa **Experimenters:** P. M. Halleck, J. O. Johnson, and Jerry Wackerle **Reference:** Wackerle, Johnson, and Halleck (1975b) **Shot no.:** 195 **Series:** LDPQ **Date:** May 2, 1974 **Thickness:** 6.35 mm **Diameter:** 41 mm **Density:** 1.402 g/cm^3 **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	Aluminum or brass projectile faced with impact-face gage described below **Impact velocity:** 0.311 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 35-mm diam by 8.65 mm thick; 6.4-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 20-mm diam by 4.1 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**



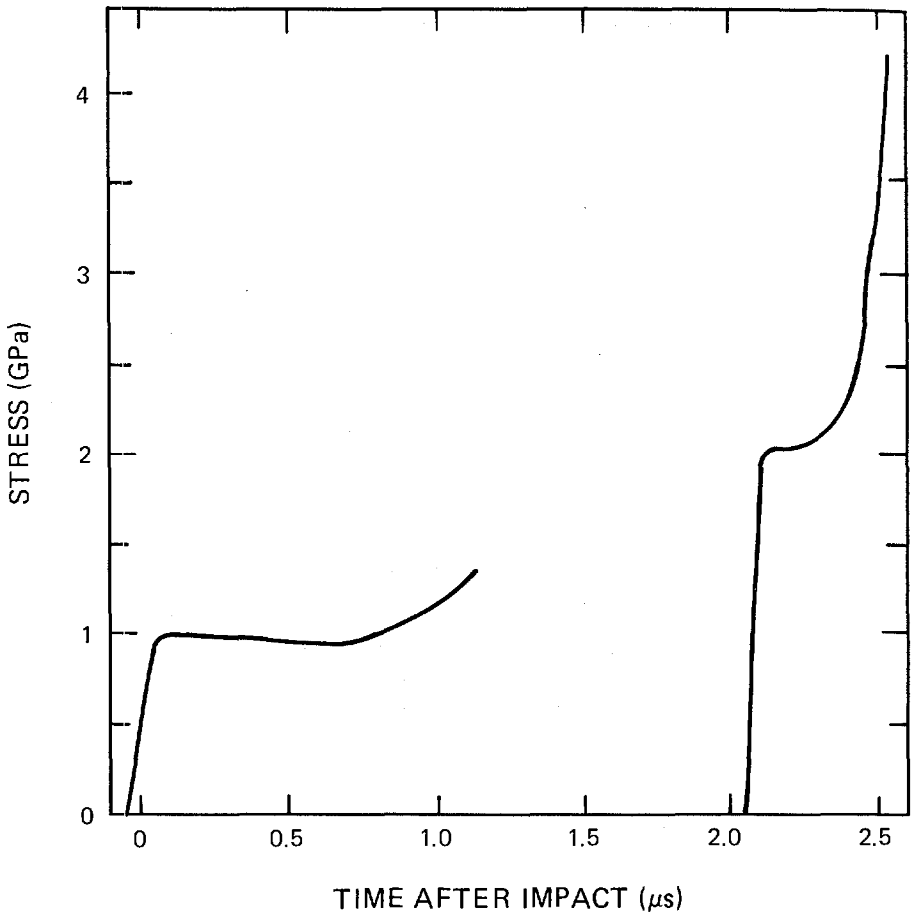
2.5
2.0
1.5
1.0
0.5
STRESS (GPa)
0
1
2
3
4
5
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.38 GPa **Experimenters:** P. M. Halleck, J. O. Johnson, and Jerry Wackerle **Reference:** Wackerle, Johnson, and Halleck (1975b) **Shot no.:** 196 **Series:** LDPQ **Date:** May 6, 1974 **Thickness:** 6.35 mm **Diameter:** 41 mm **Density:** 1.403 g/cm^3 **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	Aluminum or brass projectile faced with impact-face gage described below **Impact velocity:** 0.215 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 35-mm diam by 8.65 mm thick; 6.4-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 20-mm diam by 4.1 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**
NOTES	The target-gage record is calibrated for stress only during the first 0.7 μs of the precursor; it serves only as an arrival-time indicator for the main shock wave.

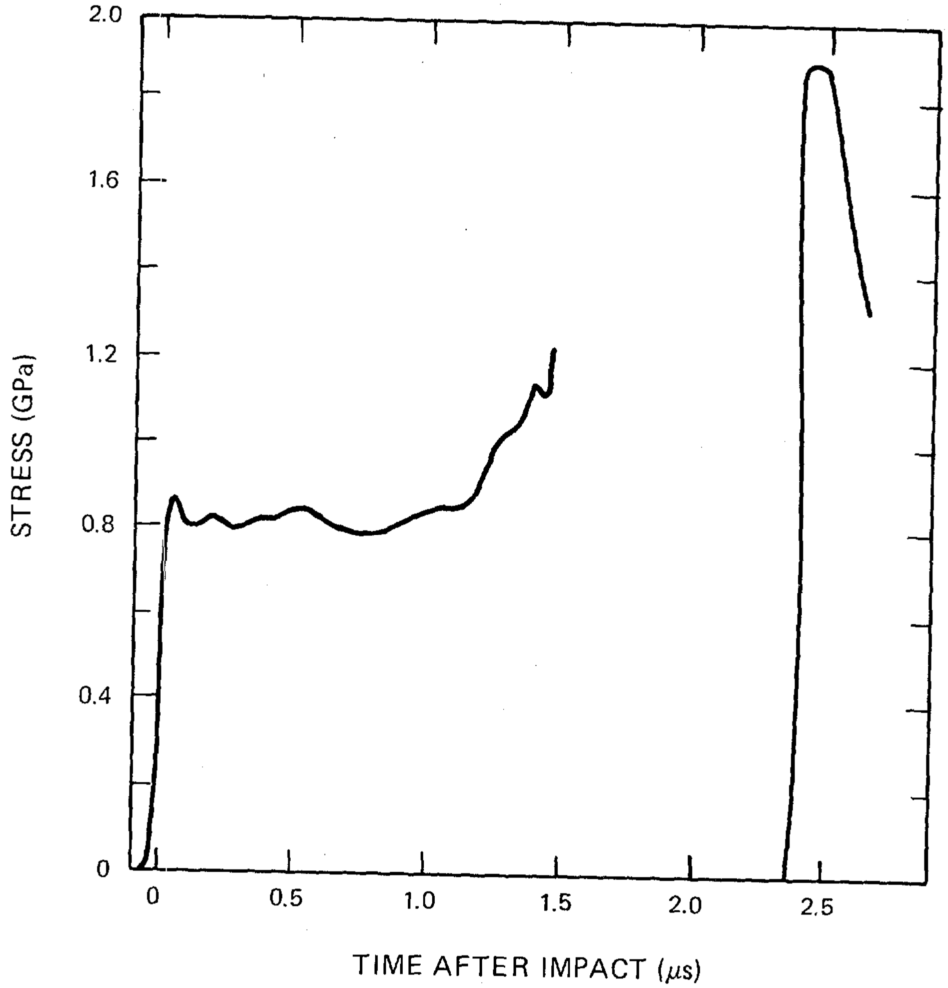


1.0
0.8
0.6
0.4
0.2
0
STRESS (GPa)
0
1
2
3
4
5
6
7
TIME AFTER IMPACT (μs)

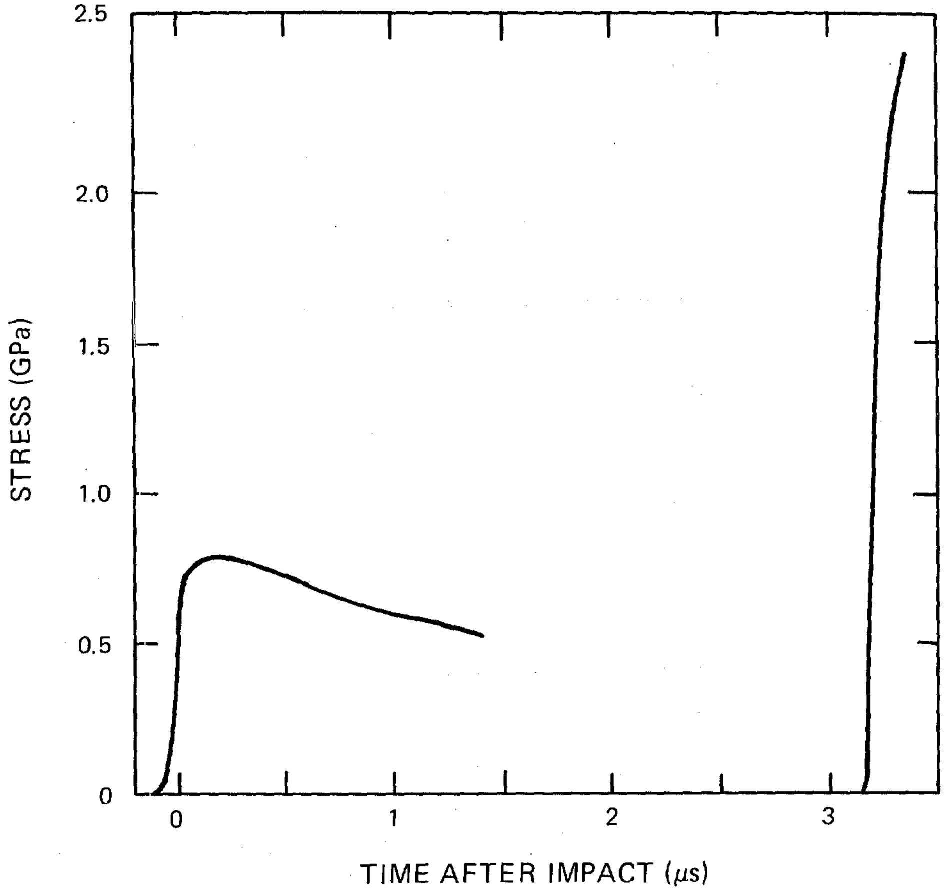
TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.99 GPa **Experimenters:** P. M. Halleck, J. O. Johnson, and Jerry Wackerle **Reference:** Wackerle, Johnson, and Halleck (1975b) **Shot no.:** 197 **Series:** LDPQ **Date:** May 7, 1974 **Thickness:** 6.34 mm **Diameter:** 41 mm **Density:** 1.400 g/cm^3 **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	Aluminum or brass projectile faced with impact-face gage described below **Impact velocity:** 0.407 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 35-mm diam by 8.65 mm thick; 6.4-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 20-mm diam by 4.1 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**


4
3
2
1
0
STRESS (GPa)
0
0.5
1.0
1.5
2.0
2.5
TIME AFTER IMPACT (μs)

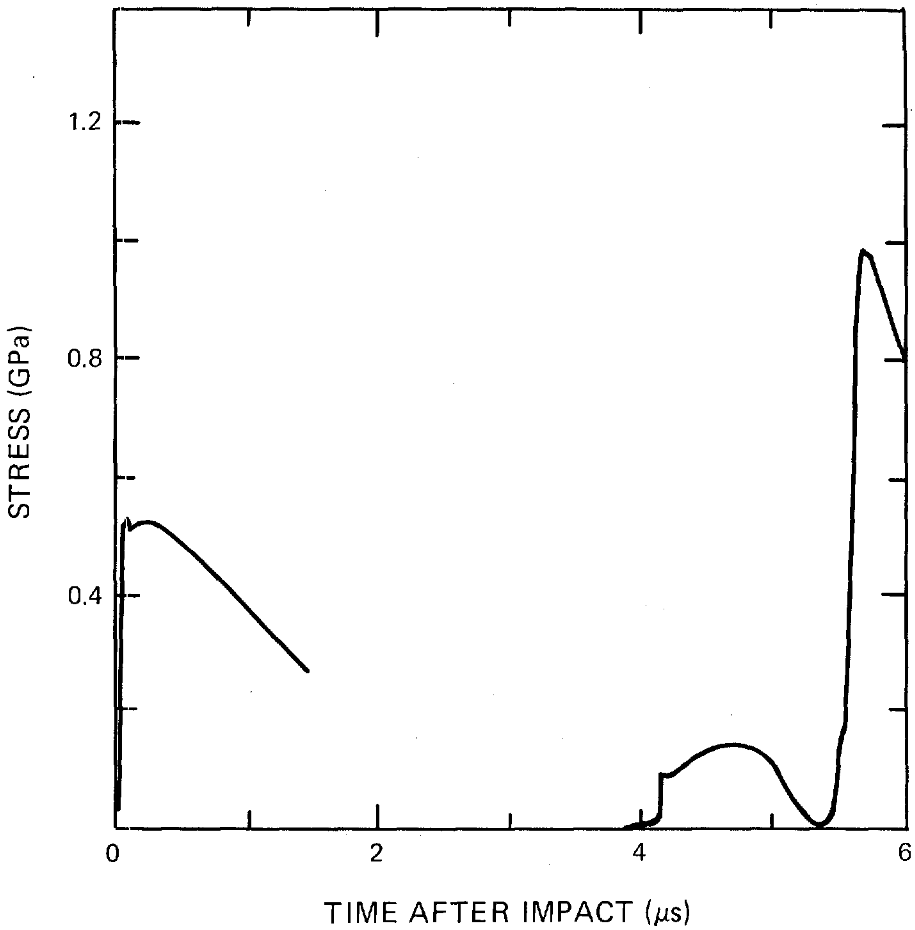
TARGET	Material: Pressed PETN Experiment type: Quartz-gage front back Impact stress: 0.85 GPa Experimenters: P. M. Halleck, J. O. Johnson, and Jerry Wackerle Reference: Wackerle, Johnson, and Halleck (1975b) Shot no.: 198 Series: LDPQ Date: May 10, 1974 Thickness: 6.35 mm Diameter: 41 mm Density: 1.399 g/cm^3 Fabrication: Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	Aluminum or brass projectile faced with impact-face gage described below Impact velocity: 0.389 mm/µs
TRANSDUCERS	Impact face: Grounded guard-ring quartz gage 35-mm diam by 8.65 mm thick; 6.4-mm-diam electrode Back face: Grounded guard-ring quartz gage 20-mm diam by 4.1 mm thick; 5.2-mm-diam electrode Calibration: Wackerle, with field-fringe correction Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact


2.0
1.6
1.2
0.8
0.4
0
STRESS (GPa)
0
0.5
1.0
1.5
2.0
2.5
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.77 GPa **Experimenters:** P. M. Halleck, J. O. Johnson, and Jerry Wackerle **Reference:** Wackerle, Johnson, and Halleck (1975b) **Shot no.:** 199 **Series:** LDPQ **Date:** May 15, 1974 **Thickness:** 6.35 mm **Diameter:** 41 mm **Density:** 1.404 g/cm^3 **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	Aluminum or brass projectile faced with impact-face gage described below **Impact velocity:** 0.354 mm/µs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 35-mm diam by 8.65 mm thick; 6.4-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 20-mm diam by 4.1 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**

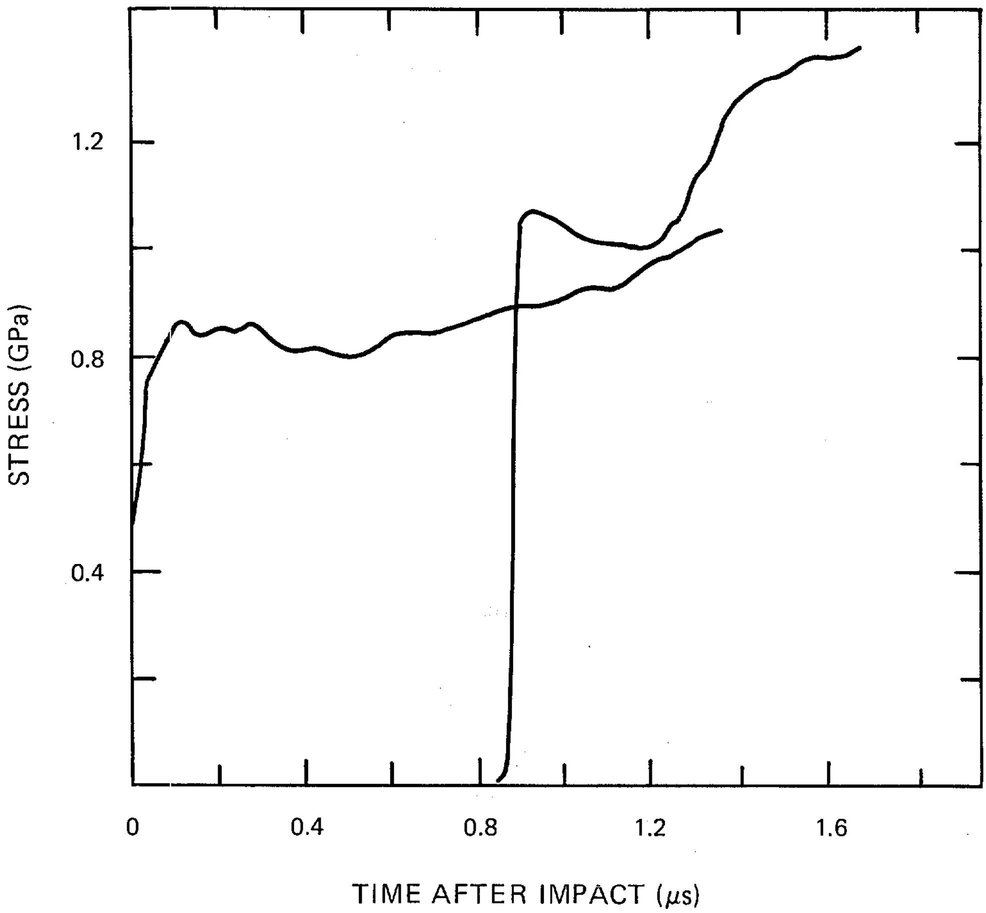

2.5
2.0
1.5
1.0
0.5
0
STRESS (GPa)
0
1
2
3
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.52 GPa **Experimenters:** P. M. Halleck, J. O. Johnson, and Jerry Wackerle **Reference:** Wackerle, Johnson, and Halleck (1975b) **Shot no.:** 200 **Series:** LDPQ **Date:** May 16, 1974 **Thickness:** 6.35 mm **Diameter:** 41 mm **Density:** 1.407 g/cm^3 **Fabrication:** Specimen was dry-pressed from permeametric specific surface 3000-cm^2/g detonator-grade PETN and was machined into disks
IMPACTOR	Aluminum or brass projectile faced with impact-face gage described below **Impact velocity:** 0.269 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 35-mm diam by 8.65 mm thick; 6.4-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 20-mm diam by 4.1 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**
NOTES	The target-gage record is calibrated for stress only during the first 0.7 μs of the precursor; it serves only as an arrival-time indicator for the main shock wave.

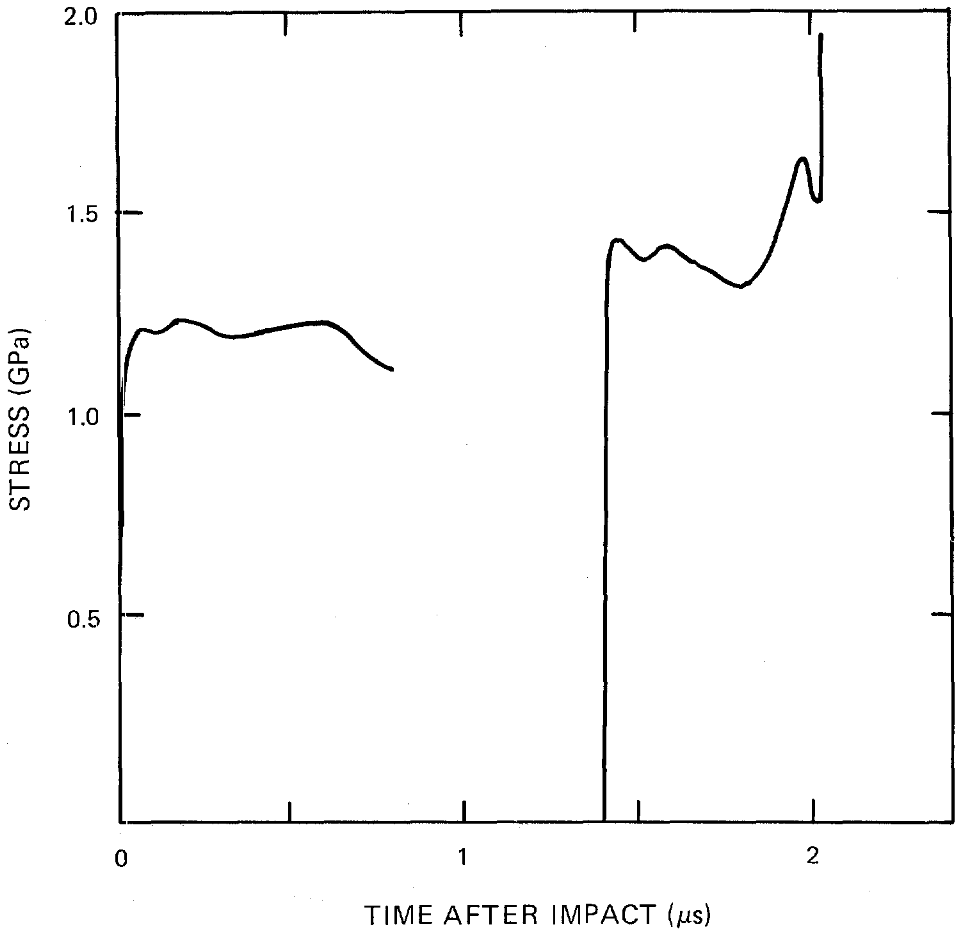


1.2
0.8
0.4
STRESS (GPa)
0
2
4
6
TIME AFTER IMPACT (μs)

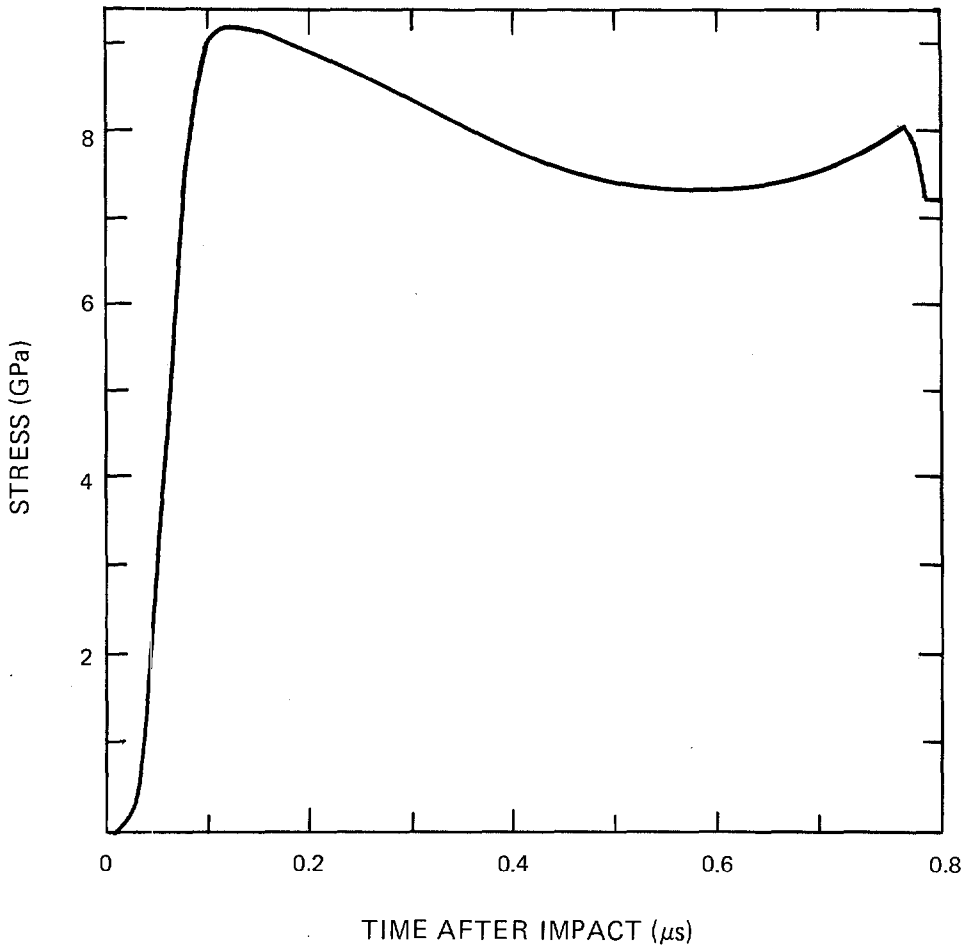
TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.84 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a); Halleck and Wackerle (1976) **Shot no.:** 91 **Series no.:** SXP **Date:** September 4, 1972 **Thickness:** 2.95 mm **Square side:** 30 mm **Density:** 1.778 g/cm^3 C_L = 2.93 mm/μs C_S = 1.82 mm/μs **Orientation:** [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.227 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 31-mm diam by 9.2 mm thick; 9.7-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 24-mm diam by 4.8 mm thick; 6.4-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**


1.2
0.8
0.4
STRESS (GPa)
0
0.4
0.8
1.2
1.6
TIME AFTER IMPACT (μs)

TARGET	Material: Single-crystal PETN Experiment type: Quartz-gage front back Impact stress: 1.2 GPa Experimenters: P. M. Halleck and Jerry Wackerle References: Wackerle, Johnson, and Halleck (1975a); Halleck and Wackerle (1976) Shot no.: 102 Series no.: SXP Date: December 1, 1972 Thickness: 4.75 mm Square side: 24 mm Density: 1.778 g/cm^3 $C_L = 2.93$ mm/µs $C_S = 1.82$ mm/µs Orientation: [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) Fabrication: Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below Impact velocity: 0.30 mm/µs, estimated
TRANSDUCERS	Impact face: Grounded guard-ring quartz gage 20-mm diam by 4.8 mm thick; 6.4-mm-diam electrode Back face: Grounded guard-ring quartz gage 16-mm diam by 4.8 mm thick; 6.5-mm-diam electrode Calibration: Wackerle, with field-fringe correction Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact


2.0
1.5
1.0
0.5
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 0.67 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), (1976) **Shot no.:** 118 **Series no.:** SXP **Date:** May 22, 1973 **Thickness:** 5.06 mm **Square side:** 25 mm **Density:** 1.778 g/cm^3 $C_L = 2.93$ mm/μs $C_S = 1.82$ mm/μs **Orientation:** [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.174 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 24-mm diam by 4.6 mm thick; 6.5-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 19-mm diam by 4.6 mm thick; 6.5-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**
NOTES	Impact face record lost; only back face record shown


STRESS (GPa)
8
6
4
2
0
0.2
0.4
0.6
0.8
TIME AFTER IMPACT (μs)

TARGET

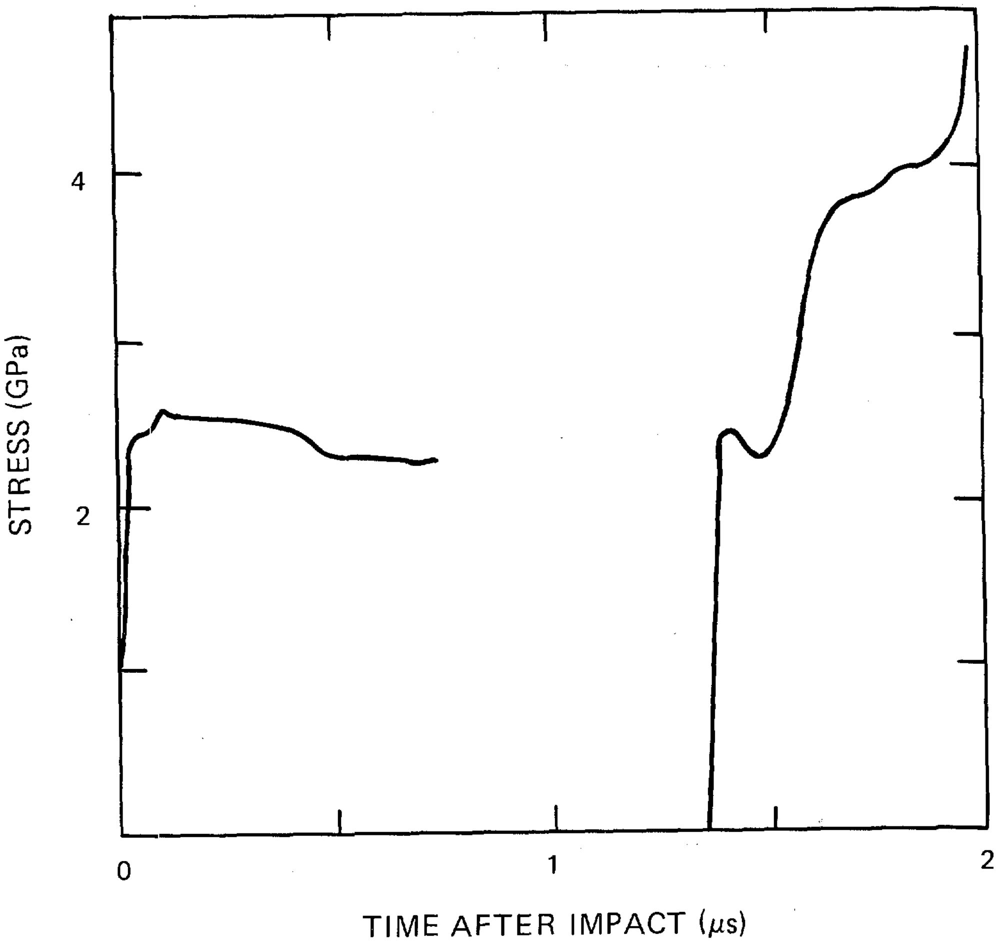
Material: Single-crystal PETN
Experiment type: Quartz-gage front back
Impact stress: 2.5 GPa
Experimenters: P. M. Halleck and Jerry Wackerle
References: Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976)
Shot no.: 119 **Series no.:** SXP **Date:** May 23, 1973
Thickness: 5.08 mm **Square side:** 28 mm
Density: 1.778 g/cm^3
$C_L = 2.93$ mm/µs $C_S = 1.82$ mm/µs
Orientation: [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes)
Fabrication: Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces

IMPACTOR

Aluminum alloy projectile faced with impact face x-cut quartz described below
Impact velocity: 0.598 mm/µs

TRANSDUCERS

Impact face: Grounded guard-ring quartz gage
24-mm diam by 4.6 mm thick; 6.5-mm-diam electrode
Back face: Grounded guard-ring quartz gage
19-mm diam by 4.6 mm thick; 6.5-mm-diam electrode
Calibration: Wackerle, with field-fringe correction
Reference: Wackerle, Johnson, and Halleck (1975a)
Time after impact


4
2
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

TARGET

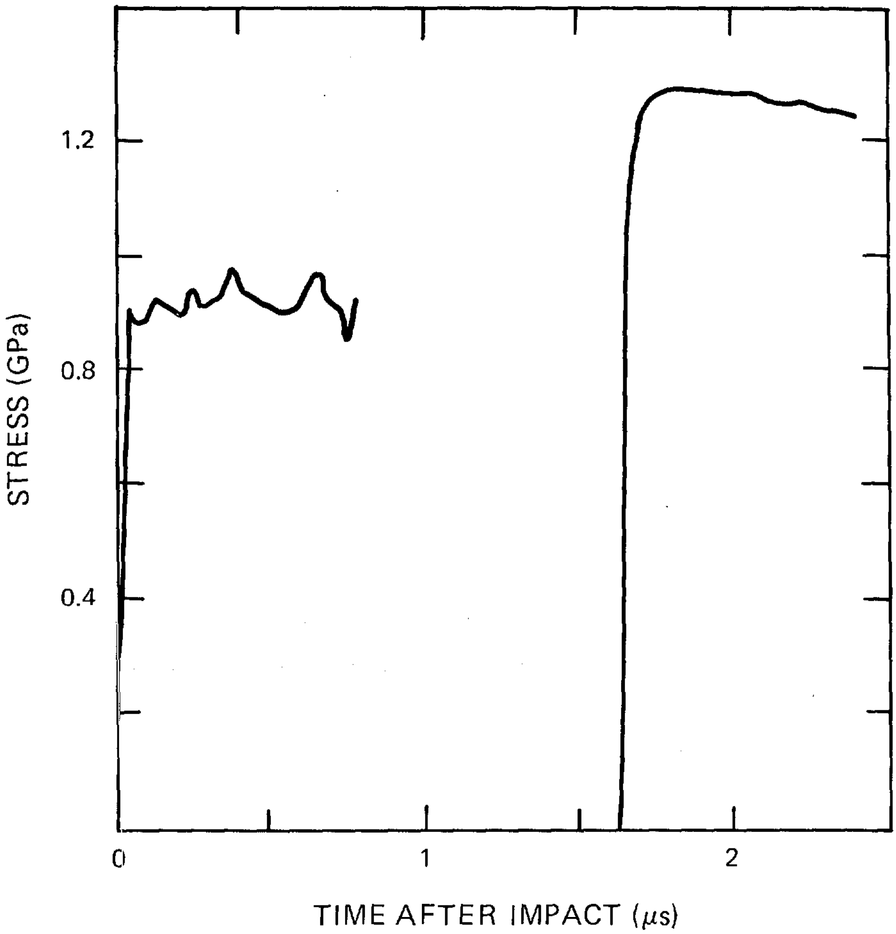
Material: Single-crystal PETN
Experiment type: Quartz-gage front back
Impact stress: 0.9 GPa
Experimenters: P. M. Halleck and Jerry Wackerle
References: Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976)
Shot no.: 120 Series no.: SXP Date: May 24, 1973
Thickness: 5.07 mm Square side: 25 mm
Density: 1.778 g/cm^3
$C_L = 2.62$ mm/μs $C_S = 1.68$ mm/μs
Orientation: [001] (Shock propagates along z-axis)
Fabrication: Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces

IMPACTOR

Aluminum alloy projectile faced with impact face x-cut quartz
Impact velocity: 0.236 mm/μs
Calibration: Wackerle, with field-fringe correction
Reference: Wackerle, Johnson, and Halleck (1975a)
Time after impact

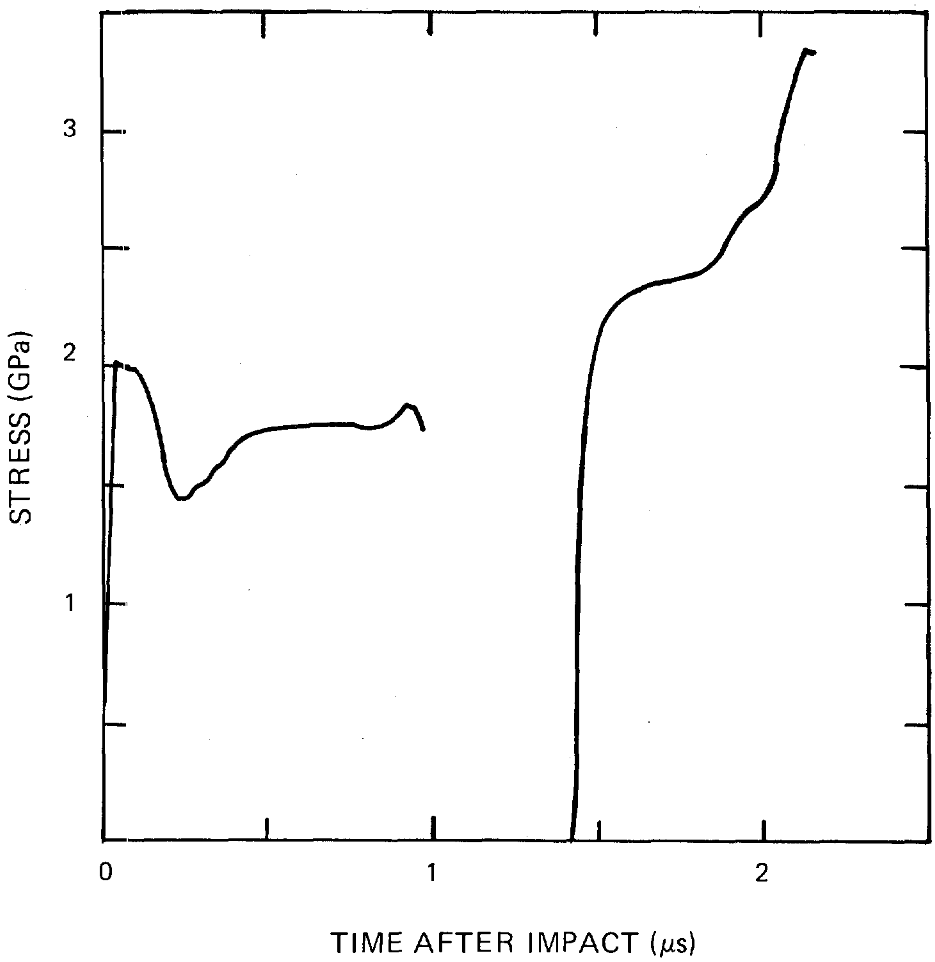
TRANSDUCERS

Impact face: Grounded guard-ring quartz gage
24-mm diam by 4.6 mm thick; 6.5-mm-diam electrode
Back face: Grounded guard-ring quartz gage
24-mm diam by 4.6 mm thick; 6.5-mm-diam electrode
Calibration: Wackerle, with field-fringe correction
Reference: Wackerle, Johnson, and Halleck (1975a)

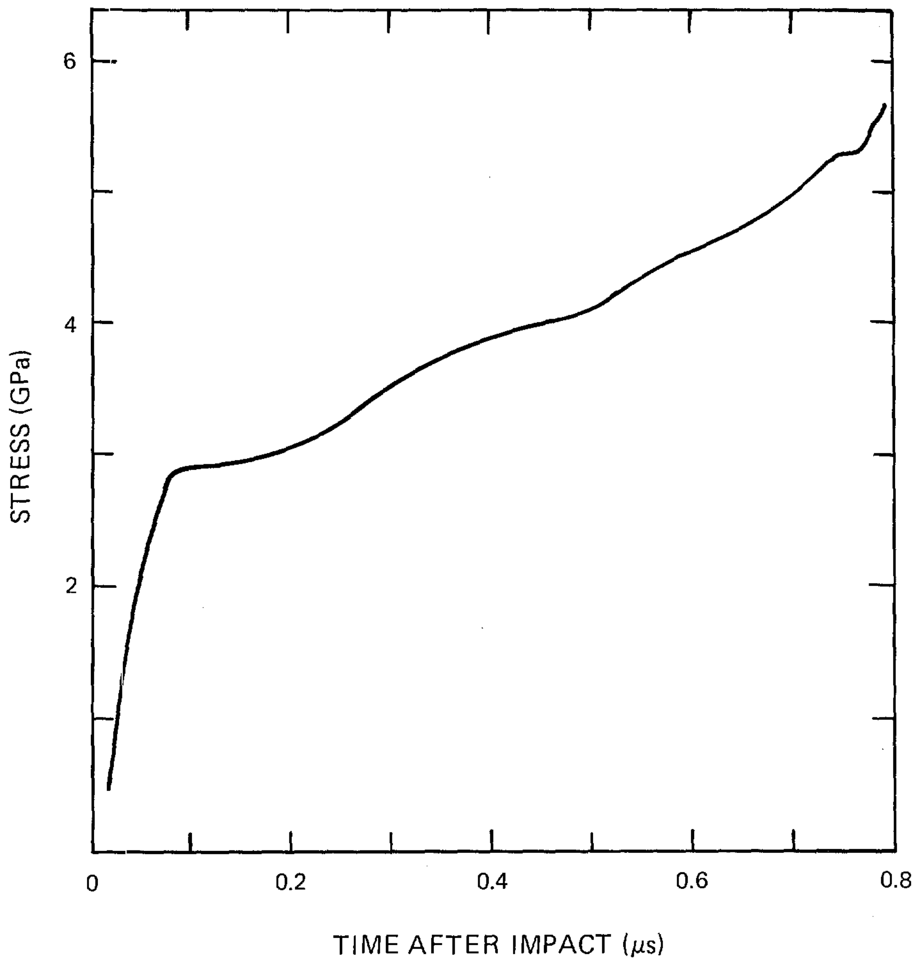


1.2
0.8
0.4
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

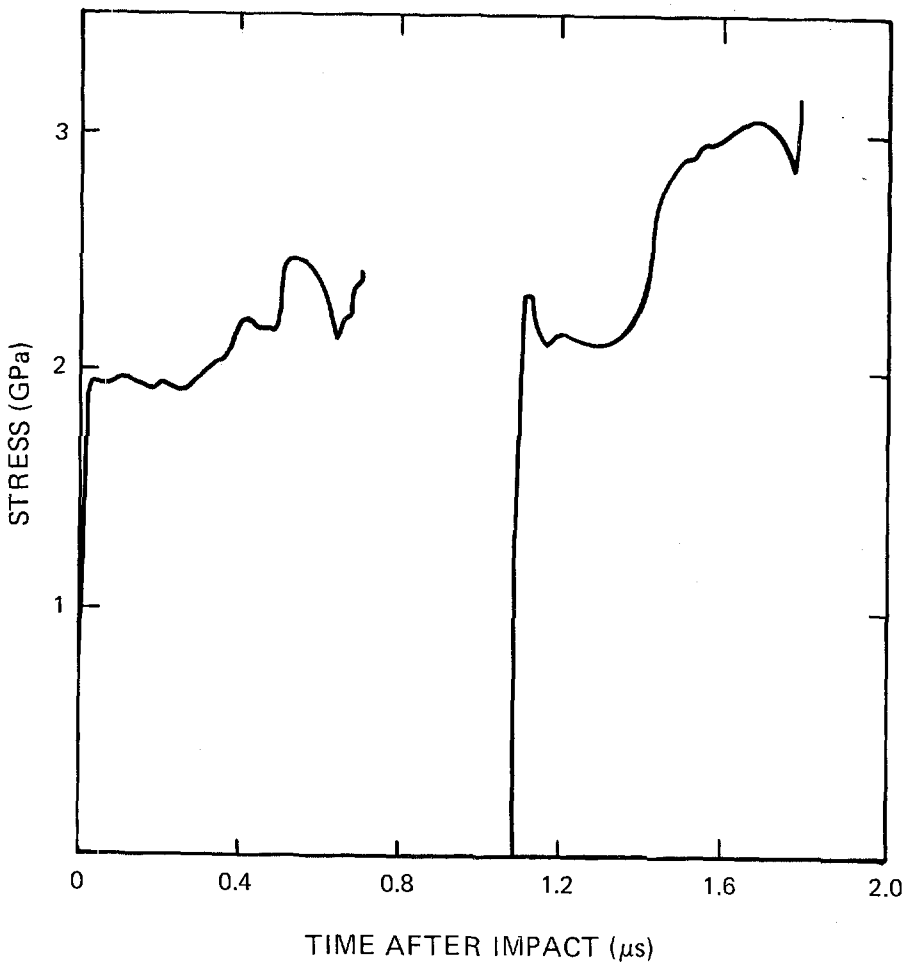
TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 2.0 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) **Shot no.:** 124 **Series no.:** SXP **Date:** June 13, 1973 **Thickness:** 5.07 mm **Square side:** 25 mm **Density:** 1.778 g/cm^3 $C_L = 2.62$ mm/μs $C_S = 1.68$ mm/μs **Orientation:** [001] (Shock propagates along z-axis) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.453 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 20-mm diam by 6.1 mm thick; 6.5-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 18-mm diam by 4.6 mm thick; 6.5-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**


3
2
1
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

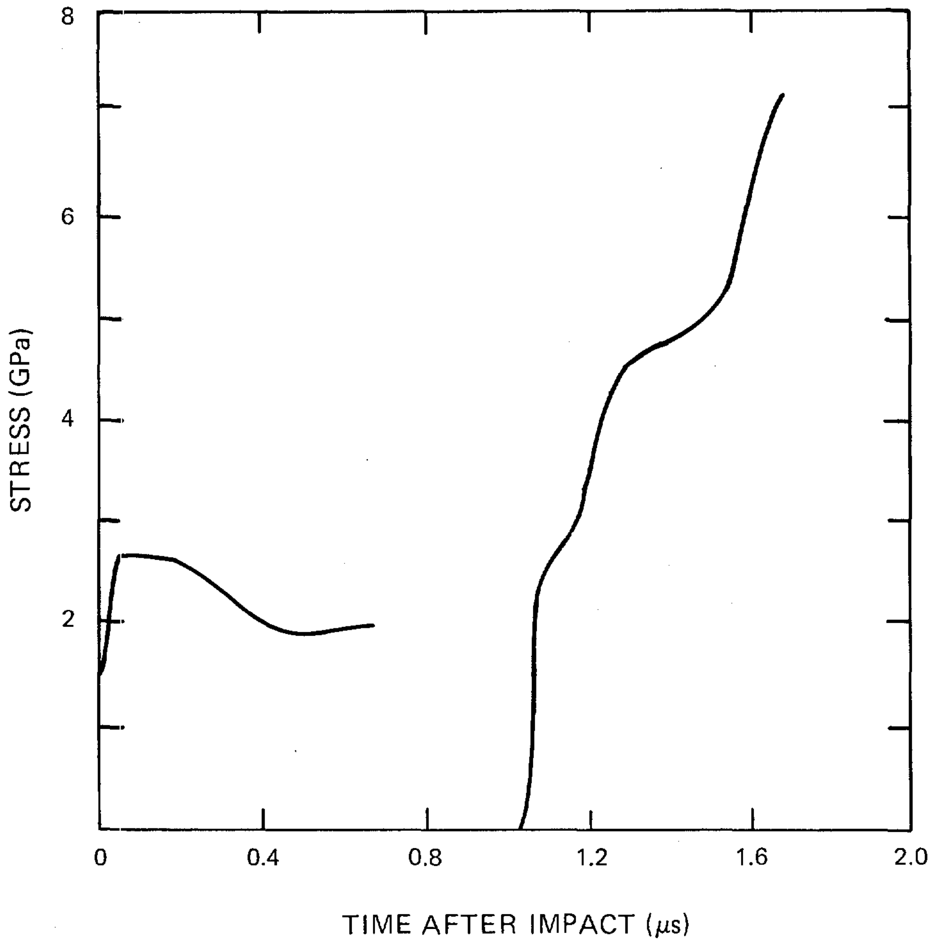
TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 2.5 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) **Shot no.:** 125 **Series no.:** SXP **Date:** June 18, 1973 **Thickness:** 5.07 mm **Square side:** 25 mm **Density:** 1.778 g/cm^3 $C_L = 2.62$ mm/µs $C_S = 1.68$ mm/µs **Orientation:** [001] (Shock propagates along z-axis) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.591 mm/µs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 20-mm diam by 4.6 mm thick; 6.5-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 18-mm diam by 4.6 mm thick; 6.5-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**
NOTES	Impact face record lost; only back face record shown


6
4
2
STRESS (GPa)
0
0.2
0.4
0.6
0.8
TIME AFTER IMPACT (μs)

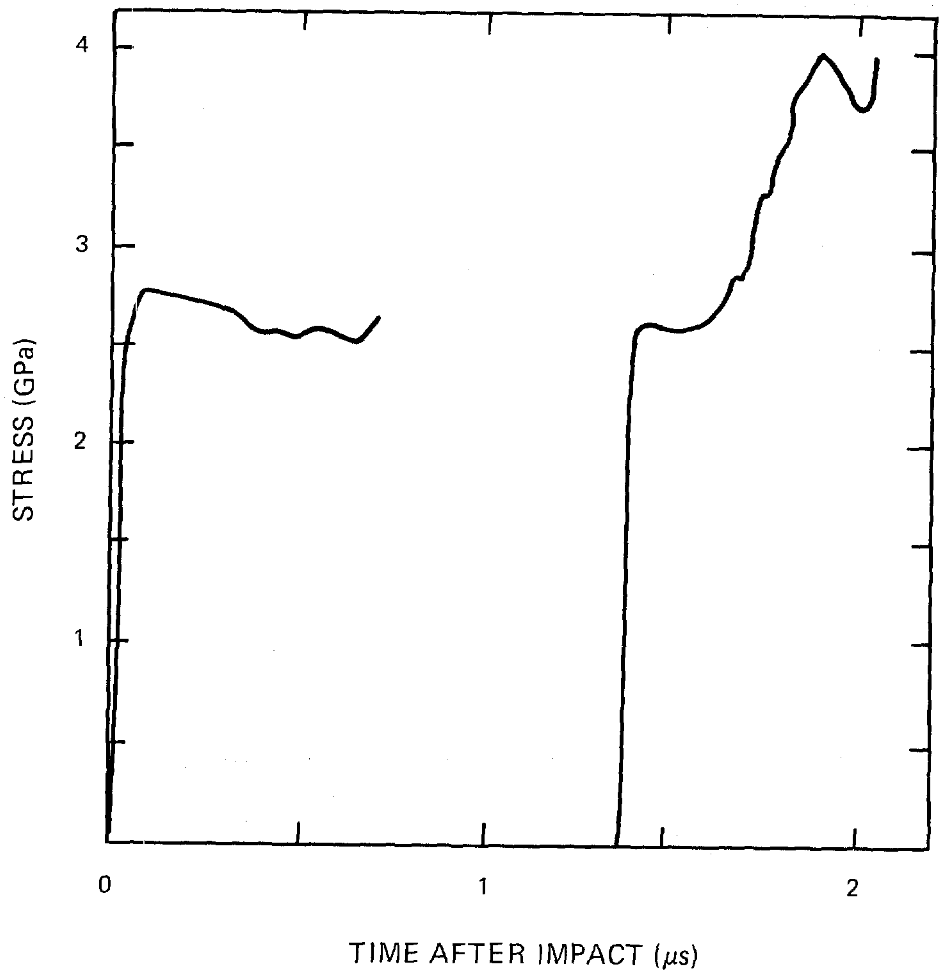
TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 1.95 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) **Shot no.:** 152 **Series no.:** SXP **Date:** October 12, 1973 **Thickness:** 3.81 mm **Square side:** 24 mm **Density:** 1.778 g/cm^3 $C_L = 2.93$ mm/μs $C_S = 1.82$ mm/μs **Orientation:** [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.452 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 20-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 16-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**


3
2
1
STRESS (GPa)
0
0.4
0.8
1.2
1.6
2.0
TIME AFTER IMPACT (μs)

TARGET	Material: Single-crystal PETN Experiment type: Quartz-gage front back Impact stress: 2.64 GPa Experimenters: P. M. Halleck and Jerry Wackerle References: Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) Shot no.: 154 Series no.: SXP Date: October 17, 1973 Thickness: 3.82 mm Square side: 25 mm Density: 1.778 g/cm^3 $C_L = 2.93$ mm/μs $C_S = 1.82$ mm/μs Orientation: [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) Fabrication: Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below Impact velocity: 0.608 mm/μs
TRANSDUCERS	Impact face: Grounded guard-ring quartz gage 20-mm diam by 4.08 mm thick; 5.2-mm-diam electrode Back face: Grounded guard-ring quartz gage 16-mm diam by 4.08 mm thick; 5.2-mm-diam electrode Calibration: Wackerle, with field-fringe correction Reference: Wackerle, Johnson, and Halleck (1975a) Time after impact

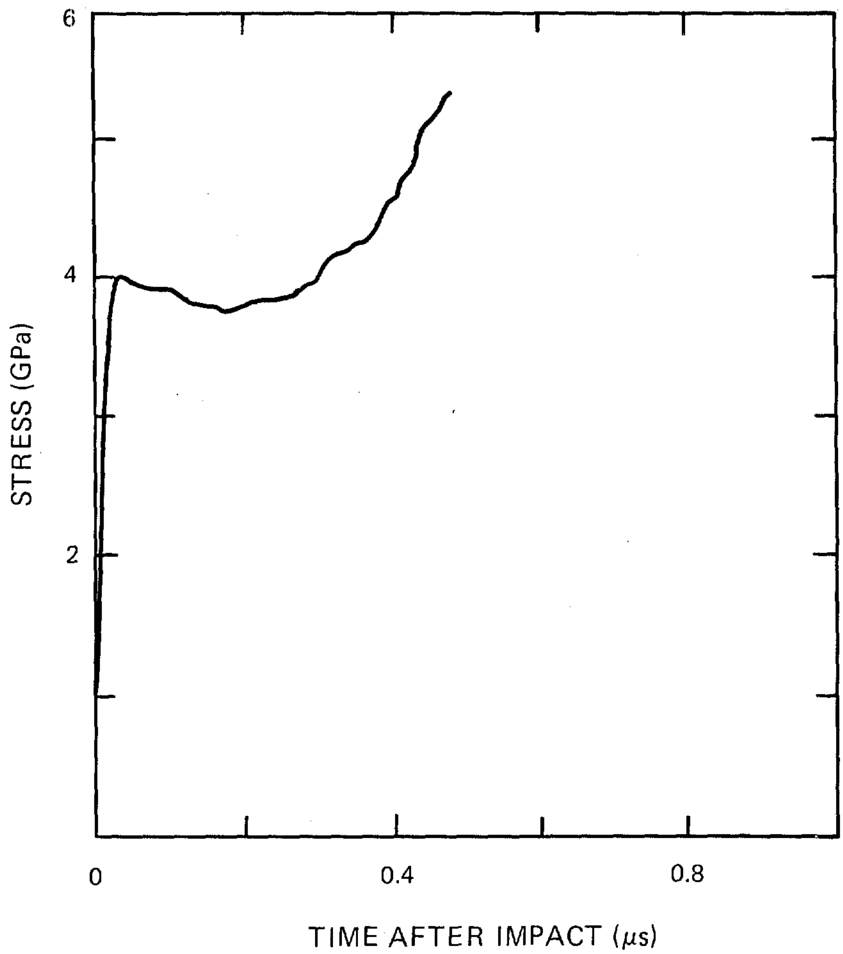

8
6
4
2
STRESS (GPa)
0
0.4
0.8
1.2
1.6
2.0
TIME AFTER IMPACT (μs)

TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 2.74 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) **Shot no.:** 156 **Series no.:** SXP **Date:** October 23, 1973 **Thickness:** 5.06 mm **Square side:** 25 mm **Density:** 1.778 g/cm^3 $C_L = 2.93$ mm/μs $C_S = 1.82$ mm/μs **Orientation:** [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.600 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 20-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 15-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**

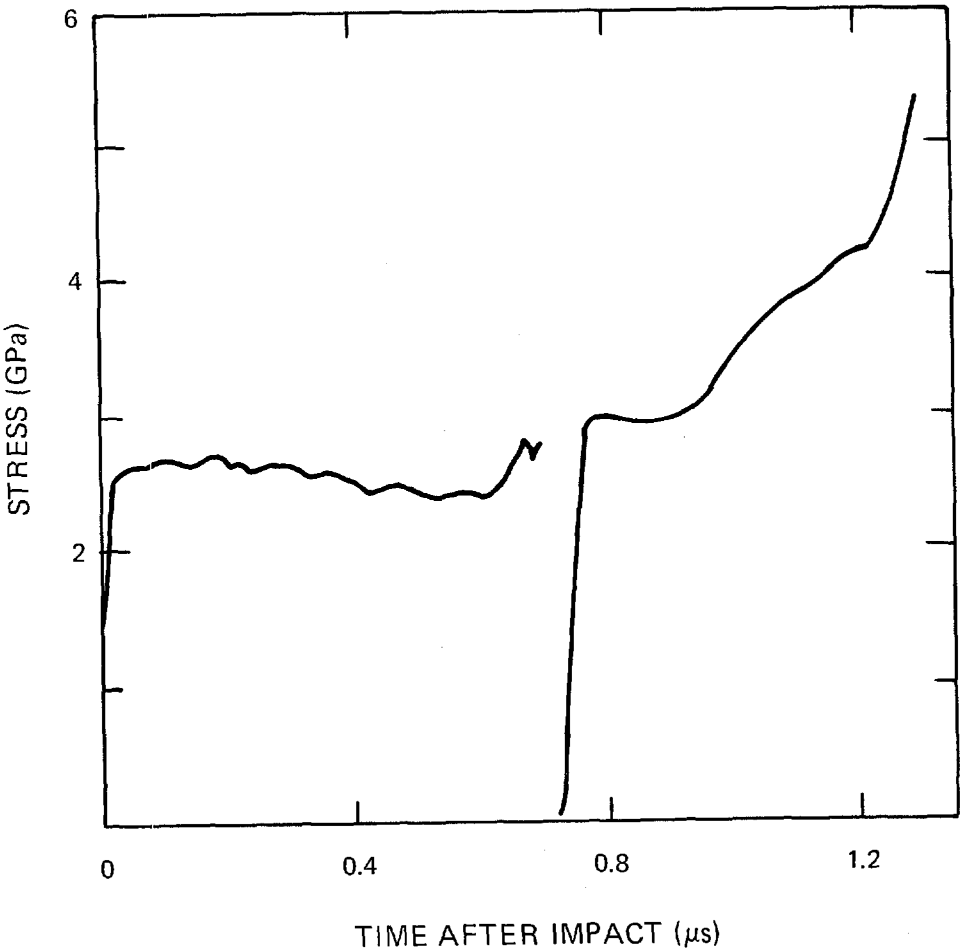


4
3
2
1
STRESS (GPa)
0
1
2
TIME AFTER IMPACT (μs)

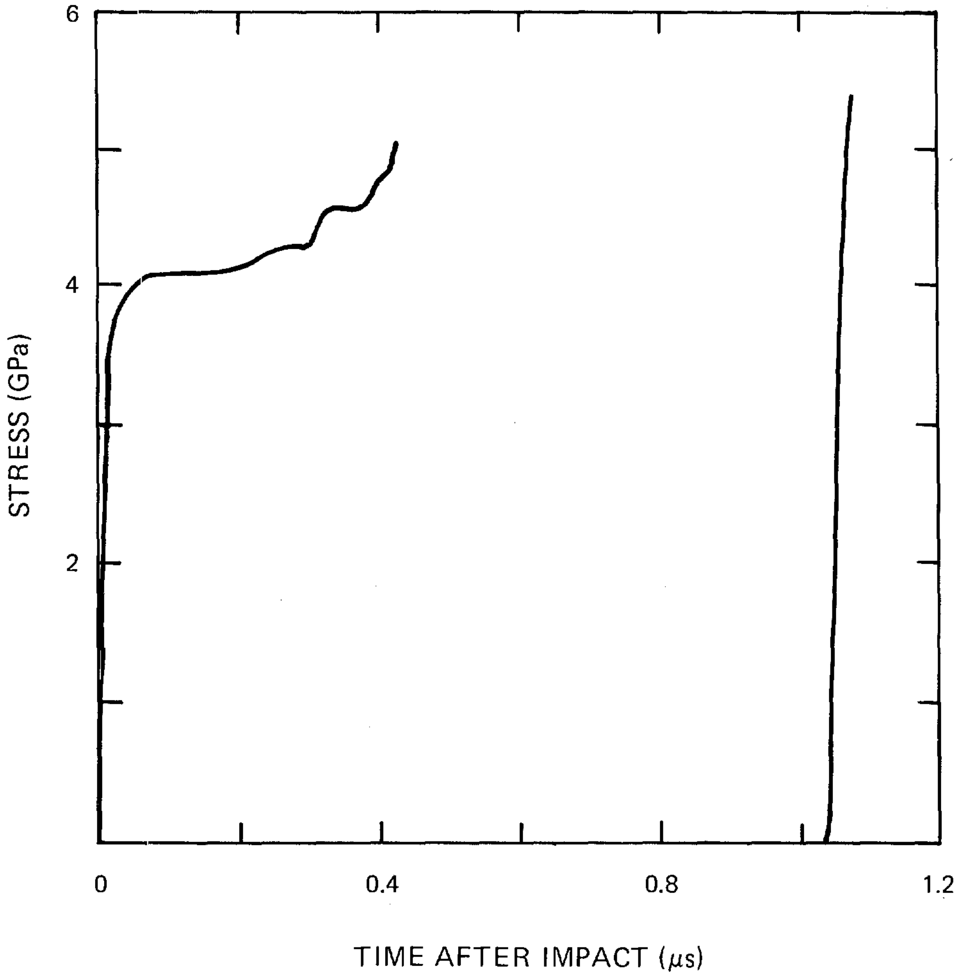
TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 4.0 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) **Shot no.:** 158 **Series no.:** SXP **Date:** October 30, 1973 **Thickness:** 3.83 mm **Square side:** 25 mm **Density:** 1.778 g/cm^3 $C_L = 2.93$ mm/µs $C_S = 1.82$ mm/µs **Orientation:** [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.860 mm/µs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 20-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 15-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**
NOTE	Back-face stress exceeds gage limit


6
4
2
STRESS (GPa)
0
0.4
0.8
TIME AFTER IMPACT (μs)

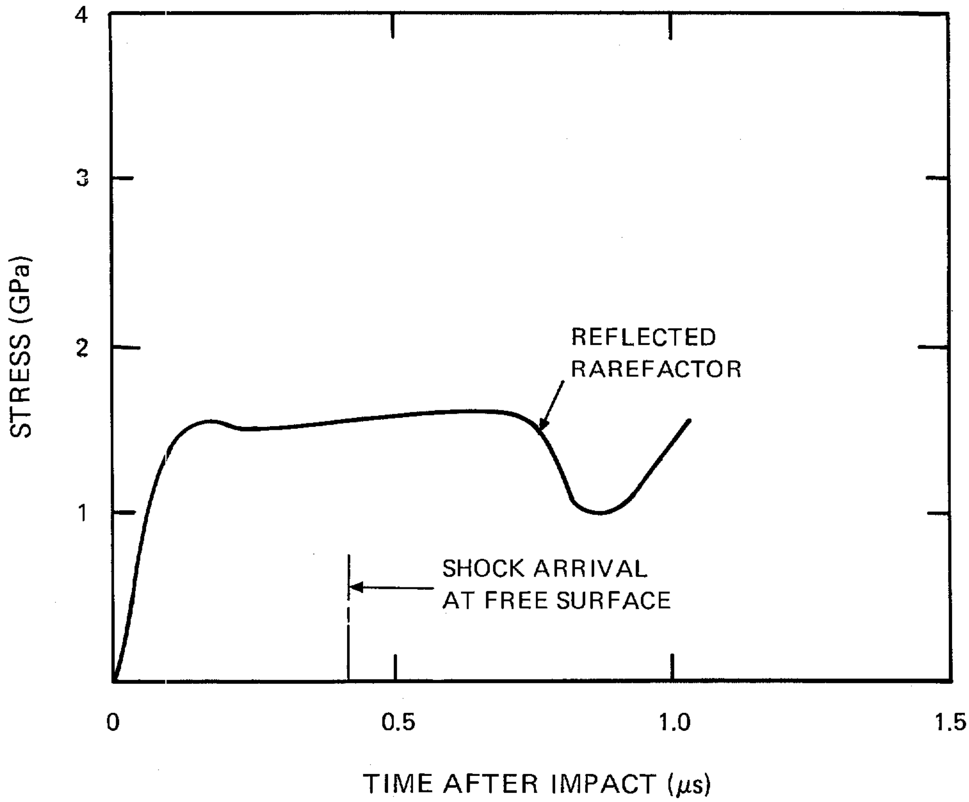
TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 2.64 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) **Shot no.:** 159 **Series no.:** SXP **Date:** November 1, 1973 **Thickness:** 2.77 mm **Square side:** 25 mm **Density:** 1.778 g/cm^3 $C_L = 2.93$ mm/μs $C_S = 1.82$ mm/μs **Orientation:** [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.599 mm/μs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 20-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 15-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**


6
4
2
STRESS (GPa)
0
0.4
0.8
1.2
TIME AFTER IMPACT (μs)

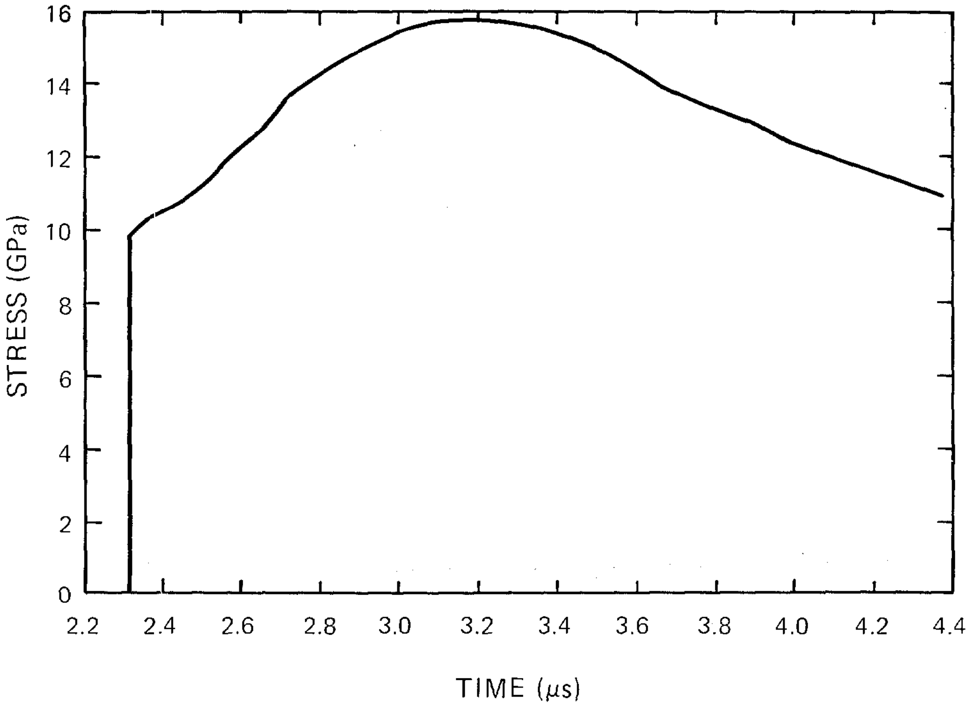
TARGET	**Material:** Single-crystal PETN **Experiment type:** Quartz-gage front back **Impact stress:** 4.1 GPa **Experimenters:** P. M. Halleck and Jerry Wackerle **References:** Wackerle, Johnson, and Halleck (1975a), Halleck and Wackerle (1976) **Shot no.:** 160 **Series no.:** SXP **Date:** November 3, 1973 **Thickness:** 4.16 mm **Square side:** 25 mm **Density:** 1.778 g/cm^3 C_L = 2.93 mm/µs C_S = 1.82 mm/µs **Orientation:** [110] (Shock propagates perpendicular to z-axis and at 45° to x- and y-axes) **Fabrication:** Crystals grown in ethyl acetate solution, sawed and hand-lapped on surfaces
IMPACTOR	Aluminum alloy projectile faced with impact face x-cut quartz described below **Impact velocity:** 0.865 mm/µs
TRANSDUCERS	**Impact face:** Grounded guard-ring quartz gage 20-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Back face:** Grounded guard-ring quartz gage 15-mm diam by 4.08 mm thick; 5.2-mm-diam electrode **Calibration:** Wackerle, with field-fringe correction **Reference:** Wackerle, Johnson, and Halleck (1975a) **Time after impact**
NOTES	Back-face stress exceeds gage limit


STRESS (GPa)
6
4
2
0
0.4
0.8
1.2
TIME AFTER IMPACT (μs)

TARGET	**Material:** Pressed PETN **Experiment type:** Quartz-gage impact face front back **Impact stress:** 1.75 GPa **Experimenters:** Jerry Wackerle and J. O. Johnson **Reference:** Wackerle and Johnson (1973) **Shot no.:** 7-12 **Series no.:** X67 **Date:** 1969 **Thickness:** 1.23 mm **Diameter:** 33 mm **Density:** 1.71 g/cm^3 $C_L = 2.9$ mm/μs $C_S = 1.5$ mm/μs **Fabrication:** Specimens were dry-pressed at ambient temperature from permeametric specific surface 3000-cm^2/g detonator-grade PETN
IMPACTOR	50-mm-diam aluminum alloy projectile faced with quartz gage described below **Impact velocity:** 0.453 mm/μs
TRANSDUCERS	**Impact face:** Shunted guard-ring quartz gage 30-mm diam by 7.3 mm thick; 9.4-mm-diam electrode **Back face:** Arrival at free surface measured with ferroelectric transducer pin **Reference:** Graham, Neilson, and Benedick (1965) **Time after impact**

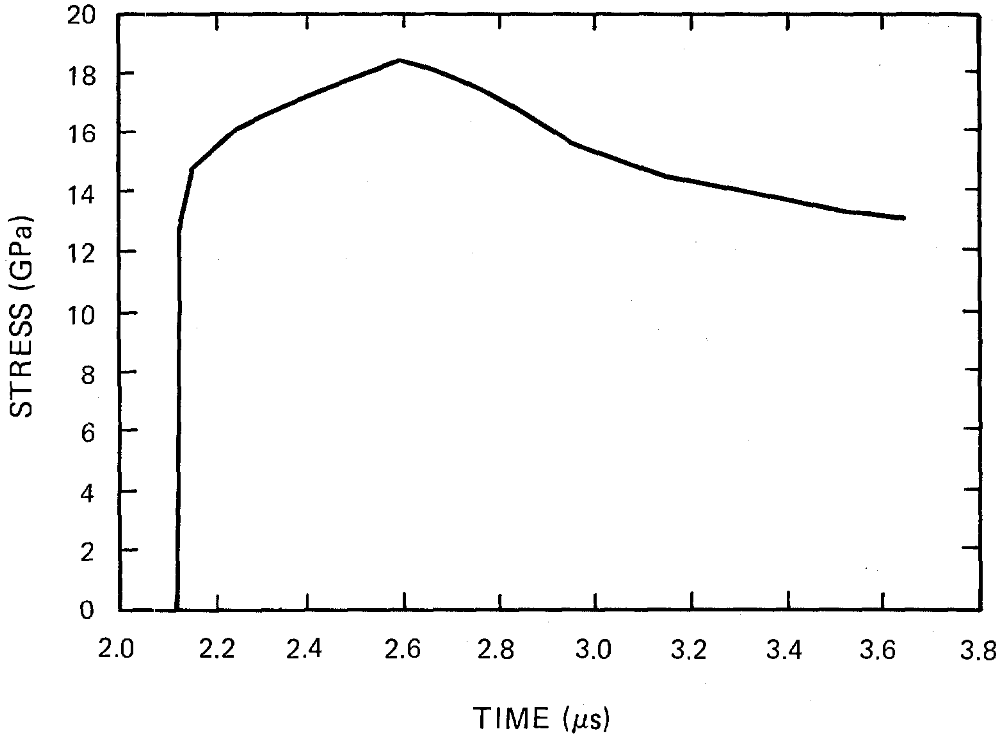

4
3
2
1
STRESS (GPa)
REFLECTED
RAREFACTOR
SHOCK ARRIVAL
AT FREE SURFACE
0
0.5
1.0
1.5
TIME AFTER IMPACT (μs)

TARGET	Material: TATB, superfine Experiment type: Embedded Manganin gage Experimenter: M. J. Ginsberg Impact stress: ~7.5 GPa Shot no.: 458 Date: June 20, 1980 Thickness: 12 mm Diameter: 51 mm Density: 1.808 g/cm^3 Fabrication technique: Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. Note: Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 6.0 mm thick, mounted on a ZK60A magnesium alloy projectile Impact velocity: 1.17 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage Distance to impact surface: 5.300 mm Heat treatment: Annealed Encapsulation: 0.25-mm Teflon on each side Calibration: As described by Vantine et al. Time: Relative Reference: Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)
NOTES	Shots 458, 461, 470, 473, 476, and 478 are a series with varying target thickness and constant impact stress.



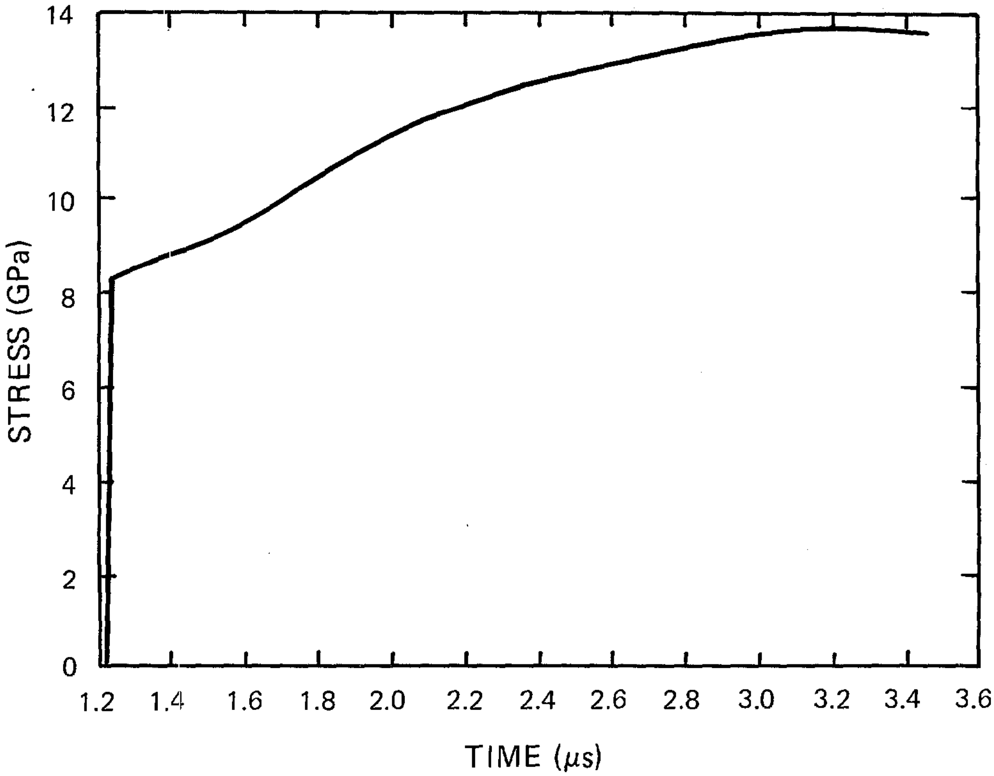
16
14
12
10
8
6
4
2
0
STRESS (GPa)
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
4.2
4.4
TIME (μs)

TARGET	**Material:** TATB, superfine **Experiment type:** Embedded Manganin gage **Experimenter:** M. J. Ginsberg **Impact stress:** ~7.5 GPa **Shot no.:** 461 **Date:** July 16, 1980 **Thickness:** 12 mm **Diameter:** 51 mm **Density:** 1.793 g/cm^3 **Fabrication technique:** Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. **Note:** Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 6.0 mm thick, mounted on a ZK60A magnesium alloy projectile **Impact velocity:** 1.17 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage **Distance to impact surface:** 6.695 mm **Heat treatment:** Annealed **Encapsulation:** 0.25-mm Teflon on each side **Calibration:** As described by Vantine et al. **Time:** Relative **Reference:** Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)
NOTES	Shots 458, 461, 470, 473, 476, and 478 are a series with varying target thickness and constant impact stress.

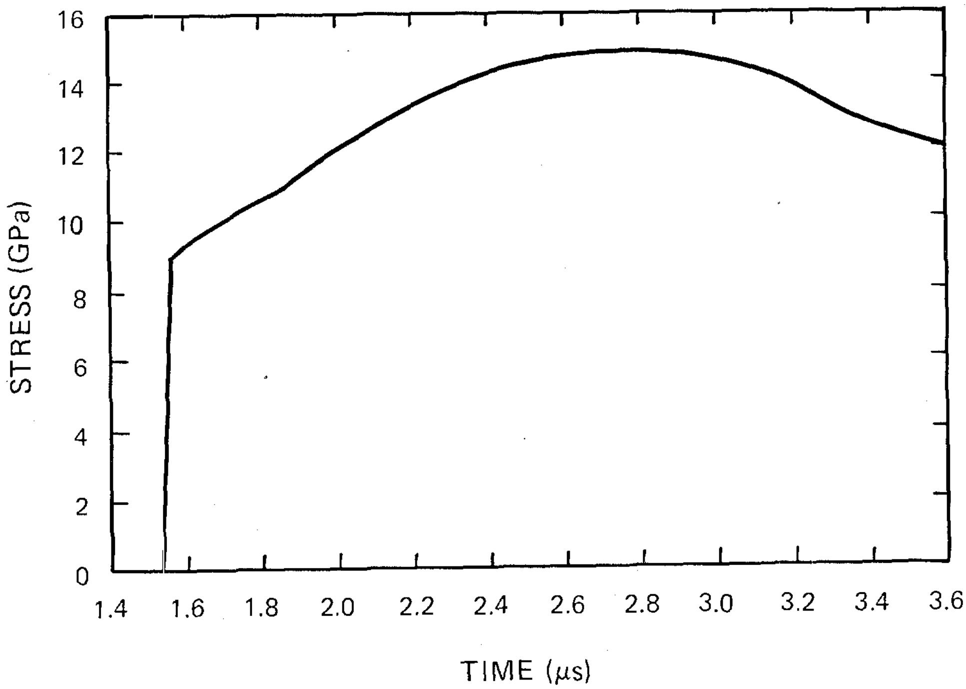


20
18
16
14
12
10
8
6
4
2
0
STRESS (GPa)
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
TIME (μs)

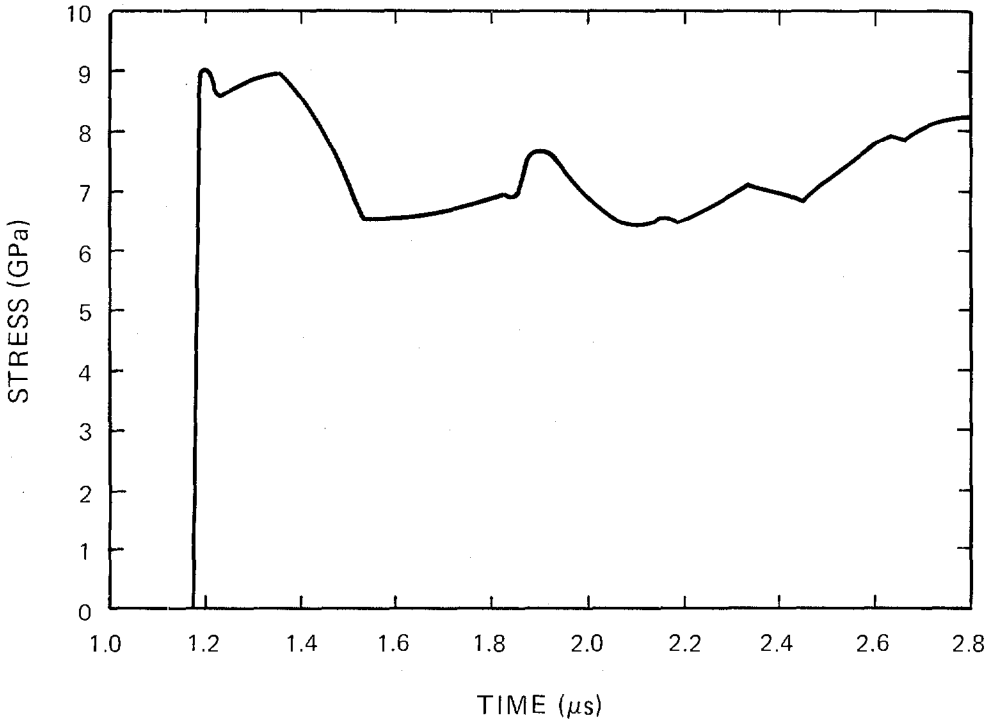
TARGET	**Material:** TATB, superfine **Experiment type:** Embedded Manganin gage **Experimenter:** M. J. Ginsberg **Impact stress:** ~7.5 GPa **Shot no.:** 470 **Date:** August 25, 1980 **Thickness:** 10 mm **Diameter:** 51 mm **Density:** 1.880 g/cm^3 **Fabrication technique:** Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. **Note:** Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 6.0 mm thick, mounted on a ZK60A magnesium alloy projectile **Impact velocity:** 1.17 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage **Distance to impact surface:** 2.285 mm **Heat treatment:** Annealed **Encapsulation:** 0.25-mm Teflon on each side **Calibration:** As described by Vantine et al. **Time:** Relative **Reference:** Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)
NOTES	Shots 458, 461, 470, 473, 476, and 478 are a series with varying target thickness and constant impact stress.


STRESS (GPa)
TIME (μs)
0
2
4
6
8
10
12
14
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6

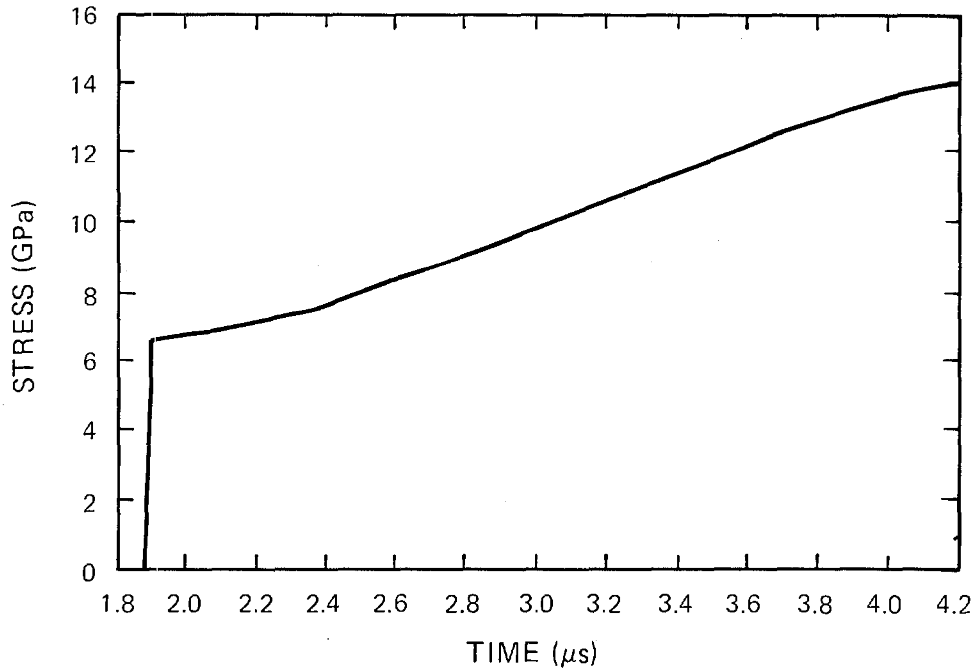
TARGET	**Material:** TATB, superfine **Experiment type:** Embedded Manganin gage **Experimenter:** M. J. Ginsberg **Impact stress:** ~7.5 GPa **Shot no.:** 473 **Date:** September 4, 1980 **Thickness:** 10 mm **Diameter:** 51 mm **Density:** 1.796 g/cm^3 **Fabrication technique:** Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. Note: Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 6.0 mm thick, mounted on a ZK60A magnesium alloy projectile **Impact velocity:** 1.17 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage **Distance to impact surface:** 3.725 mm **Heat treatment:** Annealed **Encapsulation:** 0.25-mm Teflon on each side **Calibration:** As described by Vantine et al. **Time:** Relative **Reference:** Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)
NOTES	Shots 458, 461, 470, 473, 476, and 478 are a series with varying target thickness and constant impact stress.


16
14
12
10
8
6
4
2
0
STRESS (GPa)
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
TIME (μs)

TARGET	Material: TATB, superfine Experiment type: Embedded Manganin gage, short shock case Experimenter: M. J. Ginsberg Impact stress: ~7.4 GPa Shot no.: 474 Date: September 5, 1980 Thickness: 10 mm Diameter: 51 mm Density: 1.800 g/cm^3 Fabrication technique: Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. Note: Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 1.00 mm thick, mounted on a ZK60A magnesium alloy projectile Impact velocity: 1.16 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage Distance to impact surface: 2.285 mm Heat treatment: Annealed Encapsulation: 0.25-mm Teflon on each side Calibration: As described by Vantine et al. Time: Relative Reference: Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)

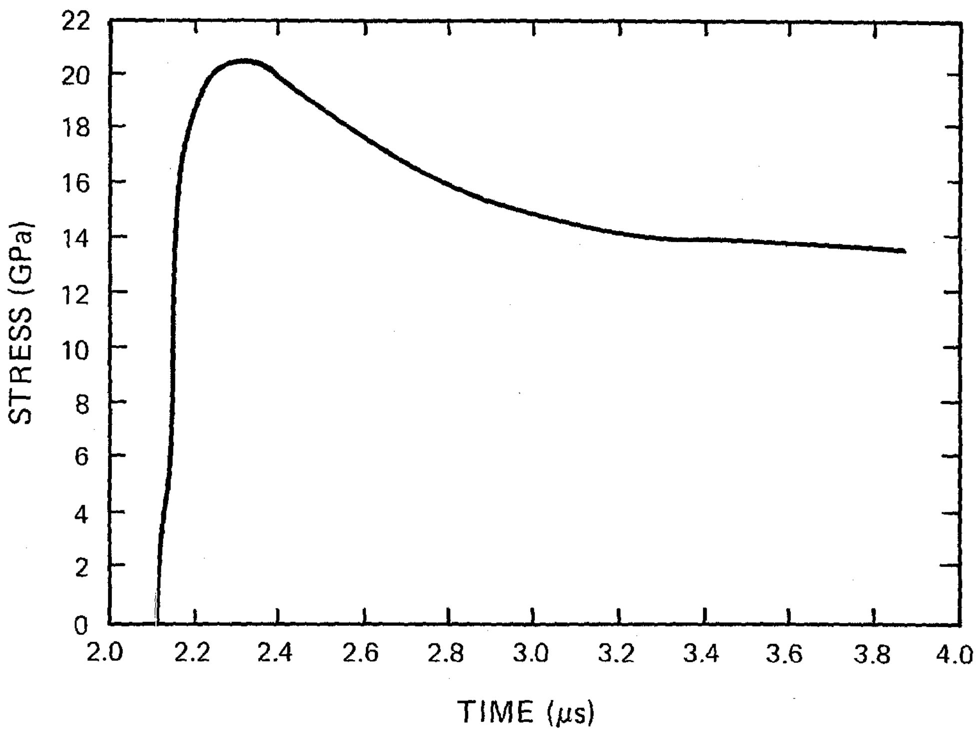

10
9
8
7
6
5
4
3
2
1
0
STRESS (GPa)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
TIME (μs)

TARGET	Material: TATB, superfine Experiment type: Embedded Manganin gage Experimenter: M. J. Ginsberg Impact stress: ~7.5 GPa Shot no.: 476 Date: September 23, 1980 Thickness: 8 mm Diameter: 51 mm Density: 1.799 g/cm^3 Fabrication technique: Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. Note: Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 6.0 mm thick, mounted on a ZK60A magnesium alloy projectile Impact velocity: 1.18 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage Distance to impact surface: 0 mm Heat treatment: Annealed Encapsulation: 0.25-mm Teflon on each side Calibration: As described by Vantine et al. Time: Relative Reference: Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)
NOTES	Shots 458, 461, 470, 473, 476, and 478 are a series with varying target thickness and constant impact stress.



16
14
12
10
8
6
4
2
0
STRESS (GPa)
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
4.2
TIME (μs)

TARGET	Material: TATB, superfine Experiment type: Embedded Manganin gage Experimenter: M. J. Ginsberg Impact stress: ~7.6 GPa Shot no.: 478 Date: September 25, 1980 Thickness: 14 mm Diameter: 51 mm Density: 1.800 g/cm³ Fabrication technique: Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. Note: Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 6.0 mm thick, mounted on a ZK60A magnesium alloy projectile Impact velocity: 1.19 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage Distance to impact surface: 7.715 mm Heat treatment: Annealed Encapsulation: 0.25-mm Teflon on each side Calibration: As described by Vantine et al. Time: Relative Reference: Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)
NOTES	Shots 458, 461, 470, 473, 476, and 478 are a series with varying target thickness and constant impact stress.


22
20
18
16
14
12
10
8
6
4
2
0
STRESS (GPa)
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
TIME (μs)

TARGET

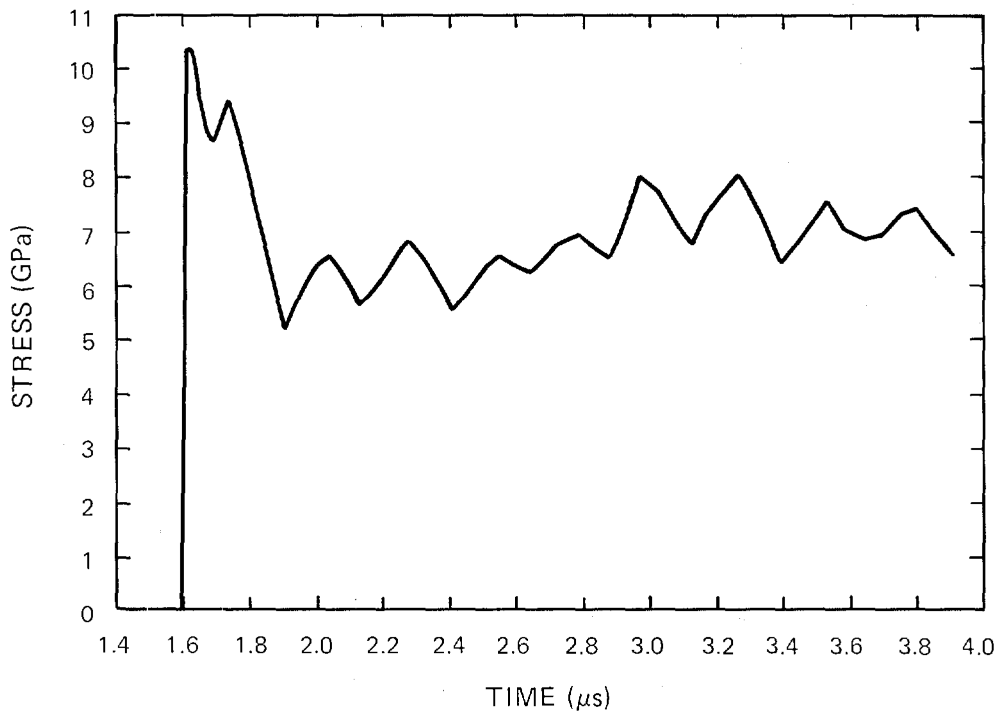
Material: TATB, superfine
Experiment type: Embedded Manganin gage, short shock case
Experimenter: M. J. Ginsberg
Impact stress: ~7.5 GPa
Shot no.: 479 **Date:** September 26, 1980
Thickness: 10 mm **Diameter:** 51 mm
Density: 1.800 g/cm^3
Fabrication technique: Hot-pressed at 50°C with 1-min dwell time. Machined to final shape.
Note: Radiographs of samples show no appreciable density discontinuities.

IMPACTOR

Annealed tough-pitch copper flyer, 1.00 mm thick, mounted on a ZK60A magnesium alloy projectile
Impact velocity: 1.17 mm/μs

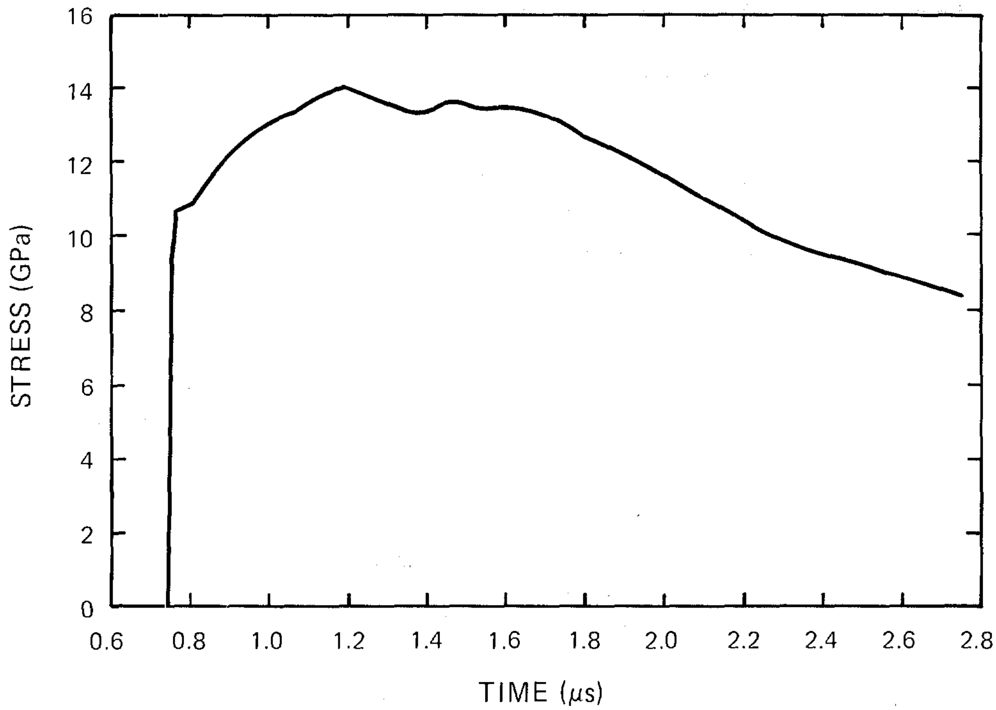
TRANSDUCER

Two-terminal, 0.020-Ω Manganin gage
Distance to impact surface: 3.715 mm
Heat treatment: Annealed
Encapsulation: 0.25-mm Teflon on each side
Calibration: As described by Vantine et al.
Time: Relative
Reference: Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)

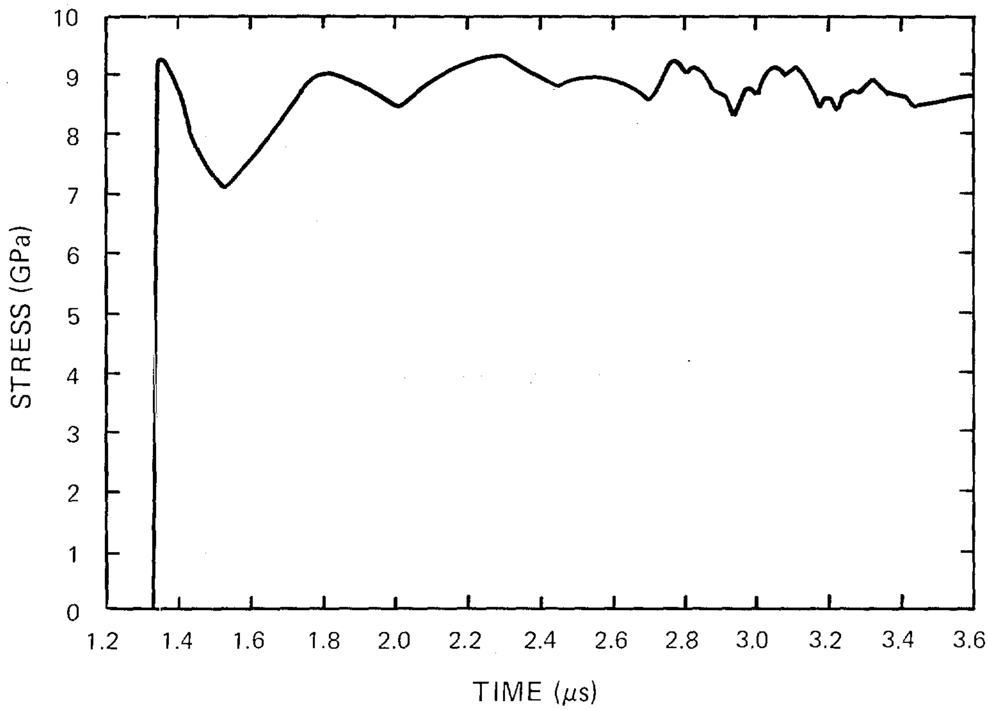


11
10
9
8
7
6
5
4
3
2
1
0
STRESS (GPa)
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
TIME (μs)

TARGET	Material: TATB, superfine Experiment type: Embedded Manganin gage; short shock case Experimenter: M. J. Ginsberg Impact stress: ~7.6 GPa Shot no.: 480 Date: October 3, 1980 Thickness: 14 mm Diameter: 51 mm Density: 1.798 g/cm³ Fabrication technique: Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. Note: Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 1.00 mm thick, mounted on a ZK60A magnesium alloy projectile Impact velocity: 1.19 mm/μs
TRANSDUCER	Two-terminal, 0.020-Ω Manganin gage Distance to impact surface: 7.735 mm Heat treatment: Annealed Encapsulation: 0.25-mm Teflon on each side Calibration: As described by Vantine et al. Time: Relative Reference: Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)

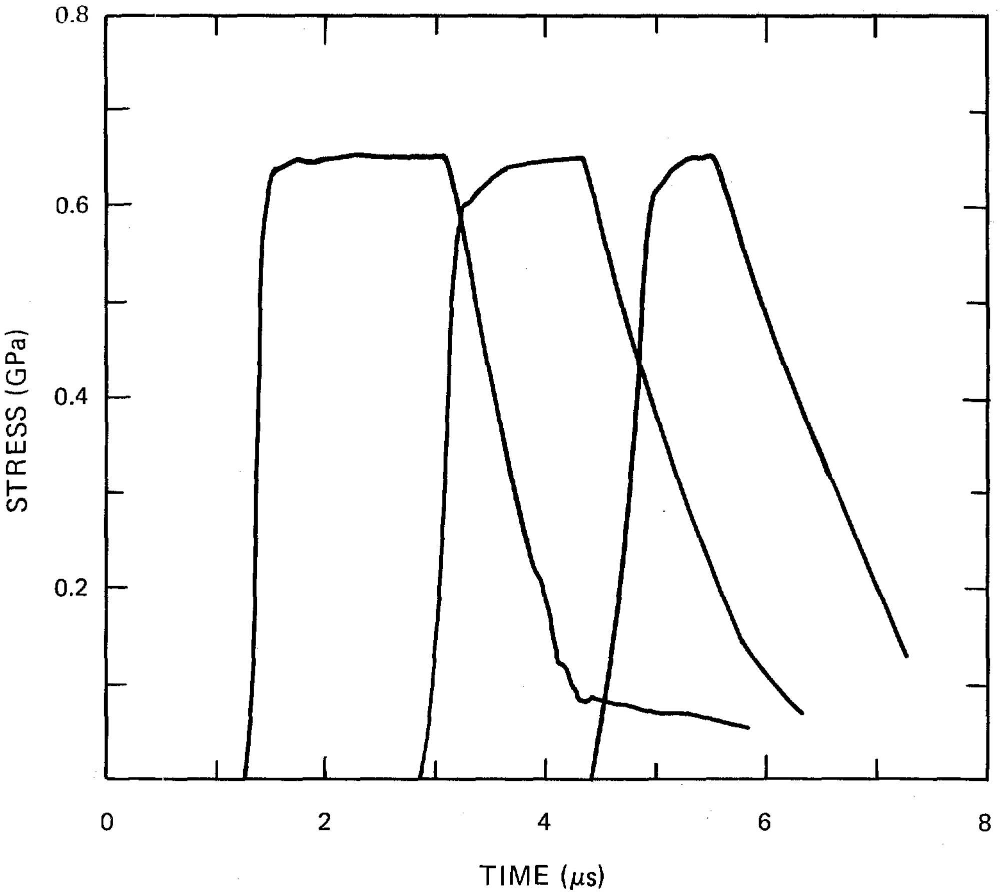

16
14
12
10
8
6
4
2
0
STRESS (GPa)
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
TIME (μs)

TARGET	Material: TATB, superfine Experiment type: Embedded Manganin gage; short shock case Experimenter: M. J. Ginsberg Impact stress: ~7.4 GPa Shot no.: 483 Date: October 22, 1980 Thickness: 12 mm Diameter: 51 mm Density: 1.798 g/cm^3 Fabrication technique: Hot-pressed at 50°C with 1-min dwell time. Machined to final shape. Note: Radiographs of samples show no appreciable density discontinuities.
IMPACTOR	Annealed tough-pitch copper flyer, 1.00 mm thick, mounted on a ZK60A magnesium alloy projectile Impact velocity: 1.15 mm/μs
TRANSDUCER	Two-terminal, 0.040-Ω Manganin gage Distance to impact surface: 5.665 mm Heat treatment: Annealed Encapsulation: 0.25-mm Teflon on each side Calibration: As described by Vantine et al. Time: Relative Reference: Vantine, Chan, Erickson, Janzen, Weingart, and Lee (1980)

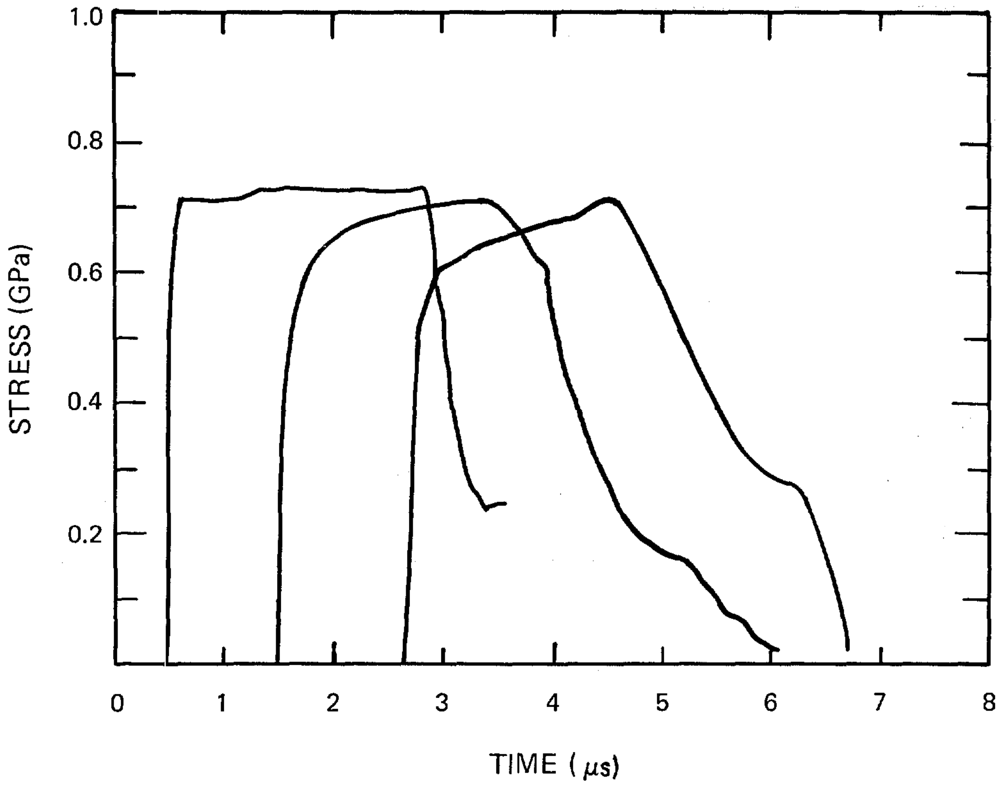


STRESS (GPa)
10
9
8
7
6
5
4
3
2
1
0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
TIME (μs)

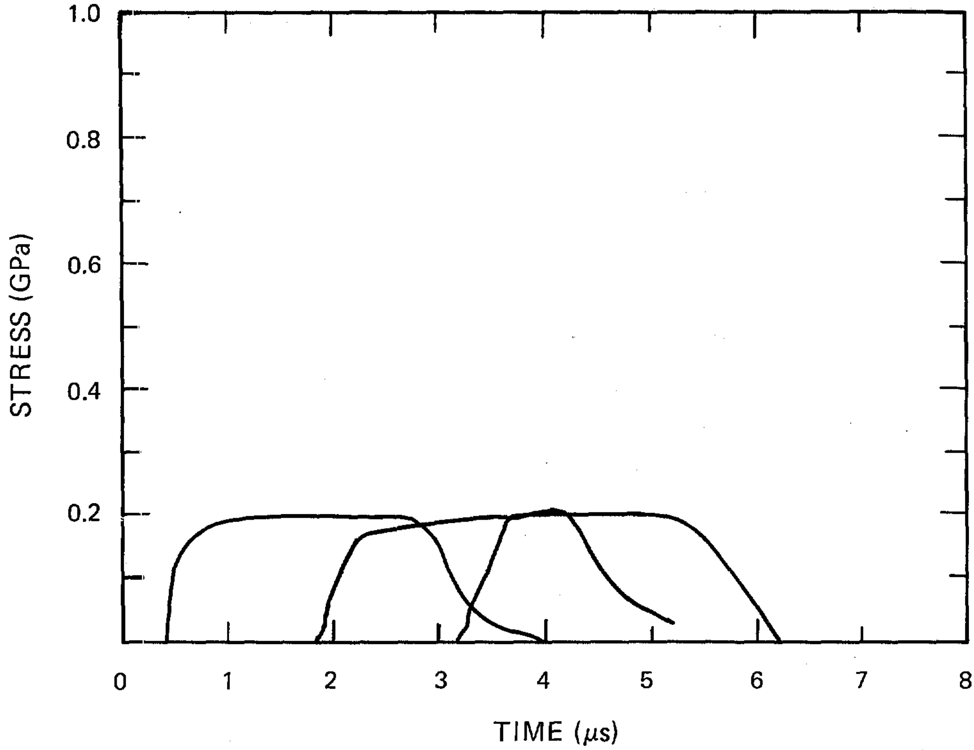
TARGET	Material: TNT Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-77-102 Date: October 25, 1977 Diameter: 38.1 mm Density: 1.63 g/cm^3 $C_L = 2.68$ mm/μs $C_S = 1.35$ mm/μs
IMPACTOR	TNT, 3.05 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.294 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 6.11 mm, and 10.18 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative


0.8
0.6
0.4
0.2
STRESS (GPa)
0
2
4
6
8
TIME (μs)

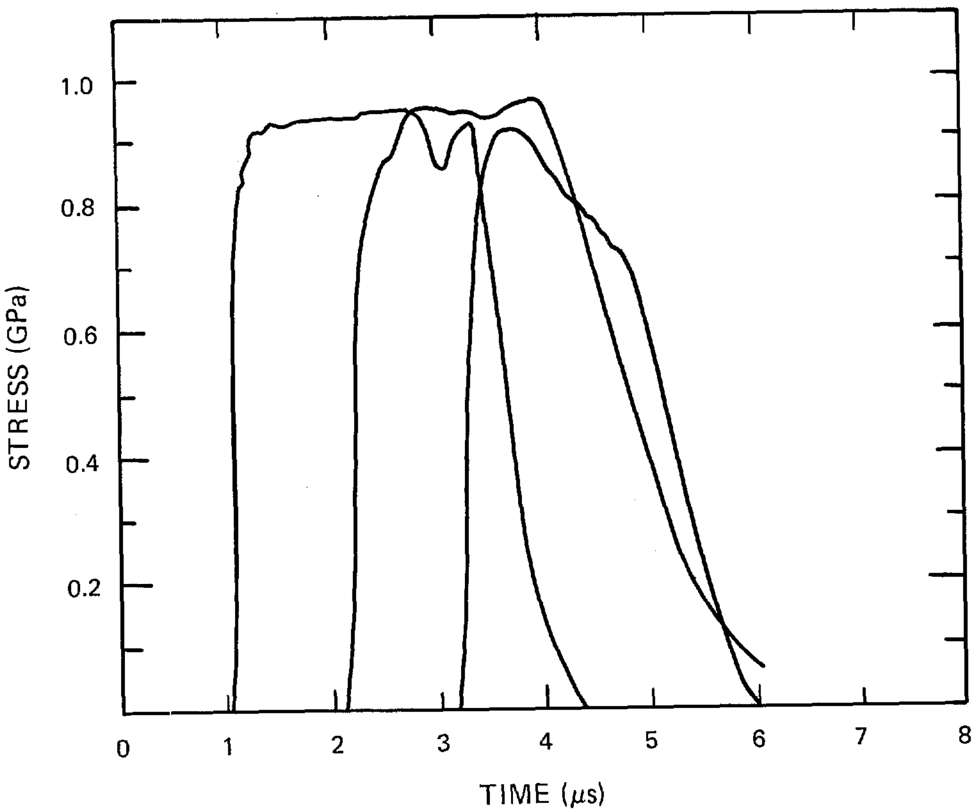
TARGET	Material: TP-N1028 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-23 Date: June 9, 1978 Diameter: 38.1 mm Density: 1.846 g/cm^3 $C_L = 2.36$ mm/μs $C_S = 0.35$ mm/μs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.27 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 1.07 mm, 4.06 mm, and 7.05 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 1.07-mm-thick PMMA. The other disks were propellant.


1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
8
TIME (μs)

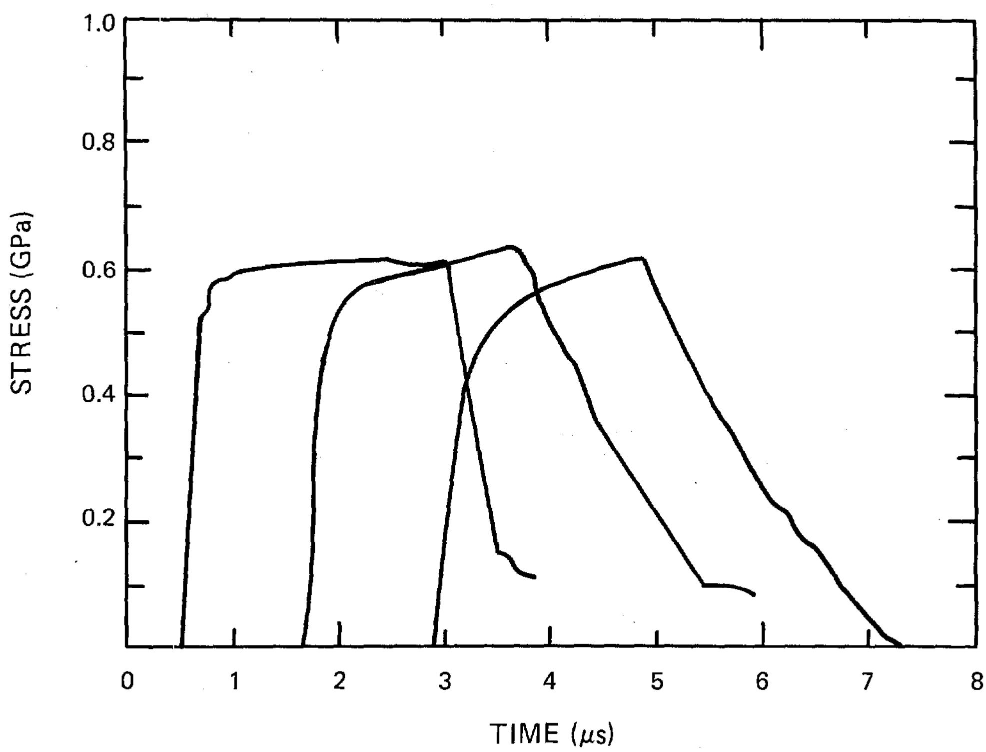
TARGET	Material: TP-N1028 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-26 Date: June 23, 1978 Diameter: 38.1 mm Density: 1.846 g/cm^3 $C_L = 2.36$ mm/µs $C_S = 0.35$ mm/µs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.18 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.04 mm, 5.02 mm, and 8.03 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 2.04-mm-thick PMMA. The other disks were propellant.


1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
8
TIME (μs)

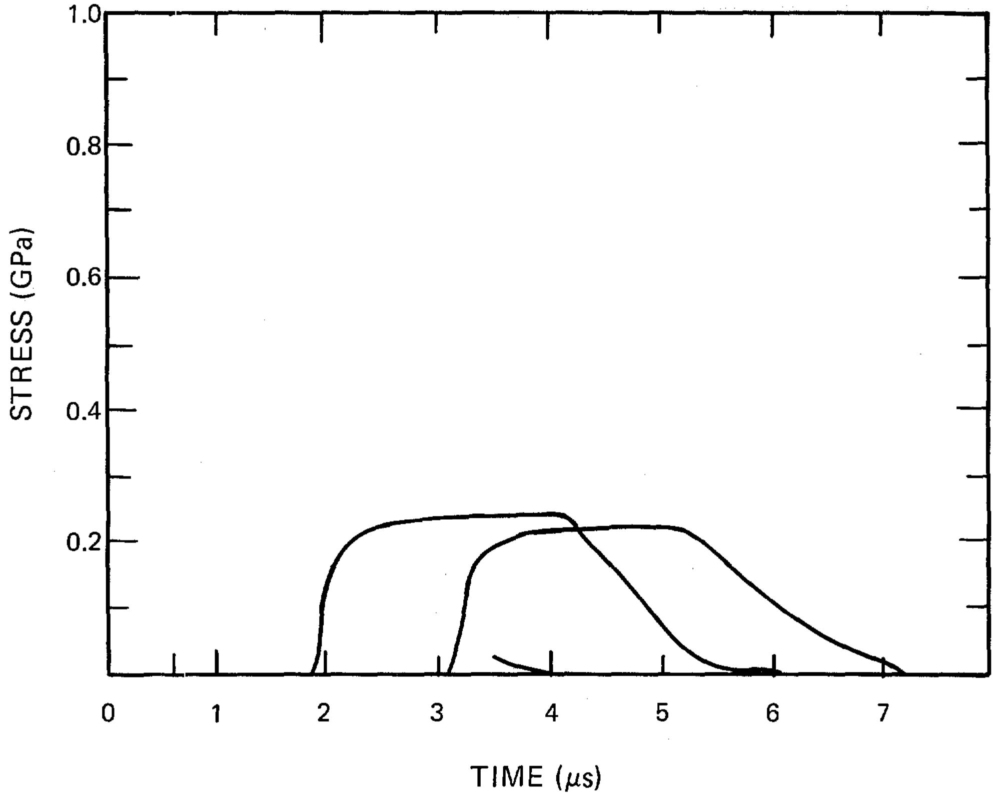
TARGET	**Material:** TP-N1028 Class VII propellant **Experiment type:** Embedded Manganin gage **Experimenter:** Bart Olinger **Shot no.:** 56-78-33 **Date:** June 28, 1978 **Diameter:** 38.1 mm **Density:** 1.846 g/cm^3 C_L = 2.36 mm/μs C_S = 0.35 mm/μs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile **Impact velocity:** 0.41 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage **Locations from impact surface:** 2.06 mm, 5.04 mm, and 8.05 mm **Heat treatment:** Annealed **Encapsulation:** None **Calibration:** J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ **Time:** Relative
NOTES	The first disk in the layered target was 2.06-mm-thick PMMA. The other disks were propellant.


1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
8
TIME (μs)

TARGET	Material: UTP-20930 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-24 Date: June 9, 1978 Diameter: 38.1 mm Density: 1.838 g/cm^3 $C_L = 2.61$ mm/μs $C_S = 0.41$ mm/μs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.26 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 1.07 mm, 4.04 mm, and 7.04 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 1.07-mm-thick PMMA. The other disks were propellant.

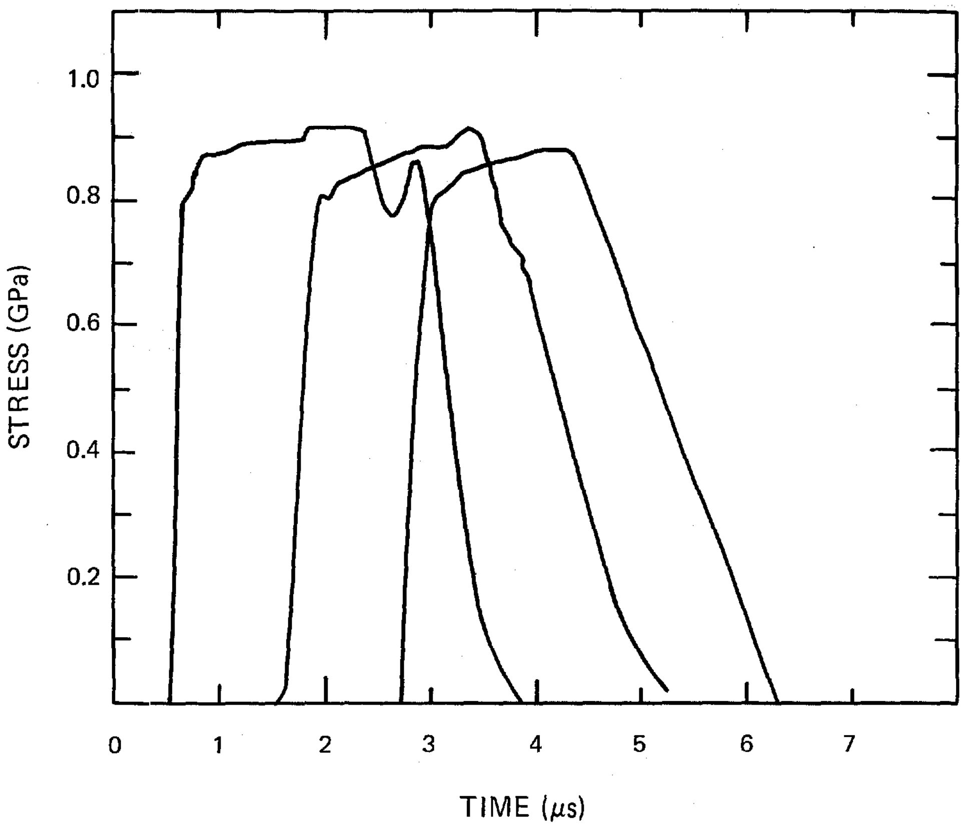

1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
8
TIME (μs)

TARGET	Material: UTP-20930 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-25 Date: June 23, 1978 Diameter: 38.1 mm Density: 1.838 g/cm^3 $C_L = 2.61$ mm/µs $C_S = 0.41$ mm/µs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.16 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 5.06 mm and 8.06 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 2.06-mm-thick PMMA. The other disks were propellant.

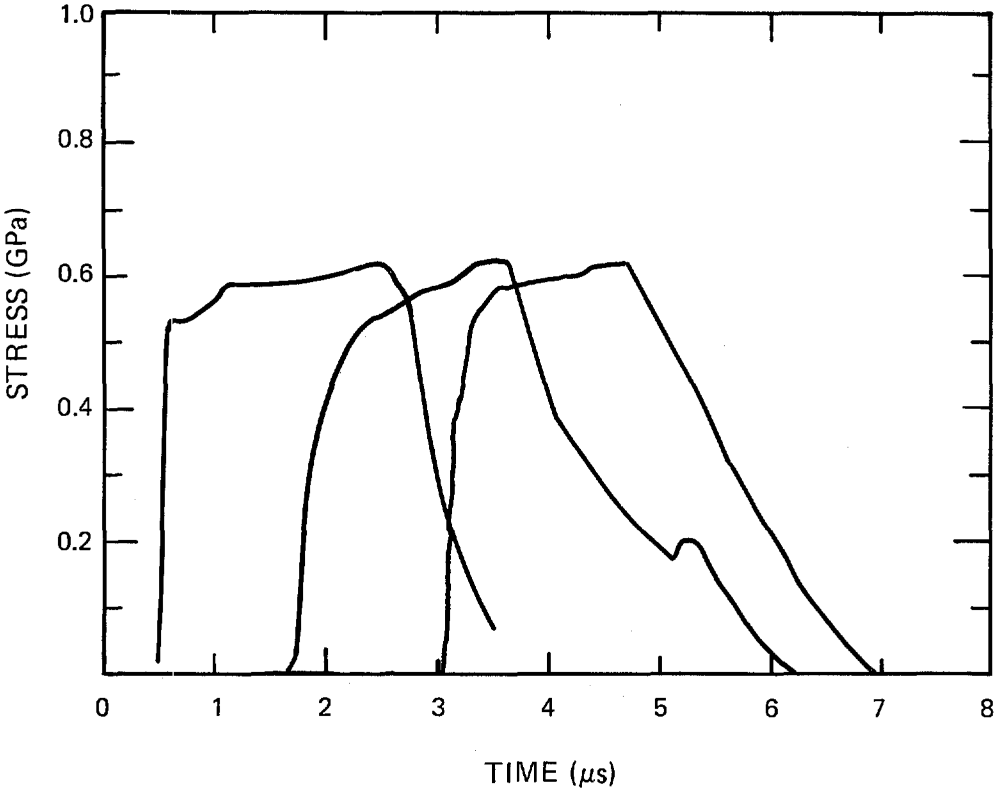


1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
TIME (μs)

TARGET	Material: UTP-20930 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-32 Date: June 27, 1978 Diameter: 38.1 mm Density: 1.838 g/cm^3 $C_L = 2.61$ mm/μs $C_S = 0.41$ mm/μs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.39 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.06 mm, 5.08 mm, and 8.06 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 2.06-mm-thick PMMA. The other disks were propellant.

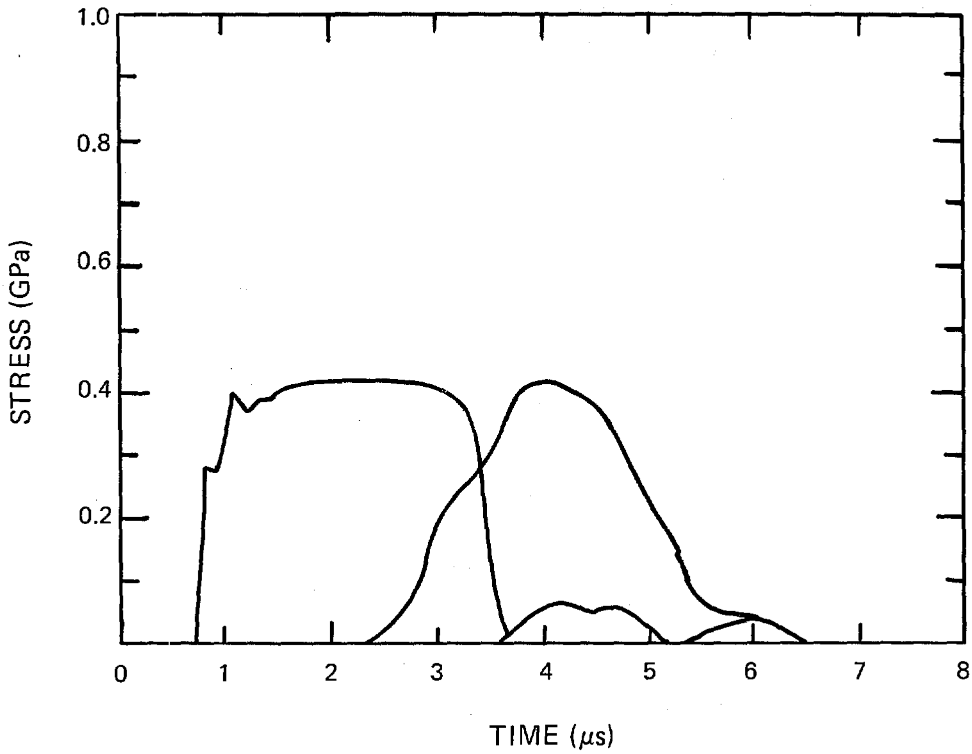

STRESS (GPa)
1.0
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
7
TIME (μs)

TARGET	Material: VWC-2 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-22 Date: June 9, 1978 Diameter: 38.1 mm Density: 1.835 g/cm^3 $C_L = 2.13$ mm/µs $C_S = 0.49$ mm/µs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.29 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 1.07 mm, 4.04 mm, and 7.01 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 1.07-mm-thick PMMA. The other disks were propellant.



1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
8
TIME (μs)

TARGET	Material: VWC-2 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-27 Date: June 23, 1978 Diameter: 38.1 mm Density: 1.835 g/cm^3 $C_L = 2.13$ mm/µs $C_S = 0.49$ mm/µs
IMPACTOR	PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.19 mm/µs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.05 mm, 5.02 mm, and 7.99 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 2.05-mm-thick PMMA. The other disks were propellant.



STRESS (GPa)
1.0
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
7
8
TIME (μs)

TARGET

Material: VWC-2 Class VII propellant
Experiment type: Embedded Manganin gage
Experimenter: Bart Olinger
Shot no.: 56-78-34 Date: June 28, 1978
Diameter: 38.1 mm
Density: 1.835 g/cm^3
$C_L = 2.13$ mm/μs $C_S = 0.49$ mm/μs

IMPACTOR

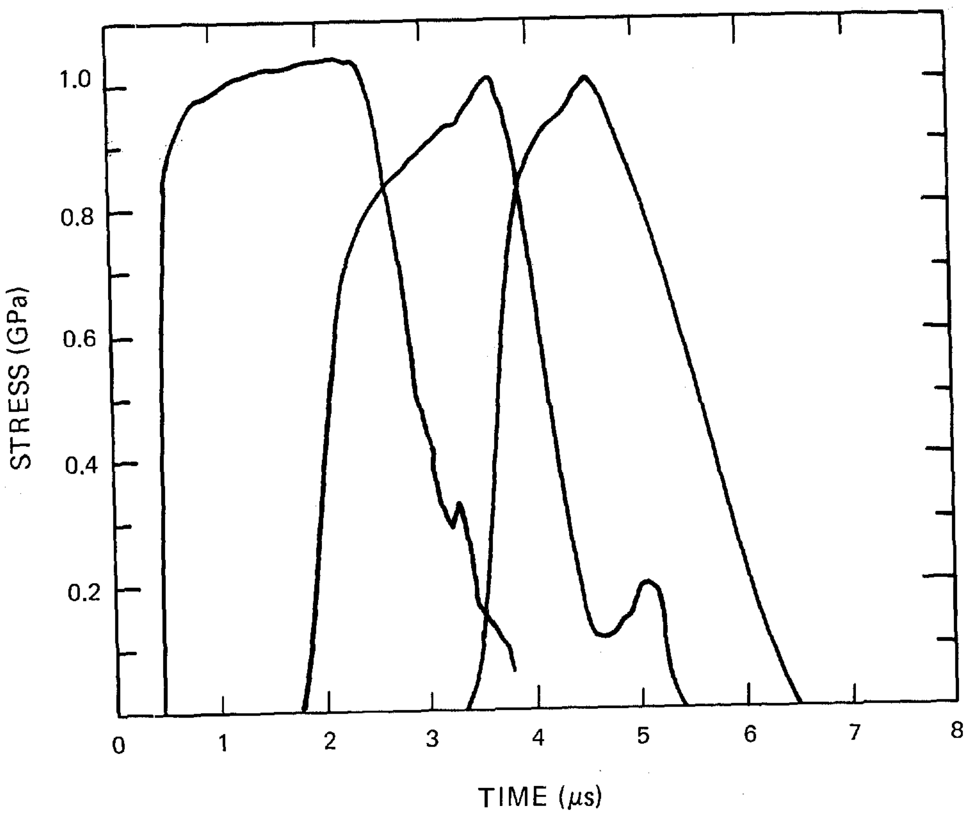
PMMA, 4.00 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile
Impact velocity: 0.42 mm/μs

TRANSDUCER

Two-terminal, 50-Ω Manganin gage
Locations from impact surface: 2.06 mm, 5.04 mm, and 8.02 mm
Heat treatment: Annealed
Encapsulation: None
Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages
$\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$,
$\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$,
where $x = \Delta R/R$.
$a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$
$a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$
Time: Relative

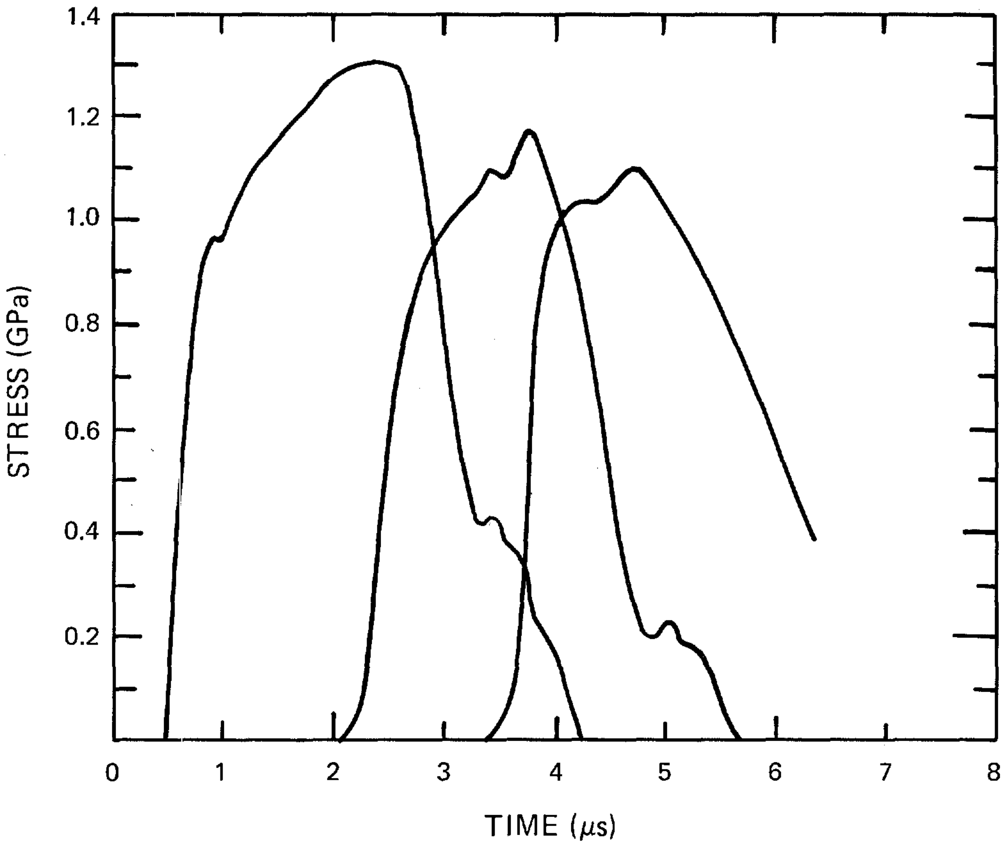
NOTES

The first disk in the layered target was 2.06-mm-thick PMMA. The other disks were propellant.



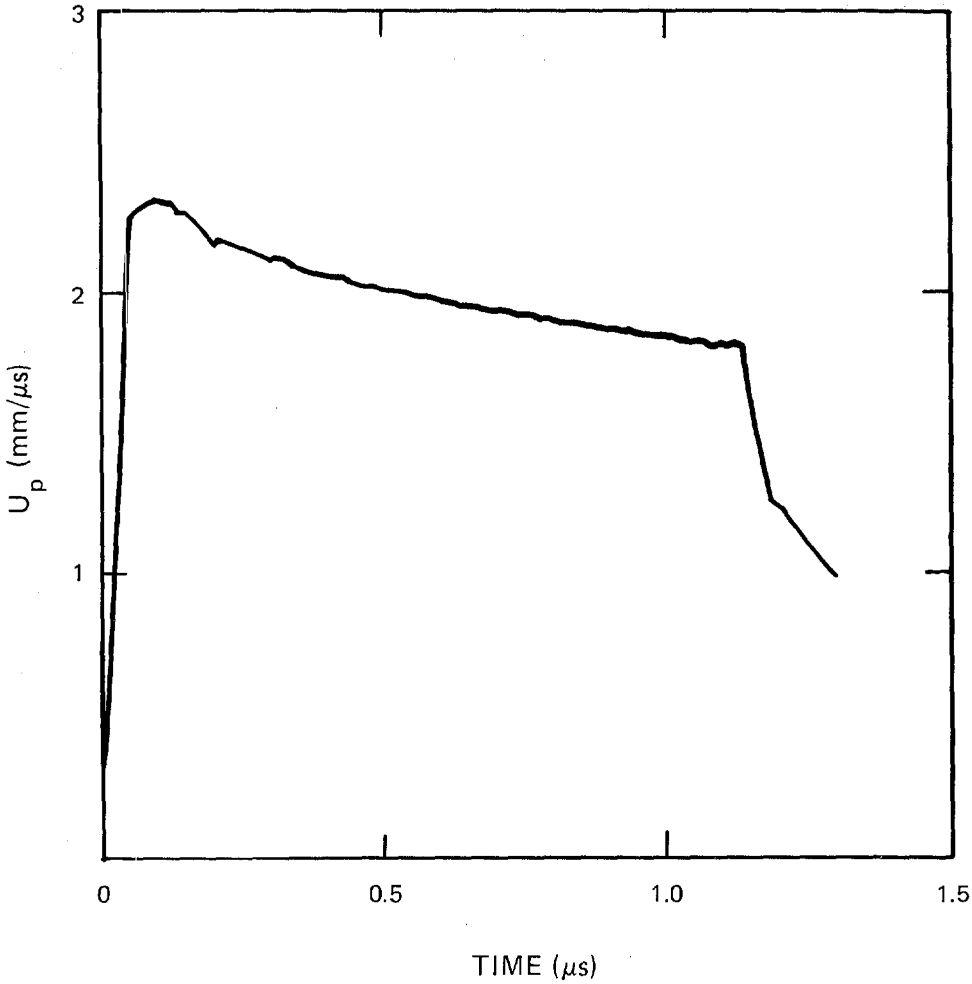
STRESS (GPa)
1.0
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
7
8
TIME (μs)

TARGET	Material: VWC-2 Class VII propellant Experiment type: Embedded Manganin gage Experimenter: Bart Olinger Shot no.: 56-78-41 Date: July 24, 1978 Diameter: 38.1 mm Density: 1.835 g/cm^3 $C_L = 2.13$ mm/μs $C_S = 0.49$ mm/μs
IMPACTOR	PMMA, 4.10 mm thick, backed with low-density polyurethane foam, mounted on 51-mm-diam aluminum alloy projectile Impact velocity: 0.41 mm/μs
TRANSDUCER	Two-terminal, 50-Ω Manganin gage Locations from impact surface: 2.06 mm, 5.06 mm, and 8.06 mm Heat treatment: Annealed Encapsulation: None Calibration: J. W. Hopson and J. W. Taylor calibration formula for Manganin gages $\sigma = a_1 x + b_1 x^2 + c_1 x^3$ for $x < 0.1$, $\sigma = a_2 + b_2 x + c_2 x^2$ for $x > 0.1$, where $x = \Delta R/R$. $a_1 = 521.32$ $b_1 = -1614.86$ $c_1 = 7648.72$ $a_2 = 6.5950$ $b_2 = 370.37$ $c_2 = 0.00$ Time: Relative
NOTES	The first disk in the layered target was 2.06-mm-thick PMMA. The other disks were propellant.

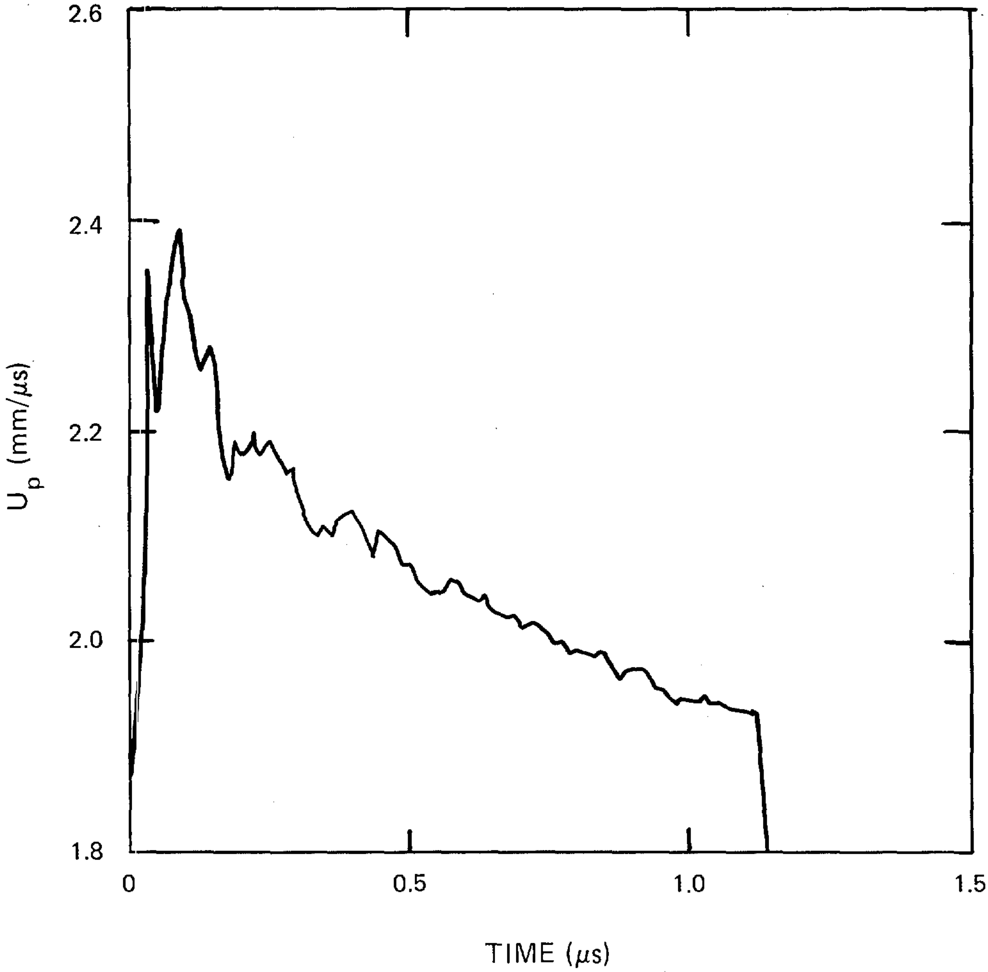


1.4
1.2
1.0
0.8
0.6
0.4
0.2
STRESS (GPa)
0
1
2
3
4
5
6
7
8
TIME (μs)

TARGET	Material: X 0290, 95 wt% TATB and 5 wt% Kel-F Experiment type: ASM probe Experimenter: W. C. Davis Reference: Davis (1976) Shot no.: F 3792 Date: August 13, 1975
HE SHOT GEOMETRY	P-080 lens/25.4 mm TNT/50.8 mm X 0290/0.075 mm aluminum//Teflon//
SHOT COMPONENTS	95 wt% TATB and 5 wt% Kel-F Density: 1.89 g/cm^3 TNT Density: 1.64 g/cm^3 $C_L = 2.48$ mm/μs $C_S = 1.34$ mm/μs Teflon Density: 2.14 g/cm^3 $C_L = 1.23$ mm/μs $C_S = 0.41$ mm/μs
TRANSDUCER	ASM probe Coil radius: 18.62 mm Initial coil spacing: 6.78 mm

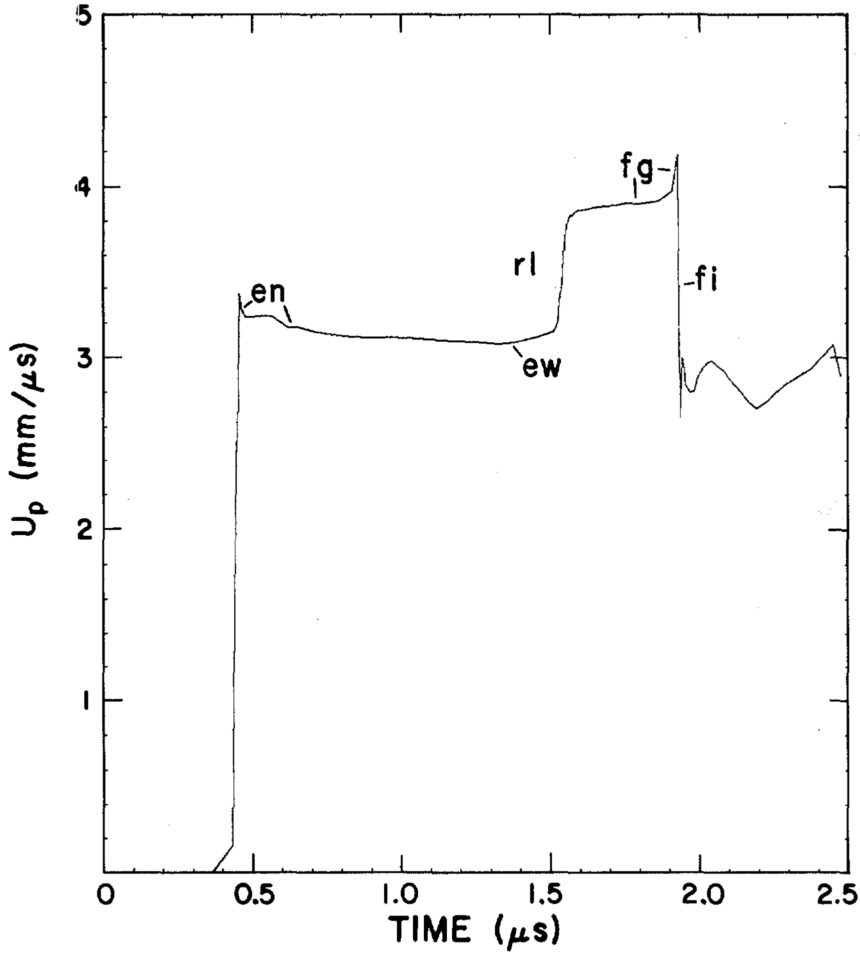

3
2
1
U_p (mm/μs)
0
0.5
1.0
1.5
TIME (μs)

TARGET	**Material:** X 0290, 95 wt% TATB and 5 wt% Kel-F **Experiment type:** ASM probe **Experimenter:** W. C. Davis **Reference:** Davis (1976) **Shot no.:** F 3795 **Date:** August 15, 1975
HE SHOT GEOMETRY	P-080 lens/25.4 mm TNT/101.6 mm X 0290//0.075 mm aluminum/6.36 mm Teflon//
SHOT COMPONENTS	95 wt% TATB and 5 wt% Kel-F **Density:** 1.89 g/cm^3 TNT **Density:** 1.64 g/cm^3 C_L = 2.48 mm/μs C_S = 1.34 mm/μs Teflon **Density:** 2.14 g/cm^3 C_L = 1.23 mm/μs C_S = 0.41 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 18.62 mm **Initial coil spacing:** 6.79 mm


2.6
2.4
2.2
2.0
1.8
U_p (mm/μs)
0
0.5
1.0
1.5
TIME (μs)

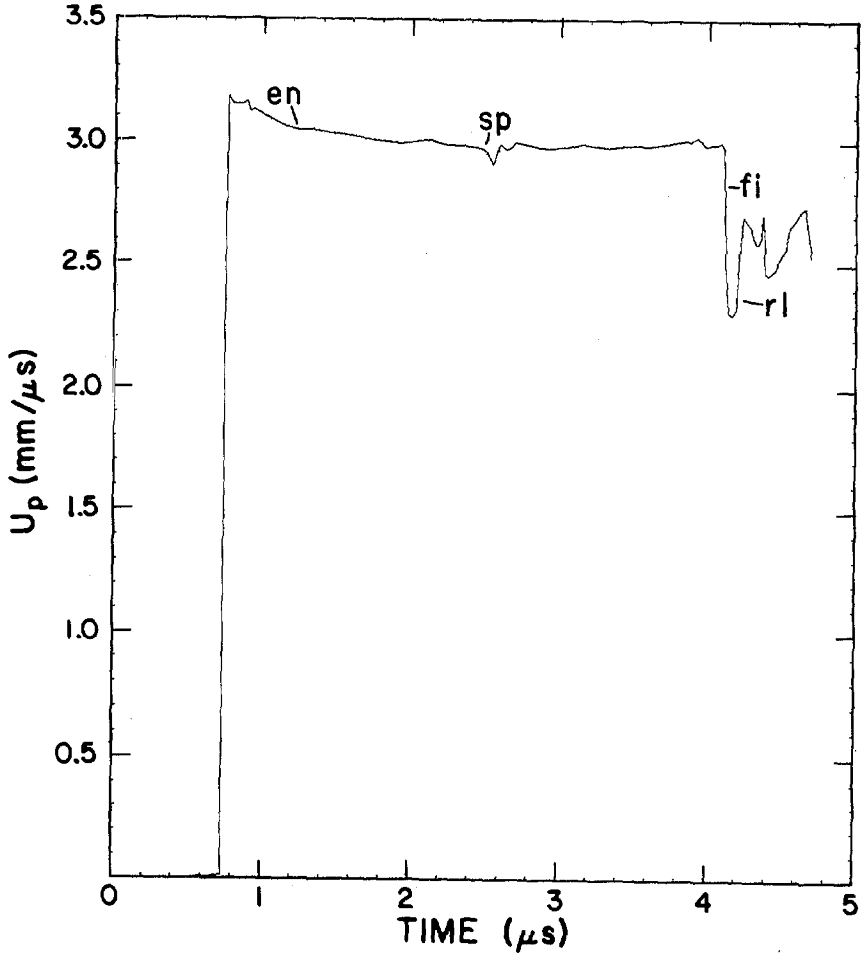
EXPLOSIVES - METAL FREE-RUN SYSTEMS

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Reference:** Mader (1979) **Shot no.:** M 32s1 **Date:** May 11, 1971
HE SHOT GEOMETRY	P-081 lens/50.8 mm Comp B/3.167 mm 2024 aluminum// 12.56 mm air/4.95 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 38.17 mm **Initial coil spacing:** 17.51 mm **Time:** Relative



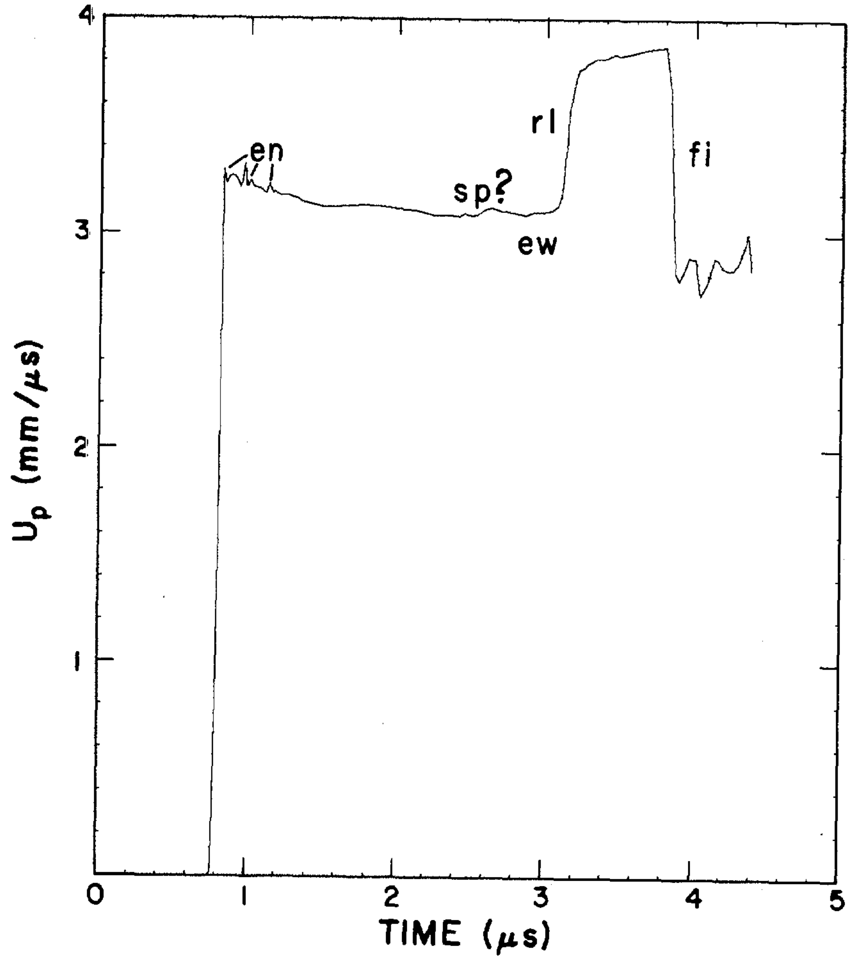
5
4
3
2
1
0
0.5
1.0
1.5
2.0
2.5
TIME (μs)
U_p (mm/μs)
en
ew
rl
fg
fi

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Reference:** Mader (1979) **Shot no.:** M 33s1 **Date:** May 13, 1971
HE SHOT GEOMETRY	P-081 lens/50.8 mm Comp B/6.296 mm 2024 aluminum //10.13 mm air/4.84 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 C_L = 6.36 mm/μs C_S = 3.16 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 38.17 mm **Initial coil spacing:** 14.97 mm **Time:** Relative



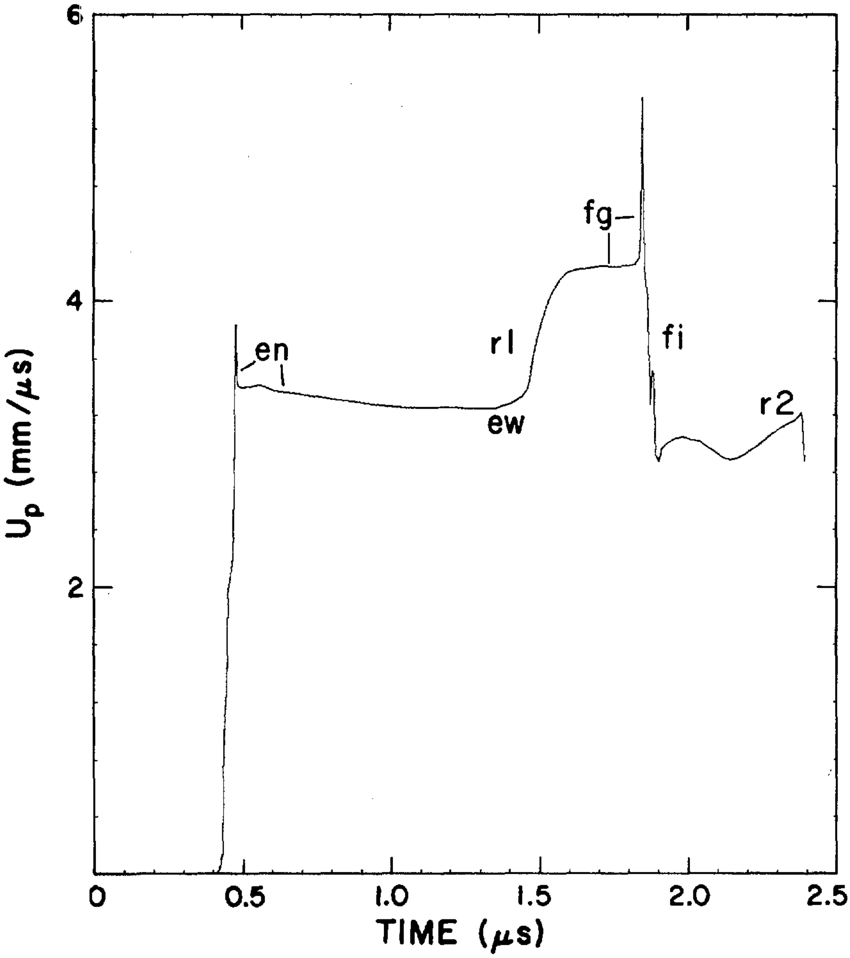
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Up (mm/μs)
0
1
2
3
4
5
TIME (μs)
en
sp
fi
rl

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 34s1 **Date:** May 17, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/6.405 mm 2024 aluminum //10.02 mm air/5.042 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 38.17 mm **Initial coil spacing:** 15.06 mm **Time:** Relative



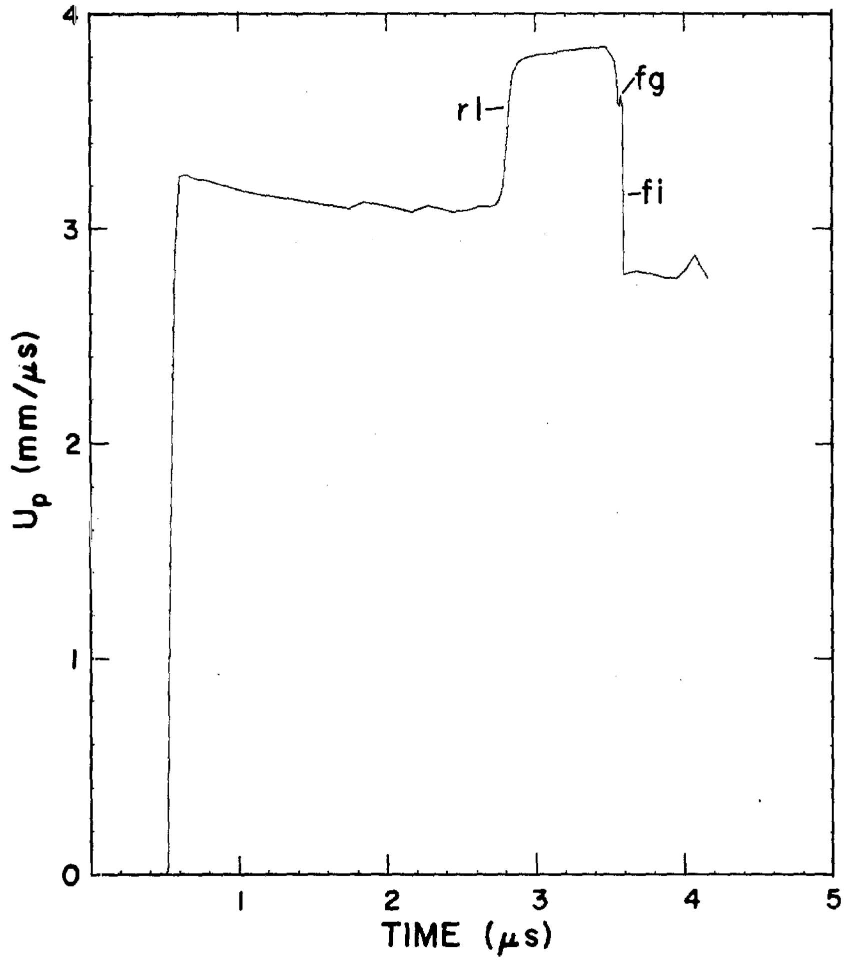
4
3
2
1
0
1
2
3
4
5
U_p (mm/μs)
TIME (μs)
en
sp?
ew
rl
fi

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 35s1 **Date:** May 18, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/3.255 mm 2024 aluminum// 7.543 mm air/5.04 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 C_L = 6.36 mm/μs C_S = 3.16 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 38.17 mm **Initial coil spacing:** 12.58 mm **Time:** Relative



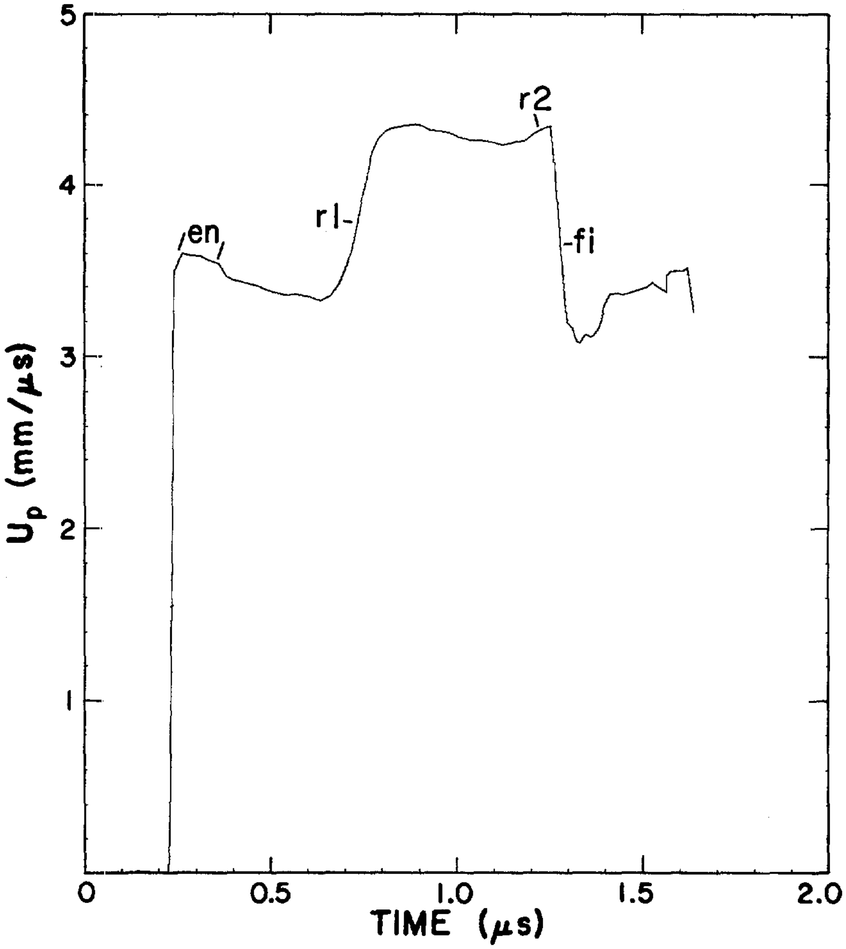
6
4
2
0
0.5
1.0
1.5
2.0
2.5
TIME (μs)
U_p (mm/μs)
en
ew
r1
fg
fi
r2

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Reference:** Fritz and Morgan (1973) **Shot no.:** M 36s1 **Date:** May 24, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/6.281 mm 2024 aluminum //10.02 mm air/5.07 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 38.17 mm **Initial coil spacing:** 15.09 mm **Time:** Relative

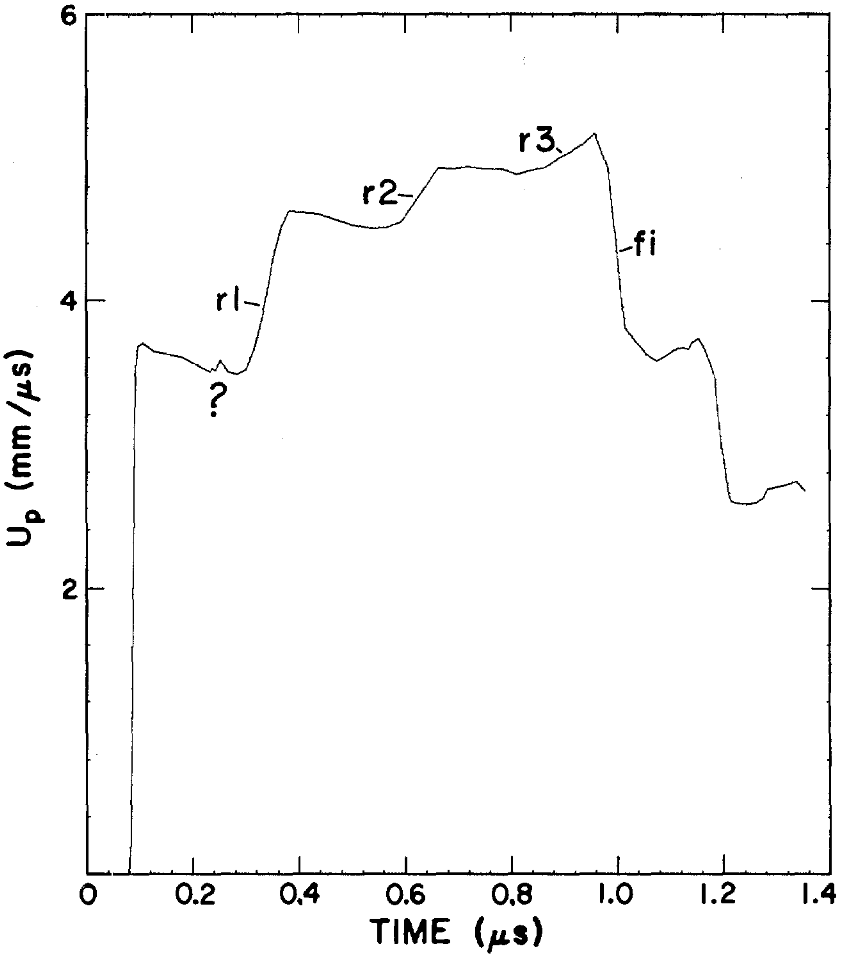


4
3
2
1
0
1
2
3
4
5
U_p (mm/μs)
TIME (μs)
r1
fg
fi

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 39s1 **Date:** August 25, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/1.623 mm 2024 aluminum// 4.00 mm air/3.01 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 9.584 mm **Initial coil spacing:** 7.01 mm **Time:** Relative

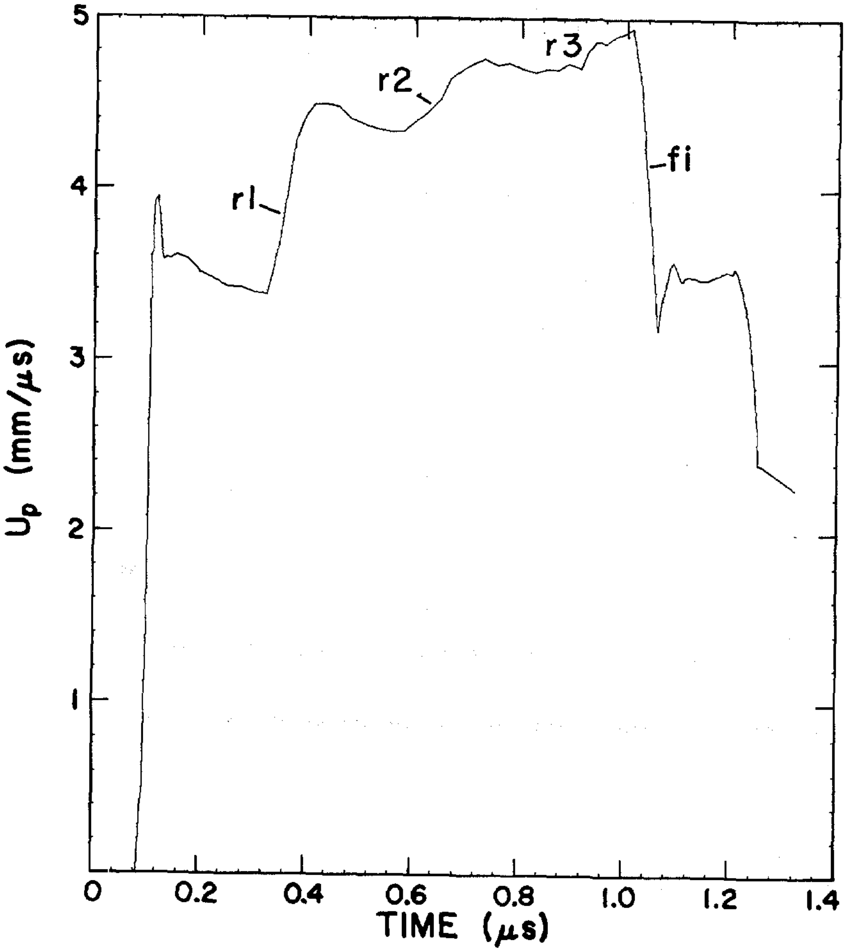

5
4
3
2
1
U_p (mm/μs)
0
0.5
1.0
1.5
2.0
TIME (μs)
en
r1-
r2
-fi

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 40s1 **Date:** August 25, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/0.828 mm 2024 aluminum //4.03 mm air/3.00 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 C_L = 6.36 mm/μs C_S = 3.16 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 9.586 mm **Initial coil spacing:** 7.03 mm **Time:** Relative

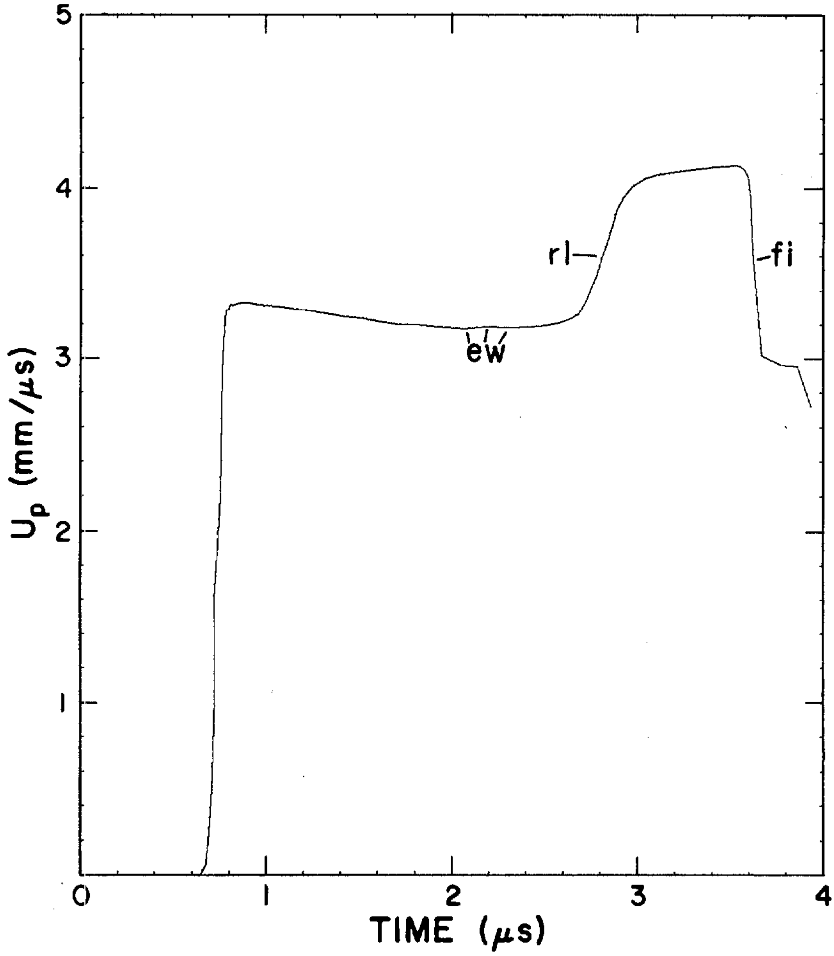


6
4
2
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
TIME (μs)
U_p (mm/μs)
r1
r2
r3
fi
?

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 41s1 **Date:** August 25, 1971
HE SHOT GEOMETRY	P-081 lens/50.8 mm Comp B/0.837 mm 2024 aluminum //4.03 mm air/3.01 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 9.588 mm **Initial coil spacing:** 7.04 mm **Time:** Relative

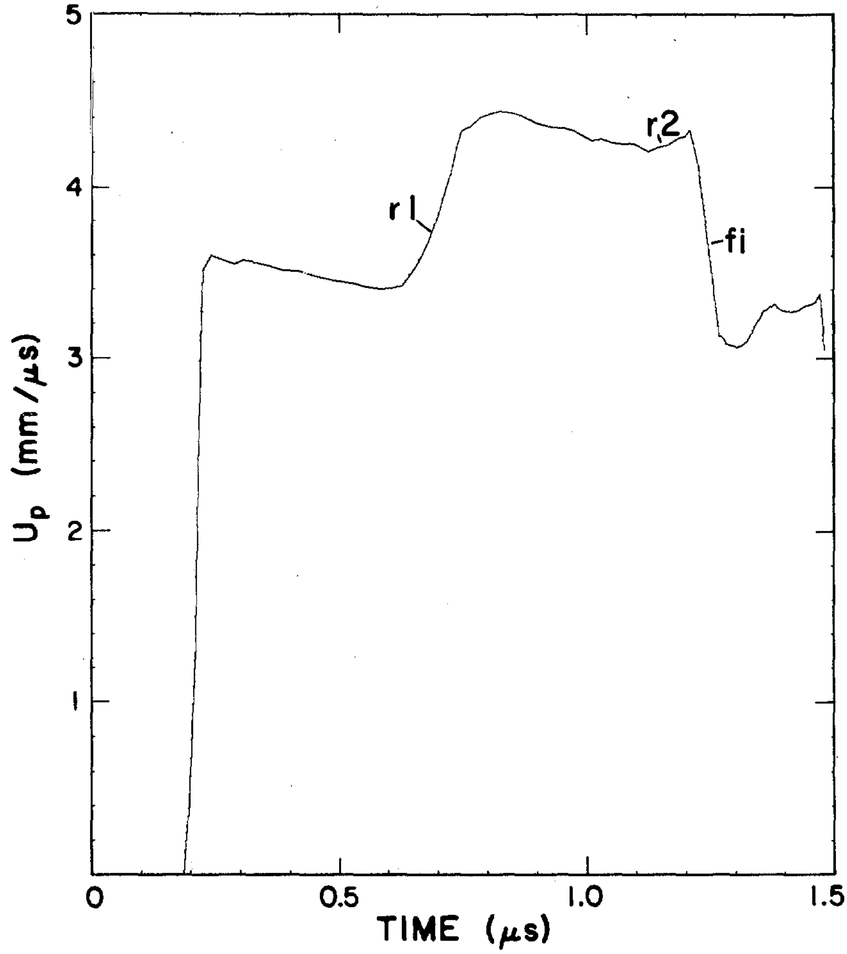

r1
r2
r3
fi
5
4
3
2
1
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
U_p (mm/μs)
TIME (μs)

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 42s1 **Date:** August 27, 1971
HE SHOT GEOMETRY	P-120 lens /152.4 mm Comp B/6.343 mm 2024 aluminum //10.02 mm air/ 5.00 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/µs C_S = 1.71 mm/µs 2024 aluminum **Density:** 2.785 g/cm^3 C_L = 6.36 mm/µs C_S = 3.16 mm/µs
TRANSDUCER	ASM probe **Coil radius:** 38.16 mm **Initial coil spacing:** 15.02 mm **Time:** Relative



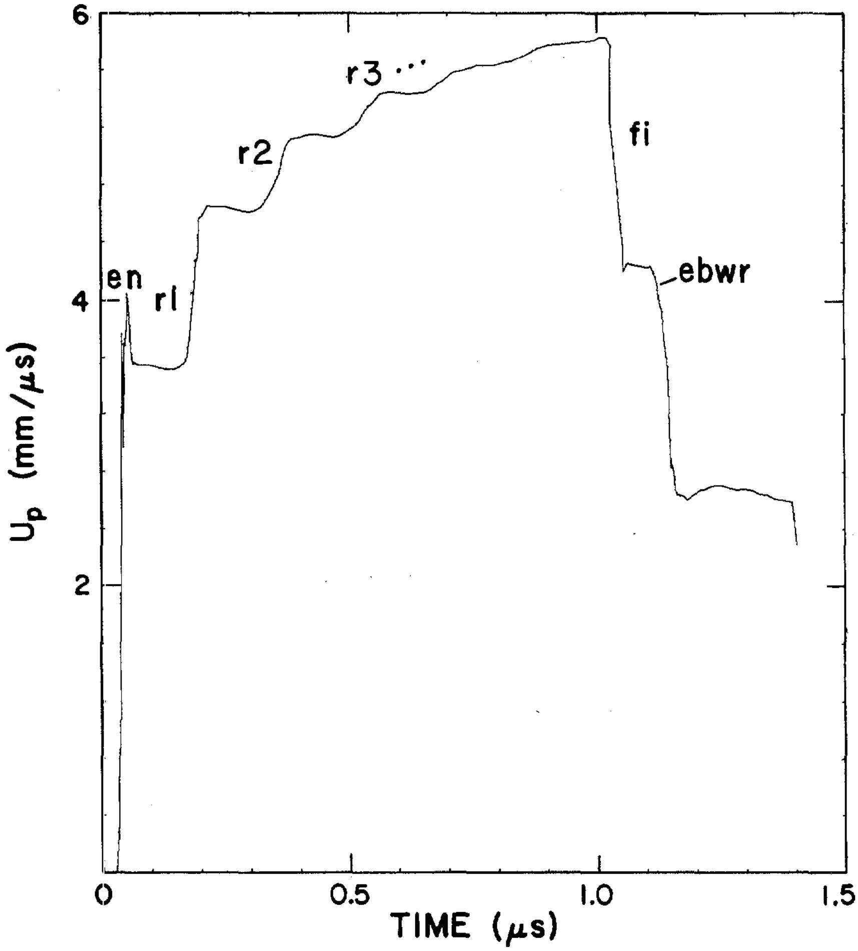
5
4
3
2
1
0
1
2
3
4
U_p (mm/μs)
TIME (μs)
rl
fi
e
w

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 43s1 **Date:** August 27, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/1.606 mm 2024 aluminum// 4.02 mm air/3.00 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 9.60 mm **Initial coil spacing:** 7.02 mm **Time:** Relative



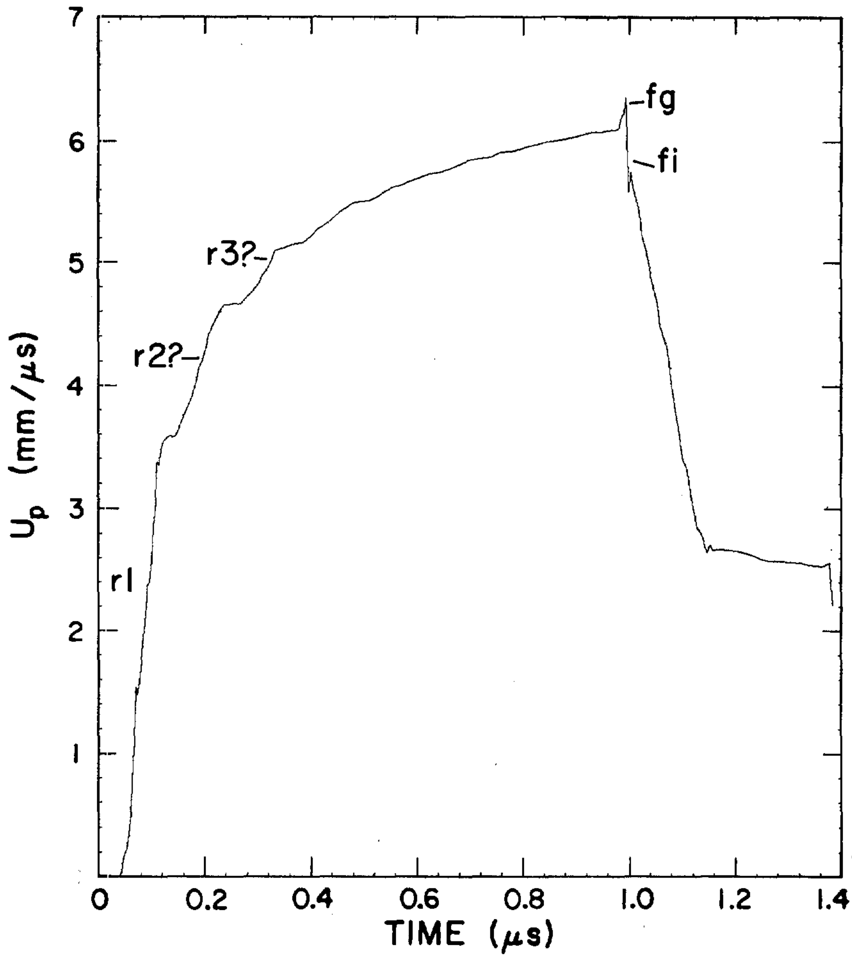
5
4
3
2
1
0
0.5
1.0
1.5
TIME (μs)
Up (mm/μs)
r1
r2
fi

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 56s2 **Date:** March 8, 1972
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/0.493 mm 2024 aluminum //5.03 mm air/4.97 mm Pyrex glass//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 C_L = 6.36 mm/μs C_S = 3.16 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.00 mm **Time:** Relative



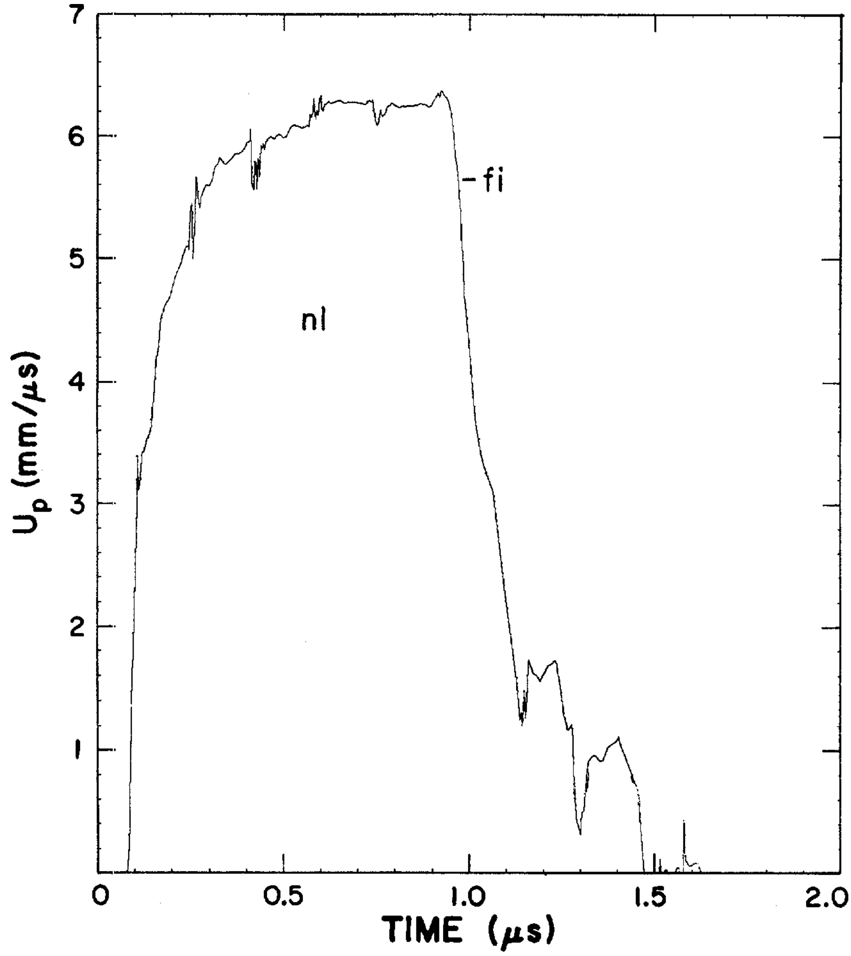
en
r1
r2
r3 ···
fi
ebwr
U_p (mm/μs)
TIME (μs)
0
0.5
1.0
1.5
2
4
6

TARGET	**Material:** Comp B - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 57 **Date:** March 12, 1972
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/0.346 mm 2024 aluminum// 5.13 mm air/5.10 mm Pyrex glass//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.23 mm **Time:** Relative



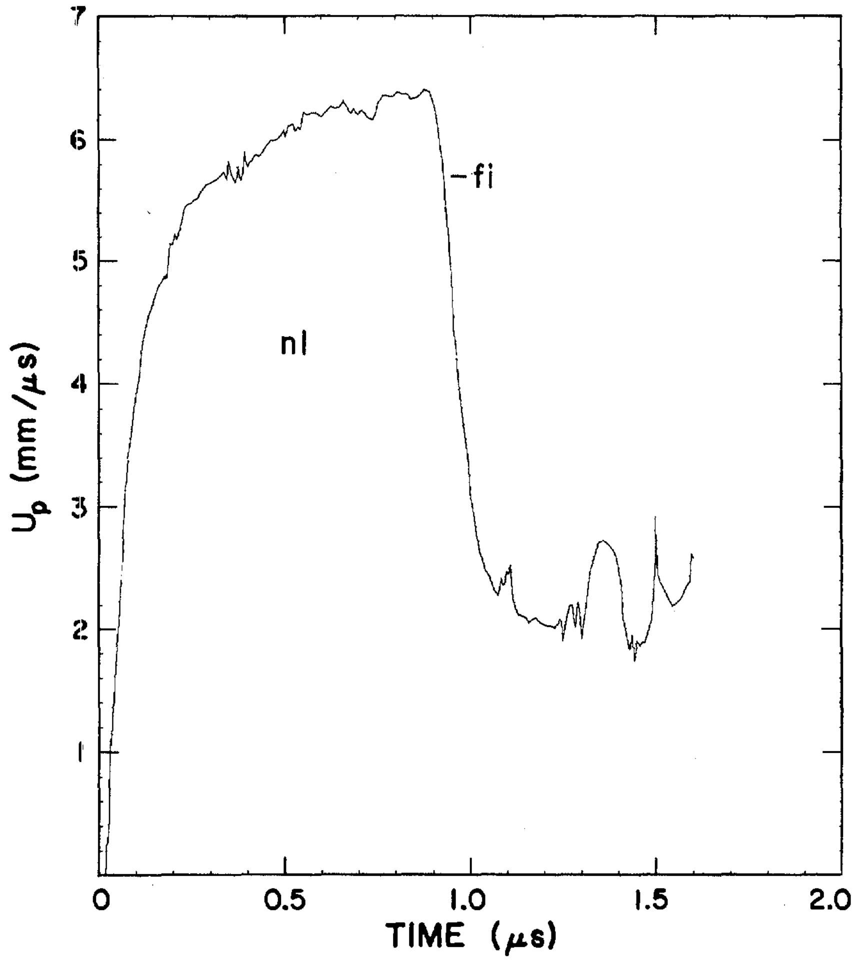
7
6
5
4
3
2
1
U_p (mm/µs)
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
TIME (µs)
r1
r2?
r3?
fg
fi

TARGET	**Material:** Comp B - aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 58 **Date:** March 21, 1972
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/0.219 mm aluminum// 5.13 mm air/5.10 mm Pyrex glass//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.23 mm **Time:** Relative



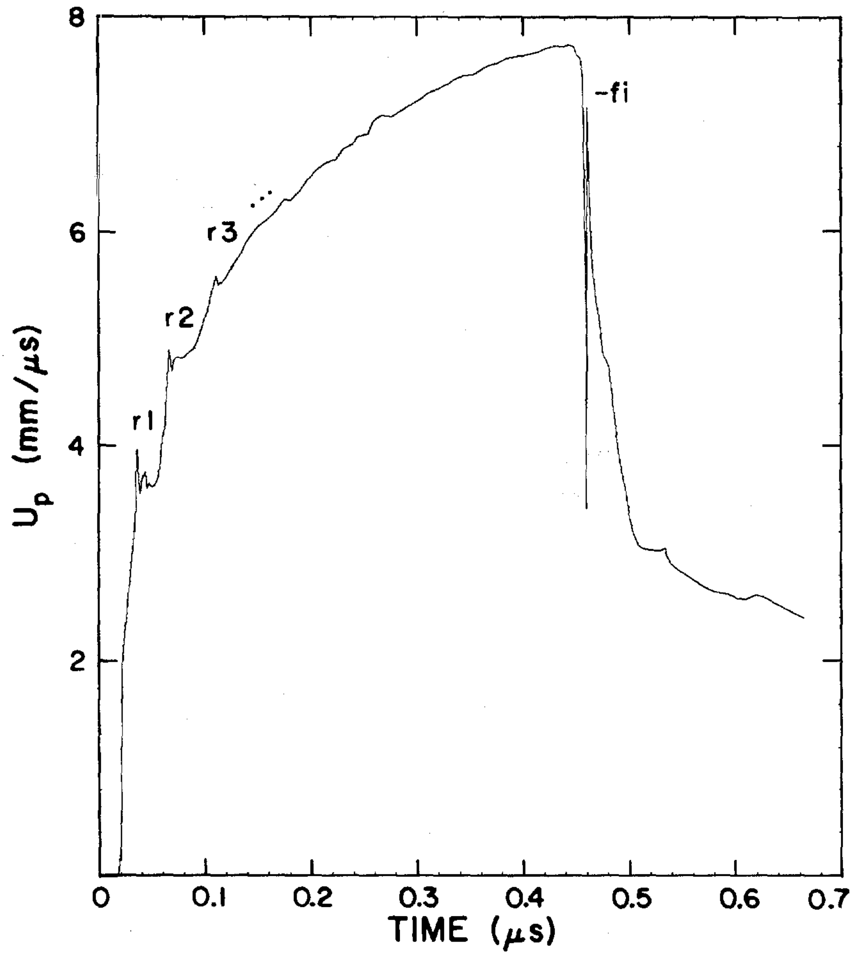
7
6
5
4
3
2
1
0
0.5
1.0
1.5
2.0
TIME (μs)
U_p (mm/μs)
-fi
nl

TARGET	**Material:** Comp B - aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 59 **Date:** March 23, 1972
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/0.221 mm aluminum// 5.13 mm air/5.14 mm Pyrex glass//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 10.27 mm **Time:** Relative



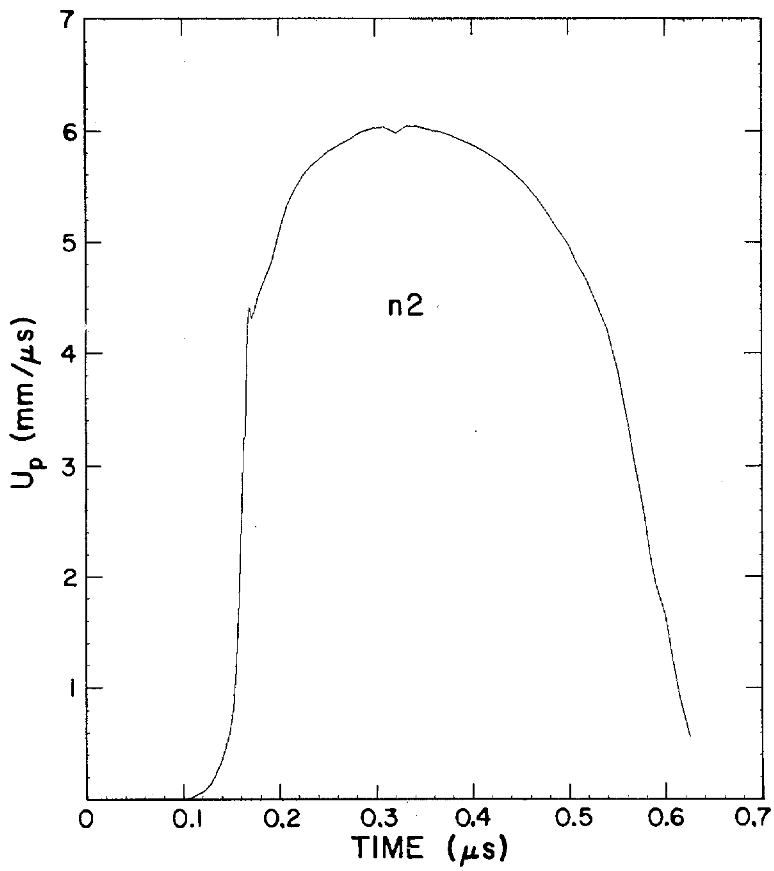
7
6
5
4
3
2
1
U_p (mm/μs)
0
0.5
1.0
1.5
2.0
TIME (μs)
-fi
nl

TARGET	Material: Comp B - aluminum free-run system Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 60 Date: April 10, 1972
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/0.222 mm aluminum// 5.01 mm air/5.04 mm Pyrex glass//
SHOT COMPONENTS	Comp B Density: 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs
TRANSDUCER	ASM probe Coil radius: 28.64 mm Initial coil spacing: 10.05 mm Time: Relative

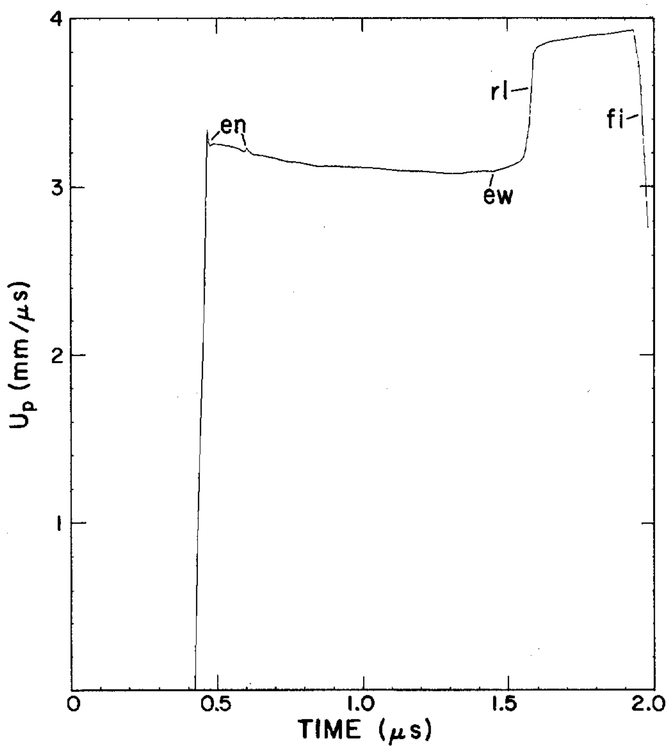


8
6
4
2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
U_p (mm/μs)
TIME (μs)
r1
r2
r3
...
-fi

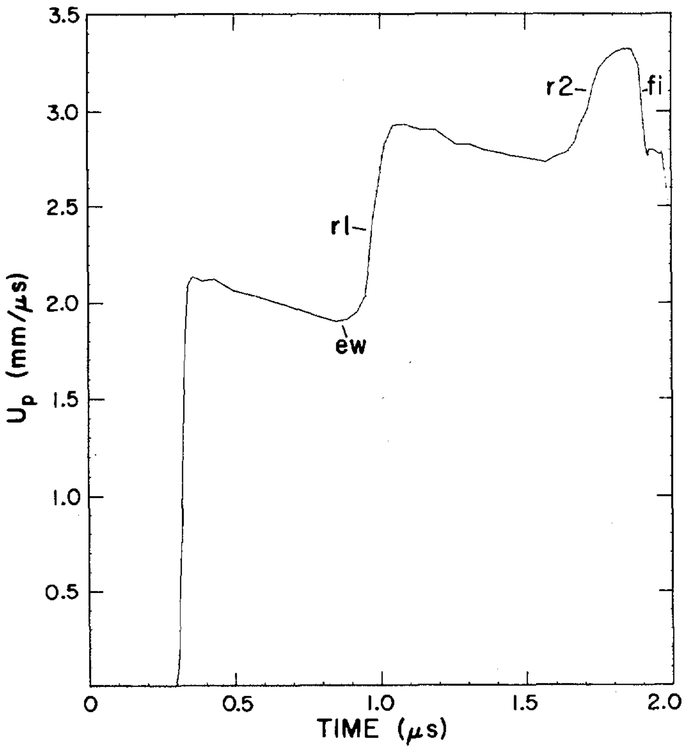
TARGET	**Material:** Comp B - aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 61 **Date:** April 11, 1971
HE SHOT GEOMETRY	P-081 lens/102 mm Comp B/0.074 mm aluminum// 2.49 mm air/5.05 mm Pyrex glass//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 7.54 mm **Time:** Relative



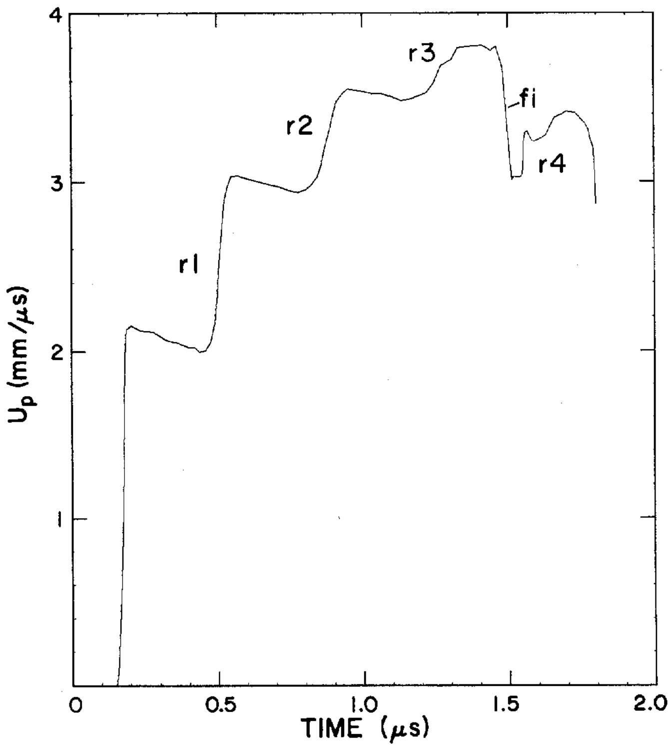
TARGET	**Material:** Comp B - 6061 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 29s1 **Date:** April 23, 1971
HE SHOT GEOMETRY	P-081 lens/50.8 mm Comp B/3.218 mm 6061 aluminum //5.014 mm air/5.00 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm³ $C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs 6061 aluminum **Density:** 2.703 g/cm³ $C_L = 6.40$ mm/μs $C_S = 3.15$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 38.25 mm **Initial coil spacing:** 10.01 mm **Time:** Relative



TARGET	**Material:** Comp B - copper free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 44s1 **Date:** August 27, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/1.613 mm OFHC copper //4.00 mm air/3.00 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 C_L = 3.12 mm/μs C_S = 1.71 mm/μs OFHC copper **Density:** 8.93 g/cm^3 C_L = 4.76 mm/μs C_S = 2.33 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 9.587 mm **Initial coil spacing:** 7.00 mm **Time:** Relative



TARGET	Material: Comp B - copper free-run system Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 45s1 Date: August 27, 1971
HE SHOT GEOMETRY	P-081 lens/101.6 mm Comp B/0.838 mm OFHC copper// 4.01 mm air/3.02 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B Density: 1.726 g/cm^3 $C_L = 3.12$ mm/µs $C_S = 1.71$ mm/µs OFHC copper Density: 8.93 g/cm^3 $C_L = 4.76$ mm/µs $C_S = 2.33$ mm/µs
TRANSDUCER	ASM probe Coil radius: 9.582 mm Initial coil spacing: 7.03 mm Time: Relative



TARGET

Material: Comp B - copper free-run system
Experiment type: ASM probe
Experimenters: J. N. Fritz and J. A. Morgan
Shot no.: M 46s1 Date: August 27, 1971

HE SHOT GEOMETRY

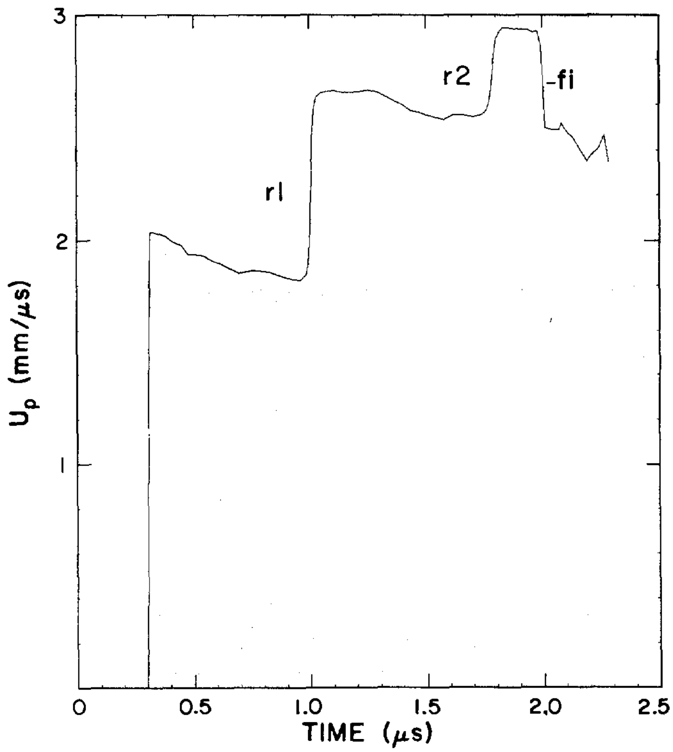
P-081 lens/50.8 mm Comp B/1.615 mm OFHC copper //3.99 mm air/3.01 mm polymethyl methacrylate//

SHOT COMPONENTS

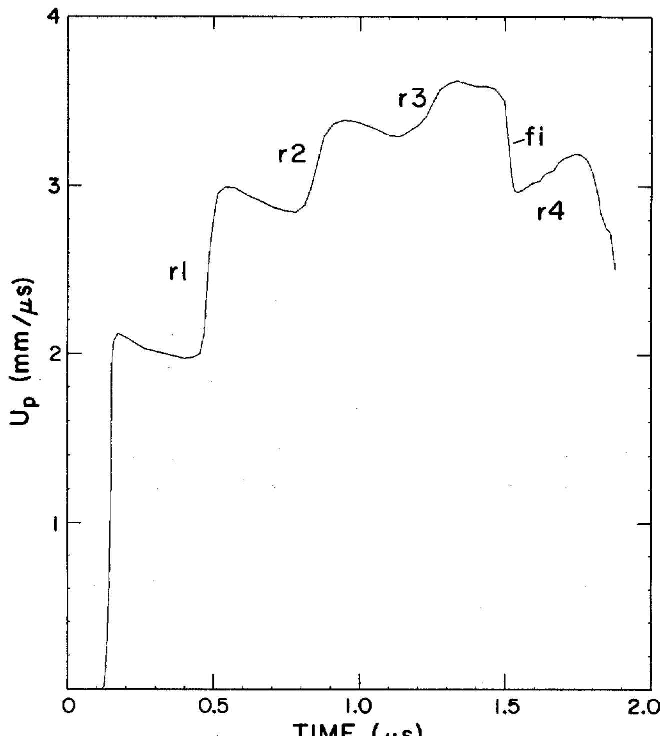
Comp B
Density: 1.726 g/cm^3
$C_L = 3.12$ mm/μs $C_S = 1.71$ mm/μs
OFHC copper
Density: 8.93 g/cm^3
$C_L = 4.76$ mm/μs $C_S = 2.33$ mm/μs

TRANSDUCER

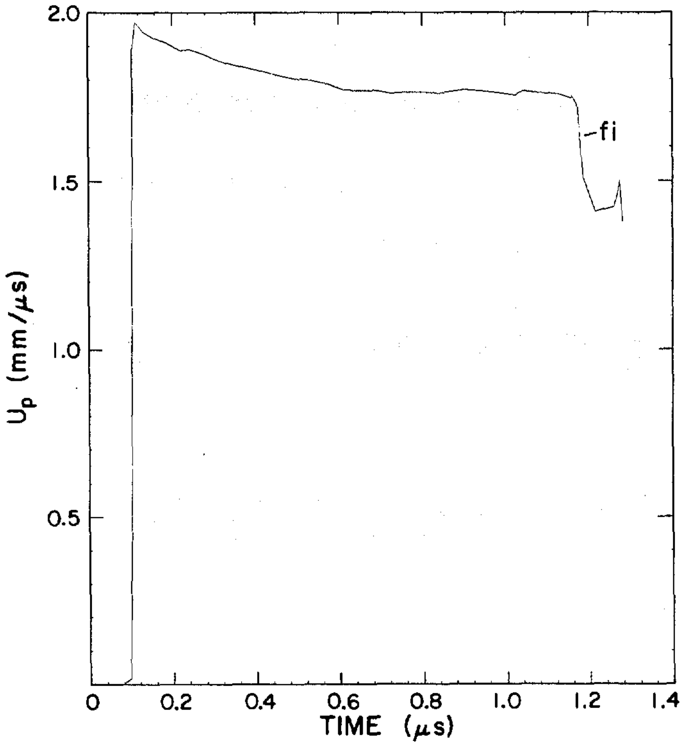
ASM probe
Coil radius: 9.573 mm Initial coil spacing: 7.00 mm
Time: Relative



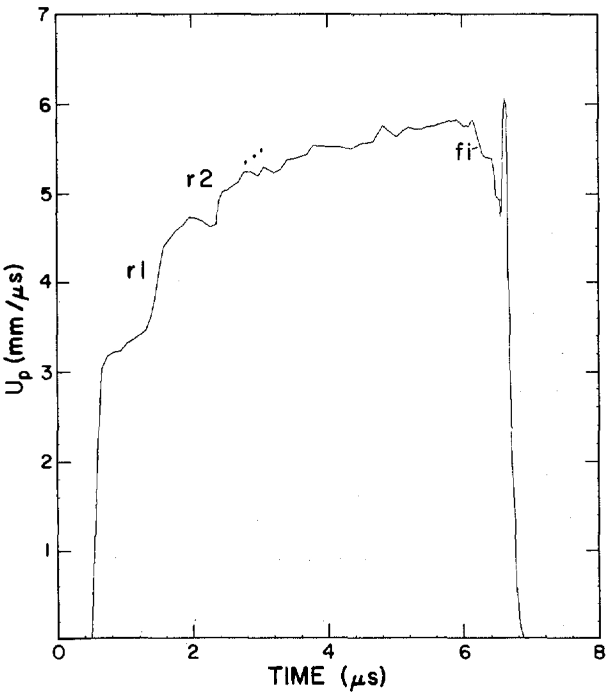
TARGET	**Material:** Comp B - copper free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 47s1 **Date:** August 27, 1971
HE SHOT GEOMETRY	P-081 lens/50.8 mm Comp B/0.832 mm OFHC copper// 4.01 mm air/2.98 mm polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/µs $C_S = 1.71$ mm/µs OFHC copper **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/µs $C_S = 2.33$ mm/µs
TRANSDUCER	ASM probe **Coil radius:** 9.59 mm **Initial coil spacing:** 6.99 mm **Time:** Relative



TARGET	**Material:** Comp B - copper free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 80 **Date:** February 15, 1973
HE SHOT GEOMETRY	P-081 lens/103 mm Comp B/5.10 mm OFHC copper //2.07 mm air/polymethyl methacrylate//
SHOT COMPONENTS	Comp B **Density:** 1.726 g/cm^3 $C_L = 3.12$ mm/µs $C_S = 1.71$ mm/µs OFHC copper **Density:** 8.93 g/cm^3 $C_L = 4.76$ mm/µs $C_S = 2.33$ mm/µs
TRANSDUCER	ASM probe **Coil radius:** 4.79 mm **Initial coil spacing:** 2.52 mm **Time:** Relative



TARGET	**Material:** PBX 9404 - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 94 **Date:** January 30, 1975
HE SHOT GEOMETRY	P-120 lens/152 mm PBX 9404/7.2 mm air/0.25 mm polyethylene/3.21 mm 2024 aluminum//28.5 mm air/ 3.5 mm foam//
SHOT COMPONENTS	PBX 9404 **Density:** 1.830 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 C_L = 6.36 mm/μs C_S = 3.16 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 35.10 mm **Initial coil spacing:** 32.00 mm **Time:** Relative



TARGET

Material: PBX 9404 - 2024 aluminum free-run system
Experiment type: ASM probe
Experimenters: J. N. Fritz and J. A. Morgan
Shot no.: M 95 Date: March 17, 1975

HE SHOT GEOMETRY

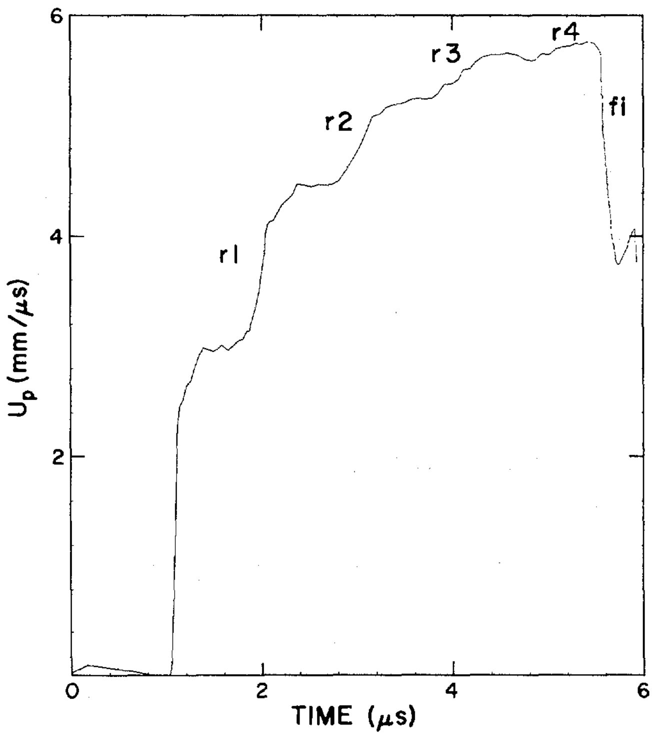
P-120 lens/152 mm PBX 9404/3.2 mm air/ 0.33 mm polyethylene/3.21 mm 2024 aluminum//28.5 mm air/plastic//

SHOT COMPONENTS

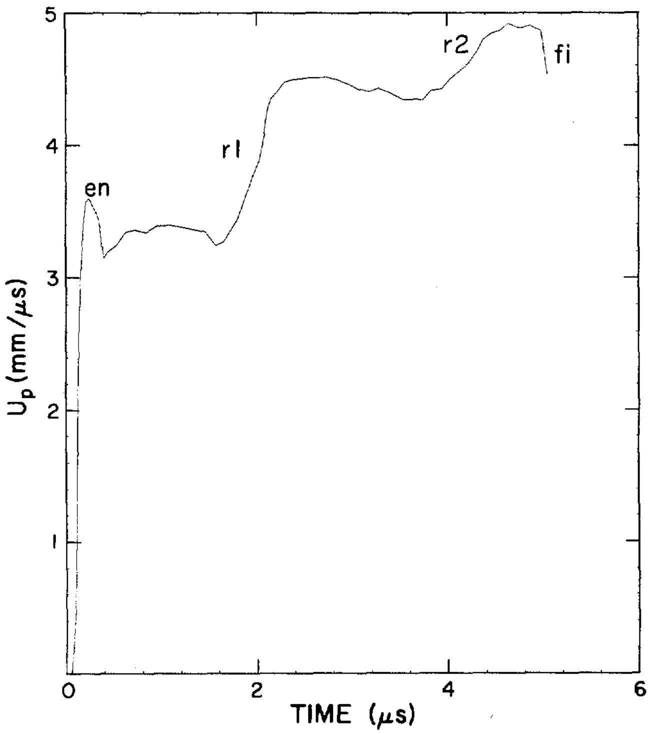
PBX 9404
Density: 1.830 g/cm^3
C_L = 2.90 mm/μs C_S = 1.57 mm/μs
2024 aluminum
Density: 2.785 g/cm^3
C_L = 6.36 mm/μs C_S = 3.16 mm/μs

TRANSDUCER

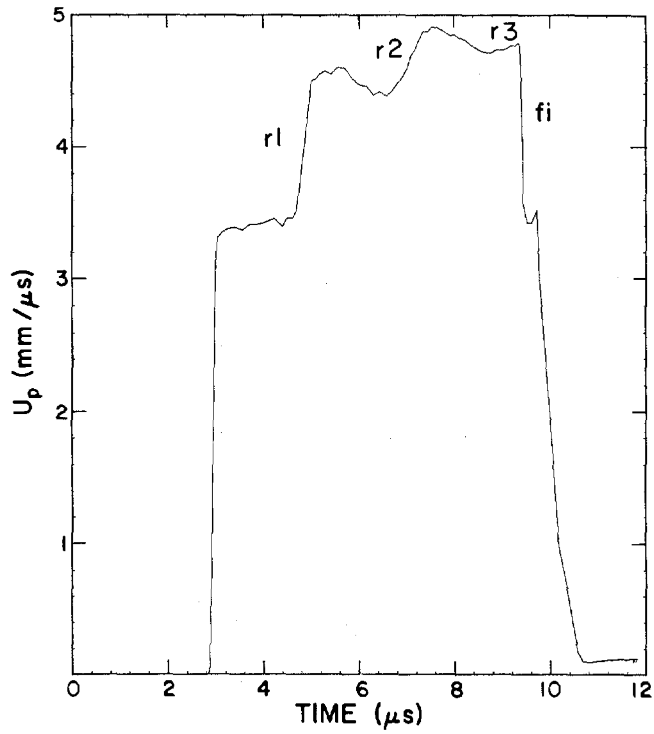
ASM probe
Coil radius: 35.7 mm
Time: Relative



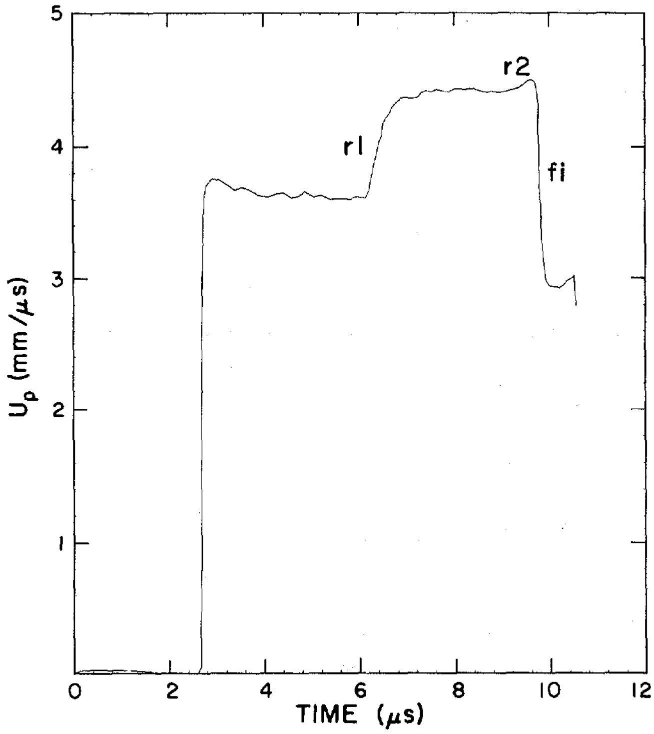
TARGET	**Material:** PBX 9404 - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 96 **Date:** November 20, 1975
HE SHOT GEOMETRY	P-120 lens/152 mm PBX 9404/3.1 mm air/7.00 mm 2024 aluminum//27.9 mm air/plastic//
SHOT COMPONENTS	PBX 9404 **Density:** 1.830 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 35.1 mm **Initial coil spacing:** 31.76 mm **Time:** Relative



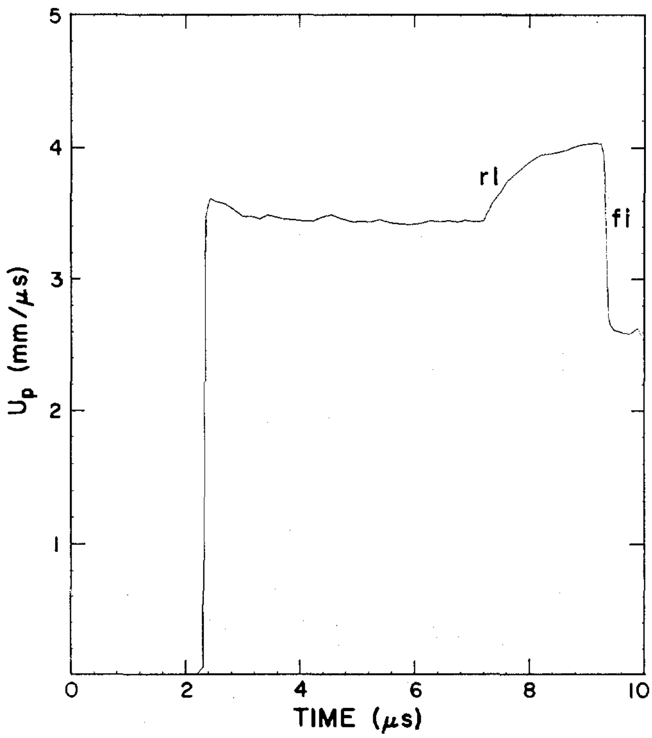
TARGET	Material: PBX 9404 - 2024 aluminum free-run system Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 98 Date: January 21, 1976
HE SHOT GEOMETRY	P-120 lens/152 mm PBX 9404/3.2 mm air/6.50 mm 2024 aluminum//27.7 mm air/plastic//
SHOT COMPONENTS	PBX 9404 Density: 1.830 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs 2024 aluminum Density: 2.785 g/cm^3 $C_L = 6.36$ mm/μs $C_S = 3.16$ mm/μs
TRANSDUCER	ASM probe Coil radius: 35.1 mm Initial coil spacing: 31.86 mm Time: Relative



TARGET	Material: PBX 9404 - 2024 aluminum free-run system Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 100 Date: July 8, 1976
HE SHOT GEOMETRY	P-081 lens/203 mm PBX 9404/10.54 mm 2024 aluminum// 28.40 mm air/5.06 mm Pyrex glass//
SHOT COMPONENTS	PBX 9404 Density: 1.830 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs 2024 aluminum Density: 2.785 g/cm^3 C_L = 6.36 mm/μs C_S = 3.16 mm/μs
TRANSDUCER	ASM probe Coil radius: 50.12 mm Initial coil spacing: 33.46 mm Time: Relative



TARGET	**Material:** PBX 9404 - 2024 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 101 **Date:** July 8, 1976
HE SHOT GEOMETRY	P-081 lens/102 mm PBX 9404/10.57 mm 2024 aluminum// 25.20 mm air/5.04 mm Pyrex glass//
SHOT COMPONENTS	PBX 9404 **Density:** 1.830 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs 2024 aluminum **Density:** 2.785 g/cm^3 C_L = 6.36 mm/μs C_S = 3.16 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 50.12 mm **Initial coil spacing:** 30.24 mm **Time:** Relative



TARGET

Material: PBX 9404 - 2024 aluminum free-run system
Experiment type: ASM probe
Experimenters: J. N. Fritz and J. A. Morgan
Shot no.: M 102 Date: July 12, 1976

HE SHOT GEOMETRY

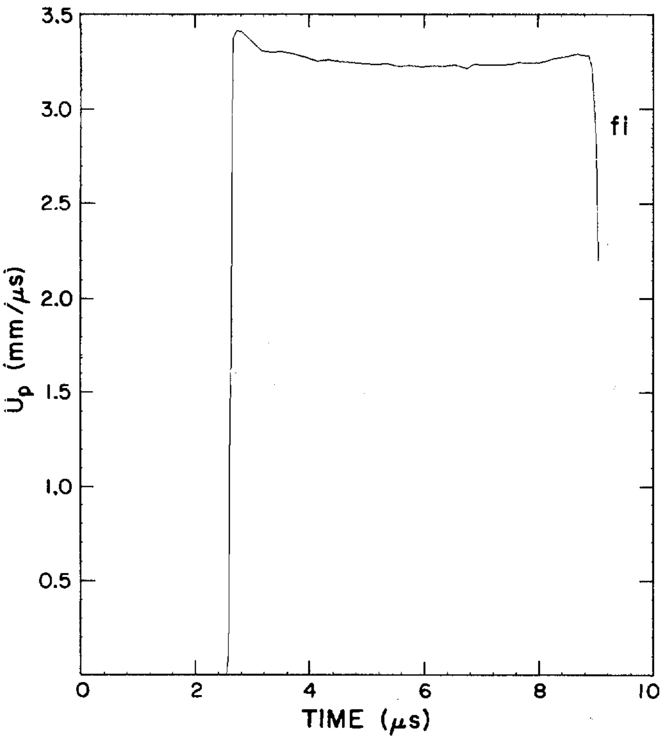
P-081 lens/51 mm PBX 9404/10.58 mm 2024 aluminum//
20.83 mm air/4.98 mm Pyrex glass//

SHOT COMPONENTS

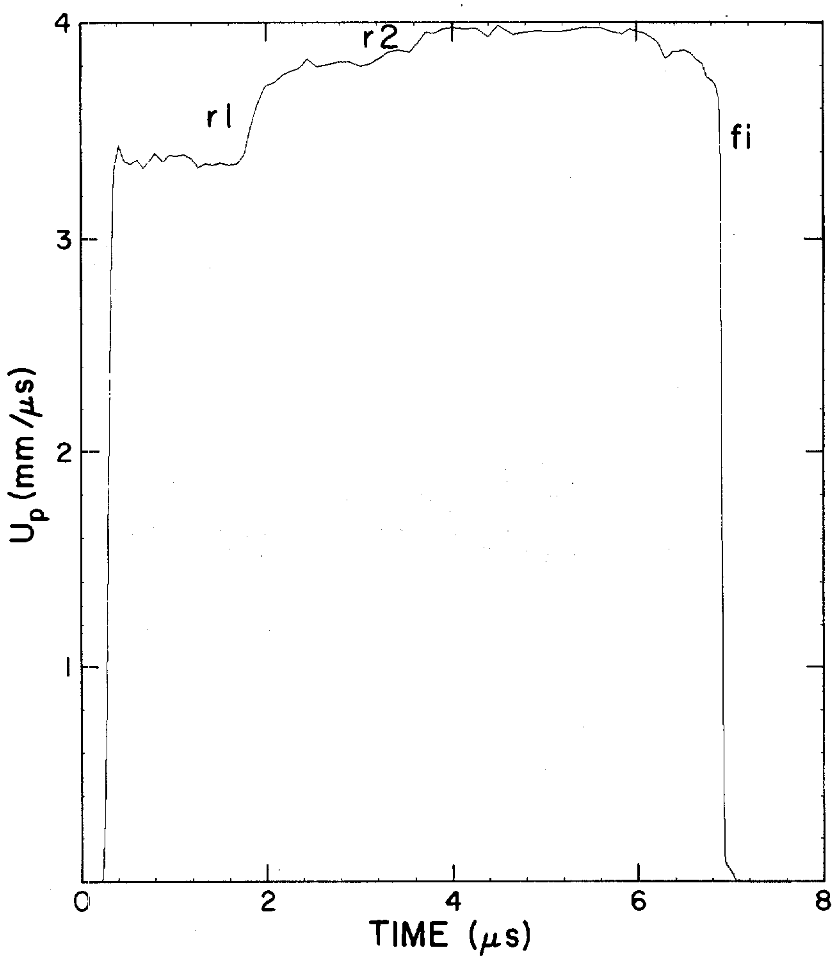
PBX 9404
Density: 1.830 g/cm^3
C_L = 2.90 mm/μs C_S = 1.57 mm/μs
2024 aluminum
Density: 2.785 g/cm^3
C_L = 6.36 mm/μs C_S = 3.16 mm/μs

TRANSDUCER

ASM probe
Coil radius: 50.12 mm Initial coil spacing: 25.81 mm
Time: Relative

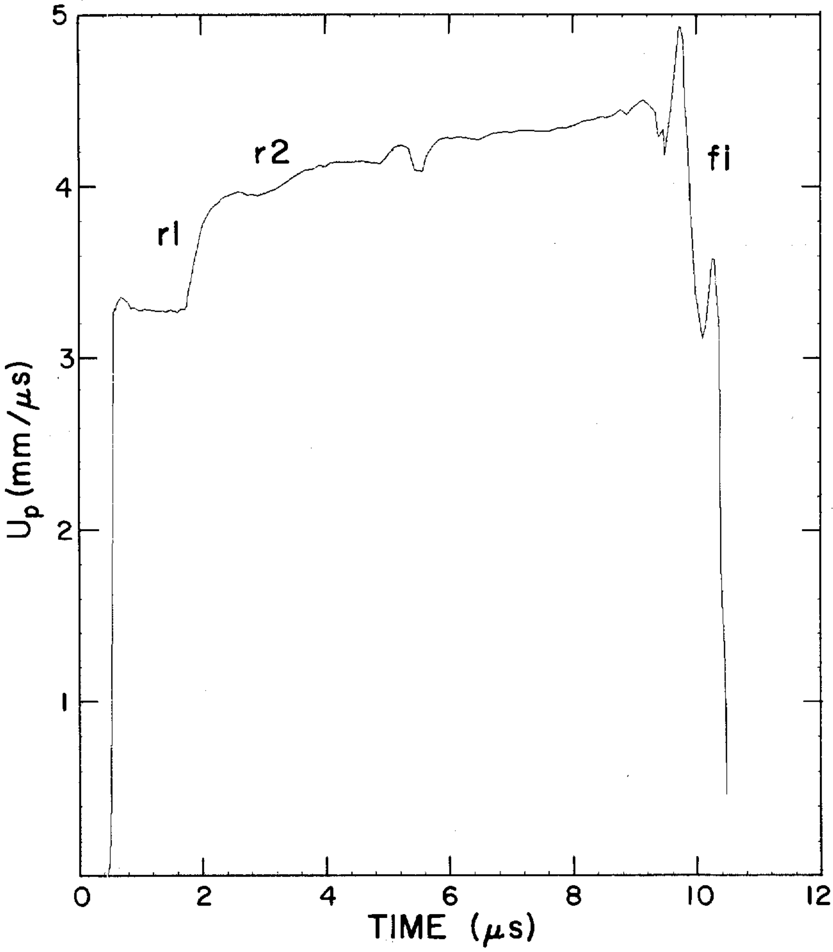


TARGET	Material: PBX 9404 - 6061 aluminum free-run system Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 87 Date: June 14, 1973
HE SHOT GEOMETRY	P-040 lens/25 mm PBX 9404/3.18 mm 6061 aluminum //25.6 mm air//
SHOT COMPONENTS	PBX 9404 Density: 1.830 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs 6061 aluminum Density: 2.703 g/cm^3 C_L = 6.40 mm/μs C_S = 3.15 mm/μs
TRANSDUCER	ASM probe Coil radius: 28.64 mm Initial coil spacing: 25.6 mm Time: Relative



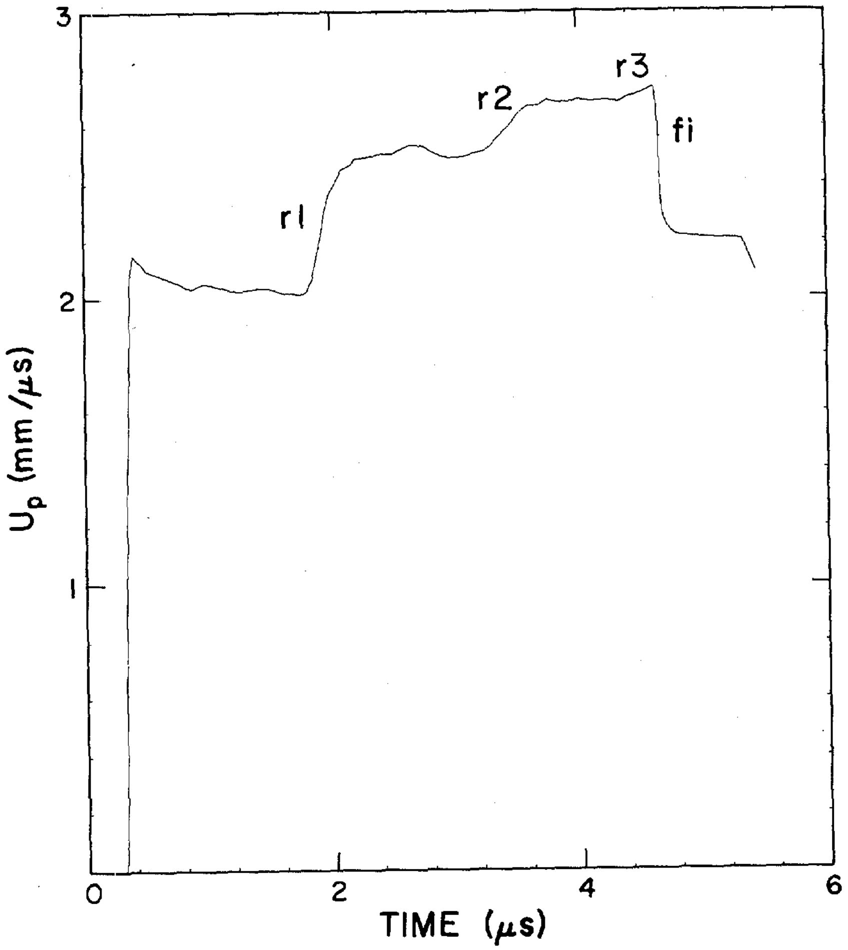
4
3
2
1
0
2
4
6
8
U_p (mm/μs)
TIME (μs)
r1
r2
fi

TARGET	**Material:** PBX 9404 - 6061 aluminum free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 91 **Date:** May 21, 1974
HE SHOT GEOMETRY	Plane wave lens/25 mm PBX 9404/5.33 mm Lucite/ 12.7 mm PBX 9404/3.19 mm 6061 aluminum//38.3 mm air/Pyrex glass//
SHOT COMPONENTS	PBX 9404 **Density:** 1.830 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs Lucite **Density:** 1.184 g/cm^3 $C_L = 2.69$ mm/μs $C_S = 1.38$ mm/μs 6061 aluminum **Density:** 2.703 g/cm^3 $C_L = 6.40$ mm/μs $C_S = 3.15$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 86.70 mm **Initial coil spacing:** 41.44 mm **Time:** Relative

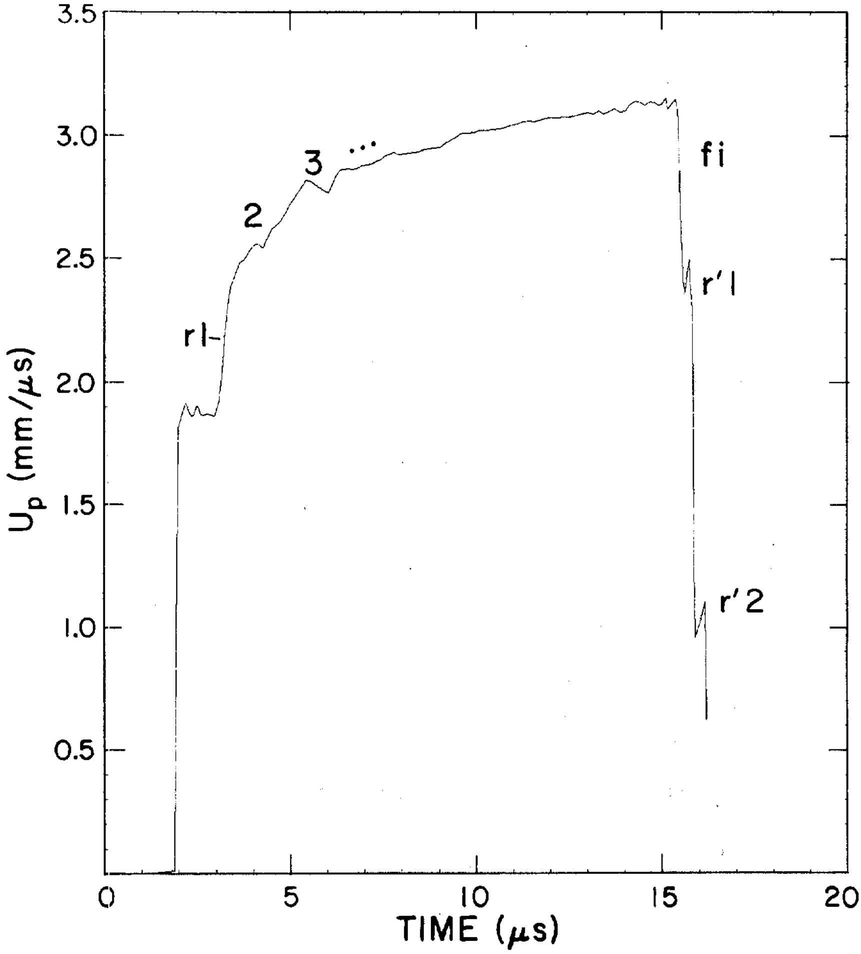


5
4
3
2
1
0
2
4
6
8
10
12
U_p (mm/μs)
TIME (μs)
r1
r2
fi

TARGET	**Material:** PBX 9404 - copper free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 85 **Date:** May 23, 1973
HE SHOT GEOMETRY	P-040 lens/25 mm PBX 9404/2.48 mm OFHC copper// 10.15 mm air/5.16 mm Pyrex glass//
SHOT COMPONENTS	PBX 9404 **Density:** 1.830 g/cm^3 C_L = 2.90 mm/μs C_S = 1.57 mm/μs OFHC copper **Density:** 8.93 g/cm^3 C_L = 4.76 mm/μs C_S = 2.33 mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 15.31 mm **Time:** Relative


3
2
1
U_p (mm/μs)
0
2
4
6
TIME (μs)
r1
r2
r3
fi

TARGET	Material: PBX 9404 - copper free-run system Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: M 92 Date: May 24, 1974
HE SHOT GEOMETRY	Plane wave lens/25.4 mm PBX 9404/5.33 mm Lucite/ 12.7 mm PBX 9404/2.41 mm OFHC copper//38.1 mm air/ Pyrex glass//
SHOT COMPONENTS	PBX 9404 Density: 1.830 g/cm^3 C_L = 2.90 mm/µs C_S = 1.57 mm/µs Lucite Density: 1.184 g/cm^3 C_L = 2.69 mm/µs C_S = 1.38 mm/µs OFHC copper Density: 8.93 g/cm^3 C_L = 4.76 mm/µs C_S = 2.33 mm/µs
TRANSDUCER	ASM probe Coil radius: 86.7 mm Initial coil spacing: 41.3 mm Time: Relative


3.5
3.0
2.5
2.0
1.5
1.0
0.5
U_p (mm/μs)
0
5
10
15
20
TIME (μs)
r1
2
3
...
fi
r'1
r'2

TARGET

Material: PBX 9404 - 304 stainless steel free-run system
Experiment type: ASM probe
Experimenters: J. N. Fritz and J. A. Morgan
Shot no.: M 71 **Date:** September 29, 1972

HE SHOT GEOMETRY

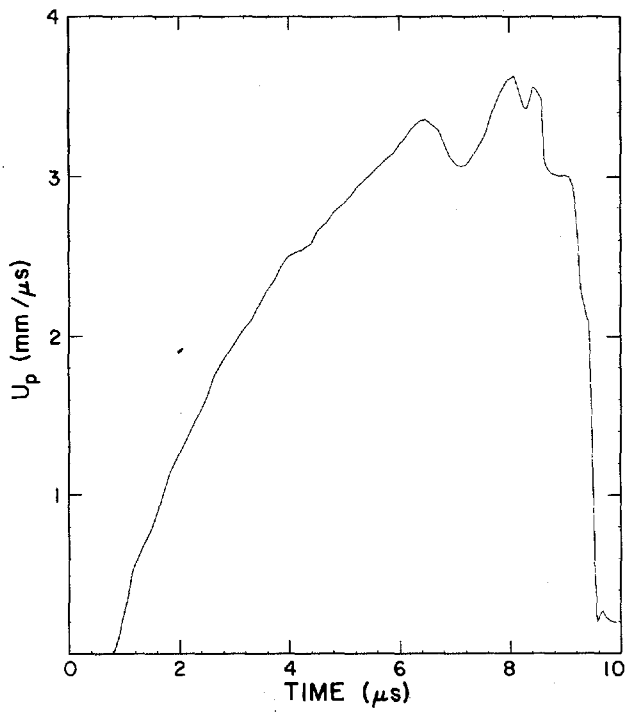
P-081 lens/38 mm PBX 9404/12.7 mm vacuum/1.932 mm 304 stainless steel/20.0 mm vacuum/6.42 mm polymethyl methacrylate//

SHOT COMPONENTS

PBX 9404
Density: 1.830 g/cm^3
C_L = 2.90 mm/µs C_S = 1.57 mm/µs
304 stainless steel
Density: 7.890 g/cm^3
C_L = 5.77 mm/µs C_S = 3.12 mm/µs

TRANSDUCER

ASM probe
Coil radius: 38.17 mm **Initial coil spacing:** 26.42 mm
Time: Relative



TARGET

Material: PBX 9404 - 304 stainless steel free-run system
Experiment type: ASM probe
Experimenters: J. N. Fritz and J. A. Morgan
Shot no.: M 76 Date: December 20, 1972

HE SHOT GEOMETRY

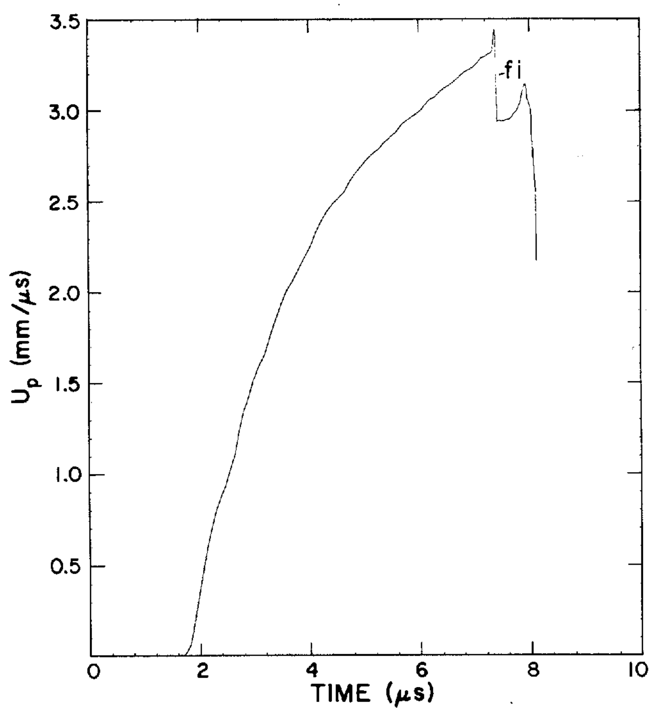
P-081 lens/38 mm PBX 9404/12.8 mm vacuum/1.93 mm 304 stainless steel//12.75 mm vacuum/5.15 mm polymethyl methacrylate//

SHOT COMPONENTS

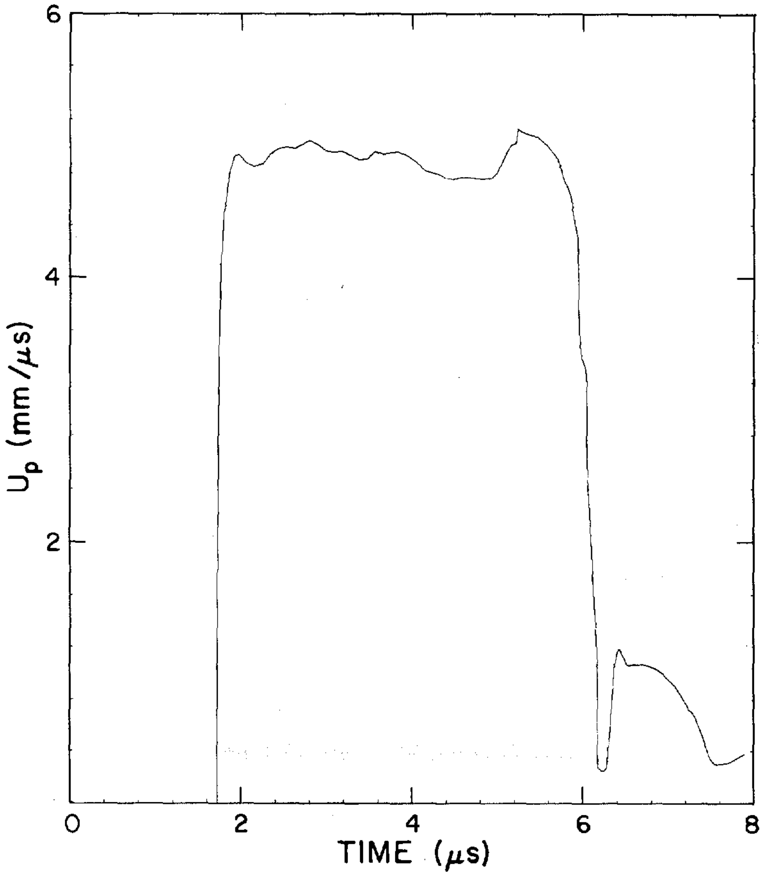
PBX 9404
Density: 1.830 g/cm^3
C_L = 2.90 mm/μs C_S = 1.57 mm/μs
304 stainless steel
Density: 7.890 g/cm^3
C_L = 5.77 mm/μs C_S = 3.12 mm/μs

TRANSDUCER

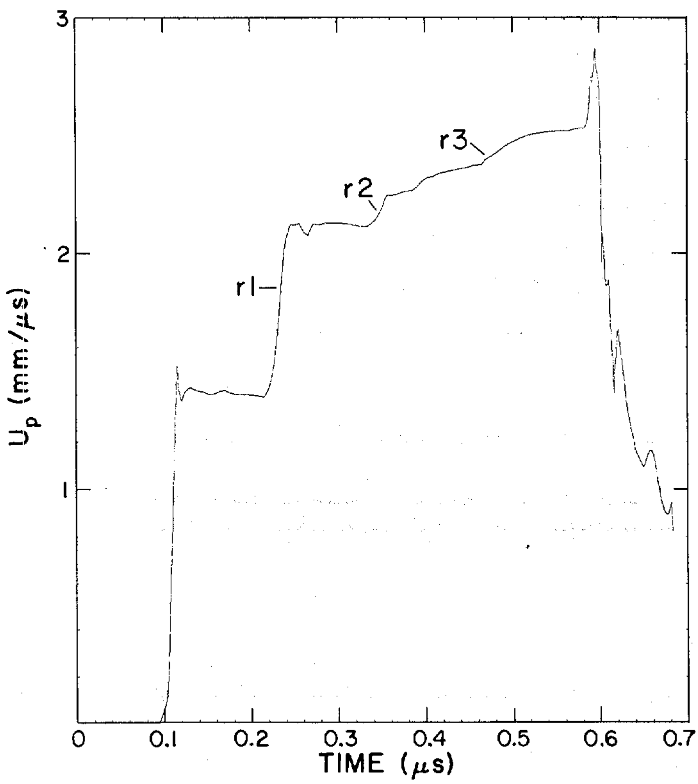
ASM probe
Coil radius: 28.64 mm Initial coil spacing: 17.90 mm
Time: Relative



TARGET	**Material:** PBX 9404 - Lexan free-run system **Experiment type:** ASM probe **Experimenters:** J. N. Fritz and J. A. Morgan **Shot no.:** M 55 **Date:** January 5, 1972
HE SHOT GEOMETRY	P-081 lens/152 mm PBX 9404/6.35 mm air/6.16 mm Lexan/0.03 mm aluminum//25.34 mm air//
SHOT COMPONENTS	PBX 9404 **Density:** 1.830 g/cm^3 $C_L = 2.90$ mm/μs $C_S = 1.57$ mm/μs
TRANSDUCER	ASM probe **Coil radius:** 28.64 mm **Initial coil spacing:** 25.34 mm **Time:** Relative



TARGET	Material: PBX 9404 - polyethylene free-run system Experiment type: ASM probe Experimenters: J. N. Fritz and J. A. Morgan Shot no.: C 4179 Date: May 20, 1972
HE SHOT GEOMETRY	P-081 lens/38 mm PBX 9404/6.38 mm polyethylene/ 2.54 mm gold//2.54 mm polyethylene//
SHOT COMPONENTS	PBX 9404 Density: 1.830 g/cm^3 C_L = 2.90 mm/µs C_S = 1.57 mm/µs Polyethylene Density: 0.916 g/cm^3 C_L = 2.04 mm/µs C_S = 0.66 mm/µs
TRANSDUCER	ASM probe Coil radius: 9.58 mm Initial coil spacing: 2.54 mm Time: Relative



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GLOSSARY

ASM	axially symmetric magnetic probe
AlVC8	a corundum mixture
C_L, C_S	longitudinal and shear plane wave velocities
CEF	tris-beta chloroethylphosphate
Comp B	59.5 wt% RDX, 39.5 wt% TNT, and 1.0 wt% wax
Comp B-3	60.0 wt% RDX, 40.0 wt% TNT, and 0.0 wt% wax
Graph Symbols	
bw:	bulk wave arrivals
bwr:	bulk wave release
comp:	complex signal interpretation
dlrt:	diffusion-limited rise time; a slightly conductive layer between the surface and the probe retards the interface signal
en:	electronic nonsense associated with 0.15-μs round-trip travel time through cable and/or electronic unfolding
ew:	elastic wave arrivals
ewr:	elastic wave release

f1, f2, f3...:	fiducials for wave arrivals; although an ~50-nm aluminum film does not significantly impede magnetic field motion, when it is subjected to large accelerations associated with shock arrivals at free surfaces and interfaces, the film causes a blip in the voltage record
fg:	real "flash-gap" structure; the first point indicates the gas in the gap striking a plastic anvil, giving the gas layer sufficient conductivity to slightly impede the lines-of-force motion, resulting in only a slight decrease in the analyzed velocity; when the plastic burns off and diffuses, the conductivity is reduced and the force lines are unretarded, giving the pip in the record before impact
fi:	fiducial impact; a free surface has moved through a gap (usually air) and has impacted a layer at a known initial distance from the conducting surface
n1:	a jitter in the records caused by electronic corrections after failure to get proper terminations in the recording circuits
n2:	surface conductivity of a thin film did not hold for the experiment
2ph:	phase transitions cause single shocks to split into a two-wave structure
pi:	imperfect contact causes a small pip of velocity until the next downstream layer is reached (a glue joint or a small intervening air gap are causes)
r1, r2, r3...:	a reverberation through a layer; a shock or a release propagates through a metal or other layer, interacts with a material of different impedance, then propagates forward or backward as a shock or release, showing up as an increased or decreased surface velocity
sp:	possible spall indication
twr:	transition wave release
HE shot geometry	the configuration in which a high-explosive shot assembly was fired; the ld layers are separated by a slash (/); the first double slash (//) indicates the surface on which the probe is focused; the second double slash indicates the location of the first element of the probe (either coil or magnet), with the coil and the front face of the magnet usually at the same level; two layers glued together are shown by /epoxy/, and material/material indicates that the layers are only butted together; the symbol -f/ describes a thin (~50-75-nm) aluminum film deposited on the right side of the material; /f- describes conversely the same film deposited on the left side of the material

Kel-F	a trademark for a series of chlorofluoroethylene polymers and copolymers
Kapton	a trademark for a polyimide film (1-5 mils thick)
Lexan	a trademark for a thermoplastic carbonate-linked polymer
NC	nitrocellulose, $C_6H_7O_2(ONO_2)_3$
OFHC	oxygen-free high-conductivity copper
PETN	pentaerythritol tetranitrate, $C_5H_8N_4O_{12}$
PBX 9404	94.0 wt% HMX, 3.0 wt% NC, 3.0 wt% CEF, 0.1 wt% diphenylamine (DPA)
PBX 9501	95.0 wt% HMX, 2.5 wt% Estane, and 2.5 wt% BDNPA/BDNPF nitroplasticizers
PBX 9502	95 wt% TATB and 5 wt% Kel-F 800
P-081 lens	a conical explosive lens with a base of 8.1 in., designed to generate a plane detonation
P-120 lens	a conical explosive lens with a base of 12.0 in., designed to generate a plane detonation
Pentek	a trademark for pentaerythritol, technical
PMMA	any of several polymethyl methacrylates
Rc	a hardness number on the Mohs scale
TATB	1,3,5-trinitrobenzene
TNT	2,4,6-trinitrotoluene, $C_7H_5N_3O_6$

APPENDIX

HUGONIOT ELASTIC LIMITS

Material	Elastic Limit (GPa)	Sample Thickness (mm)	Technique[a]
ELEMENTS			
beryllium	0 (ramp)	all	fsc
beryllium, single crystal, basal plane	0.3	---	fsc
beryllium, single crystal, C-axis	4.4	---	fsc
boron	8.6	6	fsc
copper, annealed	0 (ramp)	all	fsc
copper, 50% cold-worked	0.6	12	fsc
chromium	1.6	5	ol
germanium, single crystal [100]	5.2	8	ol
germanium, single crystal [100]	5.4	---	fsc
germanium, single crystal [111]	3.7	10	ol
germanium, single crystal [114]	4.0	10	ol
iron, Armco	1.9→0.5	1.5→50	fsc
iron, fine-grain hard	1.5	3	ol
iron, large-grain hard	1.4	3	ol
iron, fine-grain soft	1.1	3	ol
iron, large-grain soft	0.9	3	ol
lead, annealed	0 (ramp)	13	fsc
molybdenum	1.6	3	ol

[a]Free-surface capacitor technique is denoted by fsc; optical lever technique is denoted by ol.

HUGONIOT TABLE (cont)

Material	Elastic Limit (GPa)	Sample Thickness (mm)	Technique[a]
nickel	1.0	12	fsc
niobium	2.1	12	fsc
silicon, single crystal [100]	6.8	10	ol
silicon, single crystal [100]	8.2	8	fsc
silicon, single crystal [110]	6.7	10	ol
silicon, single crystal [111]	6.0	10	ol
tantalum	1.4	10	fsc
thorium	0.2	25	fsc
tin	0.3	9	fsc
titanium	1.5	10	fsc
titanium	1.9	12	fsc
tungsten	4.5	5	fsc
tungsten	3.2	5	ol
uranium	0 (ramp)	all	fsc
zirconium	1.9	6	fsc
ALLOYS			
aluminum, 2024	0.6	13	fsc
aluminum, 6061	0.6	13	fsc
98.2 wt% copper/1.8 wt% beryllium, annealed	1.5	6	fsc
98 wt% gold/2 wt% copper	0.9	8	fsc
magnesium (AZ-31B)	0.2	13	fsc
95 wt% molybdenum/5 wt% rhenium	1.6	9	fsc
steel, 1018 at 101°C	1.3	13	fsc
steel, 1018	1.4	13	fsc
steel, 1045	2.4	18	fsc
steel, 1095	2.1	16	fsc
steel, 4150; Rc = 62	3.7	13	fsc
steel, maraging, Almar 360	1.7	6	fsc
steel, maraging, HP 9-4-20	1.4	6	fsc
steel, HY 80 naval armor steel	1.7	13	fsc
steel, maraging, Vascomax 250	2.8	13	fsc
steel, maraging, Vascomax 300	2.8	9	fsc
steel, stainless A-256 Austenitic	1.4	10	fsc
steel, stainless 304	0.2	8	fsc

Material	Elastic Limit (GPa)	Sample Thickness (mm)	Technique[a]
steel, stainless 21-6-9	1.1	7	fsc
90 wt% tantalum/10 wt% tungsten, annealed at 1450°C	3.2	6	fsc
tungsten	4.0	12	fsc
tungsten carbide, Kennametal Grade K8	4.6	13	fsc
98.5 wt% tungsten/0.5 wt% nickel/1 wt% iron	2.4	13	fsc
95 wt% tungsten/2.1 wt% nickel/1.4 wt% iron/ 1.5 wt% cobalt	2.3	13	fsc
95 wt% tungsten/3.5 wt% nickel/1.5 wt% iron	3.1	13	fsc
75 wt% tungsten/25 wt% rhenium	5.5	11	fsc
91 wt% tungsten/5 wt% rhenium/1.4 wt% platinum/1.4 wt% nickel/1.2 wt% iron	3.2	13	fsc
98 wt% uranium/2 wt% molybdenum	2.1	10	fsc
97.03 wt% uranium/1.16 wt% niobium/ 1.81 wt% titanium	1.8	10	fsc
99.16 wt% uranium/0.84 wt% titanium	1.9	3	fsc
98.82 wt% uranium/1.18 wt% titanium	2.0	9	fsc
MINERALS AND COMPOUNDS			
85 wt% alumina ceramic (porous, $\rho_0 = 3.40$ g/cm^3)	4.5	12	fsc
alumina (porous, $\rho_0 = 3.39$ g/cm^3)	4.4	13	fsc
alumina (porous, $\rho_0 = 3.50$ g/cm^3)	7.2	13	fsc
beryllium oxide	8.5	13	fsc
boron carbide	9.9	8	fsc
boron nitride (porous, $\rho_0 = 2.02$ g/cm^3)	0 (ramp)	13	fsc
hafnium titanate ($\rho_0 = 6.96$ g/cm^3)	1.3	13	fsc
jadeite	6.5	10	ol
lithium hydride	0.1	13	fsc
magnesium aluminum oxide, spinel	7.3	8	fsc
magnesia, single crystal	4.0	10	ol
titanium boride ($\rho_0 = 4.3$ g/cm^3)	5.9	10	fsc
titanium boride ($\rho_0 = 4.5$ g/cm^3)	8.6	10	fsc
zirconium boride	7.5	10	fsc

LONGITUDINAL AND SHEAR WAVE VELOCITIES IN POLYCRYSTALLINE AGGREGATES

	Material	Density (g/cm^3)	C_L (mm/μs)	C_S (mm/μs)
1	barium	3.661	2.16	1.28
2	beryllium, sintered	1.851	13.15	8.97
3	bismuth	9.808	2.49	1.43
4	boron, hot-pressed	2.334	13.90	9.00
5	cadmium	8.642	3.20	1.65
6	calcium	1.536	4.39	2.49
7	carbon (M-3 graphite), sintered	1.807	2.56	1.52
8	carbon, vitreous	1.492	4.59	2.91
9	cerium	6.731	2.33	1.34
10	cobalt	8.821	5.73	3.04
11	copper, OFHC	8.929	4.76	2.33
12	copper, sintered	7.903	4.23	2.19
13	copper, sintered	7.365	3.95	2.07
14	copper, sintered	7.197	3.77	2.01
15	copper, sintered	6.428	3.30	1.80
16	copper, sintered	6.249	3.20	1.79
17	copper, sintered	5.603	2.68	1.52
18	copper, sintered	4.504	1.83	1.07
19	dysprosium	8.410	3.07	1.78
20	erbium	9.058	3.13	1.84
21	gadolinium	7.785	2.95	1.69
22	gold	19.240	3.25	1.19
23	hafnium	12.890	3.86	2.12
24	holmium	8.750	3.21	1.86
25	iridium	22.500	5.32	3.29
26	iron	7.870	5.94	3.26
27	iron, sintered	6.913	5.36	3.00
28	iron, sintered	5.925	4.55	2.37
29	lanthanum	6.136	2.69	1.51
30	lead	11.340	2.25	0.89
31	magnesium	1.740	5.74	3.15
32	molybdenum	10.200	6.45	3.48
33	neodymium	6.986	2.84	1.60
34	nickel	8.882	5.79	3.13
35	palladium	12.000	4.68	2.33
36	platinum	21.430	4.08	1.76
37	plutonium (alpha)	19.600	2.34	1.47
38	praseodymium	6.764	2.74	1.51
39	rhenium	20.990	5.30	2.89
40	rhodium	12.430	6.00	3.64
41	samarium	7.464	2.88	1.64
42	scandium	3.195	5.57	3.07
43	silicon	2.330	9.04	5.40
44	silver	10.490	3.71	1.66
45	strontium	2.585	2.70	1.45
46	tantalum	16.690	4.16	2.09
47	terbium	8.202	2.94	1.69
48	thorium	11.680	2.95	1.57
49	thulium	9.268	3.02	1.77
50	tin	7.291	3.43	1.77
51	titanium	4.517	6.16	3.19
52	tungsten	19.270	5.22	2.88
53	uranium (extrapolation of molybdenum and rhodium alloy data)	19.000	3.45	2.12
54	ytterbium	7.031	1.94	1.12
55	yttrium	4.565	4.38	2.52
56	zirconium	6.510	4.77	2.39
57	aluminum 1100	2.715	6.38	3.16
58	aluminum 2014	2.810	6.39	3.17
59	aluminum 2024	2.785	6.36	3.16
60	aluminum 2024, sintered	2.507	5.26	2.80
61	aluminum 2024, sintered	2.287	4.60	2.55
62	aluminum 2024, sintered	2.158	4.05	2.28
63	aluminum 2024, sintered	1.947	3.46	1.96
64	aluminum 2024, sintered	1.706	2.82	1.53
65	aluminum 6061	2.703	6.40	3.15
66	aluminum 921T	2.813	6.29	3.11
67	brass (J-1), free-machining, high-leaded	8.450	4.41	2.13
68	Carboloy, 86.3 wt% Ni/7.1 wt% W/5.7 wt% C/0.8 wt% Fe/0.1 wt% Co	14.720	6.85	4.14
69	Dowmetal	1.779	5.84	3.09
70	Fansteel 77	17.480	5.10	2.80
71	gold/5.8 wt% germanium	16.880	3.33	1.33
72	gold/9.3 wt% germanium	15.490	3.39	1.47
73	gold/20.6 wt% lead	16.950	2.98	1.19
74	gold/33.5 wt% lead	16.010	2.85	1.15
75	iron/40 wt% cobalt	8.102	6.20	3.66
76	iron/10 wt% nickel	7.883	5.76	3.16
77	iron/18 wt% nickel	7.962	5.56	2.94
78	iron/20 wt% nickel	7.970	6.62	3.81
79	iron/26 wt% nickel	7.974	5.38	2.72
80	iron/25 wt% silicon	6.632	6.87	3.88
81	iron/10 wt% vanadium	7.706	6.30	3.70
82	magnesium/AZ31B	1.780	5.70	3.05
83	magnesium/14 wt% Li/1 wt% Al	1.403	6.35	4.17
84	plutonium/1.0 wt% gallium (92/8 wt% delta/alpha)	16.040	1.93	1.15
85	plutonium/1.0 wt% gallium (delta)	15.760	1.90	1.07
86	steel 304 (stainless)	7.890	5.77	3.12
87	steel 304L (stainless)	7.903	5.79	3.16
88	steel 348 (stainless)	7.928	5.74	3.12
89	steel 1018	7.861	5.92	3.19
90	steel 1095	7.860	5.90	3.21
91	steel 4150	7.785	5.89	3.20
92	steel, Vega, A6 tool steel	7.835	5.82	3.18
93	uranium/0.50 wt% molybdenum (furnace-cooled)	18.910	3.44	2.08
94	uranium/0.97 wt% molybdenum (furnace-cooled)	18.810	3.38	2.02

TABLE (cont)

	Density (g/cm³)	C_L (mm/μs)	C_S (mm/μs)
95 uranium/1.95 wt% molybdenum (furnace-cooled)	18.610	3.33	1.94
96 uranium/2.92 wt% molybdenum (furnace-cooled)	18.450	3.33	1.89
97 uranium/3.30 wt% molybdenum (furnace-cooled)	18.330	3.29	1.82
98 uranium/4.00 wt% molybdenum (furnace-cooled)	18.250	3.27	1.75
99 uranium/4.47 wt% molybdenum (furnace-cooled)	18.150	3.23	1.72
100 uranium/4.72 wt% molybdenum (furnace-cooled)	17.980	2.94	1.23
101 uranium/5.37 wt% molybdenum (furnace-cooled)	17.820	2.94	1.20
102 uranium/6.82 wt% molybdenum (furnace-cooled)	17.590	3.01	1.25
103 uranium/8.31 wt% molybdenum (furnace-cooled)	17.320	3.08	1.32
104 uranium/8.79 wt% molybdenum (furnace-cooled)	17.370	3.10	1.33
105 uranium/0.97 wt% molybdenum (water-quenched)	18.770	3.32	1.93
106 uranium/1.95 wt% molybdenum (water-quenched)	18.530	3.12	1.68
107 uranium/2.92 wt% molybdenum (water-quenched)	18.300	3.12	1.61
108 uranium/4.00 wt% molybdenum (water-quenched)	18.130	3.05	1.42
109 uranium/4.47 wt% molybdenum (water-quenched)	18.020	3.01	1.43
110 uranium/4.72 wt% molybdenum (water-quenched)	17.960	2.89	1.17
111 uranium/5.37 wt% molybdenum (water-quenched)	17.820	2.95	1.21
112 uranium/6.82 wt% molybdenum (water-quenched)	17.610	3.00	1.21
113 uranium/8.79 wt% molybdenum (water-quenched)	17.360	3.07	1.29
114 uranium/6 wt% niobium	17.390	2.90	1.23
115 uranium/1.1 wt% rhodium	18.820	3.45	2.07
116 uranium/5.4 wt% rhodium	18.330	3.41	1.94
117 uranium/13.4 wt% rhodium	17.260	3.38	1.74
118 Wood's metal	9.685	2.46	1.11
119 andalusite (Al_2SiO_5), natural	3.073	7.30	4.31
120 anthracene, pressed	1.249	2.92	1.52
121 beryllium oxide (BeO), sintered	2.989	11.91	7.28
122 beryllium oxide (BeO), sintered	2.866	11.45	7.02
123 beryllium oxide (BeO), sintered	2.816	10.94	6.77
124 beryllium oxide (BeO), sintered	2.660	10.24	6.37
125 beryllium oxide (BeO), sintered	2.439	9.06	5.63
126 corundum (Al_2O_3), Lucalox	3.974	10.85	6.41
127 corundum (Al_2O_3), sintered	3.833	10.51	6.19
128 corundum (Al_2O_3), sintered	3.107	6.18	3.87
129 corundum (Al_2O_3), sintered	2.834	4.88	3.08
130 corundum (Al_2O_3), sintered	2.563	1.76	1.17
131 hematite (Fe_2O_3), natural	4.976	7.78	4.02
132 ilmenite ($FeTiO_3$), Krageroe, Norway	4.817	7.16	2.90
133 lithium hydride (enriched lithium, 95.5 at.% ^6Li)	0.698	10.67	7.18
134 lithium hydride (enriched lithium, 95.5 at.% ^6Li)	0.666	10.42	6.86
135 lithium deuteride (enriched lithium, 95.5 at.% ^6Li)	0.799	10.10	6.80
136 lithium deuteride (enriched lithium, 95.5 at.% ^6Li)	0.764	9.72	6.53
137 lithium hydride (normal lithium, 7.5 at.% ^6Li)	0.782	10.05	6.75
138 lithium hydride (normal lithium, 7.5 at.% ^6Li)	0.743	9.84	6.61
139 lithium deuteride (normal lithium, 7.5 at.% ^6Li)	0.894	9.56	6.43
140 lithium deuteride (normal lithium, 7.5 at.% ^6Li)	0.840	9.36	6.31
141 magnetite (Fe_3O_4), natural	5.118	7.00	3.32
142 periclase (MgO), hot-pressed	3.575	9.71	6.02
143 periclase (MgO), sintered	3.457	9.37	5.83
144 periclase (MgO), sintered	3.020	8.23	5.08
145 phenanthrene ($C_{14}H_{10}$), pressed	1.212	2.78	1.42
146 pyrene ($C_{16}H_{10}$), pressed	1.275	2.64	1.18
147 quartz (SiO_2), fused	2.204	5.96	3.77
148 silicon carbide (SiC)	3.121	11.73	7.43
149 sillimanite (Al_2SiO_5), Dillon, Montana	3.172	9.00	4.95
150 sodium chloride (NaCl), pressed	2.137	4.47	2.57
151 spinel ($MgAl_2O_3$), hot-pressed	3.561	9.70	5.50
152 spinel ($MgAl_2O_3$), hot-pressed	3.493	9.52	5.40
153 spinel ($MgAl_2O_3$), sintered	3.409	9.41	5.34
154 spinel ($MgAl_2O_3$), sintered	3.330	9.19	5.25
155 spinel ($MgAl_2O_3$), sintered	3.260	8.99	5.15
156 uranium dioxide (UO_2), sintered	10.510	5.17	2.68
157 uranium dioxide (UO_2), sintered	10.300	5.01	2.63

TABLE (cont)

		Density (g/cm^3)	C_L (mm/μs)	C_S (mm/μs)
158	zirconia (ZrO_2), sintered	4.224	5.88	3.35
159	albitite, Sylmar, Pennsylvania	2.611	6.46	3.07
160	AlVC8	3.500	8.94	5.25
161	anorthosite, Tahawus, New York	2.740	7.05	3.68
162	bronzitite, Stillwater Complex, Montana	3.280	7.86	4.41
163	corundum (Al_2O_3)/5 wt% fused quartz (SiO_2), sintered	3.665	9.94	5.92
164	corundum (Al_2O_3)/15 wt% fused quartz (SiO_2), sintered	3.420	8.69	5.18
165	diabase, Centreville, Virginia	2.990	6.37	3.74
166	diabase, Frederick, Maryland	3.015	6.74	3.81
167	dunite (iron-rich), Mooihoek Mine, Transvaal	3.800	7.17	4.05
168	dunite, Twin Sisters Peaks, Washington	3.320	8.77	4.86
169	eclogite, Healdsburg, California	3.420	7.71	4.42
170	eclogite, Sunnmore, Norway	3.560	7.35	4.44
171	granite, Westerly, Rhode Island	2.637	5.33	3.28
172	iron oxide (FeO)/10 wt% periclase (MgO)	5.106	5.40	2.84
173	jadeite, Burma	3.330	8.67	5.06
174	Pyrex	2.230	5.56	3.45
175	tuff, Nevada (Snubber tunnel, station 0A, air dry)	1.392	1.99	1.22
176	tuff, Nevada (Snubber tunnel, station 0B, air dry)	1.316	1.88	1.13
177	tuff, Nevada (Snubber tunnel, station 25, air dry)	1.613	1.95	1.29
178	tuff, Nevada (Snubber tunnel, station 475, air dry)	1.532	1.76	1.16
179	tuff, Nevada (Snubber tunnel, station 850L, air dry)	1.776	2.51	1.65
180	boron/23 wt% nylon	1.797	4.86	2.91
181	copper/27.2 wt% boron carbide	4.822	5.86	3.37
182	corundum (Al_2O_3)/16.8 wt% fine-grain aluminum, cermet	3.649	9.07	5.24
183	corundum (Al_2O_3)/16.8 wt% large-grain aluminum, cermet	3.651	9.07	5.26
184	elkonite 1W3, sintered, copper-infiltrated tungsten (55 wt% WC)	12.420	4.55	2.66
185	elkonite 3W3, sintered, copper-infiltrated tungsten (69 wt% WC)	13.800	4.76	2.50
186	elkonite 10W3, sintered, copper-infiltrated tungsten (76 wt% WC)	14.870	4.77	2.54
187	elkonite 2125C, sintered, copper-infiltrated tungsten (25 wt% WC)	9.748	4.18	2.15
188	elkonite TC10, sintered, copper-infiltrated tungsten (55% WC)	11.670	5.41	2.95
189	elkonite G-12, sintered, silver-infiltrated WC (40 wt% WC)	11.900	4.37	2.18
190	elkonite G-13, sintered, silver-infiltrated WC (50 wt% WC)	12.220	4.42	2.34
191	elkonite G-14, sintered, silver-infiltrated WC (62 wt% WC)	13.360	4.82	2.47
192	elkonite 3042, sintered, silver-infiltrated WC (43 wt% WC)	12.100	4.46	2.33
193	elkonite 20S, sintered, silver-infiltrated tungsten (71 wt% WC)	15.520	4.29	2.25
194	elkonite 35S, sintered, silver-infiltrated tungsten (68 wt% WC)	14.610	4.05	2.12
195	elkonite 50S, sintered, silver-infiltrated tungsten (51 wt% WC)	13.210	3.79	1.98
196	elkonite 4050, sintered, silver-infiltrated tungsten (53 wt% WC)	13.010	3.66	1.92
197	hematite (Fe_2O_3)/25.9 wt% iron, cermet	5.529	4.15	2.48
198	lithium tetraborate (LiB_2O_4)/10 wt% epoxy	2.160	4.91	2.95
199	tantalum carbide (Ta_2C)/48.4 wt% tantalum	15.600	4.94	2.63
200	thorium dioxide (ThO_2)/13.4 wt% molybdenum	9.459	6.26	3.69
201	tungsten carbide (WC)/5.3 wt% cobalt, hot-pressed	15.000	6.89	4.18
202	tungsten carbide (WC)/12 wt% cobalt, cermet	13.970	6.58	3.92
203	PBX 9404 (high-explosive neutronic mock-up)	1.618	2.81	1.48
204	PBX 9404 (high-explosive density mock-up)	1.870	3.15	1.57
205	epoxy resin	1.584	2.87	1.48
206	epoxy resin	1.192	2.63	1.16
207	Kel-F	2.133	1.74	0.77
208	Lucite	1.184	2.69	1.38
209	4-methyl-1-pentene	0.829	2.19	1.08
210	Micarta	1.404	2.67	1.50

TABLE (cont)

	Density (g/cm³)	C_L (mm/μs)	C_S (mm/μs)
211 nylon (polyamide/Polypenco 101, type 6/6, annealed)	1.140	2.54	1.08
212 paraffin	0.919	2.18	0.83
213 phenoxy	1.178	2.50	1.07
214 Plexiglas	1.189	2.72	1.36
215 polycarbonate	1.194	2.18	0.88
216 polyethylene	0.916	2.04	0.66
217 polyurethane	1.265	2.38	1.03
218 Teflon	2.151	1.23	0.41
219 baratol, 76 wt% $Ba(NO_3)_2$/ 24 wt% TNT	2.538	2.95	1.48
220 Composition B-3, 60 wt% RDX/40 wt% TNT	1.726	3.12	1.71
221 octol, 75 wt% HMX/ 25 wt% TNT	1.824	3.14	1.65
222 cyclotol, 75 wt% RDX/ 25 wt% TNT	1.752	3.12	1.69
223 X-0228, 95 wt% nitroguanidine/5 wt% Estane	1.690	3.35	1.50
224 PBX 9011-04, 85 wt% HMX/15 wt% estane	1.770	2.89	1.38
225 PBX 9010-02, 90 wt% RDX/10 wt% Kel-F	1.780	2.72	1.47
226 PBX 9407, 94 wt% RDX/ 6 wt% Exon	1.780	3.04	1.70
227 PBX 9404, 94 wt% HMX/ 3 wt% nitrocellulose/3 wt% chloroethylphosphate	1.830	2.90	1.57
228 DATB	1.780	2.99	1.55
229 TATB	1.870	1.98	1.16
230 TNT	1.610	2.48	1.34
231 Tetryl	1.680	2.27	1.24
232 RDX	1.740	2.12	1.35
233 900-10 (inert)	1.840	3.22	1.56
234 905-03 (inert)	1.610	2.70	1.48

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