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U S NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO 1049

TESTING OF WARHEADS FOR AIR TARGET GUIDED MISSILES

54th Partial Report

FRAGMENTATION TEST OF WARHEADS NO. 136

FINAL Report

Task Assignment NPG-Re3f-607-1-52

Copy No. 14

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NPG REPORT NO. 1049

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Fifty-Fourth Partial Report

on

Testing of

Warheads for Air Target Guided Missiles

Final Report

on

Fragmentation Test of Warheads No. 136

Project No.: NPG-Re3f-607-1-52
Copy No. 14
Nos of Pages: 7

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OCT 6 1952

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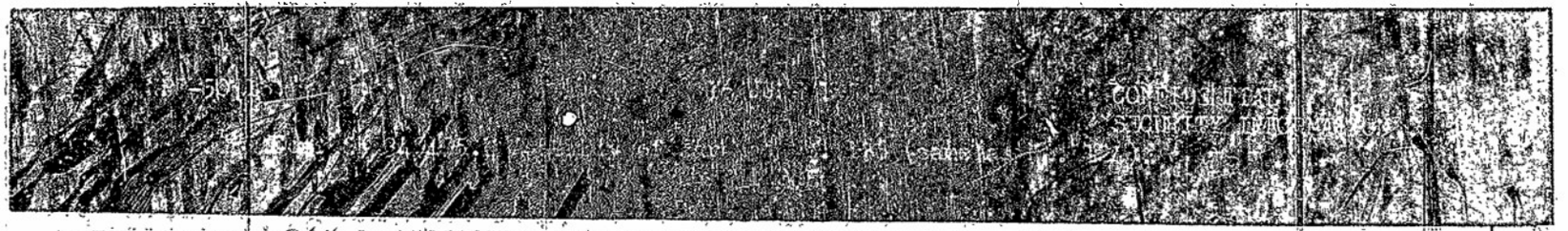

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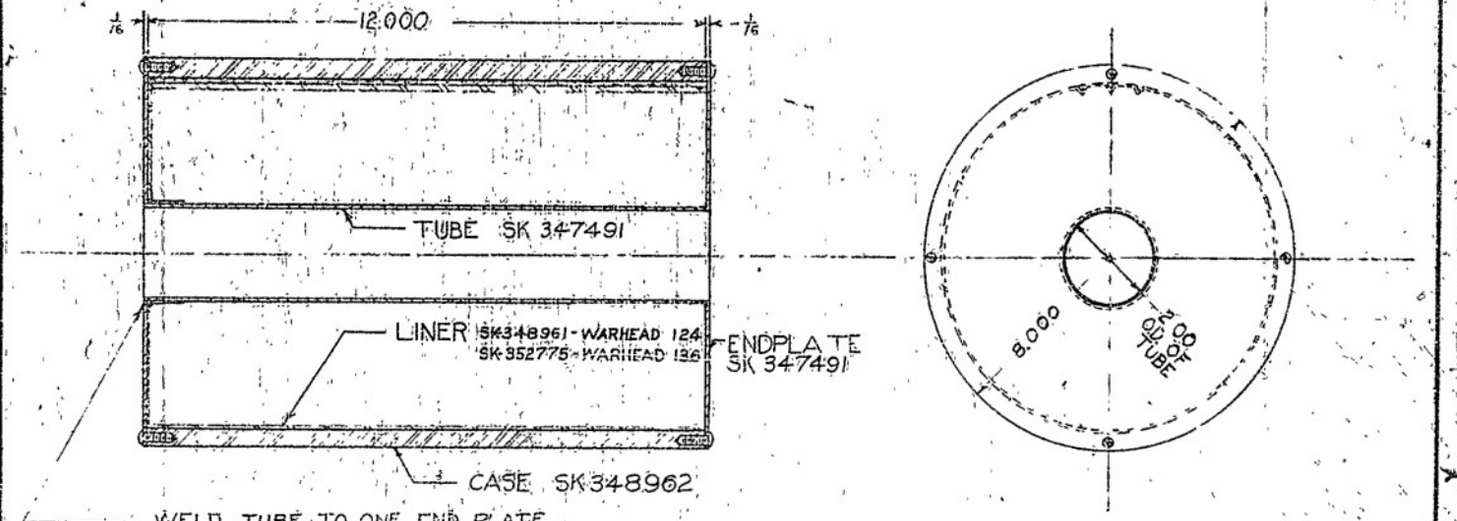

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136

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WHITE OAK
SILVER SPRING 19, MARYLAND

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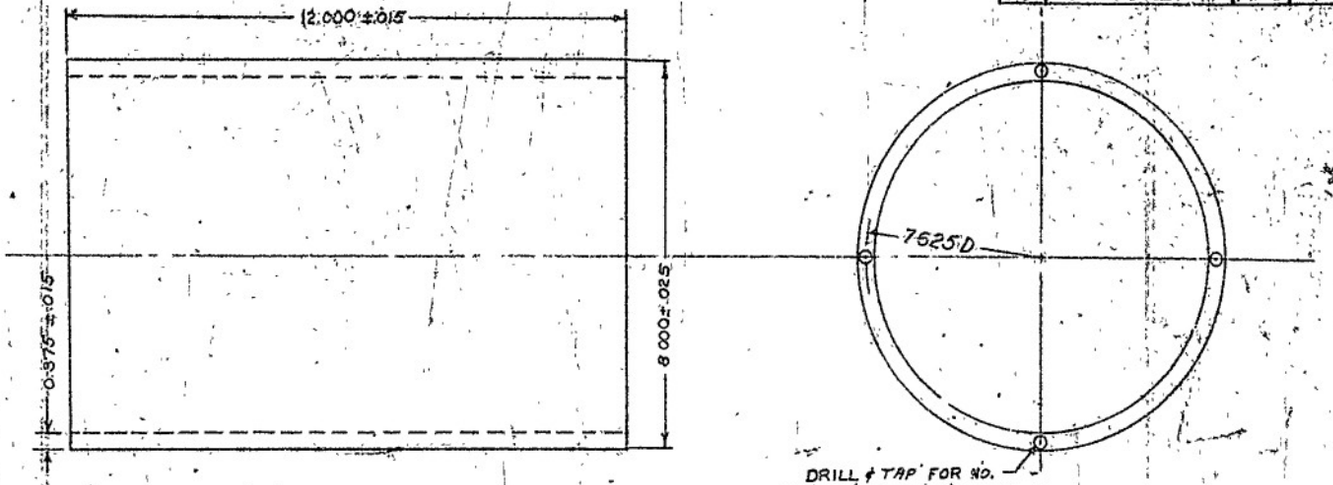

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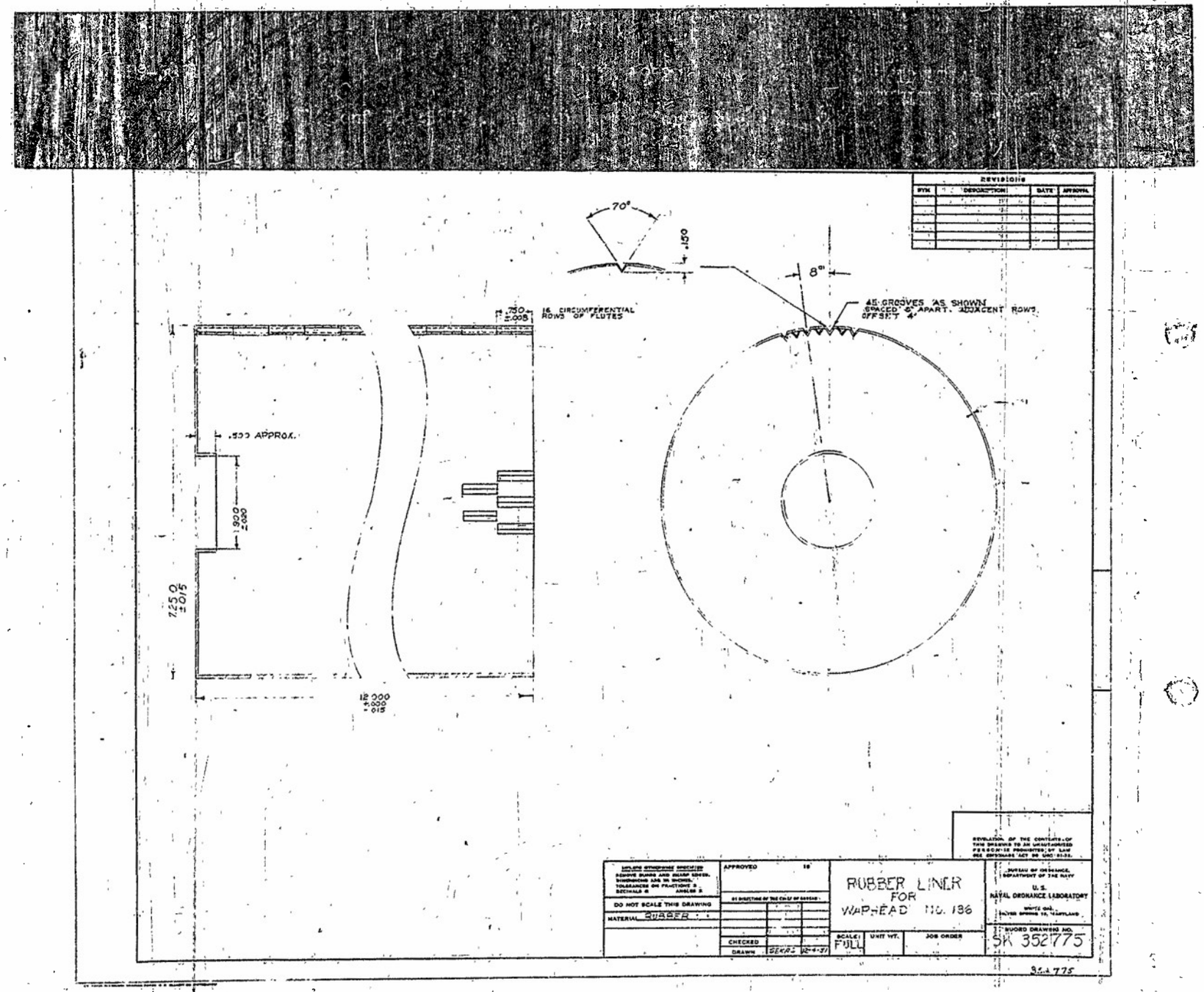
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16 JUN

Water Pit Set-up for EICU:

Ades No. 127

TPP-50019

FROM TO 1660

N.P.G. 49526

NOL WARHEADS NO. 136.

	ROUND 1	ROUND 2	ROUND 3
0 - 5/8 Gms.			
PCS.			
195 Gms.	212		200
5/8 - 1¼ Gms.			
162 PCS.	187		187
127 Gms.	158		152
1¼ - 2½ Gms.			
104 PCS.	150		152
176 Gms.	250		159
2½ - 5 Gms.			
57 PCS.	109		101
196 Gms.	371		342
5 - 10 Gms.			
65 PCS.	74		85
464 Gms.	508		562
10 - 20 Gms.			
44 PCS.	34		34
614 Gms.	484		457
20 - 40 Gms.			
15 PCS.	12		7
375 Gms.	311		176
40 - 80 Gms.			
3 PCS.	2		
174 Gms.	96		

SCALE 1"

TABLE I

MASS DISTRIBUTION DATA

Fragmentation of Warheads No. 136; Composition B Loaded

			NUMBER AND WEIGHT OF RECOVERED FRAGMENTS																		
			0-0.625 grams		0.625-1.25 grams		1.25-2.5 grams		2.5-5 grams		5-10 grams		10-20 grams		20-40 grams		40-80 grams		Total		Photo
Rd. No.	Comp. Wt. lb.	Filler Wt. lb.	Wt. gms.	No.	Wt. gms.	No.	Wt. gms.	No.	Wt. gms.	No.	Wt. gms.	No.	Wt. gms.	No.	Wt. gms.	No.	Wt. gms.	No.	Wt. gms.	Frag-ments	No. NP9
1	59.75	26.34	185	-	127	162	176	104	196	57	464	65	614	44	375	15	176	3	2313	450	49526
2	59.85	26.20	212	-	158	187	250	150	371	109	508	74	484	34	311	12	96	2	2390	568	49526
3	59.93	26.27	200	-	152	187	159	152	342	101	562	85	457	34	176	7	-	-	2048	566	49526

Fragmentation Test of Warheads No. 136

TABLE II

FRAGMENT VELOCITY DATA

Water Pit

40 Ft. Radius Arena — Date Fired: 16 June 1952

35mm Fastax Camera #1 — 3060 frames per sec.

Rd. 1, Warhead No. 136 — Filler: Comp. B

Total Weight: 59.75 Lbs. — Filler Weight: 26.34 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
21	8	5830
22	10	5560
23	7	5320
24	7	5100
25	4	4900
26	2	4710
27	5	4530
28	1	4370
Median		5400
Average		5260

Fragmentation Test of Warheads No. 136

TABLE II (Continued)

Water Pit

40 Ft. Radius Arena

35mm Fastax Camera #2

Rd. 1, Warhead No. 136

Total Weight: 59.75 Lbs.

Date Fired: 16 June 1952

3060 frames per sec.

Filler: Comp. B

Filler Weight: 26.34 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
21	8	5830
22	9	5560
23	7	5320
24	6	5100
25	5	4900
26	2	4710
27	3	4530
28	1	4370
Median		5420
Average		5280

Fragmentation Test of Warheads No. 136

TABLE III

FRAGMENT VELOCITY DATA

Water Pit

40 Ft. Radius Arena — Date Fired: 18 June 1952

35mm Fastax Camera #1 — 3090 frames per sec.

Rd. 2, Warhead No. 136 — Filler: Comp. B

Total Weight: 59.85 Lbs. — Filler Weight: 26.20 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
20	1	6180
21	8	5890
22	5	5620
23	8	5370
24	6	5150
25	3	4940
26	2	4750
27	1	4580
29	2	4260
Median		5500
Average		5350

Fragmentation Test of Warheads No. 136

TABLE III (Continued)

Water Pit

40 Ft. Radius Arena — Date Fired: 18 June 1952

35mm Fastax Camera #2 — 3060 frames per sec.

Rd. 2, Warhead No. 136 — Filler: Comp. B

Total Weight: 59.85 Lbs. — Filler Weight: 26.20 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
20	1	6120
21	8	5830
22	6	5560
23	10	5320
24	6	5100
25	4	4900
26	2	4710
27	1	4530
28	1	4370
29	1	4220
Median		5460
Average		5300

Fragmentation Test of Warheads No. 136

TABLE IV

FRAGMENT VELOCITY DATA

Water Pit

40 Ft. Radius Arena — Date Fired: 23 June 1952

35mm Fastax Camera #1 — 3060 frames per sec.

Rd. 3, Warhead No. 136 — Filler: Comp. B

Total Weight: 59.93 Lbs. — Filler Weight: 26.27 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
20	1	6120
21	8	5830
22	8	5560
23	4	5320
24	4	5100
25	2	4900
26	1	4710
27	1	4530
30	1	4080
31	1	3950
Median		5550
Average		5350

Fragmentation Test of Warheads No. 136

TABLE IV (Continued)

Water Pit

40 Ft. Radius Arena — Date Fired: 23 June 1952

35mm Fastax Camera #2 — 3060 frames per sec.

Rd. 3, Warhead No. 136 — Filler: Comp. B

Total Weight: 59.93 Lbs. — Filler Weight: 26.27 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
20	3	6120
21	9	5830
22	7	5560
23	4	5320
24	2	5100
25	2	4900
26	2	4710
27	1	4530
29	1	4220
31	1	3950
Median		5610
Average		5410

Fragmentation Test of Warheads No. 136

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Fragmentation Test of Warheads No. 136

PART A

SYNOPSIS

1. This test was conducted to obtain the fragmentation characteristics of 8" diameter Warheads No. 136, equipped with fluted rubber liners, designed to produce 720 controlled size fragments, 1/2" x 3/4" x 3/8", weighing approximately 18 grams each. Three booster positions were used (Round 1 with booster at the extreme end of the warhead; Round 2 with the booster 2-1/2" from the end of the warhead; and Round 3 with the booster in the center of the warhead) to determine the effect of booster location on case breakup.

2. a. The rubber liners proved unsuccessful in producing controlled fragmentation of the warheads.

b. Changing the booster position had little effect on fragment breakup.

c. Fragment velocities were in the order of 5500 ft./sec.

TABLE OF CONTENTS

Fragmentation Test of Warheads No. 136

PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3f-607-1-52, reference (b).

2. REFERENCES:

a. NOL Conf Work Request WG/14/52 of 26 Feb 1952
b. BUORD Conf ltr NP9 Re3f:EJHL:edb Ser 25777 of 18 Sep 1951
c. NMD Conf ltr to BUORD (Gt3) WFS:jac X24/XO Ser 0216 of 6 Jun 1952

3. BACKGROUND:

a. Reference (b) authorized the Naval Proving Ground to work directly with the Naval Ordnance Laboratory in the development and testing of warheads for guided missiles.

b. Reference (a) requested the Proving Ground to fragment three Warheads No. 136 for mass distribution and fragment velocities.

4. OBJECT OF TEST:

This test was conducted to obtain the fragmentation characteristics of 8" diameter Warheads No. 136, equipped with fluted rubber liners, designed to produce 720 controlled size fragments, 1/2" x 3/4" x 3/8", weighing approximately 18 grams each. Three booster positions were used (Round 1 with booster at the extreme end of the warhead; Round 2 with the booster 2-1/2" from the end of the warhead; and Round 3 with the booster in the center of the warhead) to determine the effect of booster location on case breakup.

5. PERIOD OF TEST:

a.	Date Project Letter	26 February 1952
b.	Date Necessary Material Received	22 May 1952
c.	Date Commenced Test	16 June 1952
d.	Date Test Completed	23 June 1952

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEM UNDER TEST:

a. Warheads No. 136 are 8"00 in outside diameter, 12"00 in length, and 0"375 in wall thickness with a 2"00 O.D. central tube, and have rubber liners with staggered flutes which are intended to produce 720 controlled size fragments. Each fragment is intended to be 0"50 x 0"75 x 0"375 and weigh 18 grams. There are 45 flutes spaced 8° apart located around the periphery of the liner, constituting one row. The entire liner is composed of 16 circumferential rows of such flutes in which the adjacent rows are offset 4°, reference (c).

b. Three warheads were Composition B loaded at the Naval Mine Depot. The warhead weights are as follows:

Rd. No.	Comp. B Wt. (lbs.)	Weight of Liner (lbs.)	Empty Wt. (lbs.)	Total Wt. (lbs.)
1	26.34	0.45	32.96	59.75
2	26.20	0.57	33.08	59.85
3	26.27	0.50	33.16	59.93

Radiographic analysis (at the Mine Depot) showed that the liner in case No. 3 (Round 3) might have been pulled slightly away from the case. Warhead drawings are shown in Figures 1-3.

7. PROCEDURE:

a. Each warhead was suspended over the water pit in a horizontal position with the nose pointing towards 0°. Fragments recovered in the water pit represent 1/6 of the fragments expected in the total polar angle zone 60°-120°. Vertical steel panels 20 feet high and in polar angle zone 77°-103° were placed at 40 feet from the warhead. The detonation and the fragment flashes on the panels were recorded by two high speed 35mm Fastax cameras, and the fragment velocities were computed from the film data. A photograph of the field setup is shown in Figure 4.

b. Initiation was accomplished by means of a No. 6 blasting cap and a 70 gram tetryl booster (1"825 O.D. x 1"00 thick) placed in the central conduit. To study effect of booster positions on case breakup, the booster was placed at the extreme end of the warhead for Round 1, the center of the booster was 3" from the end of the warhead for Round 2, and the booster was placed in the center of the warhead for Round 3.

8. RESULTS AND DISCUSSION:

a. Detailed mass distribution data are listed in Table I. A photograph of the recovered fragments is shown in Figure 5. The rubber liner was unsuccessful in producing fragments of design size. Of the nearly 720 fragments of design size (weighing 18 grams each), 120 (or one-sixth of the total) were expected in the water pit. In the three rounds fired only from one-fourth to one-third of the fragments approached design size (10-20 gram weight group). The number of these fragments is as as follows:

	No. Fragments Recovered Zone 60° - 120°		
Weight Group	Rd. No. 1	Rd. No. 2	Rd. No. 3
10-20 grams	44	34	34

The case breakup varied only slightly from that expected in uncontrolled fragmentation, and the booster location appeared to have little effect.

b. Fragment velocities are given in Tables II through IV and are summarized as follows:

	Average Median Fragment Velocities
Rd. 1	5410 ft./sec.
Rd. 2	5480 ft./sec.
Rd. 3	5580 ft./sec.

PART D

CONCLUSIONS

9. a. The rubber liners proved unsuccessful in producing controlled fragmentation of the Warheads No. 136.

b. Changing the booster position had little effect on fragment breakup.

c. Fragment velocities were in the order of 5500 ft./sec.

Fragmentation Test of Warheads No. 136

The tests upon which this report is based were conducted by:
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