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AUTHORITY
28 Feb 1965, DoDD 5200.10; USNSWC ltr, 4 Mar 1976

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[redacted]

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1083

TESTING OF WARHEADS FOR AIR TARGET GUIDED MISSILES

60th Partial Report

FRAGMENTATION OF DOUBLE SLEEVE WARHEAD NO. 141

FINAL Report

Task Assignment NPG-Re3f-607-1-53

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Fragmentation of Double Sleeve Warhead No. 141

- -

PART A

SYNOPSIS

1. This test was conducted to determine the fragmentation characteristics of double sleeve Warhead No. 141 and ascertain the effect of a 0.208 air gap between sleeves on fragment velocity.

2. a. Warhead No. 141 produced:

(1) 1547 fragments weighing over 5/8 grams.

(2) 516 effective fragments in polar zone 75° - 100°.

(3) An average median fragment velocity of 3200 ft/sec.

b. The 0.208 air gap between the warhead sleeves was responsible for a fragment velocity loss of about 600 ft/sec.

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PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3f-607-1-53, reference (b).

2. REFERENCES:

a. NOL Conf Work Request No. WG/25/53 of 3 Nov 1952
b. BUORD Conf ltr NP9 Re3f:EKJ:gg Ser 42699 of 29 Jul 1952
c. NPG Conf Report No. 904 of 21 Jan 1952
d. NPG Conf Report No. 815 of 14 Jul 1951

3. BACKGROUND:

The Warhead for the Angled Arrow Projectile has a double sleeve construction with the air gap between sleeves containing rocket propellant. A model of this type of warhead was constructed, No. 141, to obtain data on the effect of the air gap on fragmentation. Reference (c) reported double sleeve warhead data in which the sleeves were of thin aluminum and the air gap was filled with water.

4. OBJECT OF TEST:

This test was conducted to determine the fragmentation characteristics of double sleeve warhead No. 141 and ascertain the effect of a 0.208 air gap between sleeves on fragment velocity.

5. PERIOD OF TEST:

a.	Date Project Letter	3 November 1952
b.	Date Necessary Material Received	18 November 1952
c.	Date Commenced Test	24 November 1952
d.	Date Test Completed	11 December 1952

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEM UNDER TEST:

Warhead No. 141, Figure 1, 8.00 long, 3.75 outside diameter, had a double concentric sleeve construction with a 0.200 thick inner sleeve, a 0.192 thick outer sleeve, and a 0.208 air gap separating the sleeves. The inside 2.55 diameter was fully loaded with Composition C-3 explosive at the Naval Proving Ground. One end of the warhead had a 1/8" thick end plate secured by screws to the warhead and the other end was open. The warhead and explosive weights are as follows:

Warhead No.	Empty Wt. (lbs)	Comp C-3 Wt (lbs)	Total Wt (lbs)
141-1	9.38	2.34	11.72
141-2	9.32	2.36	11.68
141-3	9.32	2.36	11.68
141-4	9.38	2.35	11.73

7. PROCEDURE:

a. Warheads Nos. 141-1 and 141-2 were detonated in a sawdust filled chamber for fragment mass distribution determinations. After each detonation, the sawdust was sifted and the fragments recovered by the use of sieves and a magnetic separator.

b. Warheads Nos. 141-3 and 141-4 were detonated, for space and velocity data, in a horizontal position in the center of a 30 foot radius semi-circular space arena which consisted of 5' high panels of 1/8" thick mild steel. The arena was marked off in 5° polar angle zones with the open end of the warhead pointed toward 0°. Opposite the arena were 10' high velocity plates, covering the polar angle zone from 80° to 120°, at 30' from the detonation. One 35mm Fastax camera, viewing these plates, recorded the detonation and fragment flashes on the plates from which the fragment velocities were computed.

8. RESULTS AND DISCUSSION:

a. Fragment Mass Distribution:

Since Warhead No. 141-1 detonated low order in the chamber, the test was repeated with Warhead No. 141-2. Detailed data and fragments are shown in Figures 2 and 3. The fragment numbers and weights for Warhead No. 141-2 are as follows:

Fragment Wt Group (grams)	No. Fragments	Total Wt (grams)
0 - 5/8	--	752
5/8 - 1-1/4	663	575
1-1/4 - 2-1/2	488	835
2-1/2 - 5	286	986
5 - 10	100	670
10 - 20	10	120

b. Fragment Space Distribution:

The average number of effective fragment hits, those capable of penetrating 1/8" mild steel, obtained from two warheads are as follows:

Polar Angle Zone	Average hits per total zone
0 - 75°	0
75° - 100°	516
100° - 170°	0
170° - 180°	*14

* End plate fragments

Detailed data by 5° zones are listed in Table I.

c. Fragment Velocity Data:

Although the velocity plates were in zone 80° - 120°, the only hits recorded were in zone 80° - 100° and the average median fragment velocity was 3200 feet per second. Detailed velocity data are listed in Table II. In order to determine the effect of the air gap between sleeves on fragment velocity, data in references (c) and (d) were used in obtaining a Gurney constant for

Composition C-3 loaded plain sleeve cylinders. The velocitics used were average median velocities measured over standard base lines. A Gurney constant of 7600 was obtained and using this value, a single sleeve warhead having a wall thickness equal to that of the double sleeve Warhead No. 141 would produce an average median fragment velocity of 3800 ft./sec. Therefore, the air gap in Warhead No. 141 was responsible for a velocity loss of about 600 ft./sec.

PART D

CONCLUSIONS

9. a. Warhead No. 141 produced:

(1) 1547 fragments weighing over 5/8 grams.

(2) 516 effective fragments in polar zone 75° - 100°.

(3) An average median fragment velocity of 3200 ft./sec.

b. The OY208 air gap between the warhead sleeves was responsible for a fragment velocity loss of about 600 ft./sec.

Fragmentation of Double Sleeve Warhead No. 141

The tests upon which this report is based were conducted by:
A. N. HUGHES, Lieutenant,
Fragmentation Firing Officer
Fragmentation Division,
Terminal Ballistics Department

This report was prepared by:
V. PHILIPCHUK, Fragmentation Battery Officer
Fragmentation Division,
Terminal Ballistics Department

This report was reviewed by:
R. H. LYDDANE, Director of Research
Terminal Ballistics Department
E. L. LEVSTIK, Lieutenant Commander, USNR
Terminal Ballistics Batteries Officer
Terminal Ballistics Department
W. B. ROBERTSON, Lieutenant Commander, USN
Terminal Ballistics Officer
Terminal Ballistics Department
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

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NPG REPORT NO. 1083

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Sixtieth Partial Report

on

Testing of

Warheads for Air Target Guided Missiles

- -

Final Report

on

Fragmentation of Double Sleeve

Warhead No. 141

Project No.: NPG-Re3f-607-1-53
Copy No.: 12
No. of Pages: 7

Date: FEB 10 1953

CONFIDENTIAL
SECURITY INFORMATION

184

24 November 1952

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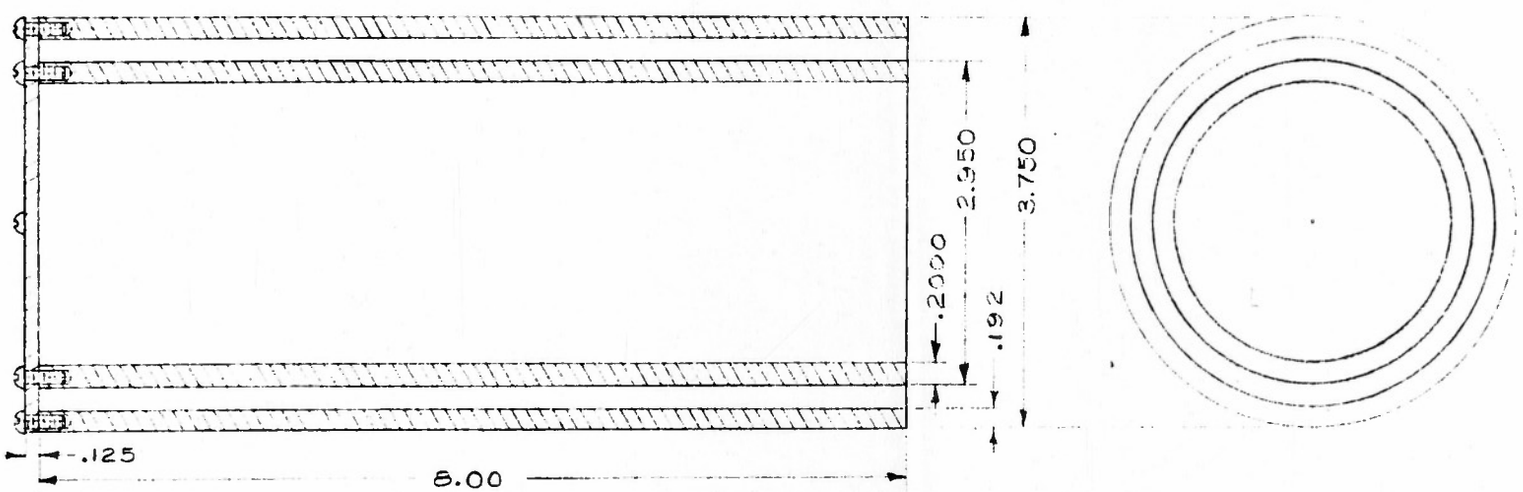
OD Drawing No. SK 397832. Warhead No. 141.

FIGURE 1

SK 397832

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



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WARHEAD 141

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SILVER SPRING 19, MARYLAND

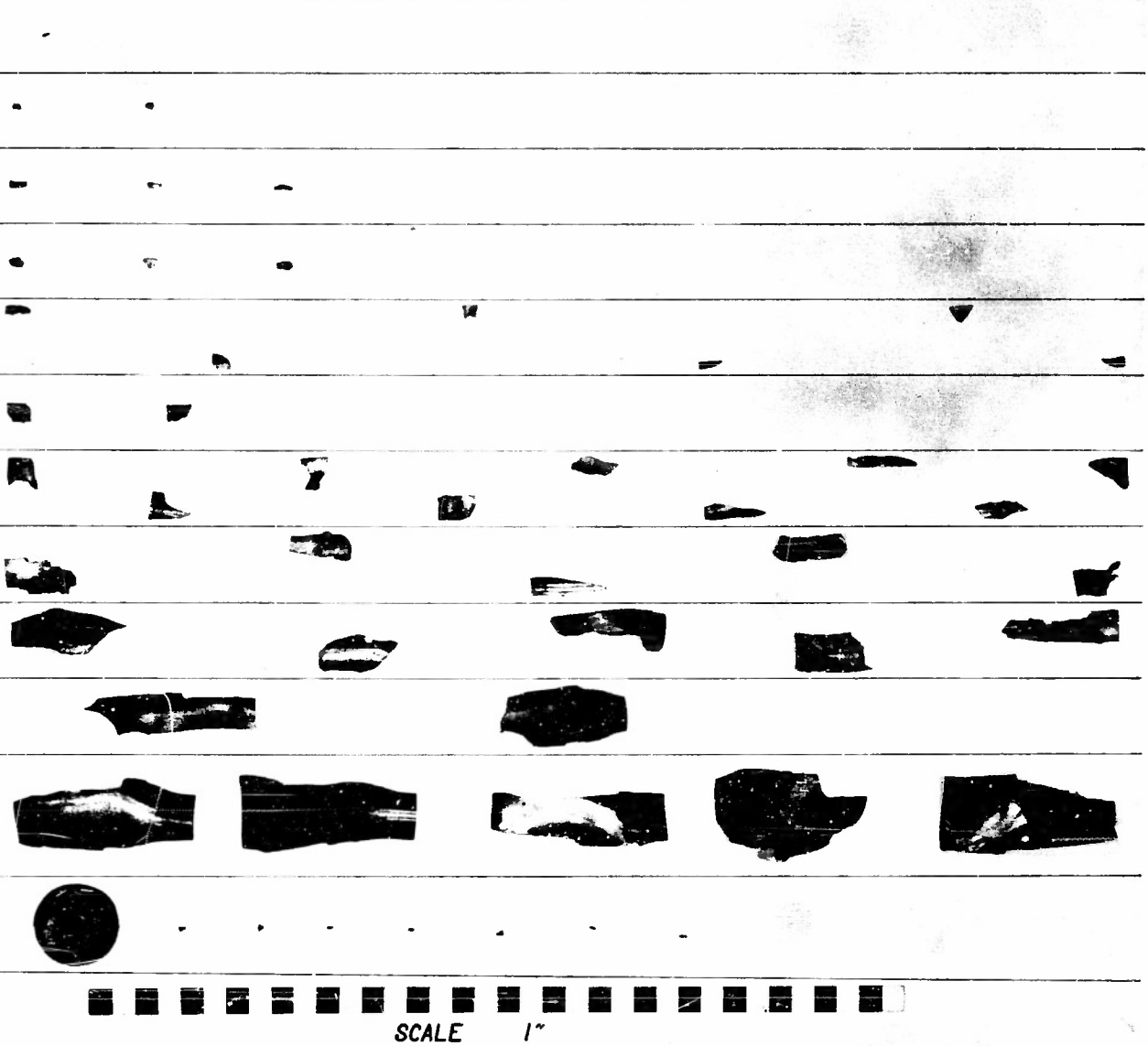
SUORD DRAWING NO.
SK 397832

DRAWING SHEET FRNC NO. 5361 B REV 12-51

FRAG NO. 1691 [redacted] NP 51699

NOL WARHEAD NO 141-1

0 - 5/8	Gms.
1	PCS.
.2	Gms.
5/8 - 1¼	Gms.
2	PCS.
1.5	Gms.
1¼ - 2½	Gms.
3	PCS.
5.7	Gms.
2½ - 5	Gms.
3	PCS.
9.2	Gms.
5 10	Gms.
6	PCS.
41.5	Gms.
10-20	Gms.
2	PCS.
24.7	Gms.
20 - 40	Gms.
9	PCS.
256	Gms.
40 - 80	Gms.
5	PCS.
284	Gms.
80 - 160	Gms.
5	PCS.
603	Gms.
160 - 320	Gms.
2	PCS.
510	Gms.
320 - 640	Gms.
5	PCS.
2306	Gms.
END PLATE	
8	PCS.
197	Gms.



SCALE 1"

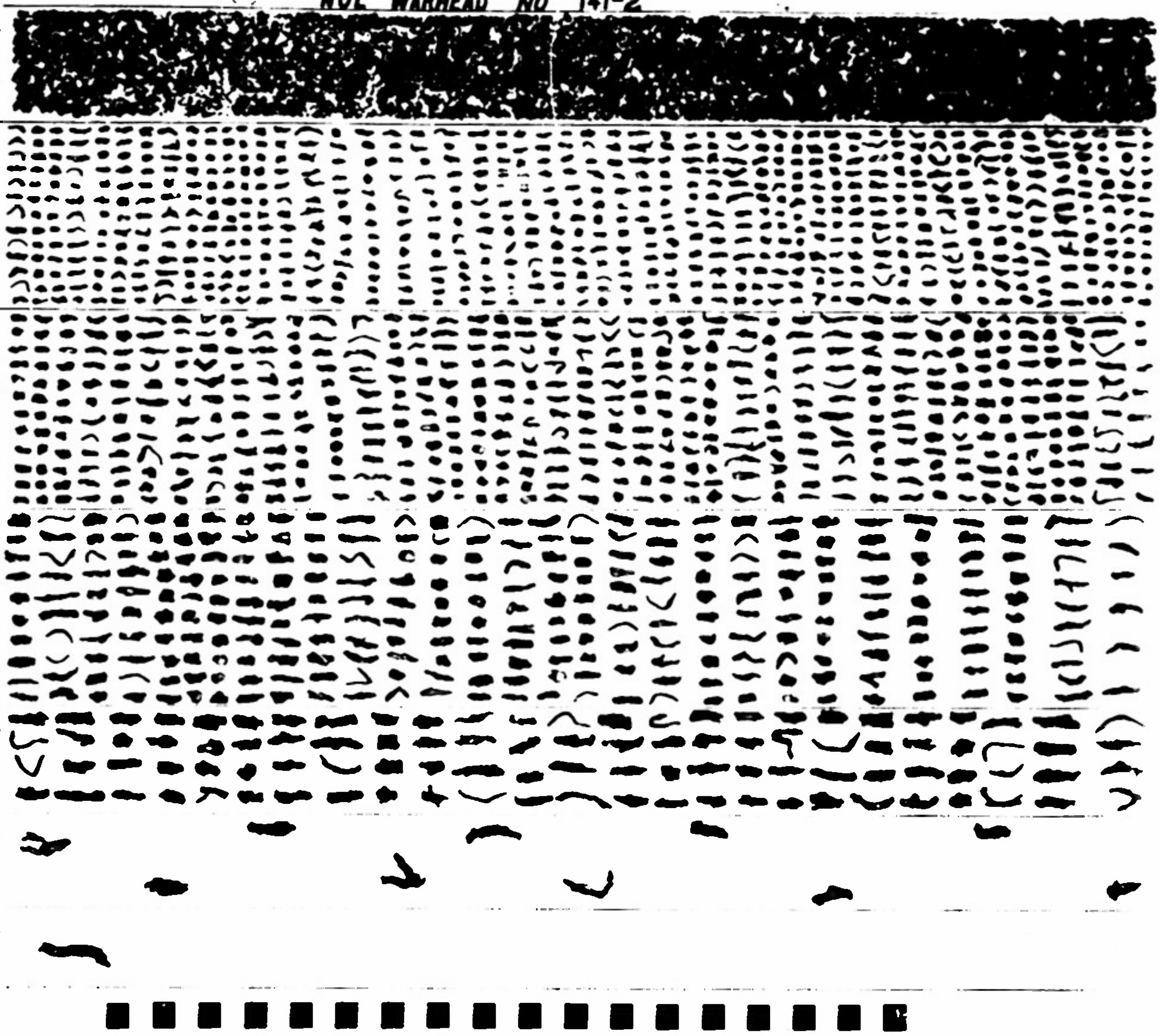
NP-51699 24 Nov [illegible] 19 2 CONFIDENTIAL SECURITY INFORMATION

Mass Distribution of warhead No. 141- [illegible] is warhead detonated low order.

FRAG NO. 1692 [redacted] N.P.9 51748

NOL WARHEAD NO 141-2

Size range	PCS.	Gms.
0 - 5/8 Gms.		752
5/8 - 1 1/4 Gms.	663	575
1 1/4 - 2 1/2 Gms.	488	835
2 1/2 - 5 Gms.	286	986
5 - 10 Gms.	100	670
10 - 20 Gms.	10	120
20 - 40 Gms.	1	21



SCALE 1"

[illegible]-51748 8 December 19[illegible] [illegible]

[illegible]ass Distribution [illegible] arhead No. 141-2. This warhead [illegible] high order.

Fragmentation of Double Sleeve Warhead No. 141

TABLE I

FRAGMENT SPACE DISTRIBUTION

NOL Warheads Nos. 141-3 and 141-4

30' Radius Space Arena. (Semi-circular)
1/8" M.S. panels 5' high

	Warheads Nos. 141-3	141-4	Total	Aver. Impacts Per 5° Zone on Panel	Aver. Impacts Per Total 5° Zone on Panel	Aver. Impacts Per Unit Solid Angle
0-5						
5-10						
10-15						
15-20						
20-25						
25-30						
30-35						
35-40						
40-45						
45-50						
50-55						
55-60						
60-65						
65-70						
70-75						
75-80	2		2	1	40	70
80-85		2	2	1	40	70
85-90		4	4	2	80	140
90-95	8	8	16	8	300	600
95-100	2	1	3	1.5	56	103
100-105						
105-110						
110-115						
115-120						
120-125						
125-130						
130-135						
135-140						
140-145						
145-150						
150-155						
155-160						
160-165						
165-170						
170-175	2	2	4	2	9	120
175-180	2	3	5	2.5	5	210

TABLE II

FRAGMENT VELOCITY DATA

30 Ft. Radius Arena — Date Fired: 12-11-52

35mm Fastax Camera — 2200 frames per sec.

Rd. 3 - 3M75 Warhead #141-3 — Filler: Comp. C-3

Total Weight: 11.68 lbs. — Filler Weight: 2.36 lbs.

Zones 80° - 100°

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
19	4	3470
20	8	3300
21	6	3140
22	6	3000
23	3	2870
24	1	2750
25	3	2640
26	2	2540
Median		3170
Average		3080

Fragmentation of Double Sleeve Warhead No. 141

TABLE II (Continued)

30 Ft. Radius Arena — Date Fired: 12-11-52

35mm Fastax Camera — 2250 frames per sec.

Rd. 4 - 3875 Warhead #141-4 — Filler: Comp. C-3

Total Weight: 11.73 lbs. — Filler Weight: 2.35 lbs.

Zones 80° - 100°

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
19	1	3550
20	6	3380
21	8	3210
22	11	3070
23	7	2930
Median		3220
Average		3150

Fragmentation of Double Sleeve Warhead No. 141

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