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C9162

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1082

HYPERVELOCITY PROJECTILES
29th Partial Report

STATIC TESTS OF 3"/2/1"6 HYPERVELOCITY PROJECTILES VERSUS AIRCRAFT

FINAL Report

Task Assignment NPG-Re3b-211-2-53

Copy No. [redacted]

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NPG REPORT NO. 1082

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Twenty-ninth Partial Report

on

Hypervelocity Projectiles

- -

Final Report

on

Static Tests of 3"/2/1"6 Hypervelocity Projectiles

Versus Aircraft

Project No.: NPG-Re3b-211-2-53

Date: JAN 26 1953

Copy No.: [redacted]

No. of Pages: 7

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Static Tests of 3"/2/1"6 Hypervelocity Projectiles Versus Aircraft

PART A

SYNOPSIS

1. This test was conducted to determine the fragment velocity and blast fragment damage produced by a 3"/2/1"6 hypervelocity projectile, HBX-1 loaded, statically detonated in the proximity of an aircraft.

2. The hypervelocity projectiles detonated in the engine, fuselage (just aft of the engine), and wing panel near the fuselage joint of BTD and SB2C aircraft caused severe damage. The results for the five (5) rounds tested ranged from an immediate kill to a kill in 5 minutes. The average median fragment velocity was 3640 feet per second.

Static Tests of 3"/2/1"6 Hypervelocity Projectiles Versus Aircraft

TABLE OF CONTENTS

Static Tests of 3"/2/1"6 Hypervelocity Projectiles Versus Aircraft

PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment No. NPG-Re3b-211-2-53, reference (b).

2. REFERENCES:

a. NOL Conf ltr NP/NOL/X1-1 (3506) WG:WBR:dk Ser 02312 of 23 October 1952
b. BUORD Conf ltr Re3b-RS:mt NP9 Ser 42220 of 18 July 1952

3. OBJECT OF TEST:

This test was conducted to determine the fragment velocity and blast fragment damage produced by a 3"/2/1"6 hypervelocity projectile, HBX-1 loaded, statically detonated in the proximity of BTD and SB2C aircraft.

4. PERIOD OF TEST:

a.	Date Project Letter	23 October 1952
b.	Date Necessary Material Received	30 October 1952
c.	Date Commenced Test	25 November 1952
d.	Date Test Completed	26 November 1952

PART C

DETAILS OF TEST

5. DESCRIPTION OF ITEM UNDER TEST:

3"/2/1"6 hypervelocity projectiles, 19"25 long, 1"60 maximum outside diameter with wall thickness varying from 0"125 to 0"2. All eight (8) projectiles were loaded with HBX-1 explosive. The total weight with the modified Mk 27 nose fuze was 5.4 * .1 lbs and the explosive weight was 505 grams. Drawings of the projectile assembly and body are shown in Figures 1 and 2.

6. DESCRIPTION OF TEST EQUIPMENT:

a.	BTD aircraft	(Rounds 1, 2, and 3)
b.	SB2C aircraft	(Rounds 4 and 5)
c.	30' radius velocity arena	(Rounds 6, 7, and 8)

7. PROCEDURE:

a. Aircraft Tests:

The 5 rounds tested versus aircraft were placed with their center of gravity located approximately 6 inches inside the skin of the aircraft.

b. Velocity Tests:

Each projectile was placed vertically in the center of a 30 foot radius arena with its center 6 feet above ground level and initiated from the top by a special engineers blasting cap. Fragment velocities were obtained by the usual high speed photographic technique. The camera used was a 35mm Fastax. Fragment velocities obtained are the mean velocities over the first thirty (30) feet of travel of beam spray (polar angle 80° - 110°) fragments.

8. RESULTS AND DISCUSSION:

a. Aircraft Tests:

The 3"/2/1"6 hypervelocity projectile was very effective against the BTD and SB2C aircraft when detonated in engine, wing, and fuselage locations. The detailed damage data are listed as follows:

(1) Round 1 versus BTD engine, projectile entry at 135° from aircraft nose (0°) and 5' to rear of nose. The damage consisted of 3 cylinders broken up, 4 cylinders damaged, exhaust pipes blown out, skin around engine blown off, oil lines cut, and cable lines cut. The engine, if running, would have stopped within five (5) minutes and would have been on fire almost instantaneously. Control of the aircraft after the hit would be questionable. A photograph of this engine is shown in Figure 3.

(2) Round 2 versus BTD wing panel, nose-on attack with projectile entry normal to leading edge, into wing panel fuel cell about 1 foot outboard from panel joint on fuselage. The damage consisted of opening up the fuel cell and wing panel, and tearing of the forward spar in the vertical and horizontal plane. This spar lost all of its structural strength since the vertical tear was complete. Eight (8) fragment hits were noted in the cockpit. The panel joint to the fuselage was badly weakened. If this plane had been flying when hit, it would have lost the wing panel and caught fire, and the pilot would have been injured or dead. A photograph of the wing panel is shown in Figure 4.

(3) Round 3 versus BTD engine, projectile entry at 45° from airplane nose (0°) and 1-1/2 feet to the rear of the propeller. The damage consisted of 2 cylinders broken up, 1 cylinder damaged, 10" x 5" hole in motor block, cable lines cut, and skin around motor blown off. Damage to the operating aircraft was similar to that for Round 1. A photograph of this engine is shown in Figure 5.

(4) Round 4 versus SB2C fuselage, side on attack with entry 90° from aircraft nose (0°) and 3 feet forward of cockpit. Almost all of the instruments are in the location selected for this hit. The damage consisted of almost complete destruction of the instruments, cut cables, cut electrical leads, fuselage skin around cockpit blown off, all cockpit shielding blown off, and numerous holes in the cockpit seat. The immediate result of this type of hit on a SB2C in flight would be loss of control and a dead pilot. The chance of a fire is not considered great. A photograph of the SB2C fuselage is shown in Figure 6.

(5) Round 5 versus SB2C engine, projectile entry at 90° from aircraft nose (0°) and 3 feet to the rear of the propeller. The damage consisted of skin around the engine blown off, cables cut, exhaust pipes blown off, and two (2) damaged cylinder heads. This plane if hit in flight would probably have caught fire and remained operable for about 5 minutes. A photograph of this engine is shown in Figure 7.

b. Fragment Velocity Tests:

Detailed fragment velocity data are listed in Table I. The results are summarized as follows:

Round No.	Median Fragment Velocity (ft./sec.)
6	3610
7	3620
8	3680
3 round average	3640

PART D

CONCLUSIONS

9. It is concluded that:

a. The hypervelocity projectiles detonated in the engine, fuselage (just aft of the engine), and wing panel near the fuselage joint of the BTD and SB2C aircraft caused severe damage. The results for the five (5) rounds tested ranged from an immediate kill to a kill in 5 minutes.

b. The projectile has an average median fragment velocity of 3640 feet per second.

Static Test of 3"/2/1"6 Hypervelocity Projectiles Versus Aircraft

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Detailed fragment velocity data are listed in Table I. The results are summarized as follows:

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b. The projectile has an average median fragment velocity of 3640 feet per second.

Static Tests of 3"/2/1"6 Hypervelocity Projectiles Versus Aircraft

The tests upon which this report is based were conducted by:
V. PHILIPCHUK, Firing Director
Fragmentation Division
Terminal Ballistics Department

This report was prepared by:
V. PHILIPCHUK, Firing Director
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Terminal Ballistics Department
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Terminal Ballistics Officer
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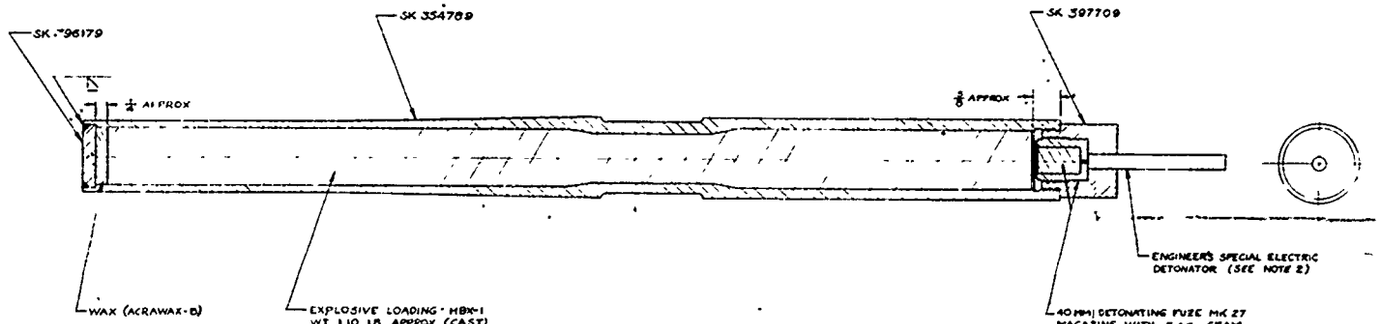
C. C. BRAMBLE, Director of Research, Ordnance Group

APPROVED: J. F. BRYNE
Captain, USN
Commander, Naval Proving Ground

E. A. RUCKNER
Captain, USN
Ordnance Officer
By direction

NOTES:

1. COAT INTERIOR SURFACES WITH CAVITY PAINT (SPEC. JAN-P-450) PRIOR TO EXPLOSIVE LOADING.
2. ASSEMBLE DETONATOR IN HOLDER AS FINAL STEP IN FIELD INSTALLATION, HOLD WITH TAPE AS REQUIRED
3. BOOSTER MAGAZINE POSITION IN HOLDER SHOULD BE ADJUSTED TO BRING BOOSTER IN CONTACT WITH EXPLOSIVE CHARGE.



SCALE: DIAGRAMATIC DESIGNATION: ROUND

ASSEMBLY

SK 35

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REVISIONS			
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NOTES:
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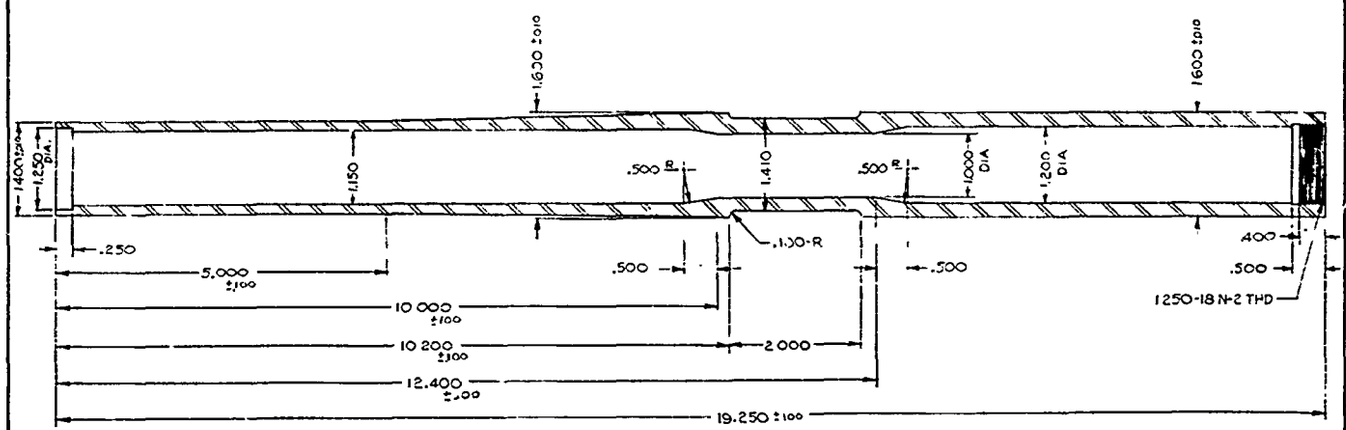
2. HEAT TREAT TO R_c 35-45. SCALING TO BE HELD TO A MINIMUM



SK-354789

REFERENCE ONLY

14 OCT 1952

[redacted]

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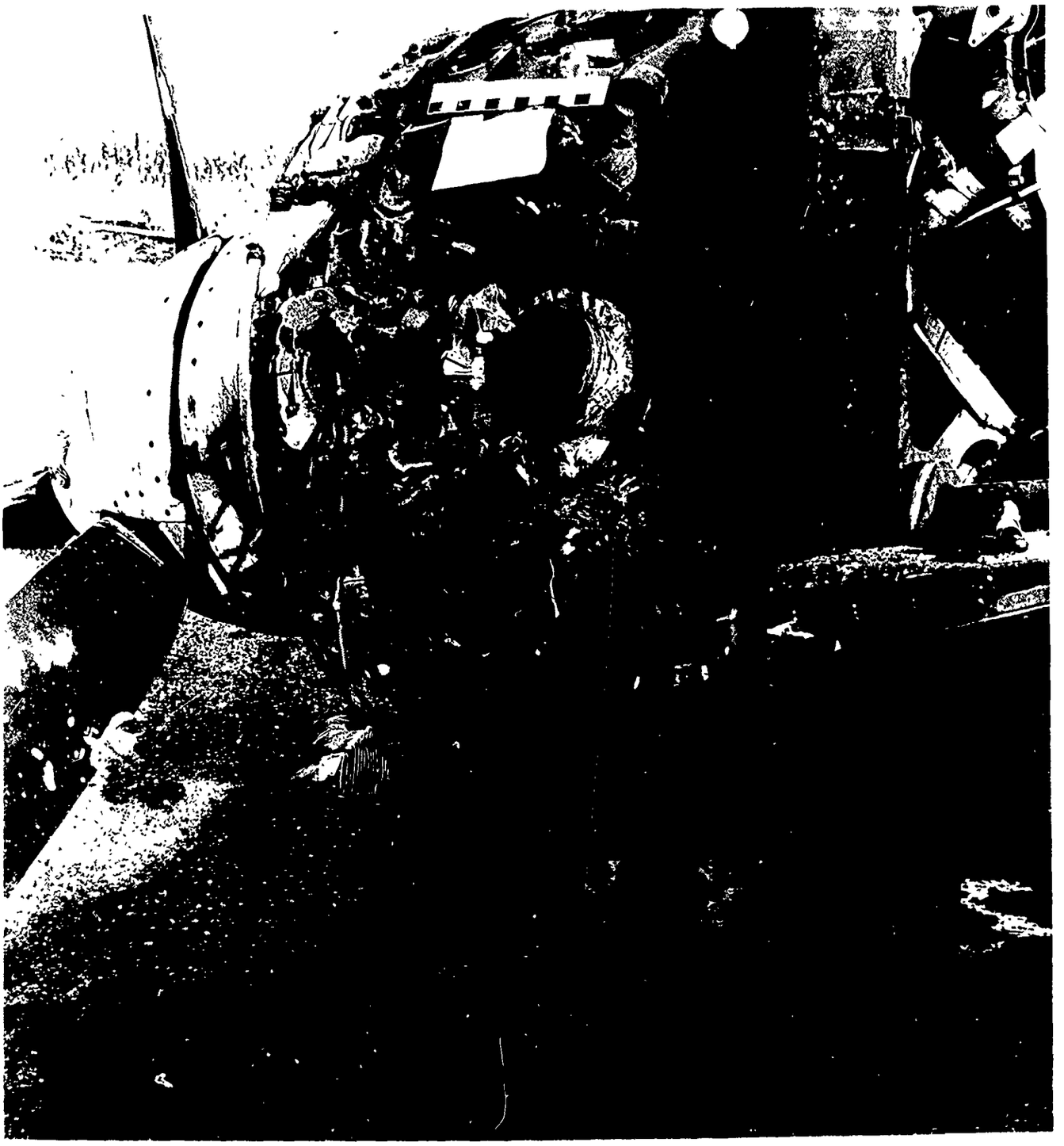

NP9-51821 25 November 1952
Round 1, 3"/2/1"6 Projectile versus BTD Engine.

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Figure 3

NP9-51822

25 November 1952

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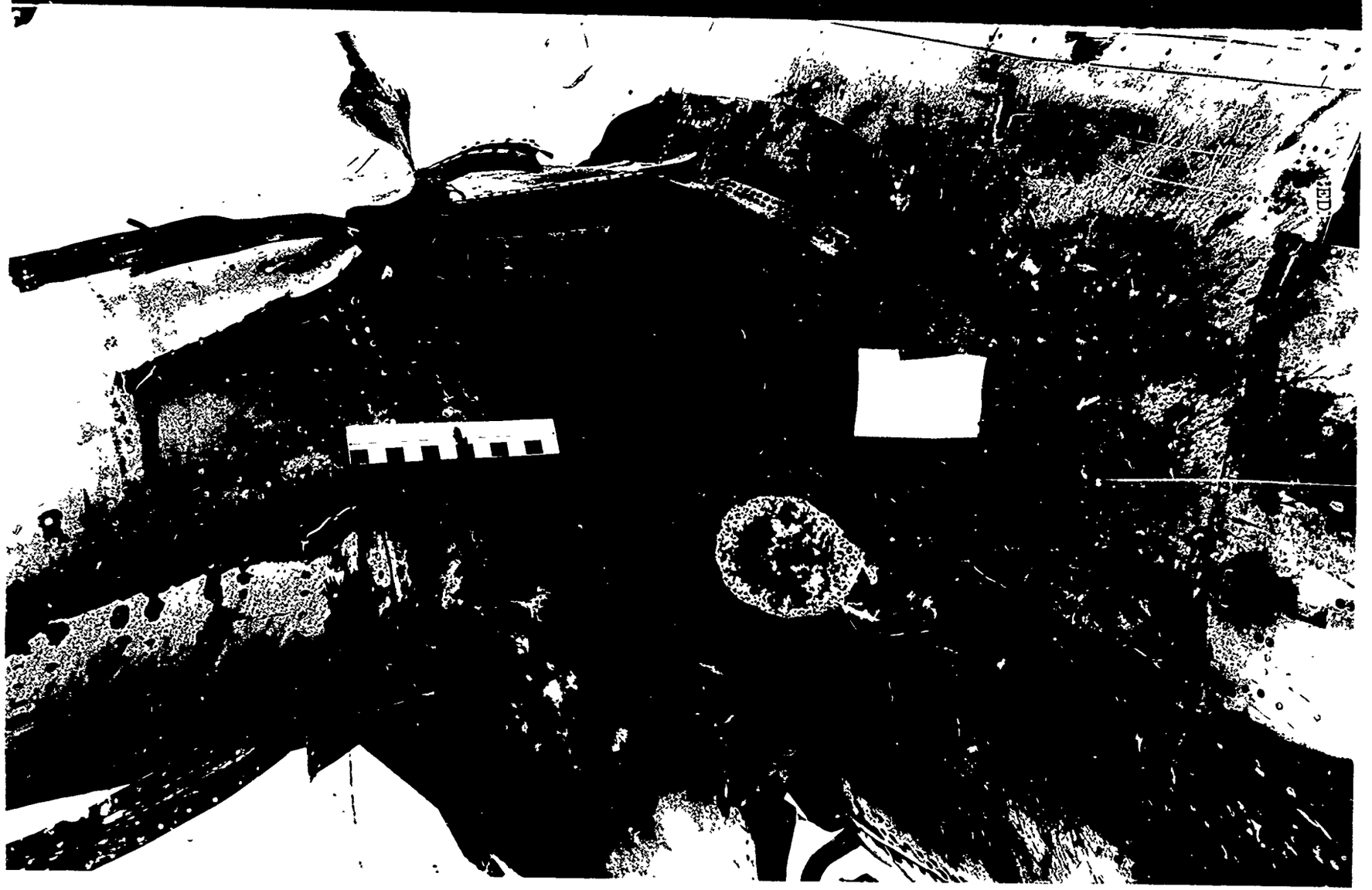
Round 2, 3"/2/1"6 Projectile versus BTD Wing Panel

FIGURE 4



NP9-51823 25 November 1952

Round 3, 3"/2/1"6 Projectile versus BTD Engine.

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Figure 5

NP9-51824

25 November 1952

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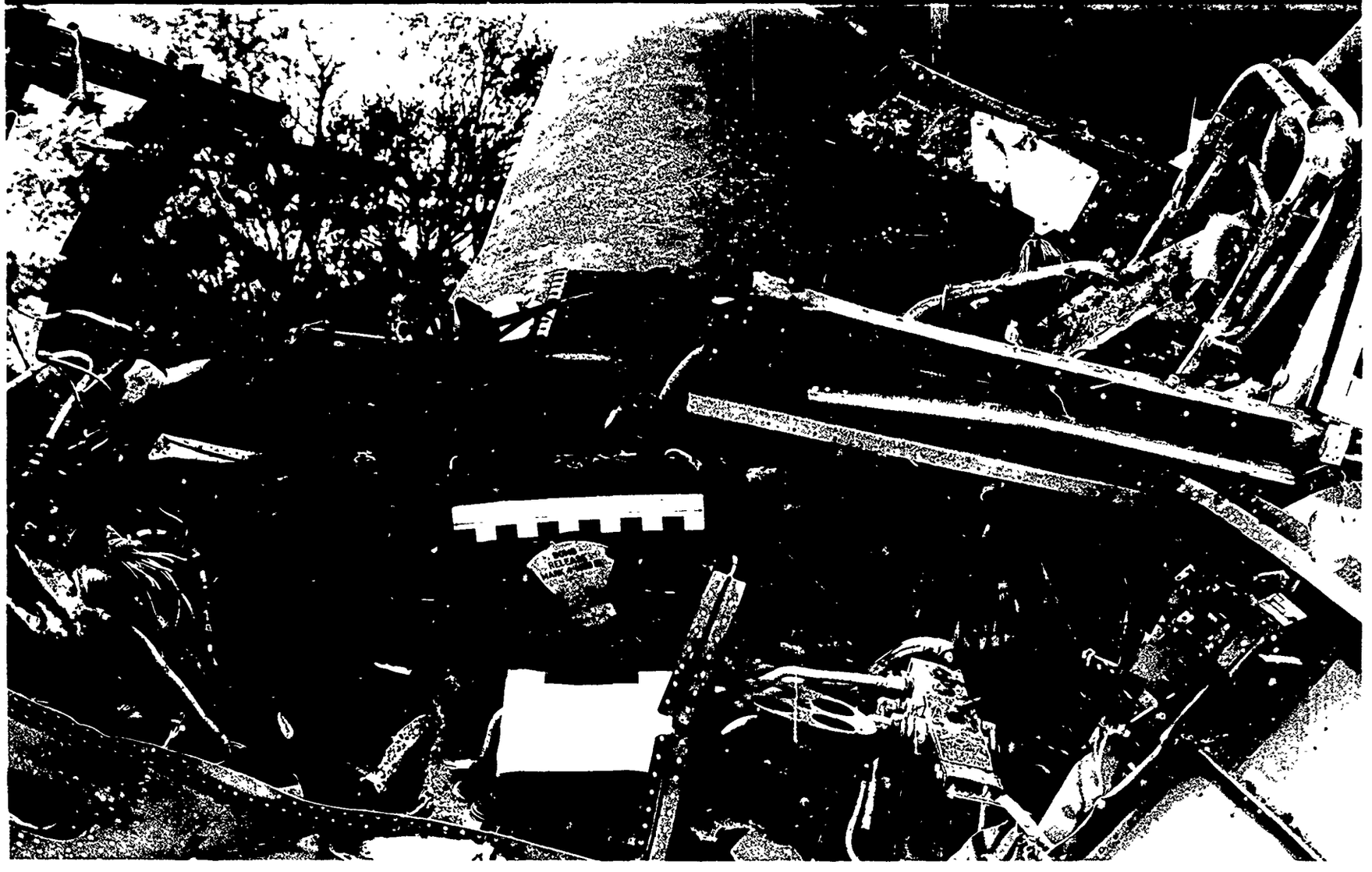
Round 4, 3"/12 Projectile versus SB2C Fuselage forward of cockpit.
FIGURE 6



NP9-51825 25 November 1952 CONFIDENTIAL
Round 5, 3"/2/1"6 Projectile versus SB2C Engine. SECURITY INFORMATION
Figure 7

Static Tests of 3"/2/1"6 Hypervelocity Projectiles Versus Aircraft

TABLE I

FRAGMENT VELOCITY DATA

30 Ft. Radius Arena — Date Fired: 11/26/52

35mm Fastax Camera — 3150 Frames per sec.

Rd. 6 3"/2/1"6 Hypervelocity Proj. — Filler: HBX-1

Total Weight: 5.4 lbs. — Filler Weight: 505 gms.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
22	3	4300
23	7	4110
24	4	3940
25	10	3780
26	4	3630
27	6	3500
28	9	3380
29	8	3260
30	5	3150
31	1	3050
32	2	2950
34	2	2780
Median		3610
Average		3570

Static Tests of 3"2/1"6 Hypervelocity Projectiles Versus Aircraft

TABLE I (Continued)

30 Ft. Radius Arena — Date Fired: 11/26/52

35mm Fastax Camera — 3100 Frames per sec.

Rd. 7 3"2/1"6 Hypervelocity Proj. — Filler: HBX-1

Total Weight: 5.4 lbs. — Filler Weight: 505 gms.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
21	2	4430
22	1	4230
23	8	4040
24	9	3880
25	10	3720
26	5	3580
27	7	3440
28	8	3320
29	8	3210
30	6	3100
31	1	3000
32	2	2910
Median		3620
Average		3570

Static Tests of 3"2/1"6 Hypervelocity Projectiles Versus Aircraft

TABLE I (Continued)

30 Ft. Radius Arena — Date Fired: 11/26/52

35mm Fastax Camera — 3100 Frames per sec.

Rd. 8 3"2/1"6 Hypervelocity Proj. — Filler: HBX-1

Total Weight: 5.4 lbs. — Filler Weight: 505 gms.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
21	3	4430
22	8	4230
23	7	4040
24	8	3880
25	6	3720
26	10	3580
27	5	3440
28	7	3320
29	6	3210
30	5	3100
31	4	3000
33	2	2820
Median		3680
Average		3630

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