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U. S. NAVAL PROVING GROUND DAHLGREN, VIRGINIA	
REPORT NO. 997	
WARHEADS FOR AIR TARGET GUIDED MISSILES; TESTING OF	
<u>46th</u> Partial Report	
NOTCHED RING WARHEAD NO. 139; FRAGMENTATION TEST OF	
<u>FINAL</u> Report	Task Assignment NPG-Re3f-607-1-58
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NPG REPORT NO. 997

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Forty-Sixth Partial Report
on
Warheads for Air Target Guided Missiles;
Testing of

Final Report
on
Notched Ring Warhead No. 139;
Fragmentation Test of



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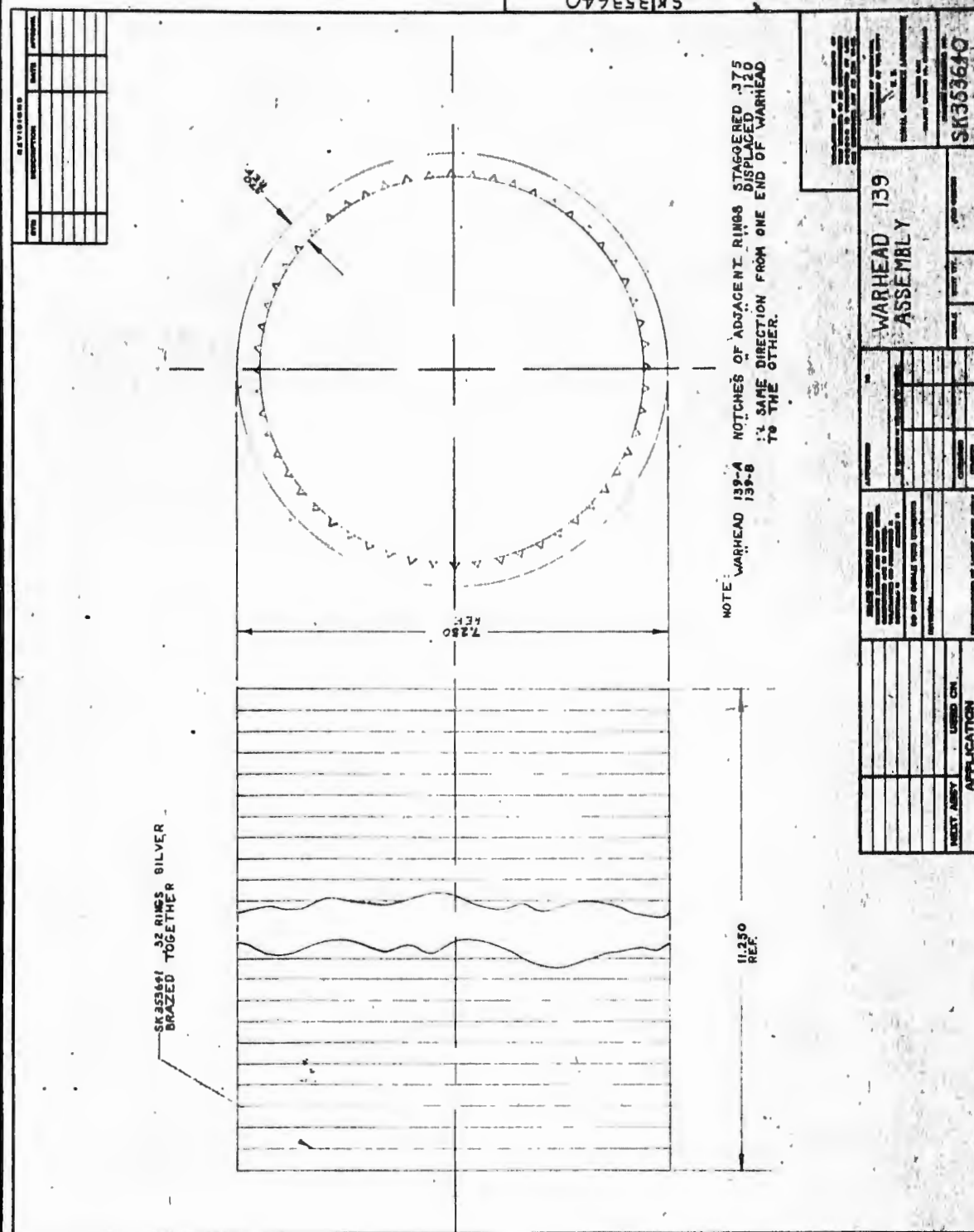
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NP9-49033

COMPONENTAL

NCJ 117100

8 April 1952
BUORD Drawing Sk 353640. Warhead 139 Assembly.
Figure 1

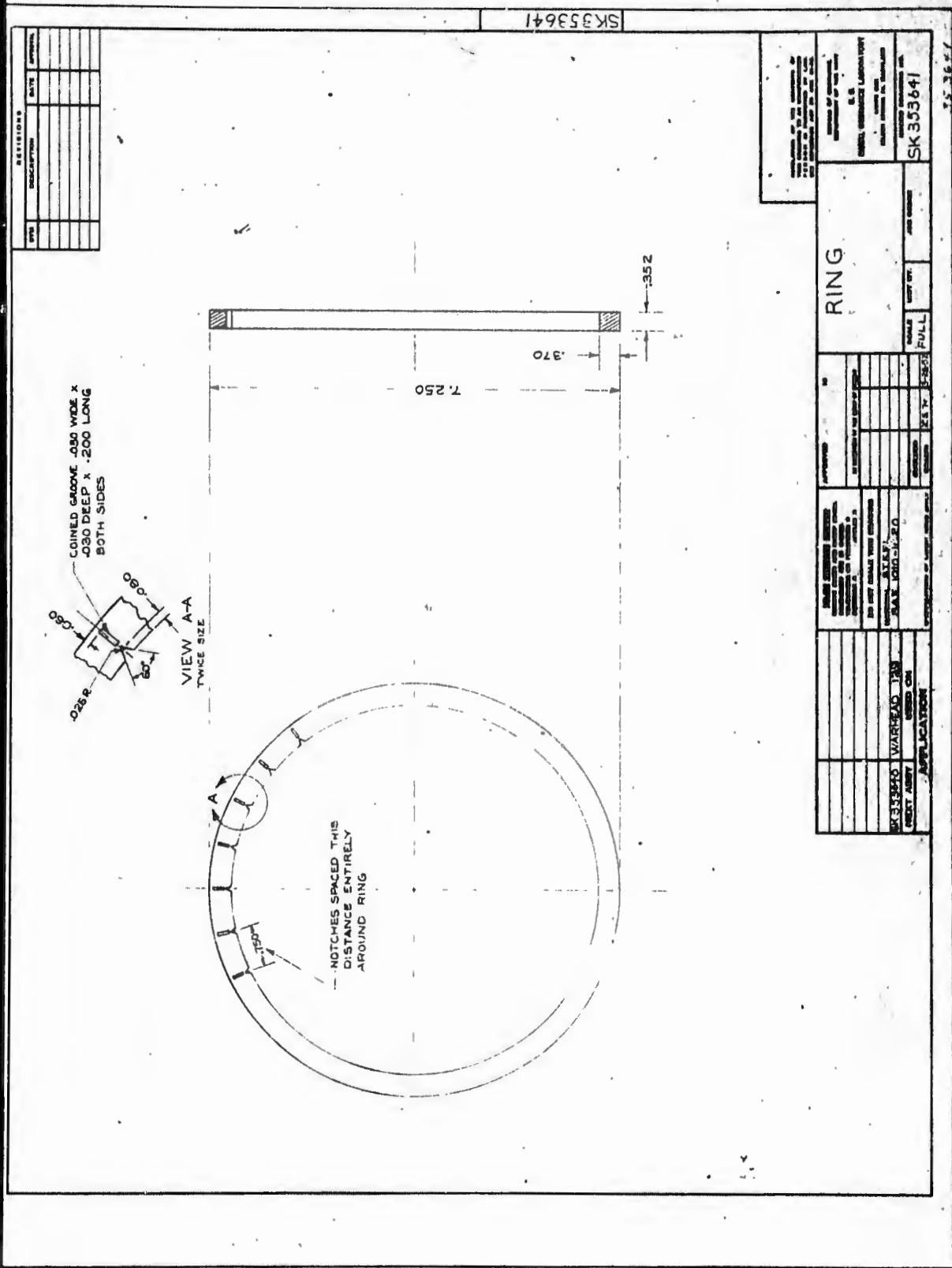


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STANDARD Drawing Sk 353641. Notched Ring for Warhead 139.

Figure 2



NP9-49040

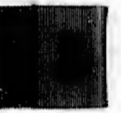
8 April 1952

Water Pit Set Up for Fragmentation Test of Notched Ring Warheads Nos. 139.

Figure 3

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FRAG NO. 1652

PRI

N.P. 49013

WATER PIT RECOVERY

		WARHEAD NO. 139A		WARHEAD NO. 139B
0 - 1/8	Gms.			
46	PCS.		53	
1/8 - 1/4	Gms.			
28	PCS.		16	
21	Gms.		13	
1/4 - 2 1/2	Gms.			
12	PCS.		11	
18	Gms.		16	
2 1/2 - 5	Gms.			
9	PCS.		7	
33	Gms.		28	
5 - 10	Gms.			
18	PCS.		27	
126	Gms.		181	
10 - 20	Gms.			
124	PCS.		117	
1508	Gms.		1422	

SCALE 1"

NP9-49013

8 April 1952

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Remnants from Warhead Nos. 139A and 139B recovered from Water Pit.
Remnants are 1/6 of total expected in polar zone 60°-12°. Warheads
suspended in horizontal position before firing.

Figure 4

TABLE I

MASS DISTRIBUTION DATA

FRAGMENTATION OF NOTCHED RING WARHEADS NOS. 139A & 139B; COMPOSITION C-3 LOADED
NUMBER AND WEIGHT OF RECOVERED FRAGMENTS

Warhead No.	Comp.	Filler Wt. lb.	0-0.625		0.625-1.25		1.25-2.5		2.5-5		5-10		10-20		20-40		Total		Photo. No. NP9
			grams Wt.	grams Gms.	grams Wt.	grams Gms.	grams Wt.	grams Gms.	grams Wt.	grams Gms.	grams Wt.	grams Gms.	grams Wt.	grams Gms.	grams Wt.	grams Gms.	grams Wt.	grams Gms.	
139A	45.14	20.15	46	21	28	18	12	33	9	126	18	1508	124	-	-	1752	191	49013	
139B	45.71	20.89	53	13	16	16	11	28	7	181	28	1422	117	-	-	1713	178	49013	

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Notched Ring Warhead No. 139; Fragmentation Test of

TABLE II

FRAGMENT VELOCITY DATA

Arena: Water Pit

Date: 8 April 1952

Steel Panels at 40 feet

35mm Fastax Camera #1

2760 frames per sec.

Warhead #139A

Comp. C-3

Total Weight 45.14 Lbs.

Filler Weight 20.15 Lbs.

<u>Frame in Which Hit Occurred</u>	<u>Zone (84°-110°) No. Fragments</u>	<u>Velocity (f/s)</u>
19	2	5810
20	15	5520
21	12	5250
22	7	5010
23	5	4800
24	2	4600
25	3	4410
26	2	4240
Median		5310
Average		5160

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Notched Ring Warhead No. 139; Fragmentation Test of

TABLE II (Continued)

Arena: Water Pit

Date: 8 April 1952

Steel Panels at 40 feet

35mm Fastax Camera #2

2610 frames per sec.

Warhead #139A

Comp. C-3

Total Weight 45.14 Lbs.

Filler Weight 20.15 Lbs.

<u>Frame in Which Hit Occurred</u>	<u>Zone (84°-110°) No. Fragments</u>	<u>Velocity (f/s)</u>
19	6	5490
20	14	5230
21	10	4970
22	5	4750
23	3	4530
24	4	4350
25	2	4170
26	1	4010
Median		5090
Average		4960

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Notched Ring Warhead No. 139; Fragmentation Test of

TABLE III

FRAGMENT VELOCITY DATA

Arena: Water Pit

Date: 10 April 1952

Steel Panels at 40 feet

35mm Fastax Camera #1

2730 frames per sec.

Warhead #139B

Comp. C-3

Total Weight 45.71 Lbs.

Filler Weight 20.89 Lbs.

<u>Frame in Which Hit Occurred</u>	<u>Zone (84°-110°) No. Fragments</u>	<u>Velocity (f/s)</u>
19	2	5750
20	19	5470
21	10	5200
22	7	4960
23	4	4750
24	4	4550
25	1	4370
Median		5310
Average		5190

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Notched Ring Warhead No. 139; Fragmentation Test of

TABLE III (Continued)

Arena: Water Pit

Date: 10 April 1952

Steel Panels at 40 feet

35mm Fastax Camera #2

2580 frames per sec.

Warhead #139B

Comp. C-3

Total Weight 45.71 Lbs.

Filler Weight 20.89 Lbs.

<u>Frame in Which Hit Occurred</u>	<u>Zone (84°-110°) No. Fragments</u>	<u>Velocity (f/s)</u>
18	1	5730
19	19	5430
20	7	5160
21	7	4920
22	4	4690
23	3	4490
24	1	4290
Median		5270
Average		5150

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Notched Ring Warhead No. 139; Fragmentation Test of

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Notched Ring Warhead No. 139; Fragmentation Test of

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Notched Ring Warhead No. 139; Fragmentation Test of

PART A

SYNOPSIS

1. This test was conducted to compare the fragmentation characteristics of two notched ring Warheads 139, one having adjacent rings staggered one-half the notch spacing (0°375) and the other having notches of adjacent rings displaced only 0°120. Both warheads tested were 7 1/4" in diameter and Composition C-3 loaded.
2. a. The different notched ring arrangement of the two warheads did not vary the warhead fragmentation characteristics significantly.
b. Both warheads produced fragments averaging 12.1 grams, and median fragment velocities in the order of 5250 feet per second.
c. The fragment control method employed in the manufacture of these warheads is considered satisfactory.

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Notched Ring Warhead No. 139; Fragmentation Test of

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APPENDIX B - WATER PIT SET-UP.	FIGURE 3
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Notched Ring Warhead No. 139; Fragmentation Test of
-----PART BINTRODUCTION

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/19/52 of 31 Mar 1952
- b. BUORD conf ltr NP9 Re3f:EJHL:edb Ser 25777 of 18 Sep 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 load and fragment two notched ring warheads, Nos. 139A and 139B. Both warheads have internal notches, as well as grooves on the mating surface of the rings. Rings employing this control method can be rapidly produced with existing industrial equipment. Warhead 139A had the notches of adjacent rings staggered one-half the notch spacing (0.375) and Warhead 139B had the notches of adjacent rings displaced only 0.120, with the displacement in the same direction from one end of the warhead to the other so that the notches formed a spiral pattern. Design fragment size for both warheads approximated a parallelepiped 3/4" long with a 3/8" square cross section, weighing 12.6 grams.

4. OBJECT OF TEST:

This test was conducted to compare the fragmentation characteristics of two notched ring Warheads 139, one having adjacent rings staggered one-half the notch spacing (0.375) and the other having notches of adjacent rings displaced only 0.120. Both warheads tested were 7 1/4" in diameter and Composition C-3 loaded.

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Notched Ring Warhead No. 139; Fragmentation Test of

5. PERIOD OF TEST:

a. Date Project Letter	31 March 1952
b. Date Necessary Material Received	28 March 1952
c. Date Commenced Test	8 April 1952
d. Date Test Completed	10 April 1952

6. REPRESENTATIVES PRESENT:

This test was witnessed in part by Messrs. L. E. Hightower, R. Suessle, and D. J. Stretmeyer representing the Naval Ordnance Laboratory.

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

a. Warhead No. 139A, cylindrical, 11.25 long, 7.25 diameter, .370 wall thickness, assembled by silver brazing 32 notched rings (SAE 1010-1020 Steel) together. Each ring is .352 thick with internal V-notches having a 60° included angle, .080 deep at intervals of .750. In addition, grooves .030 wide by .030 deep and 3/16" long are coined across both mating surfaces of each ring adjacent to and radially outward from the internal notches. The internal notches of adjacent rings are staggered one-half the notch spacing (.375). The warhead is designed to produce 896 fragments weighing 12.6 grams each.

b. Warhead No. 139B, same as 139A except that the internal notches of adjacent rings are displaced only .120. This displacement is in the same direction from one end of the warhead to the other so that the notches form a spiral pattern.

c. Both warheads were loaded with Composition C-3 at the Proving Ground. The warhead weights in pounds are as follows:

<u>Warhead No.</u>	<u>Empty</u>	<u>C-3</u>	<u>Total</u>
139A	24.99	20.15	45.14
139B	24.82	20.89	45.71

Warhead drawings are shown in Figures 1 and 2.

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Notched Ring Warhead No. 139; Fragmentation Test of

8. PROCEDURE:

a. Each warhead was suspended over the water pit in a horizontal position and detonation was obtained by a 26 gram tetryl pellet and a No. 8 blasting cap at one end, which was pointed toward 0°. Fragments recovered in the water pit represent 1/6 of the fragments expected in polar angle zone 60°-120°. Vertical steel panels 20 feet high and in polar zone 84°-110°. were placed at 40 feet from the warhead. The detonation and 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 set up is shown in Figure 3.

9. RESULTS AND DISCUSSION:

a. Mass Data:

Detailed fragment mass distribution data listed in Table I and shown in Figure 4 are summarized as follows:

Wt. Group (grams)	No. Recovered Fragments		No. Expected Fragments in total zone 60°-120°	
	139A	139B	139A	139B
0.625-1.25	28	16	168	96
1.25-2.5	12	11	72	66
2.5-5	9	7	54	42
5-10	18	28	108	168
10-20	*124	*117	748	702

* Average weight of fragments in 10-20 gram group for both warheads was 12.1 grams.

b. Velocity Data:

Detailed fragment velocity data listed in Tables II and III are summarized as follows:

Warhead	Average Median Fragment Velocity Polar Zone 84°-110°
139A	5200 ft./sec.
139B	5290 ft./sec.

Velocities are a mean over the first 40 feet of fragment travel.

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Notched Ring Warhead No. 139; Fragmentation Test of

PART D

CONCLUSIONS

10. a. The different notched ring arrangement of the two warheads did not vary the warhead fragmentation characteristics significantly.
- b. Both warheads produced fragments averaging 12.1 grams each and median fragment velocities in the order of 5250 feet per second.
- c. The fragment control method employed in the manufacture of these warheads is considered satisfactory.

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Notched Ring Warhead No. 139; Fragmentation Test of

The tests upon which this report is based were conducted by:
A. N. HUGHES, Lieutenant, USN, 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. BYRNE
Captain, USN
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