DEVELOPMENT OF A METEOROID PENETRATION DISTRIBUTED TRANSDUCER

CONTRACT NAS-8-20194

QUARTERLY REPORT

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ATTN: PR-EC
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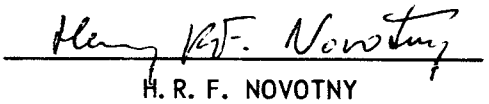

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SUMMARY

This fourth quarterly report consists mostly of experimental data gathered during the three-month period, March through May 1966. It is being issued in consequence of a three-month, no-cost extension of the originally one-year NASA/MSFC Contract NAS 8-20194 under which the developmental and experimental program is being carried out. The overall format is essentially that of an interim report since the final report will be issued in four weeks' time.

Experimental data contained in Section 2.0 which represents the bulk of this report have been obtained by impacting 3.11 mg cylindrical lexan slugs on aluminum targets at speeds of from 18,000 ft./sec. to 30,000 ft./sec. A number of these impacts were made at 30° and 60° to the target surface normal to evaluate directional properties of stress waves generated by oblique impacts.

SECTION 1.0

INTRODUCTION

The contractual work carried out by Northrop Space Laboratories during the fourth quarter under the extended one-year NASA/MSFC Contract NAS-20194 has consisted mainly of preparations for, and execution of, the planned hypervelocity impact test programs. These were designed to provide adequate data for evaluating the usefulness and performance of experimental micrometeoroid impact sensors developed earlier under the present contract.

Experimental data contained in Section 2.0 have been obtained by impacting 3.11 mg lexan cylindrical slugs on aluminum targets at speeds of from 18,000 ft./sec. to 30,000 ft./sec. A number of impacts were made either at 30° or 60° to the normal to the target surface to evaluate differential stress wave propagation characteristics in different directions from the point of the oblique impact.

Section 3.0 contains a brief review of the laser simulation work performed in the last contractual quarter, and Section 4.0 then contains a summary of the progress achieved to date together with a brief evaluation of obtained data.

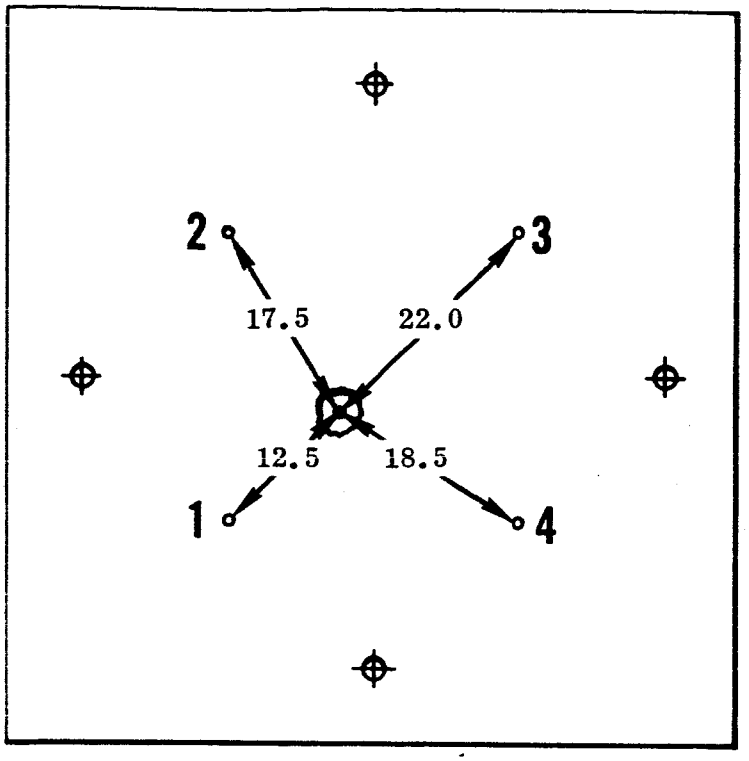
At the time this report is being issued, impact data are being gathered in tests where 50 and 90 micron in diameter borosilicate glass particles are used as projectiles impacting aluminum targets at velocities ranging from 20,000 ft./sec. to 40,000 ft./sec. and higher. These results will be included in the final report to be issued in about four weeks.

SECTION 2.0

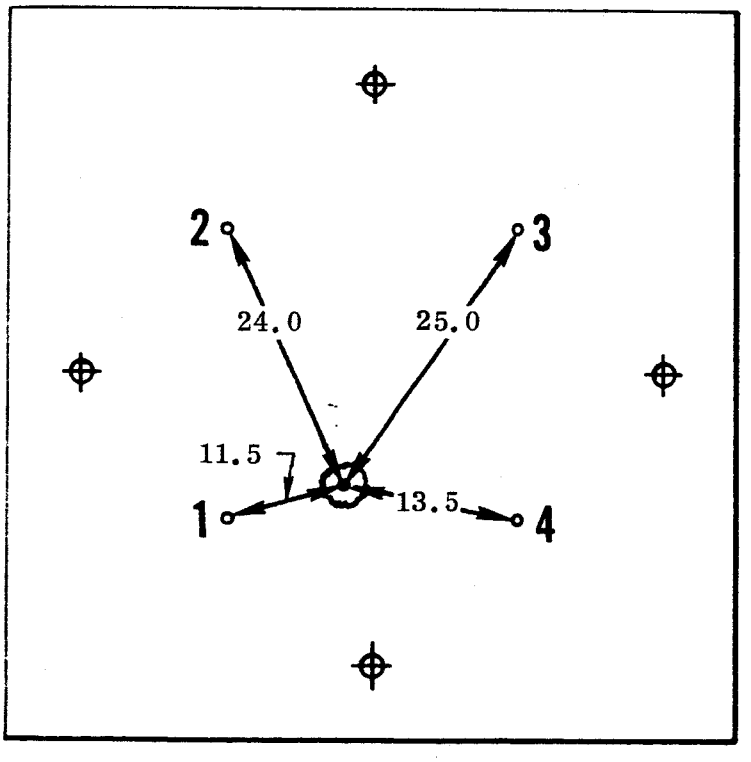
EXPERIMENTAL DATA

Data presented on the following pages consist of photographs of oscilloscope traces of quartz crystal transducer outputs obtained on impacting aluminum target plates with 3.11 mg cylindrical lexan slugs at velocities ranging from 18,000 ft./sec. to 30,000 ft./sec. Each impact was monitored by four transducers of which outputs were recorded at the same time so that times of stress wave arrivals to the various points on the target where transducers were located could be compared. The time period that a stress wave takes to travel from the point of impact to the recording transducer depends on the distance it has to traverse. To show the magnitudes of the various distances in question, each set of data is accompanied by a diagram depicting the relative position of the impact point with respect to the four transducers with pertinent distances being given in millimeters.

The lexan projectiles were made to impact the targets at three different angles: normally to the surface, and at 30^{o} and 60^{o} to the surface normal. The angle at which each impact occurred is shown both on the impact location diagrams and on the data sheets themselves.

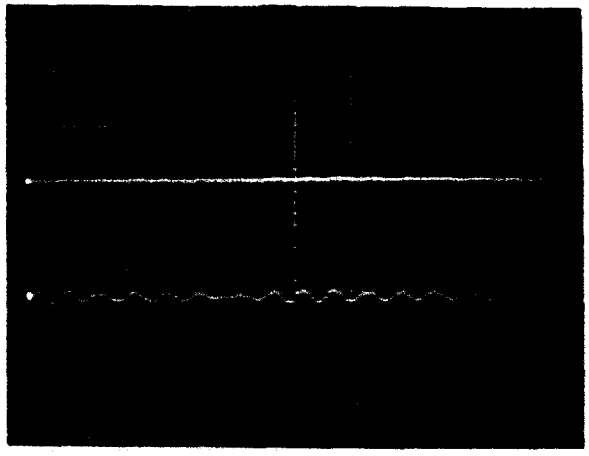


Test No. 12



Test No. 13

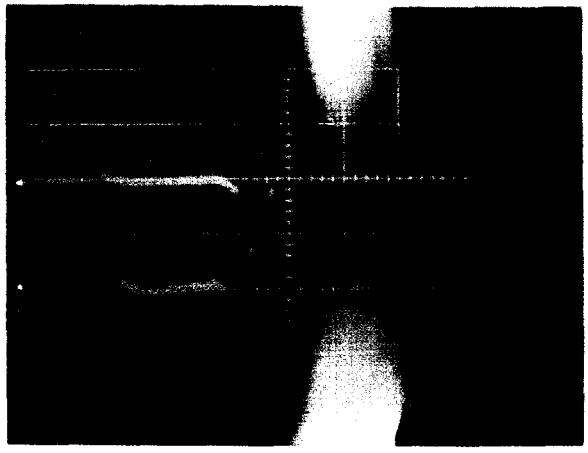
LOCATION OF IMPACT AREAS: TEST NOS. 12 AND 13
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

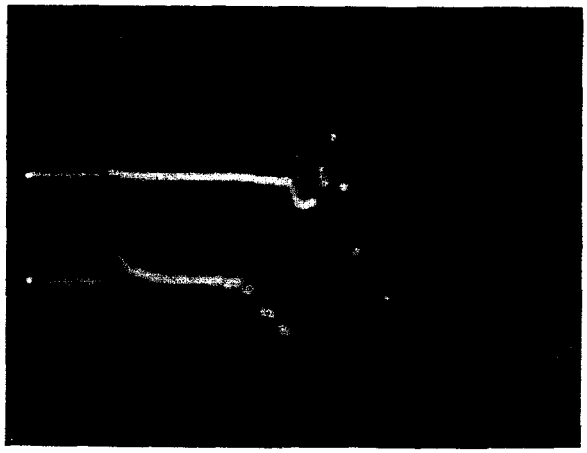
Gain (Xducer/Scope): 40



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 40



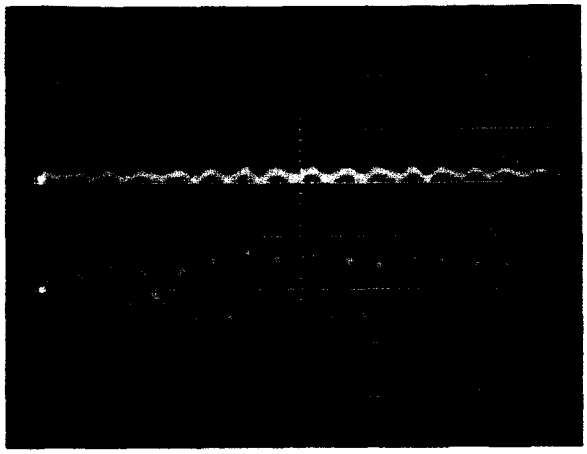
Channel 3

Upper: 1 μ sec/div. (cm)
0.5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.05 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 25

IMPACT TEST NO. 12
(Channels 1, 2 and 3)
19 April 1966 - Shot #2

PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 40

Recording Spoiled
Due to a Faulty
Camera

Trigger Display

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Channels 1 and 4 oscilloscopes had "Trigger Level" set at the wrong polarity and did not trigger on time.
- Projectile Velocity: 27,600 ft/sec
- Impact at normal incidence.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum

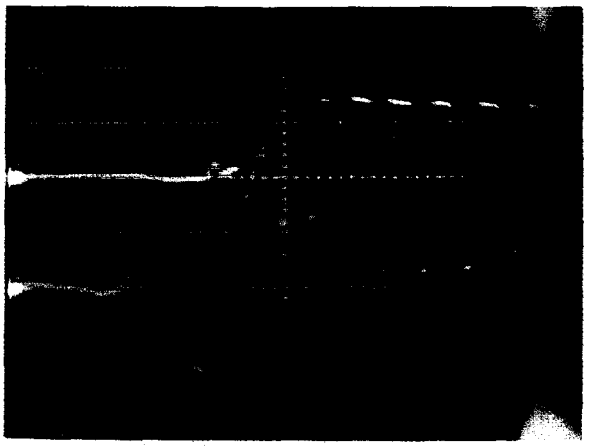
IMPACT TEST NO. 12
(Channel #4 and Trigger Display)
19 April 1966 - Shot #2

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 1

Upper: 1 μ sec/div. (cm)
2 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 μ sec/div. (cm)
Load: 570 Ω

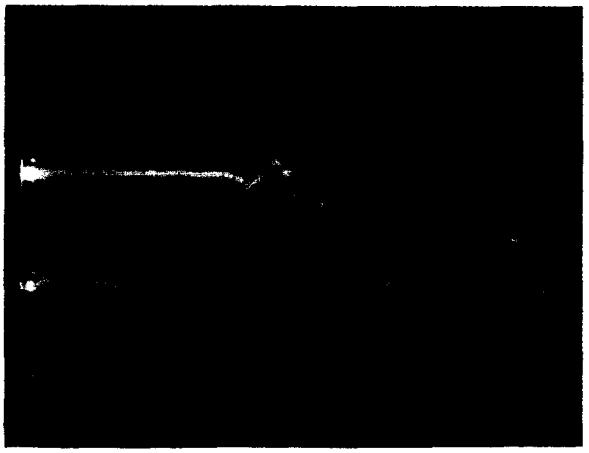
Gain (Xducer/Scope): 8



Channel 2

Upper: 1 μ sec/div. (cm)
2 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 μ sec/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 8



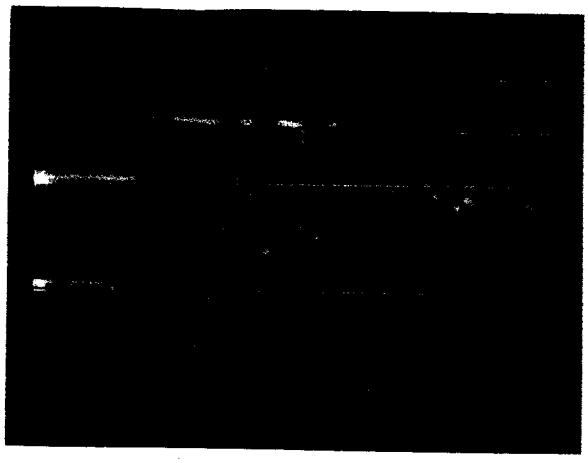
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.05 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 5

IMPACT TEST NO. 13
(Channels 1, 2 and 3)
20 April 1966 - Shot #3

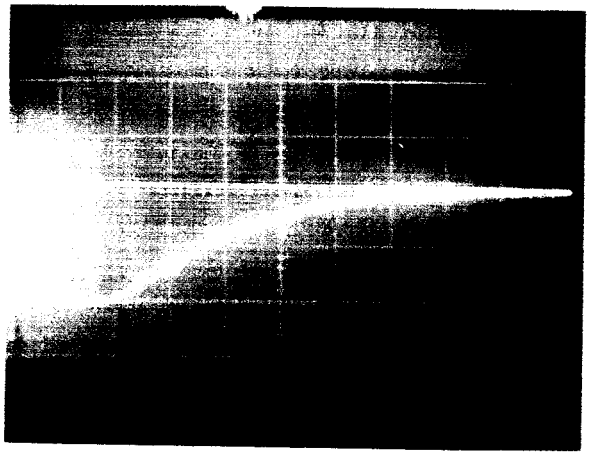
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
2 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 μ sec/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 8



Trigger Display

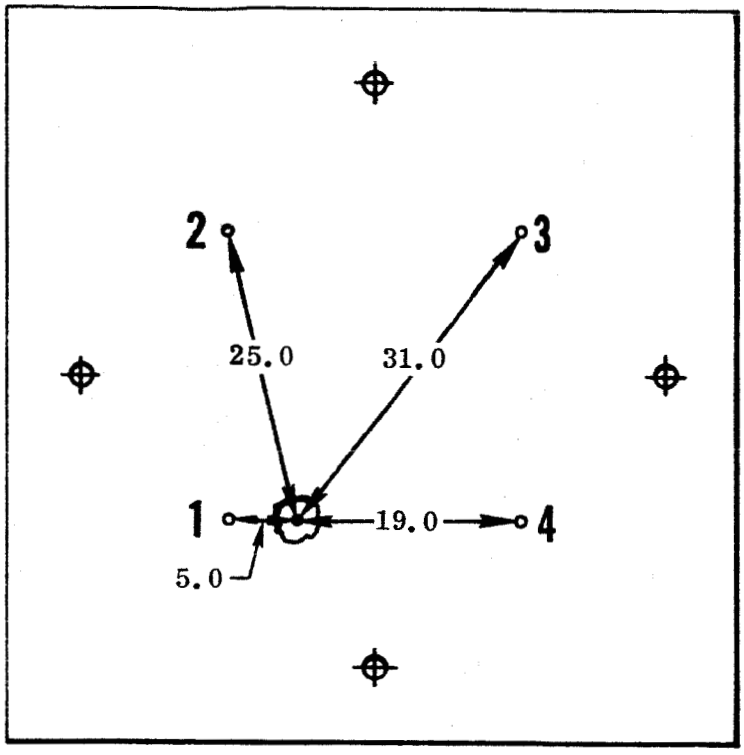
Upper: 10 μ sec/div. (cm)
20 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.05 V/div. (cm)

Additional Data:

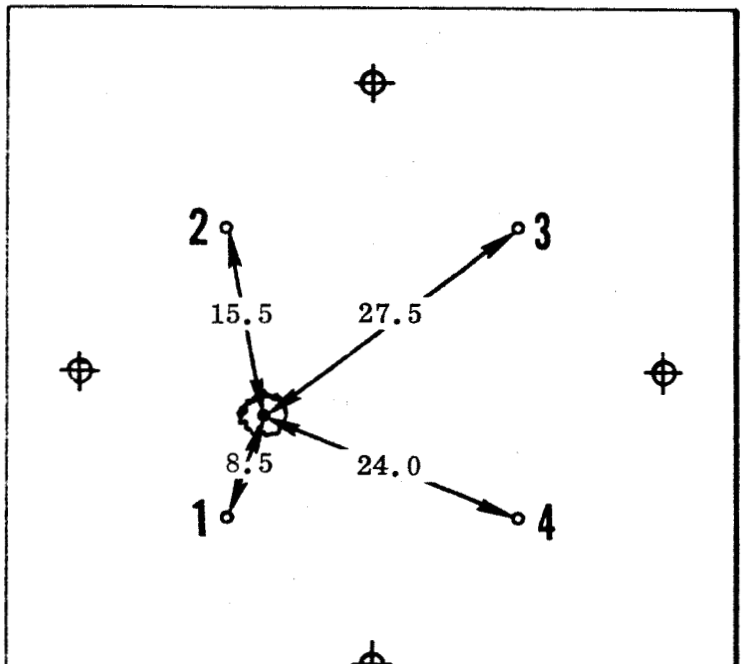
- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 28,300 ft/sec.
- Impact at normal incidence.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 13
(Channel #4 and Trigger Display)
20 April 1966 - Shot #3

PROJECTILE: LEXAN SLUG (3.11 mg)

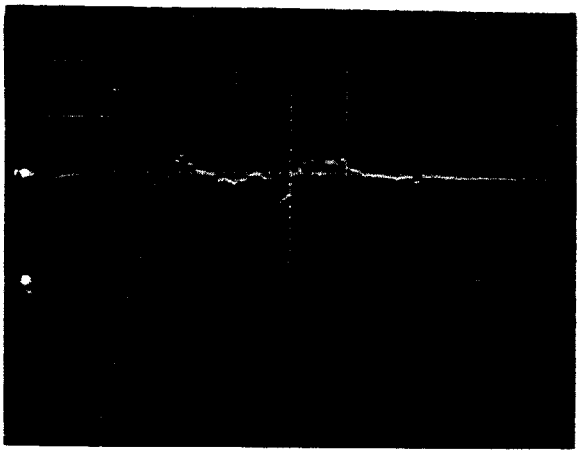


Test No. 15



Test No. 16

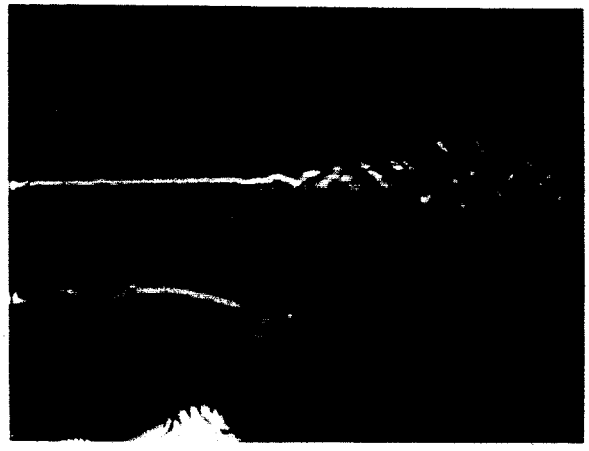
LOCATION OF IMPACT AREAS: TEST NOS. 15 AND 16
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

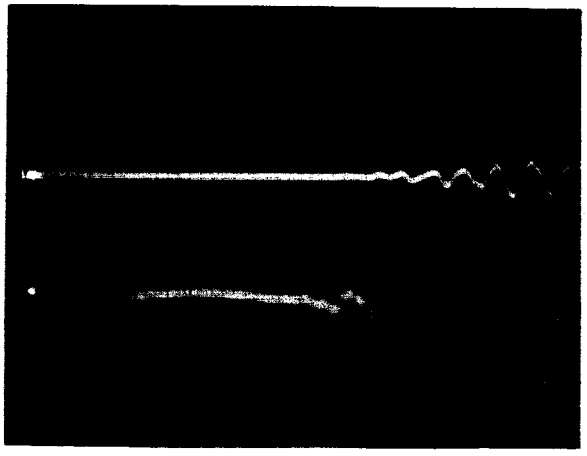
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 15
(Channels 1, 2 and 3)
20 April 1966 - Shot #5

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

Recording Spoiled
Due to a Faulty Camera

Trigger Display

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 28,700 ft/sec.
- Impact at normal incidence.
- # 1 transducer and spacer were shattered by impact.
- Transducers: Quartz x - cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024 - T3 Aluminum

IMPACT TEST NO. 15
(Channel #4 and Trigger Display)
20 April 1966 - Shot #5

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 1

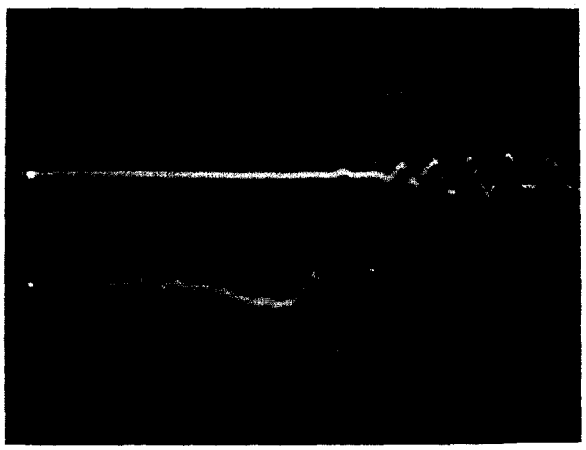
Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



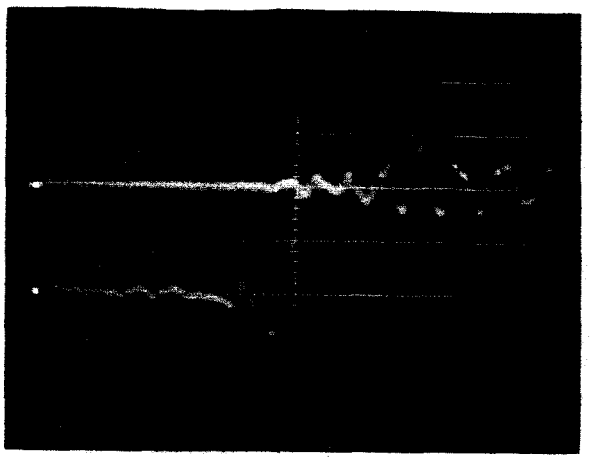
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 16
(Channels 1, 2 and 3)
21 April 1966 - Shot # 6

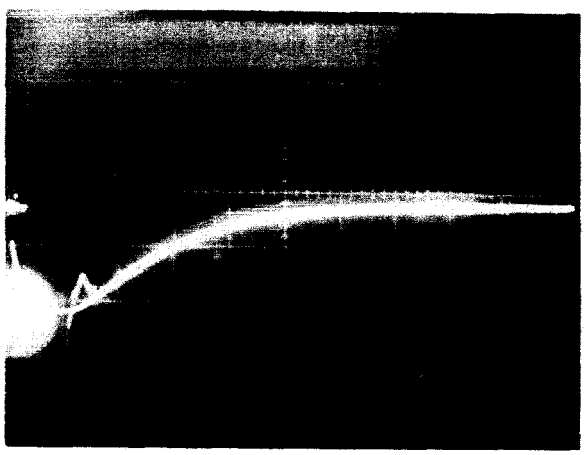
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

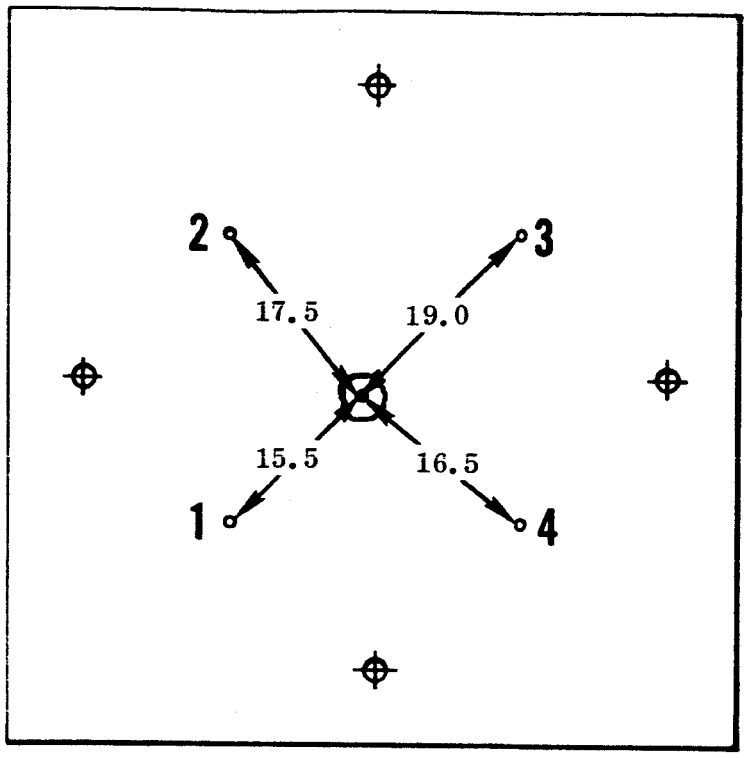
Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ /div. (cm)
0.02 V/div. (cm)

Additional Data:

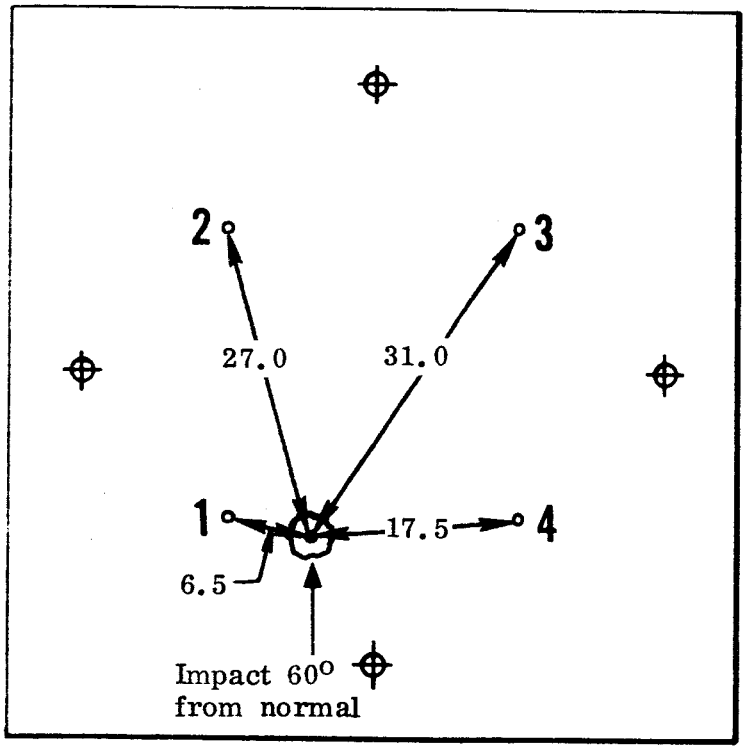
- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 28,200 ft/sec.
- Impact at normal incidence.
- #1 transducer was shattered by impact.
- Transducers: Quartz x - cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024 - T3 Aluminum.

IMPACT TEST NO. 16
(Channel #4 and Trigger Display)
21 April 1966 - Shot #6

PROJECTILE: LEXAN SLUG (3.11 mg)



Test No. 18

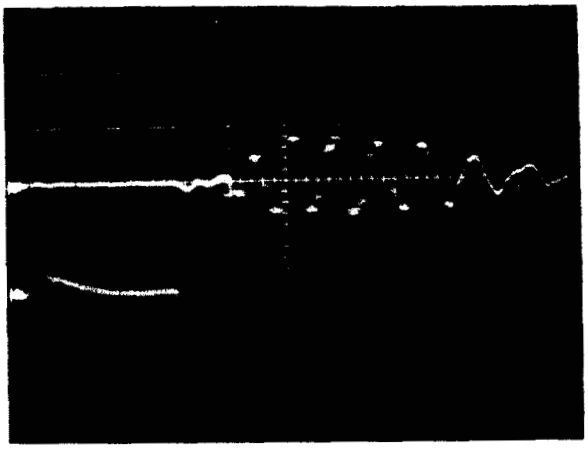


Test No. 20

LOCATION OF IMPACT AREAS: TEST NOS. 18 AND 20
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)

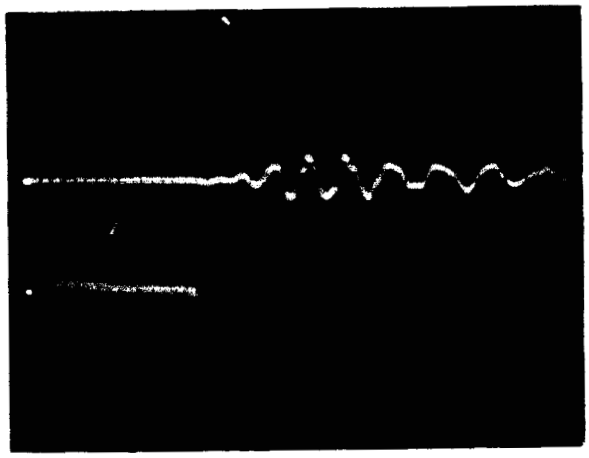
Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 1.3



Channel 3

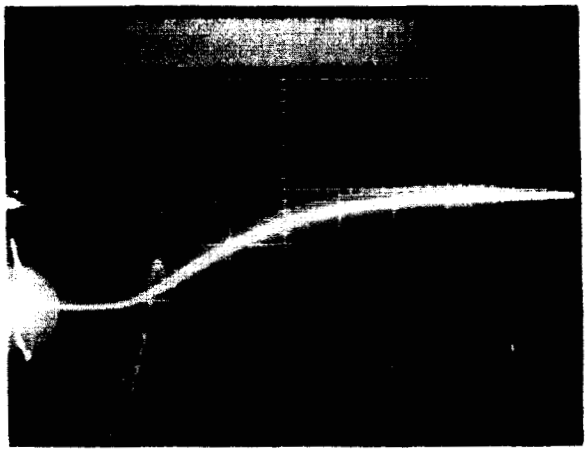
Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 18
(Channels 1, 2 and 3)
21 April 1966 - Shot # 8
PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 4

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

Upper: 10 μsec/div. (cm)
10 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 26,700 ft/sec.
- Impact at normal incidence.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

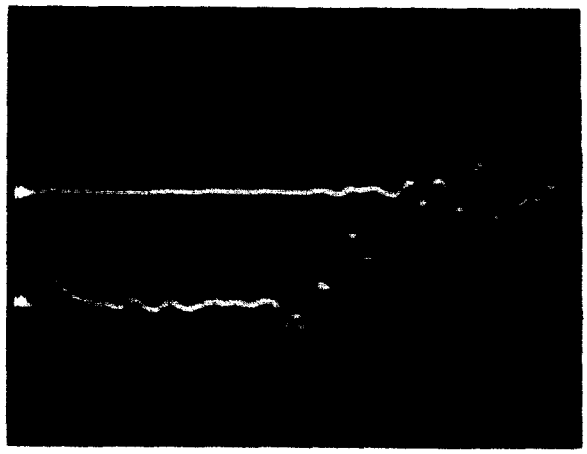
IMPACT TEST NO. 18
(Channel #4 and Trigger Display)
21 April 1966 - Shot # 8

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

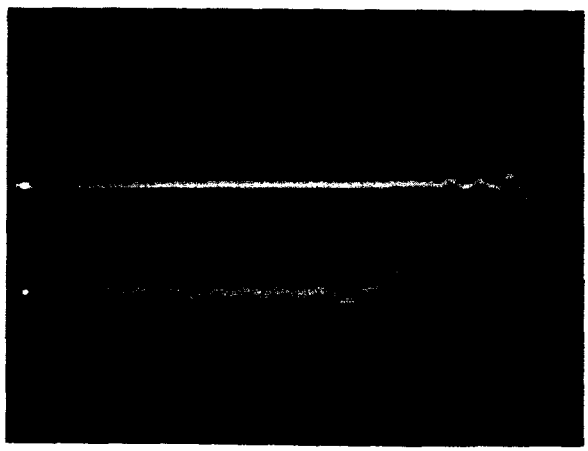
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

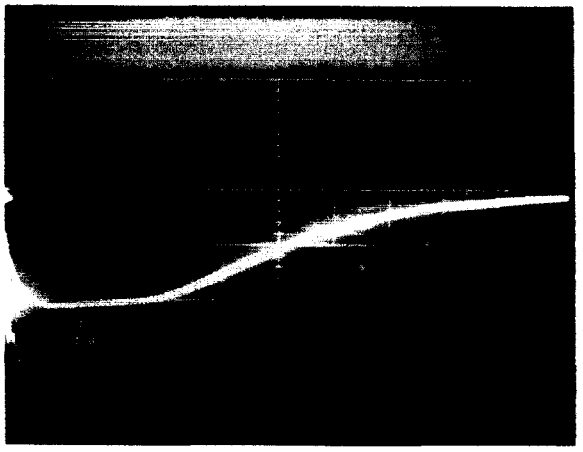
IMPACT TEST NO. 20
(Channels 1, 2 and 3)
21 April 1966 - Shot # 10

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

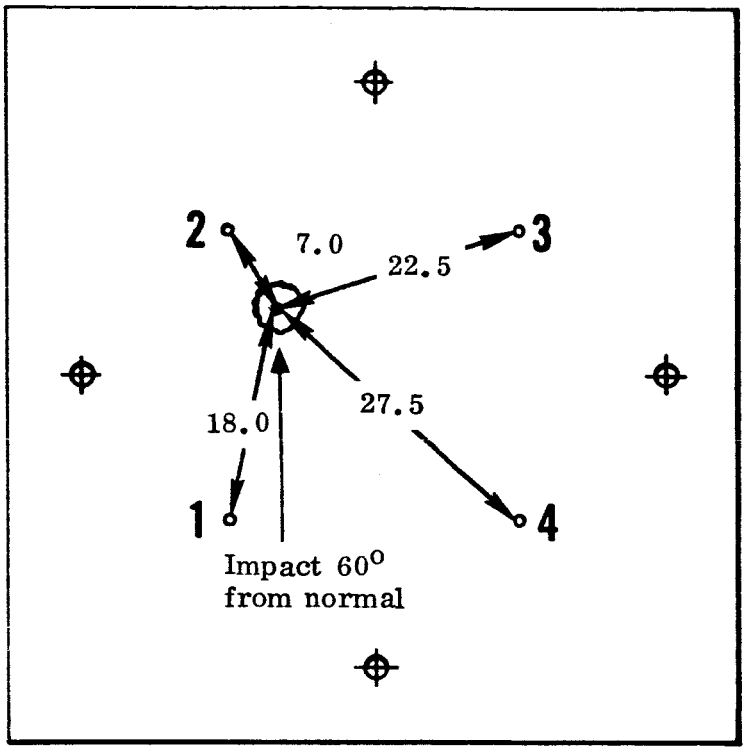
Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

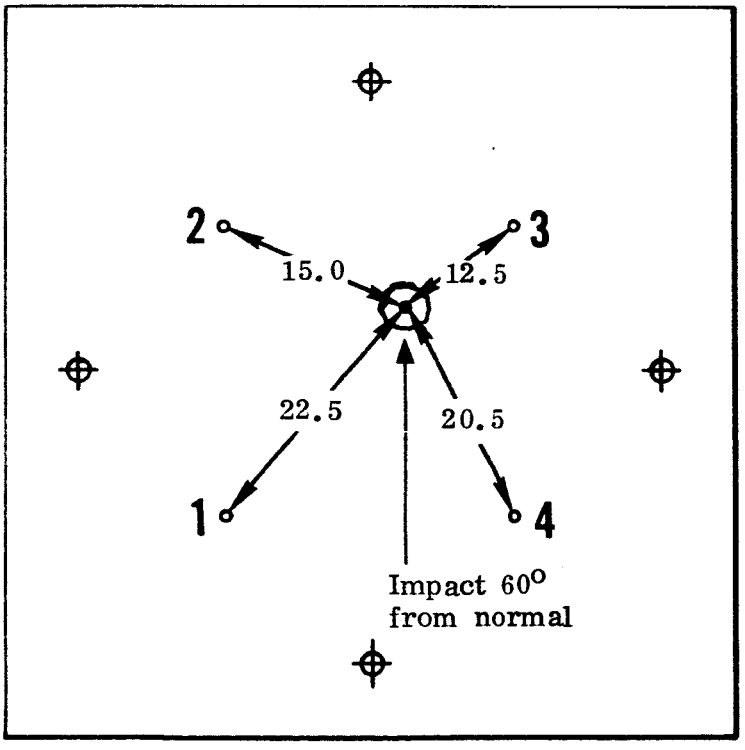
- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 30,100 ft/sec.
- Impact at 60^{o} to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 20
(Channel #4 and Trigger Display)
21 April 1966 - Shot #10

PROJECTILE: LEXAN SLUG (3.11 mg)



Test No. 21



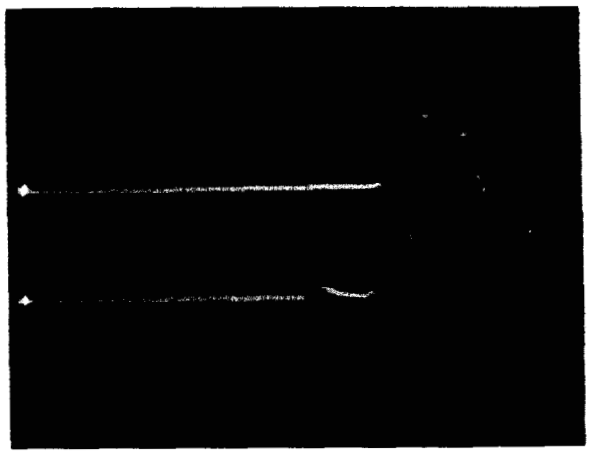
Test No. 22

LOCATION OF IMPACT AREAS: TEST NOS. 21 AND 22
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

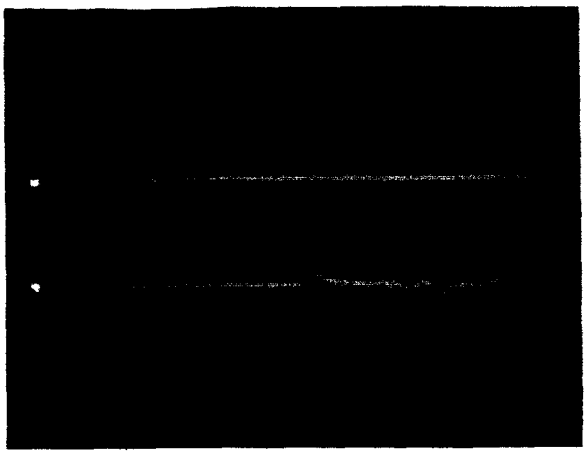
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

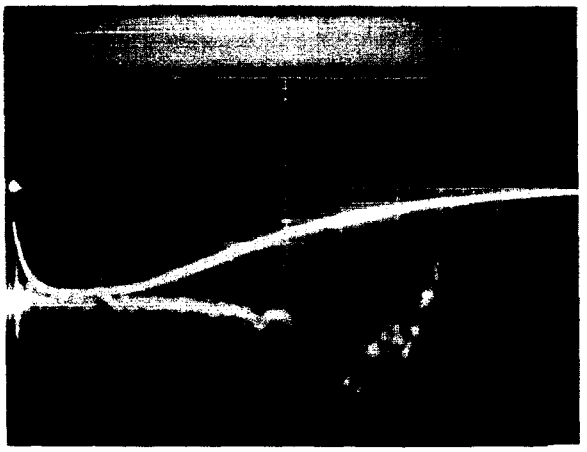
IMPACT TEST NO. 21
(Channels 1, 2 and 3)
21 April 1966 - Shot #11

PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 1.3



Trigger Display

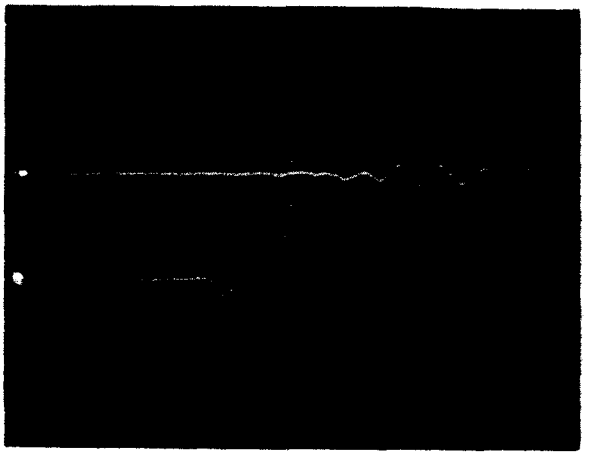
Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 27,300 ft/sec.
- Impact at 60^{o} to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum

IMPACT TEST NO. 21
(Channel #4 and Trigger Display)
21 April 1966 - Shot #11

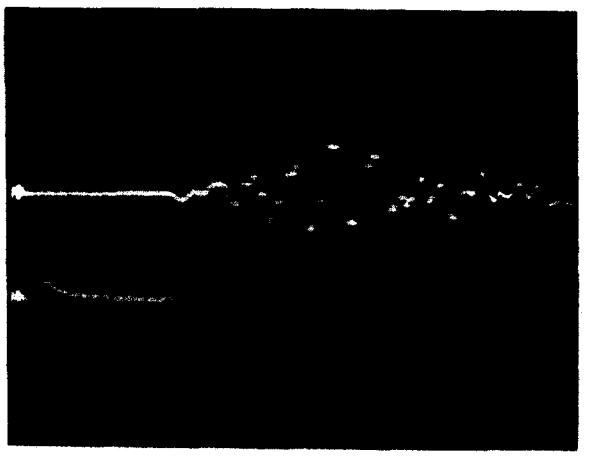
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μsec/div. (cm)
5 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

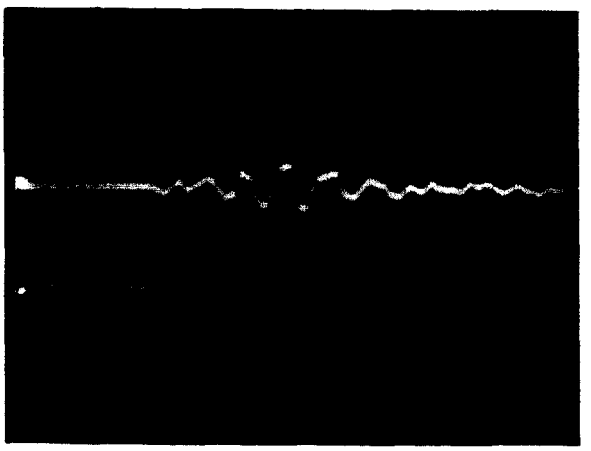
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 3

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 22
(Channels 1, 2 and 3)
21 April 1966 - Shot # 12

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 4

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

Trigger Display

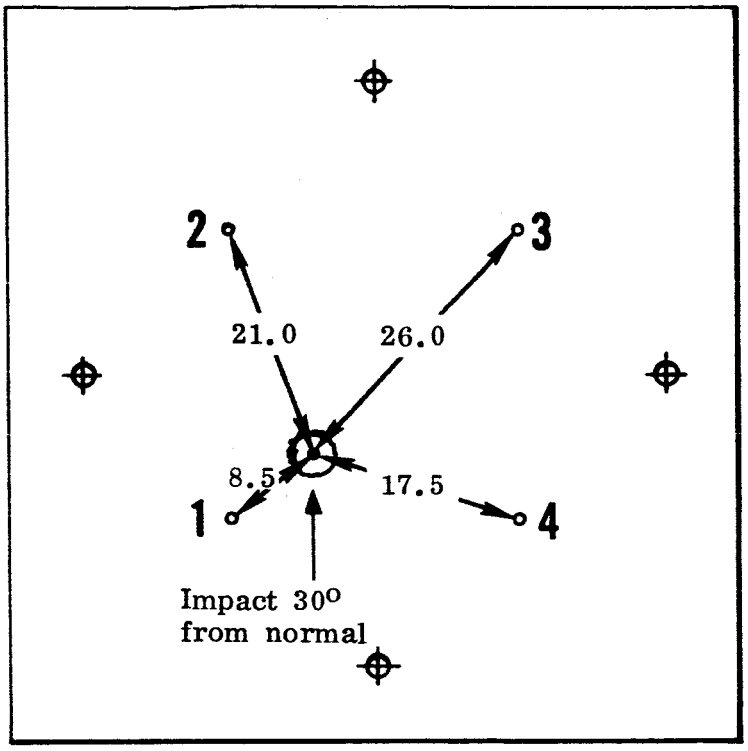
Upper: 10 μsec/div. (cm)
10 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.02 V/div. (cm)

Additional Data:

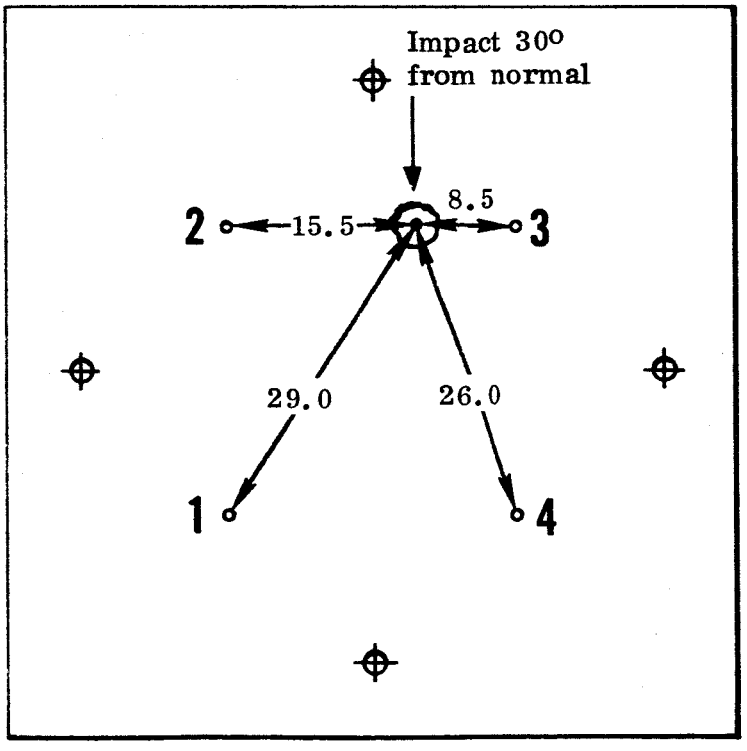
- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 28,200 ft/sec.
- Impact at 60^{o} to the normal.
- Polarity of transducer #1 was later found reversed.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum

IMPACT TEST NO. 22
(Channel #4 and Trigger Display)
21 April 1966 - Shot #12

PROJECTILE: LEXAN SLUG (3.11 mg)



Test No. 23



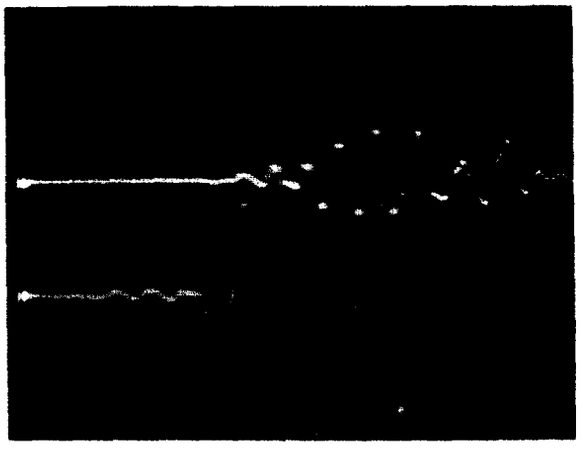
Test No. 24

LOCATION OF IMPACT AREAS: TEST NOS. 23 AND 24
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 1

Upper: 1 μsec/div. (cm)
5 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

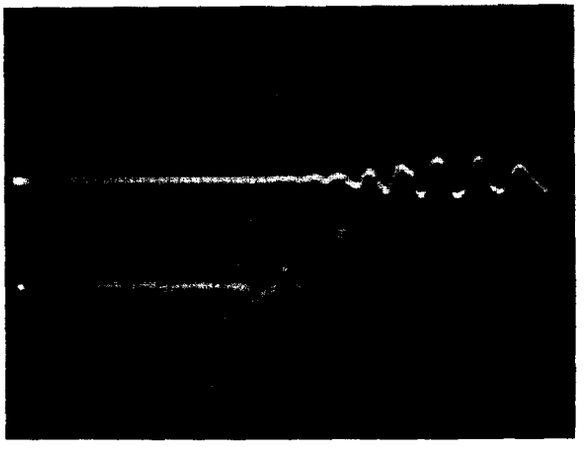
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 3

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

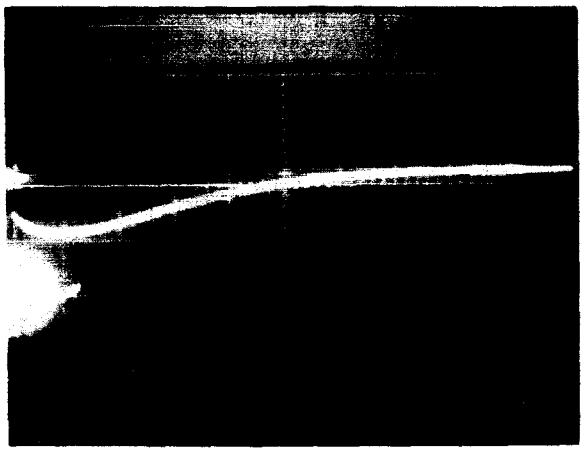
Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 23
(Channels 1, 2 and 3)
22 April 1966 - Shot #13
PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 4

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



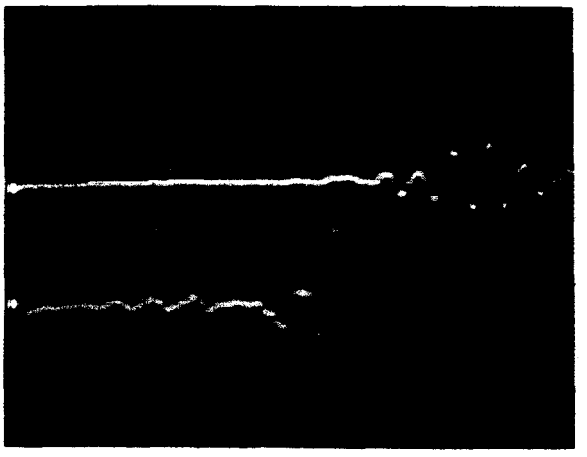
Trigger Display

Upper: 10 μsec/div. (cm)
10 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 18,500 ft/sec.
- Impact at 30^{o} to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum

IMPACT TEST NO. 23
(Channel #4 and Trigger Display)
22 April 1966 - Shot #13
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

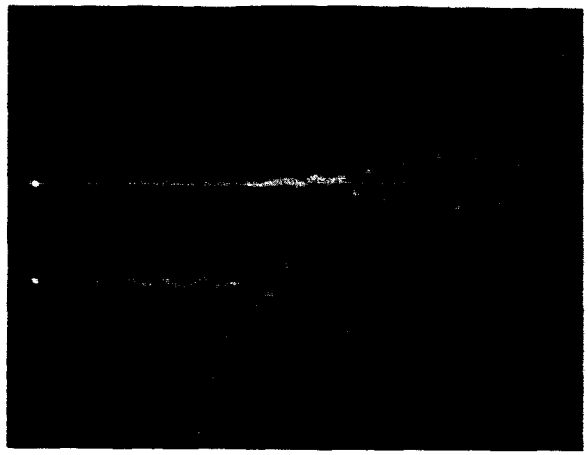
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 24
(Channels 1, 2 and 3)
22 April 1966 - Shot # 14

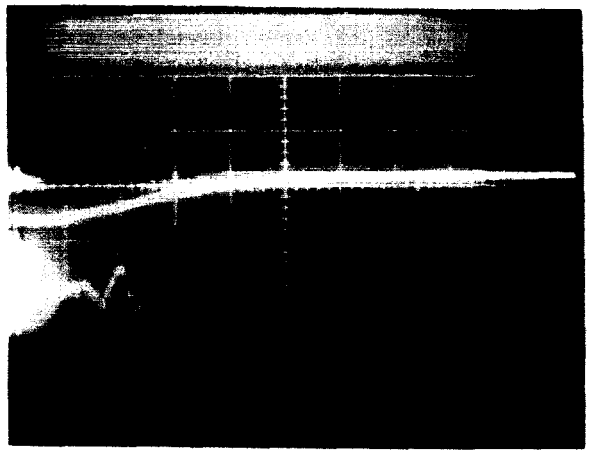
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

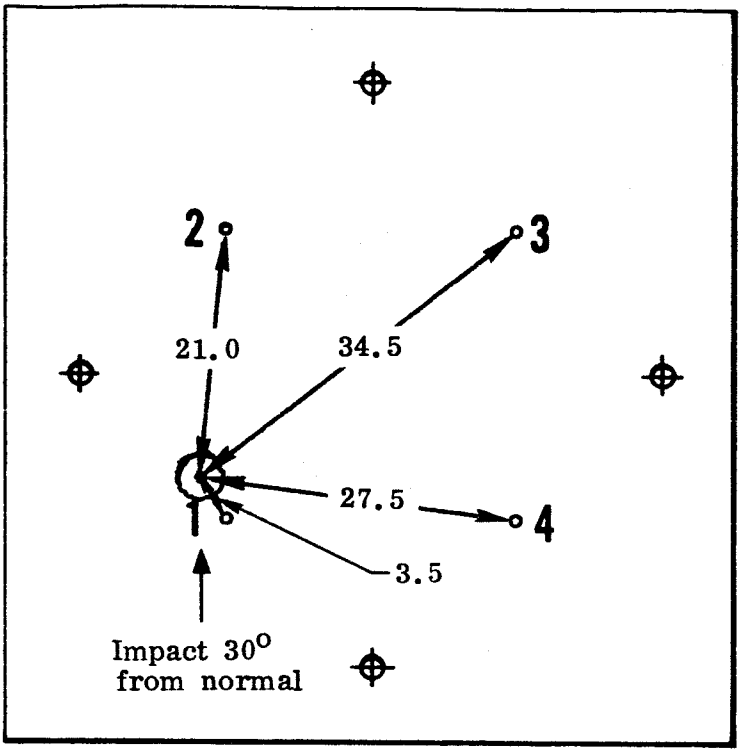
Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

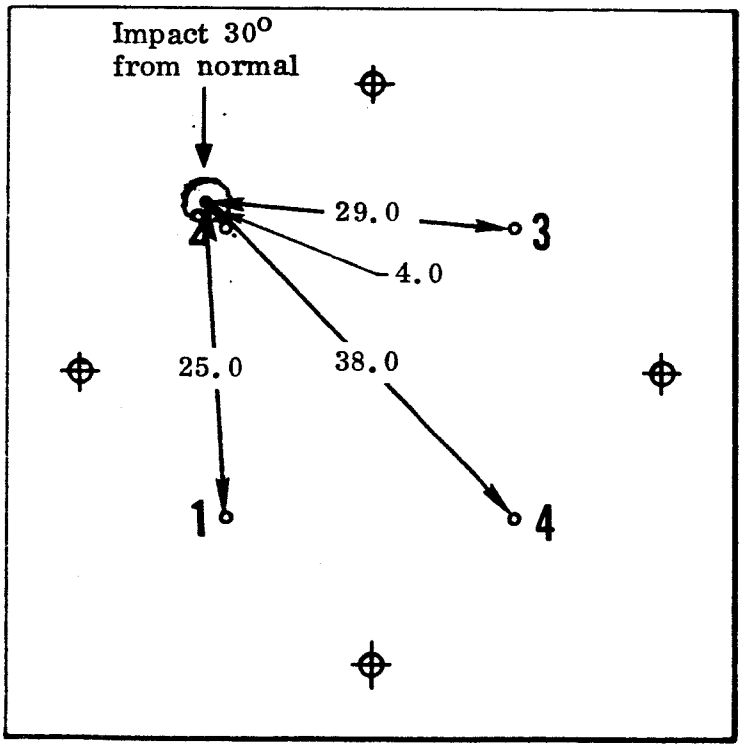
- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 2.
- Projectile Velocity: 19,100 ft/sec.
- Impact at 30° to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 24
(Channel #4 and Trigger Display)
22 April 1966 - Shot #14

PROJECTILE: LEXAN SLUG (3.11 mg)

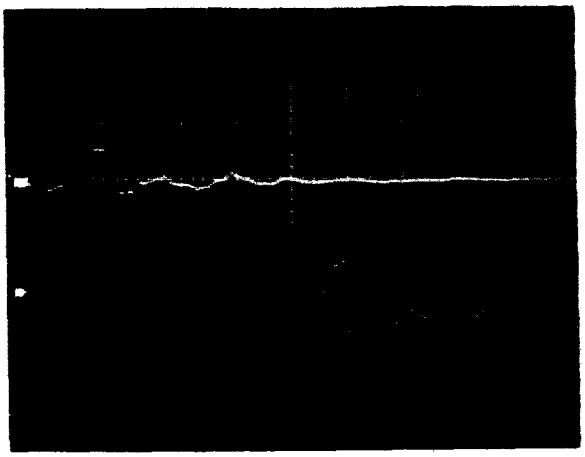


Test No. 25



Test No. 28

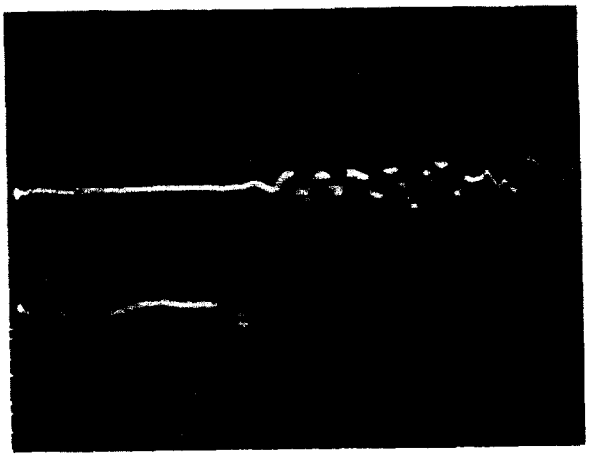
LOCATION OF IMPACT AREAS: TEST NOS. 25 AND 28
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

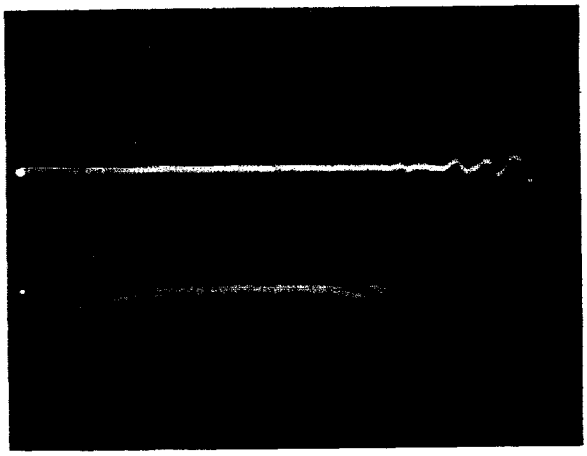
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



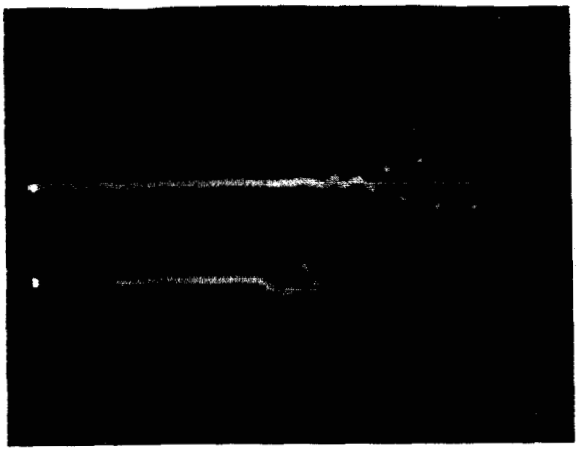
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 25
(Channels 1, 2 and 3)
22 April 1966 - Shot #15

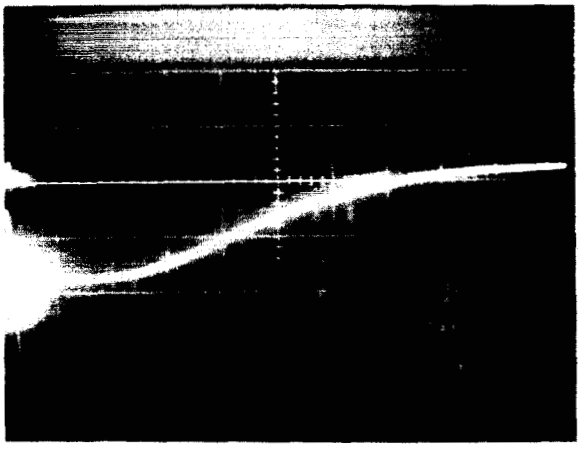
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

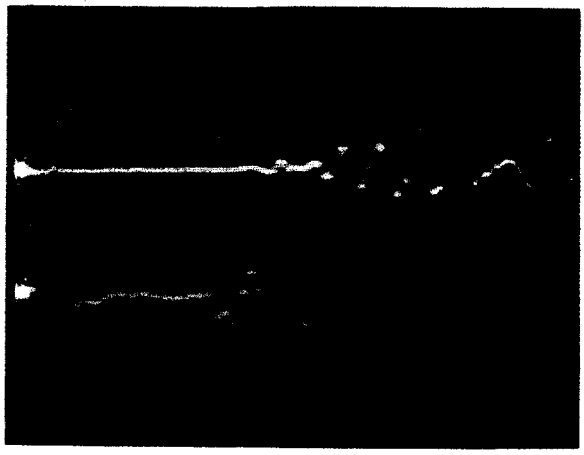
Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 26,400 ft/sec.
- #1 transducer and spacer were shattered by impact.
- Impact at 30° to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 25
(Channel #4 and Trigger Display)
22 April 1966 - Shot # 15

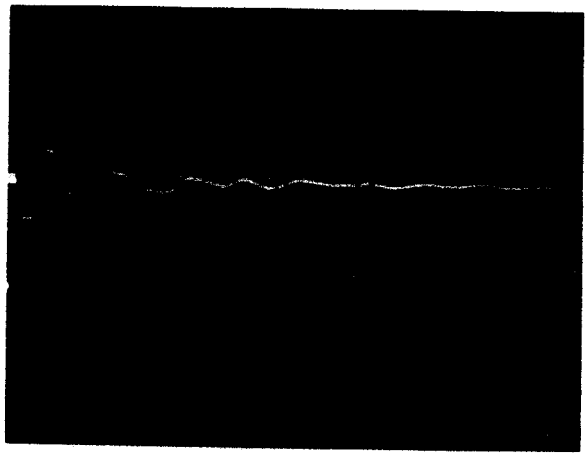
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

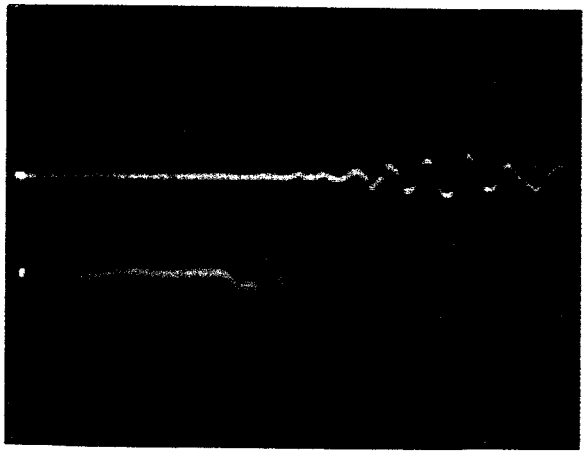
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



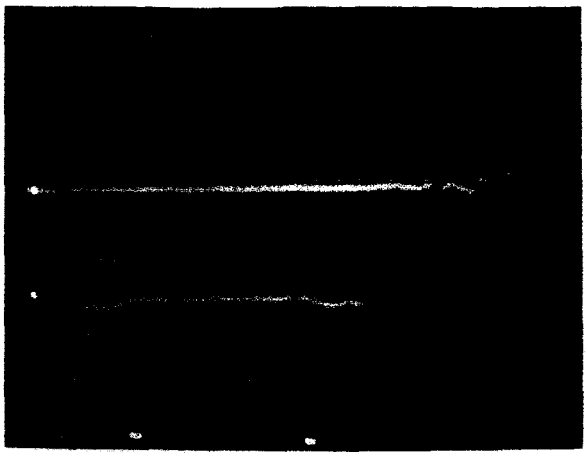
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 28
(Channels 1, 2 and 3)
22 April 1966 - Shot #18

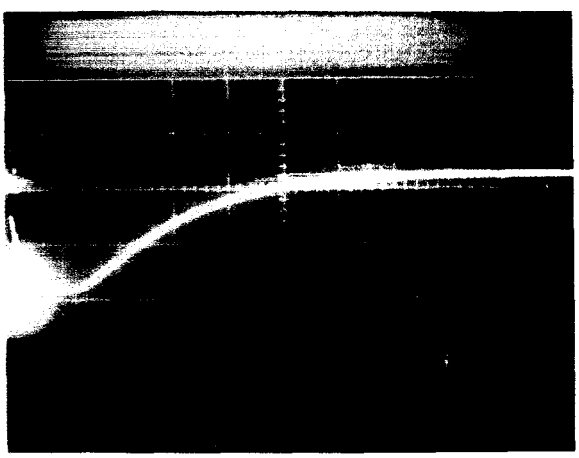
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

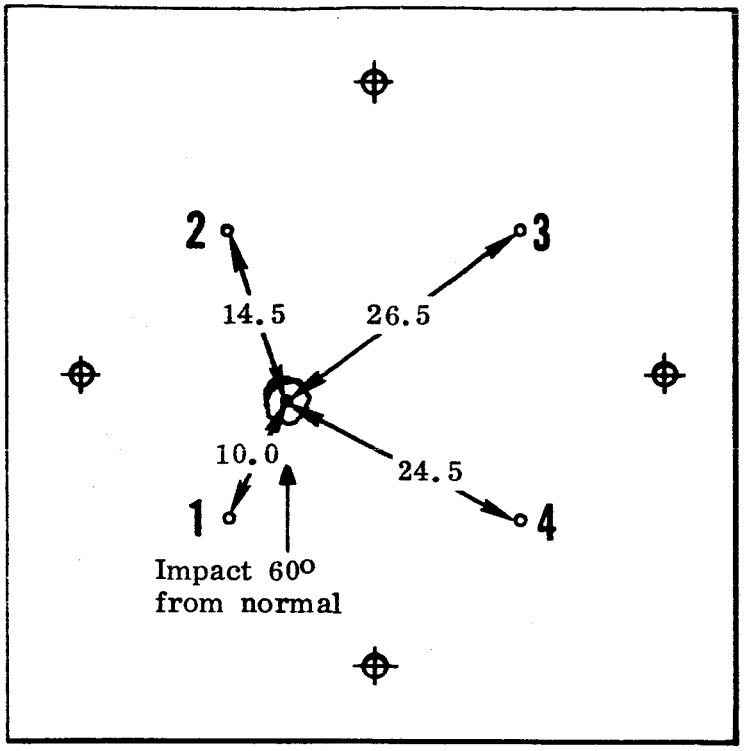
Upper: 10 μsec/div. (cm)
10 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.02 V/div. (cm)

Additional Data:

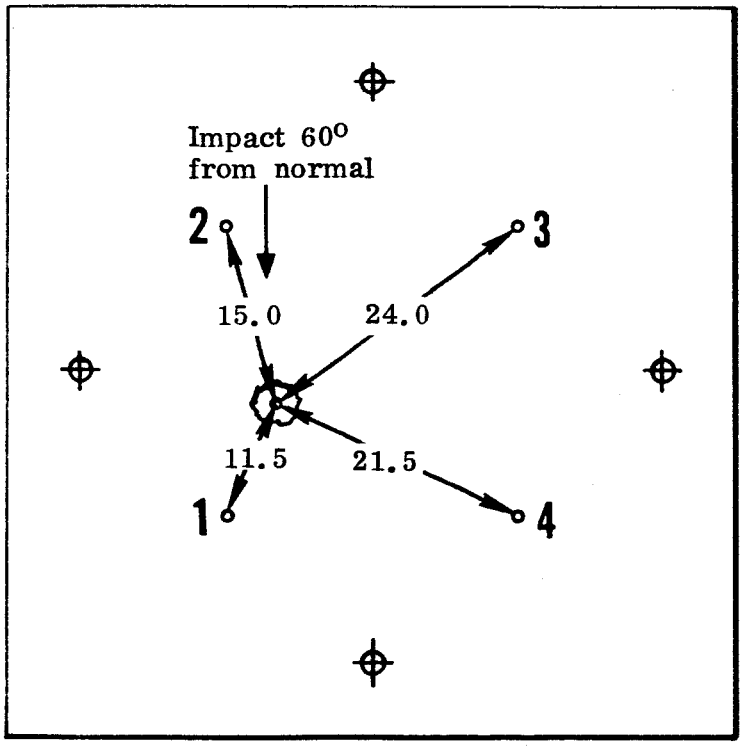
- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 2.
- Projectile Velocity: 27,400 ft/sec.
- #2 transducer and spacer were shattered by impact.
- Impact at 30^{o} to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 28
(Channel #4 and Trigger Display)
22 April 1966 - Shot #18

PROJECTILE: LEXAN SLUG (3.11 mg)

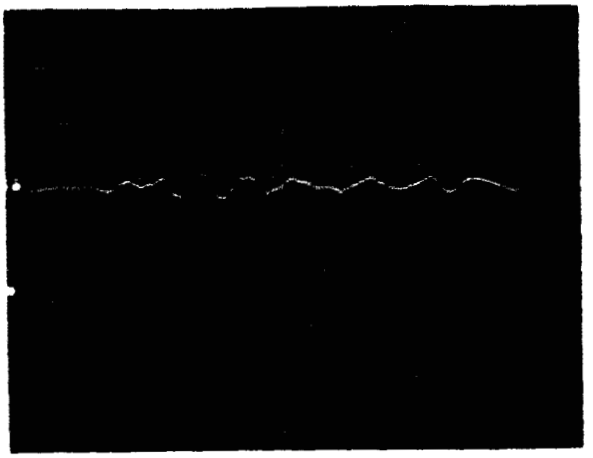


Test No. 29



Test No. 30

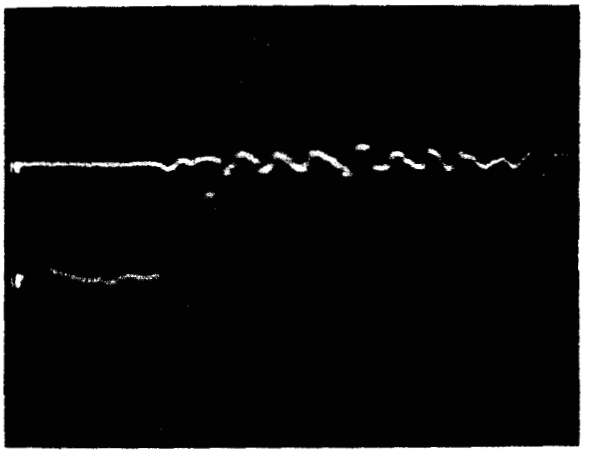
LOCATION OF IMPACT AREAS: TEST NOS. 29 AND 30
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

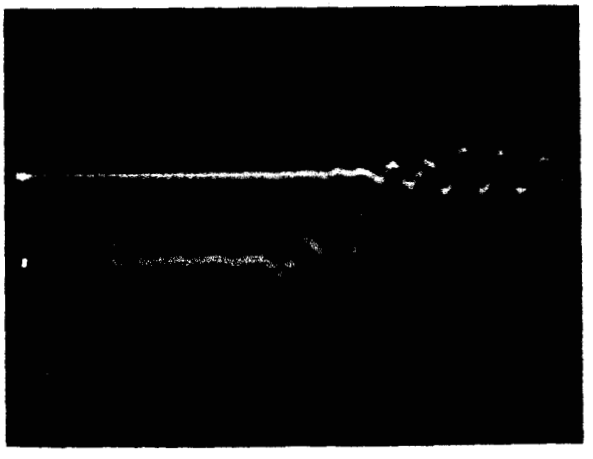
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



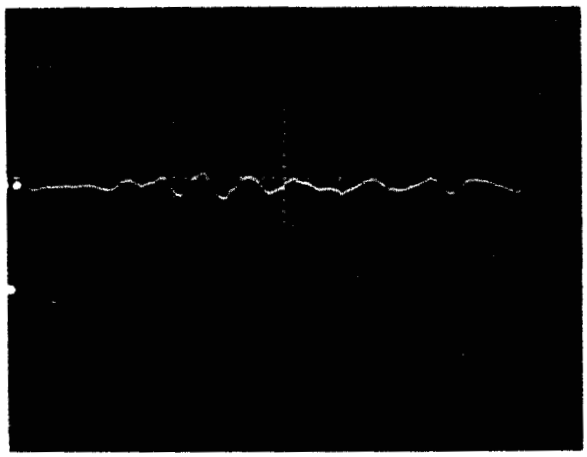
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 29
(Channels 1, 2 and 3)
22 April 1966 - Shot #19

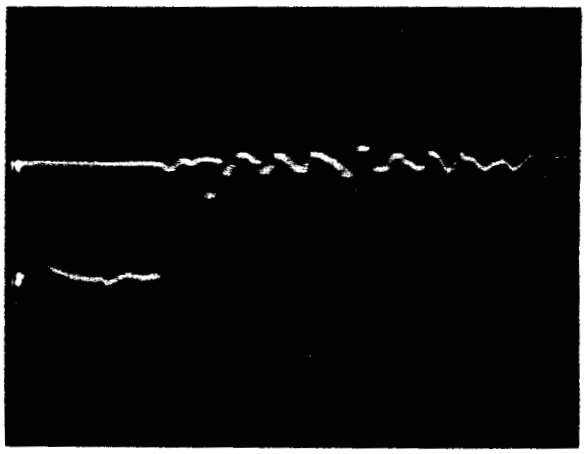
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

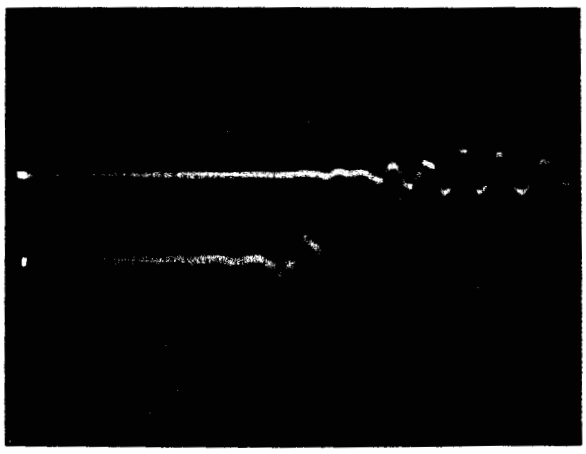
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

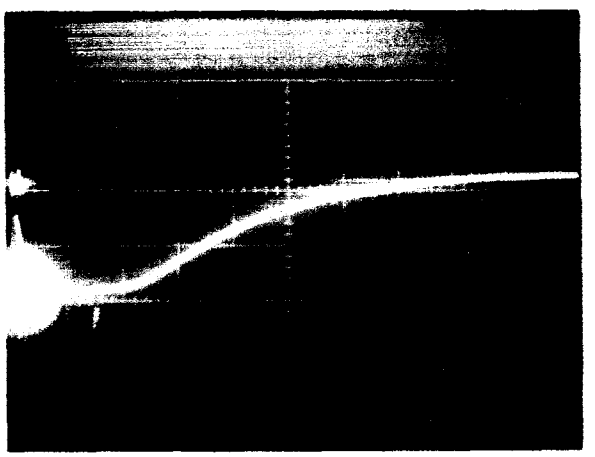
IMPACT TEST NO. 29
(Channels 1, 2 and 3)
22 April 1966 - Shot #19

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 30,000 ft/sec.
- Impact at 60° to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum

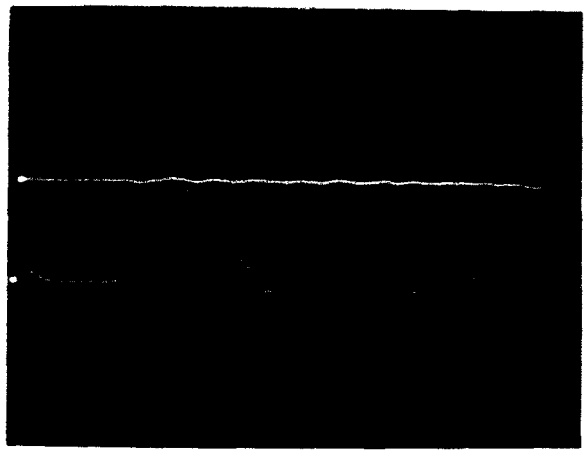
IMPACT TEST NO. 29
(Channel #4 and Trigger Display)
22 April 1966 - Shot #19

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

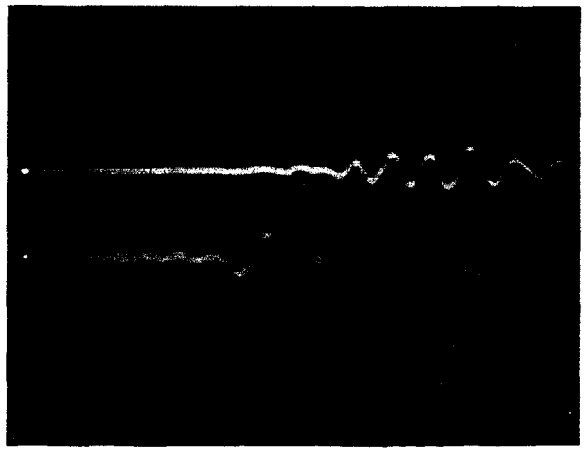
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



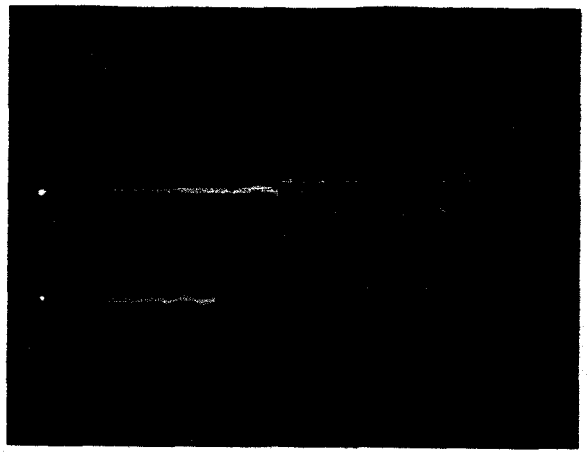
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 30
(Channels # 1, 2 and 3)
22 April 1966 - Shot #20

PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

Recording Spoiled
Due to a Faulty Camera

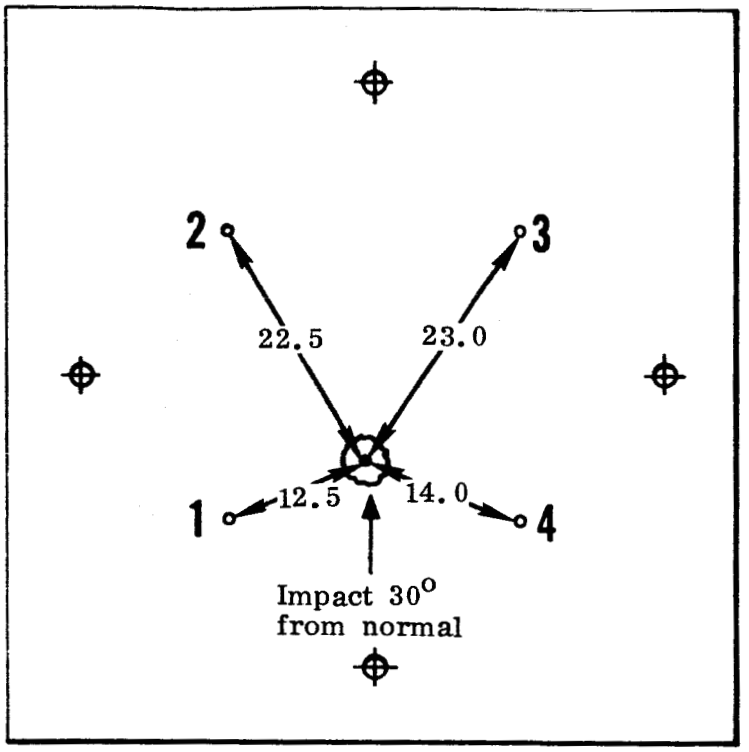
Trigger Display

Additional Data:

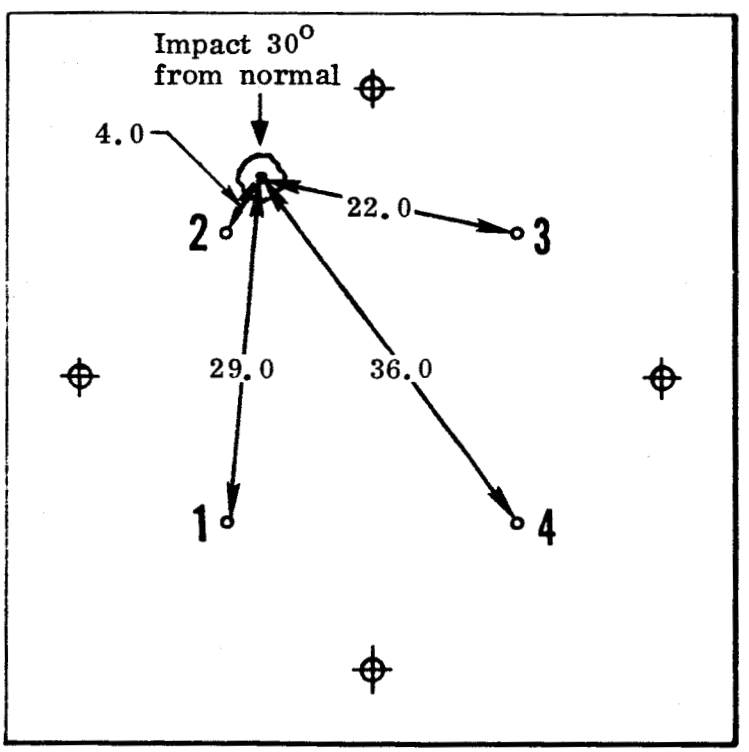
- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 2.
- Projectile Velocity: 30,250 ft/sec.
- Impact at 60^{o} to the normal.
- Same target plate used for tests Nos. 29 and 30; craters partially overlap.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick,
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 30
(Channel #4 and Trigger Display)
22 April 1966 - Shot #20

PROJECTILE: LEXAN SLUG (3.11 mg)



Test No. 33



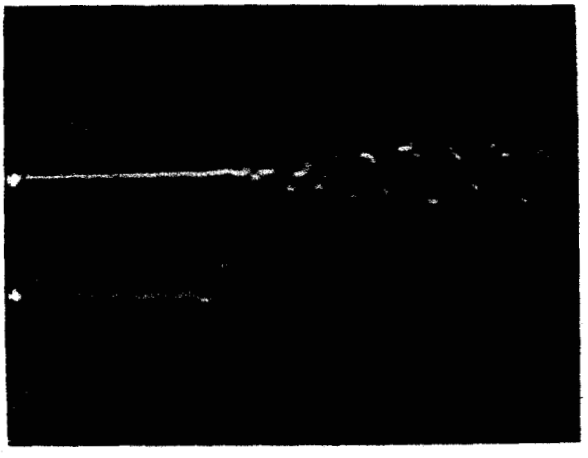
Test No. 34

LOCATION OF IMPACT AREAS: TEST NOS. 33 AND 34
(Distances between impact area centers and transducer edges shown in millimeters)
PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 33
25 April 1966 - Shot # 23
(Channels 1, 2 and 3)

PROJECTILE: LEXAN SLUG (3.11 mg)

Channel 4

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

Trigger Display

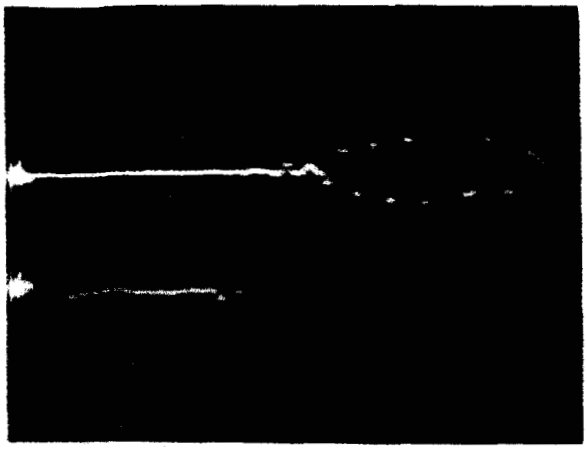
Upper: 10 μsec/div. (cm)
10 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile Velocity: 26,500 ft/sec.
- Impact at 30^{o} to the normal.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 33
(Channel #4 and Trigger Display)
25 April 1966 - Shot #23

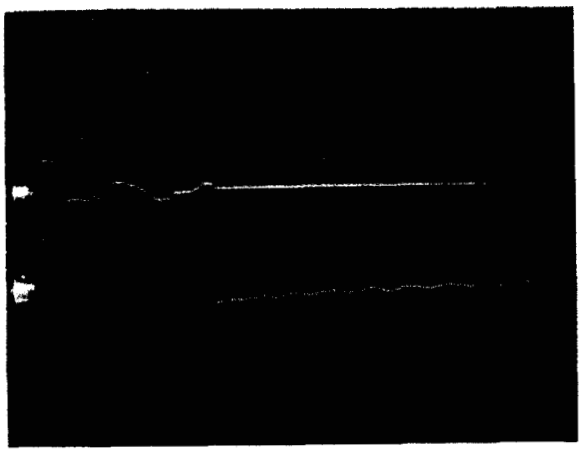
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μsec/div. (cm)
5 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3

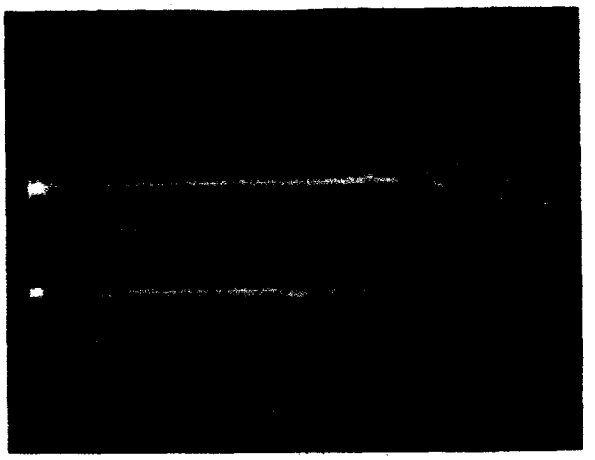
Channel 3

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 34
(Channels 1, 2 and 3)
25 April 1966 - Shot #24

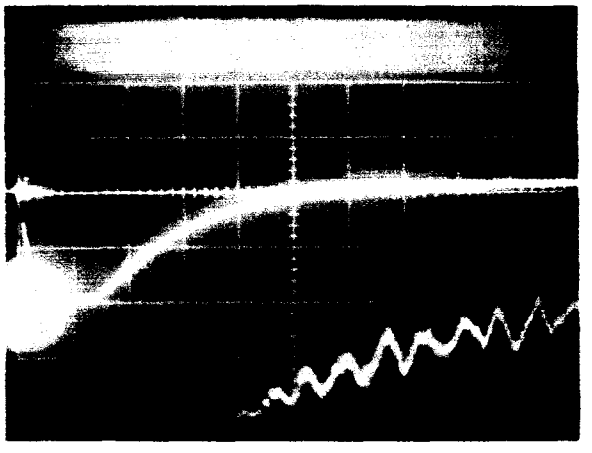
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 2.
- Projectile Velocity: 27,100 ft/sec.
- Impact at 30^{o} to the normal.
- #2 transducer and spacer were shattered by the impact.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

IMPACT TEST NO. 34
(Channel #4 and Trigger Display)
25 April 1966 - Shot # 24

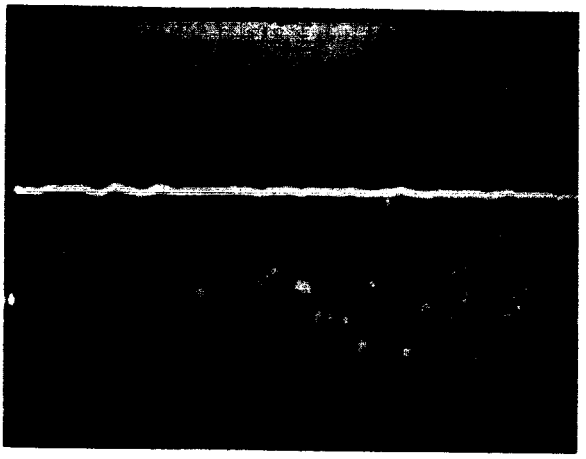
PROJECTILE: LEXAN SLUG (3.11 mg)

MISCELLANEOUS

AND

INCOMPLETE

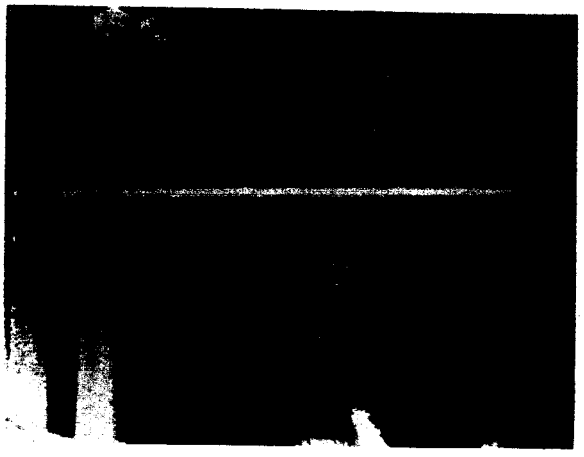
DATA



Channel 1

Upper: 1 μ sec/div. (cm)
2 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.05 V/div. (cm)
Load: 570 Ω

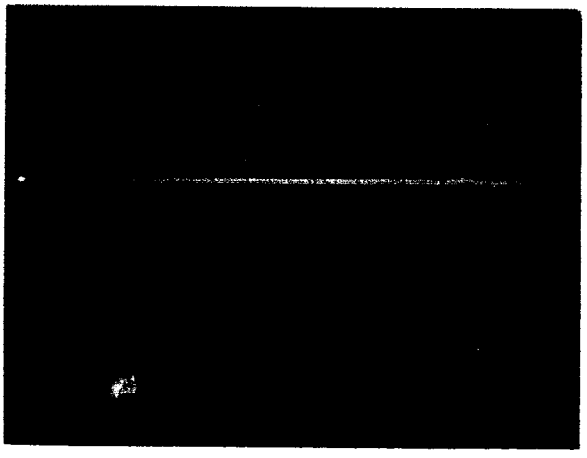
Gain (Xducer/Scope): 40



Channel 2

Upper: 1 μ sec/div. (cm)
2 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.05 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 40



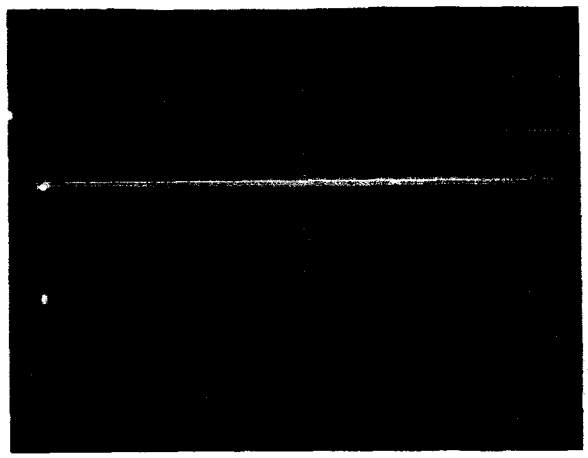
Channel 3

Upper: 1 μ sec/div. (cm)
2 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.05 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 40

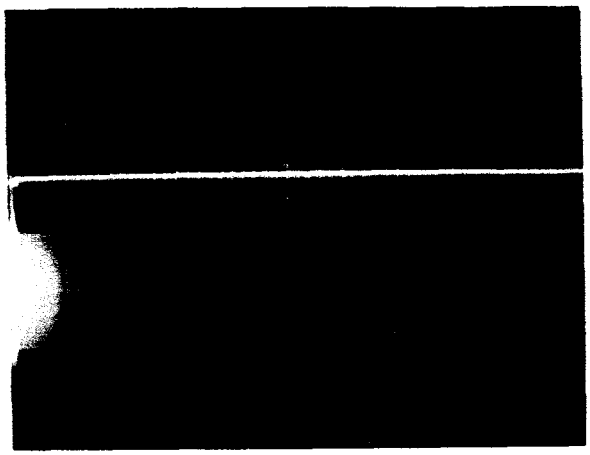
IMPACT TEST NO. 11
(Channels 1, 2 and 3)
19 April 1966 - Shot #1

PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
2 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.05 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 40



Trigger Display

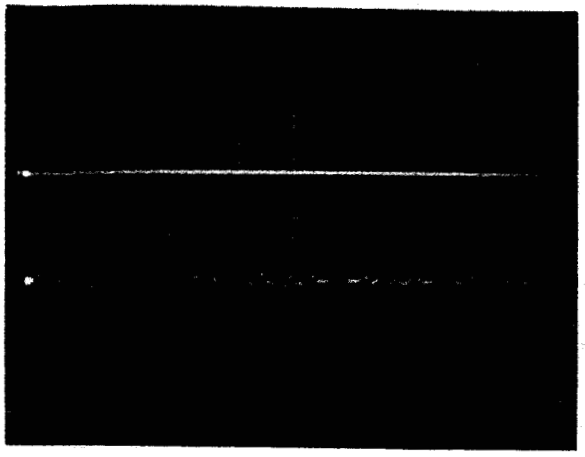
Upper: 10 μ sec/div. (cm)
20 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.01 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile hit the shield and the target was only hit by a gas cloud (no visible damage).
- (Recorded "Projectile Velocity": 21,600 ft/sec)
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum.

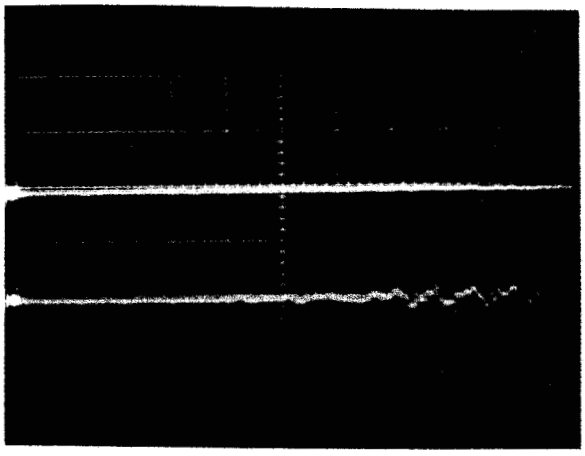
IMPACT TEST NO. 11
(Channel #4 and Trigger Display)
19 April 1966 - Shot # 1

PROJECTILE: LEXAN SLUG (3.11 mg)



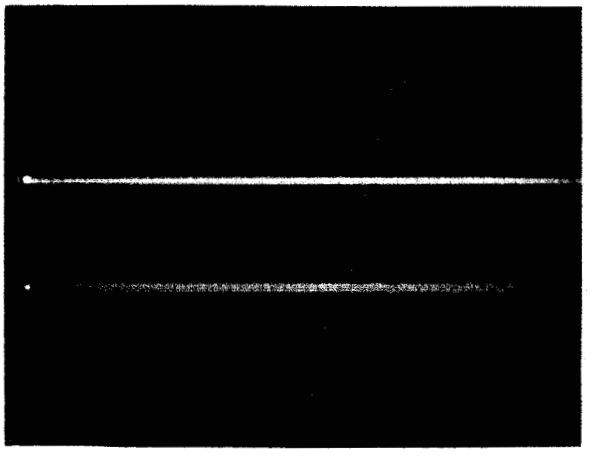
Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 1.3



Channel 2

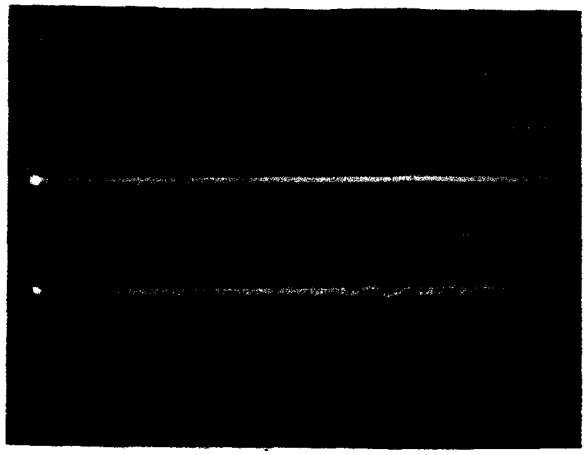
Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 1.3



Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω
Gain (Xducer/Scope): 1.0

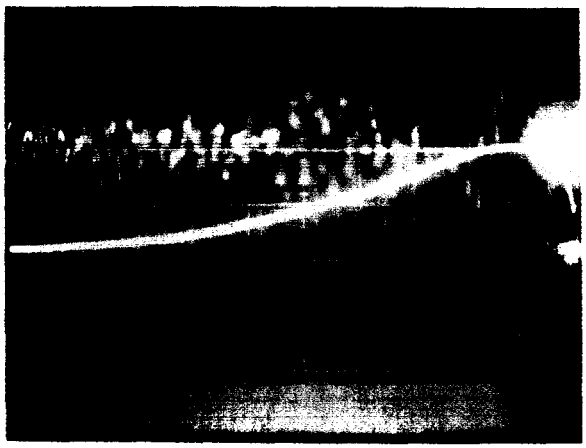
IMPACT TEST NO. 17
(Channels 1, 2 and 3)
21 April 1966 - Shot #7
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μsec/div. (cm)
1 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

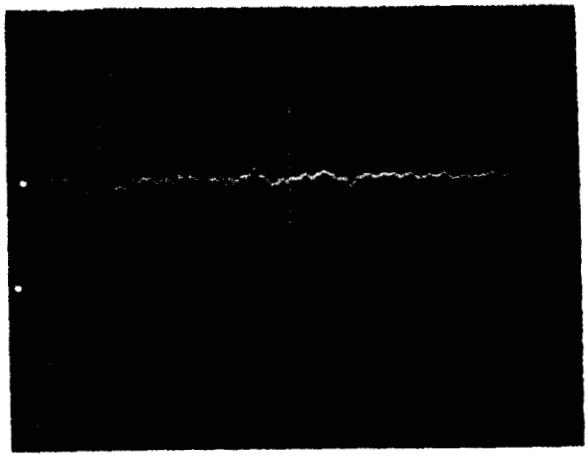
Upper: 10 μsec/div. (cm)
10 V/div. (cm)
Lower: 1 μsec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile hit the shield and the target was impacted by a spray of secondary particles ranging up to about 100 microns in diameter.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024-T3 Aluminum

IMPACT TEST NO. 17
(Channel #4 and Trigger Display)
21 April 1966 - Shot # 7

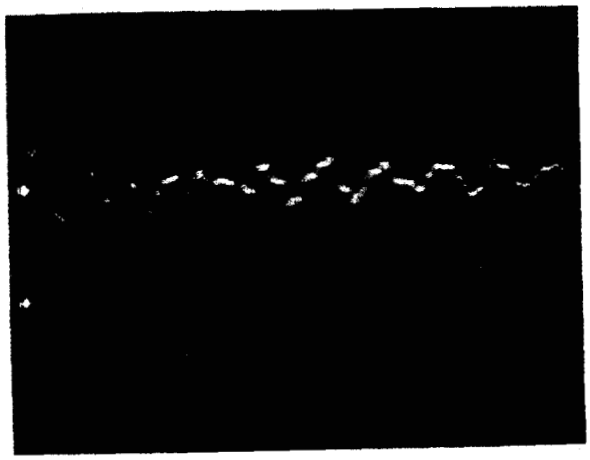
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

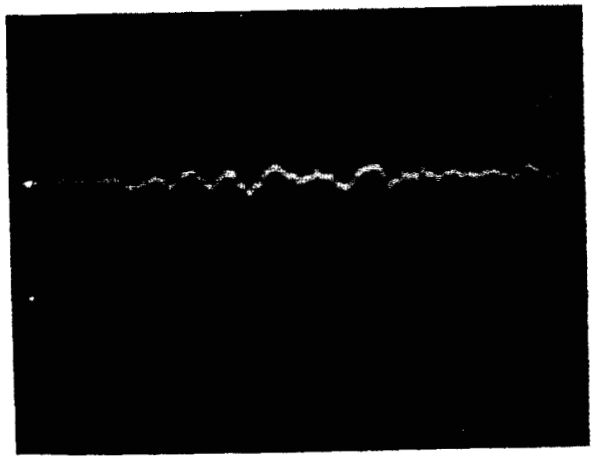
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



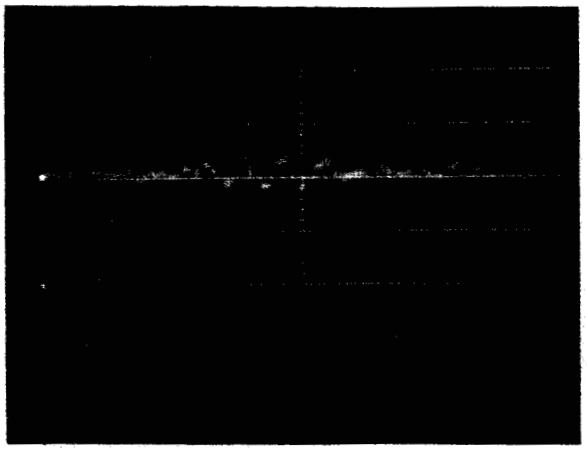
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 31
(Channels 1, 2 and 3)
22 April 1966 - Shot # 21

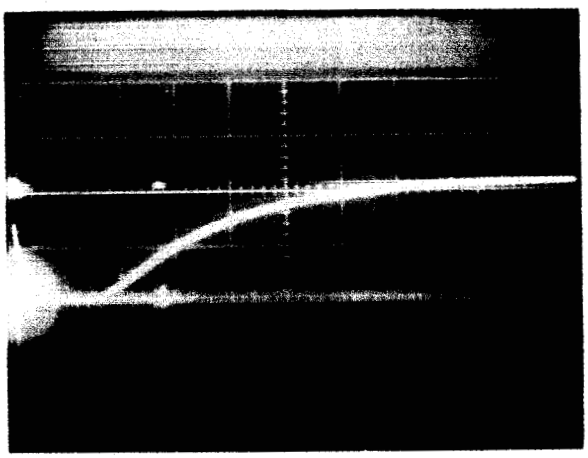
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

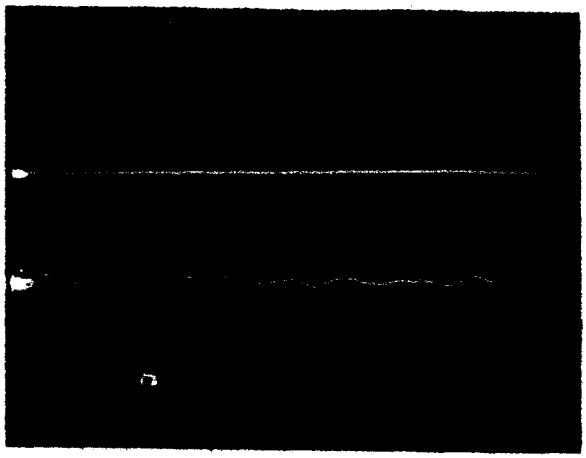
Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile hit shield and target was sprayed by secondary metallic fragments.
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024 -T3 Aluminum.

IMPACT TEST NO. 31
(Channel #4 and Trigger Display)
22 April 1966 - Shot #21

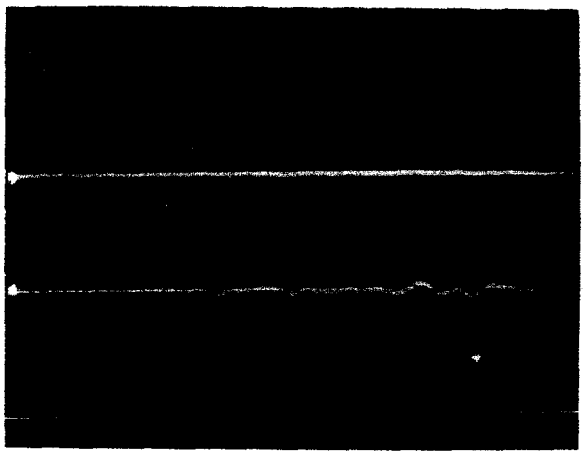
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 1

Upper: 1 μ sec/div. (cm)
5 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.2 V/div. (cm)
Load: 570 Ω

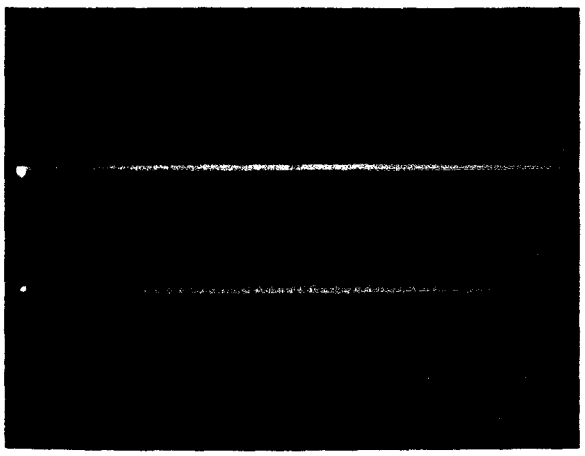
Gain (Xducer/Scope): 1.3



Channel 2

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



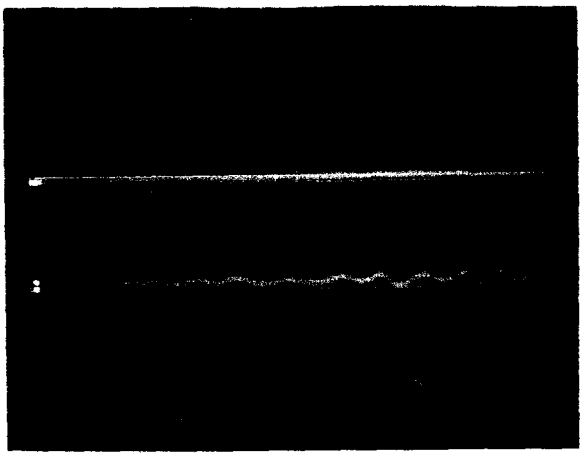
Channel 3

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.0

IMPACT TEST NO. 32
(Channels 1, 2 and 3)
25 April 1966 - Shot #22

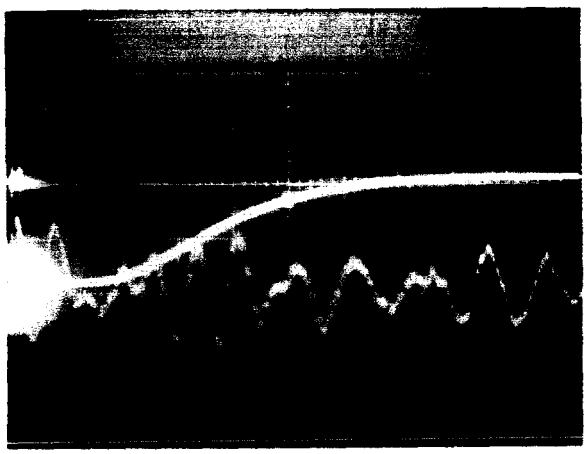
PROJECTILE: LEXAN SLUG (3.11 mg)



Channel 4

Upper: 1 μ sec/div. (cm)
1 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.1 V/div. (cm)
Load: 570 Ω

Gain (Xducer/Scope): 1.3



Trigger Display

Upper: 10 μ sec/div. (cm)
10 V/div. (cm)
Lower: 1 μ sec/div. (cm)
0.02 V/div. (cm)

Additional Data:

- Channels 1, 2, 3 and 4 oscilloscopes triggered by the signal in Channel 1.
- Projectile hit shield and target was only subjected to impact of gas cloud (no visible damage).
- Transducers: Quartz x-cut wafers 0.063" in diameter and 0.063" thick.
- Target Plate: 4" x 4" x 1/8" 2024 - T3 Aluminum.

IMPACT TEST NO. 32
(Channel #4 and Trigger Display)
25 April 1966 - Shot #22

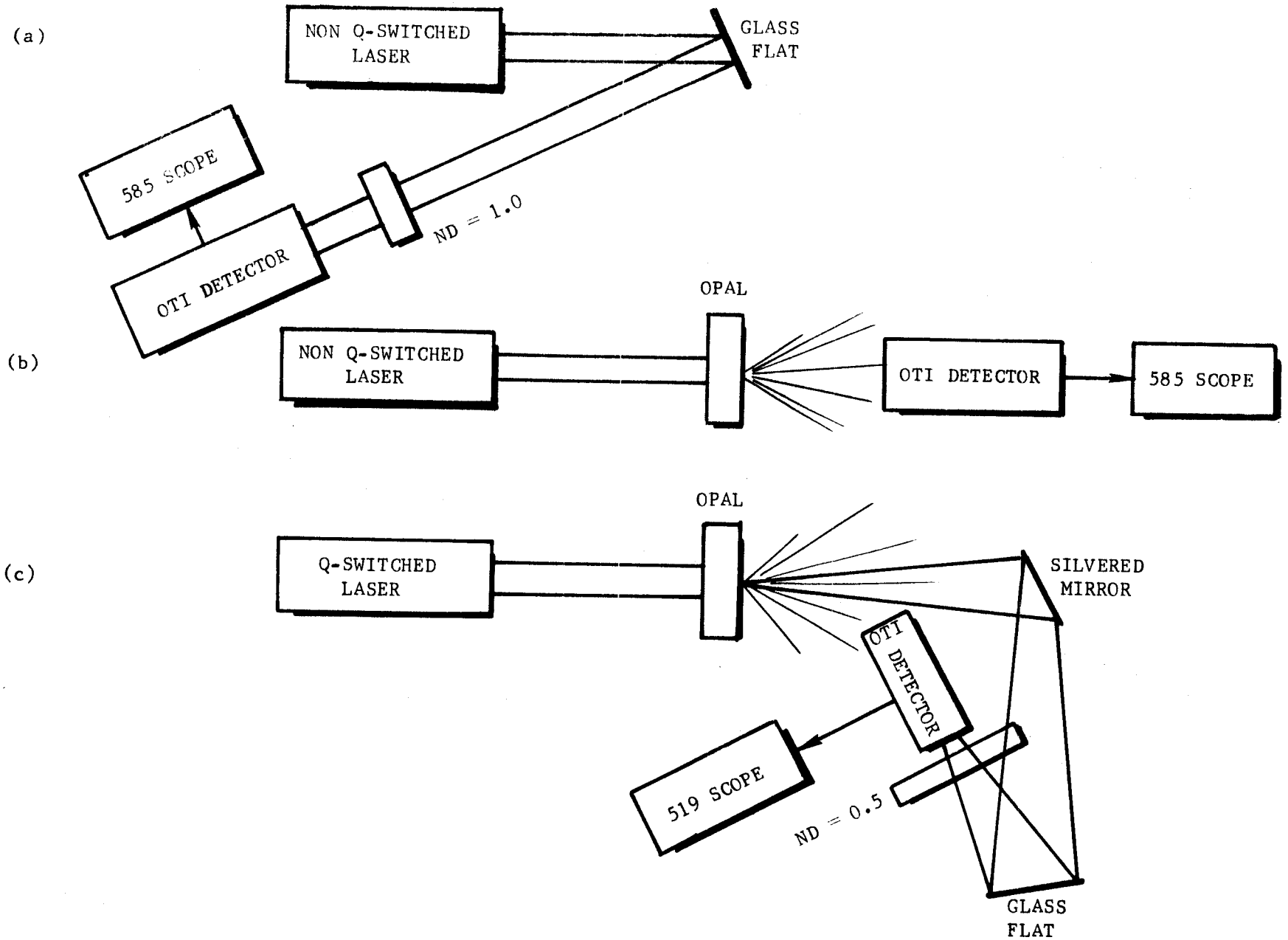
PROJECTILE: LEXAN SLUG (3.11 mg)

SECTION 3.0

LASER IMPACT SIMULATION

The design, assembly, and alignment of optical components for the laser hypervelocity impact simulator have been described in the previous quarterly reports. At the time of the last quarterly report, first attempts to Q-switch had not been successful. After anti-reflection coating of the flat face of the ruby with ¼ wavelength of magnesium fluoride, Q-switched pulses were obtained which had an average pulse width of 10 - 15 nanoseconds at half height. Delay times for the kerr cell trigger pulse and reflectivity of the external reflector were varied and as expected were not found to be extremely critical. Reflectivity of about 30% and trigger delay of 1.0 millisecond were used.

An approximate power calibration was made by using the sensitivity figure quoted by OTI for their ultra fast detector (Model 620) and pulsing the laser (non Q-switched) almost at normal incidence off of a glass flat, so as to avoid burning the filters, and then through neutral density filters to the detector. (See Fig. 3-1a). Under these conditions at room temperature, a pulse of 1 millisecond duration and 4-5 killowatts or 4 or 5 joules was obtained. Then by using an opal diffuser to scatter the laser beam and placing the detector a known distance away, the diffuse properties of the opal can be calibrated. (See Fig. 3-1b). Then the opal, in conjunction with a glass flat and a mirror, was used to reduce the Q-switched beam to a level that could be calibrated and did not saturate the detector (See Fig. 3-1c). A power level of about 30 megawatts was detected implying an average energy of about ½ joule.



LASER OUTPUT POWER CALIBRATION
FIGURE 3-1

To perform impact tests, many pulses must be fired so that the lens parameters and target material effects can be studied. After about fifty firings, the laser output was greatly reduced, which necessitated tearing down the assembly, replating the flash lamp reflectors, replacing the flash lamp, etc. After a few more firings, the kerr cell, which had leaked earlier, apparently became contaminated to an extent where Q-switching was no longer possible. After refilling with ultra purity nitrobenzene, successful operation was again maintained until internal chipping of one of the kerr cell windows took place. This is a relatively common form of deterioration, although usually occurs only with powers exceeding a couple hundred megawatts.

The bleachable cell on order for several months has not yet arrived because of liquid contamination problems yet to be solved by the manufacturer. Thus, a delay of 10 days in the laser part of the program has occurred.

Some craters have been made in various types of aluminum; usually, when close to the focal point of the system, a rather smooth crater symmetrical in shape, about 200 microns across but considerably less in depth, is obtained. An examination of the shock wave outputs were just under investigation when the latest kerr cell failure took place.

It is believed that during the next several weeks a sufficient number of simulated impact tests will be accomplished so that an adequate evaluation of the simulation program may be undertaken. All results and experimental data will be included in the final report.

SECTION 4.0

PROGRESS REVIEW AND EVALUATION

The contractual work performed by the NSL during the fourth quarter of the extended contract period consisted mostly of carrying out the scheduled hypervelocity impact tests. After careful preparations, the test programs were initiated by completing successfully the upper mass range (3.11 mg) test series of which experimental results are presented in Section 2.0. The lower range mass test series (borosilicate glass beads 20, 50 and 90 microns in diameter) is currently underway; the test results will be included in the final report.

Definite conclusions concerning the quality of obtained experimental data, and the resulting evaluation of the utilized micrometeoroid impact sensor, may only be achieved after an adequate analysis of all the data gathered; however, a preliminary analysis of the incomplete tests results to date has been carried out and seems to give the following indications:

a) The maximum peak to peak output amplitude is clearly a function of the mass and the velocity (i.e., of the momentum and the kinetic energy) of the impacted particle, as well as of the distance traversed by the stress wave from the point of impact to the recording transducer.

b) The location of the impact may be quite accurately calculated (within a small fraction of the distance between adjacent transducers which is one inch) from the differences in arrival times of the stress wave at the four transducers closest to the impact area.

c) The interfering attenuation factor may be eliminated from the equation by comparing the amplitudes and arrival times of outputs from the several transducers for any particular impact.

d) Impacting the target surface at oblique angles results in overall decreased output amplitudes but there seem to be few, if any, directional effects detectable with the employed experimental sensor design.

e) A hypervelocity impact may be differentiated from a very low velocity impact, just as from various processes acting as sources of stress wave trains such as stress-relieving mechanisms occurring in the sensor structure in consequence of, e.g., unequal thermal expansion of the various sensor components. The duration and frequency composition of the respective stress waves depend on the mode of their generation; the data presented in Section 2.0 indicate that the overall duration of the main part of a hypervelocity impact stress wave is of the order of microseconds while stress wave trains originated by the other processes span substantially longer periods of time.

f) The sensitivity of the present sensor-preamplifier combination, i.e., the S/N ratio of the instrument, seems to be high enough for impacts of projectiles with mass of 10^{-8} gram to be detected.

In summary, then, the preliminary analysis of experimental data gathered to date seems to indicate a strong dependence of the output amplitudes on the mass and velocity (hence, the momentum and kinetic energy) of the impacted projectiles. Comparing outputs from several transducers, all originated by the same impact, promises to allow elimination of the interfering factor of amplitude attenuation by wave propagation. Furthermore, differences in stress wave arrival times allow a quite accurate computation of the impact area location, relative to the position of recording transducers.

A thorough analysis of all data will be undertaken in the next few weeks and should result in discovering still other relationships between impact parameters and output waveform characteristics, as well as yielding more quantitative results.