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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1201

FRAGMENTATION CHARACTERISTICS

24th Partial Report

BASE FRAGMENT VELOCITIES OF SERVICE NAVY PROJECTILES

FINAL Report

Task

Assignment NPG-Re3d-418-1-53

Copy No. 12

Classification CONFIDENTIAL
SECURITY INFORMATION

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NPG REPORT NO. 1201

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Twenty-fourth Partial Report
on
Fragmentation Characteristics

Final Report
on
Base Fragment Velocities of Service Navy Projectiles

Project No.: NPG-Re3d-418-1-53
Copy No. 12
No. of Pages: 7

Date: NOV 24 1953

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SECURITY INFORMATION

Base Fragment Velocities of Service Navy Projectiles

PART A

SYNOPSIS

1. "Dangerous base fragments" may be defined for purposes of this report as those which, on premature detonation of a projectile, may produce a fragment hazard to the personnel of the firing ship. In order to determine which service Navy projectiles produced such fragments, base fragment velocities were measured for statically detonated 3", 5", 6", 8", 12", 14", and 16" high-capacity projectiles.
2. If fired at service charge from new or worn guns, only the 5", 14", and 16" projectiles will produce dangerous base fragments. If fired at reduced charge, the 5", 12", 14", and 16" projectiles will produce dangerous base fragments.
3. The static base fragment velocities for the projectiles tested are as follows:

<u>Proj.</u>	<u>Mk</u>	<u>Filler</u>	<u>Base Fragment Velocity (ft/sec)</u>	
			<u>Median</u>	<u>Maximum</u>
3" AA	33	Comp. A-3	1940	2040
5" AAC	35	Comp. A-3	2060	2560
6" HC	39	Expl. "D"	1780	2030
8" HC	24	Expl. "D"	1240	1240
12" HC	17	Expl. "D"	1900	2440
14" HC	19	Expl. "D"	2560	6190
16" HC	13	Expl. "D"	2120	5090

Base Fragment Velocities of Service Navy Projectiles

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Base Fragment Velocities of Service Navy Projectiles

PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3d-418-1-53, reference (b).

2. REFERENCES:

- a. BUORD Conf ltr S78-1(117)-Re3d-ANB:bc Ser 33638 of 6 February 1952
- b. BUORD ltr NP9-Re3d-ANB:bc of 29 July 1952

3. BACKGROUND:

Since the premature detonation of a projectile may create a fragment hazard to the firing ship's personnel, reference (a) requested information on base fragment velocities for all service Navy projectiles. A base fragment whose rearward velocity with respect to the projectile center of gravity exceeds the projectile's muzzle velocity will move toward the firing gun, and in case of a premature detonation will constitute a hazard.

4. OBJECT OF TEST:

This test was conducted to determine upon static detonation the velocities of base fragments from service Navy projectiles: 3", 5", 6", 8", 12", 14", and 16", and to determine which, if any exceed the muzzle velocity of the projectile.

5. PERIOD OF TEST:

- a. Date Project Letter 6 February 1952
- b. Date all Necessary Material Received 8 July 1953
- c. Date Commenced Test 12 May 1952
- d. Date Completed Test 24 July 1953

Base Fragment Velocities of Service Navy Projectiles

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEMS UNDER TEST:

The following is a table of the standard service projectiles tested:

<u>No.</u> <u>Rds.</u>	<u>Projectile</u> <u>Caliber</u>	<u>Mk</u>	<u>Explosive</u> <u>Charge</u>	<u>Total</u> <u>Weight</u>	<u>Base</u> <u>Fuze Mk</u>	<u>Nose Fuze</u> <u>Type - Mk</u>	<u>Aux. Det.</u> <u>Fuze</u>
3	3"/50 A.A.	33-0.	Comp. A-3	12.1	None	VT 72	44-1
3	5"/38 A.A.C.	35-10	Comp. A-3	53.4	plug	VT 53-2	44-1
2	6"/47 H. C.	39-0	Expl. "D"	101.2	plug	VT 47	44-1
2	8"/55 H.C.	24-5	Expl. "D"	258.	28-15	MTF 18	44-1
2	12"/50 H.C.	17-2	Expl. "D"	940.	48-1	PDF 29	55-1
2	14"/50 H.C.	19-4	Expl. "D"	1275	48	PDF 29	55-0
2	16"/50 H.C.	13	Expl. "D"	1897	48	PDF 29	55-1

Each round was initiated by the nose fuzes, which was modified for static detonation.

7. PROCEDURE:

a. The 3" and 5" projectiles were each placed horizontally on a platform 12' high with their bases pointed at the geometrical center of an array of 1" mild steel plates, 24 feet high and 20 feet wide, and 30 feet from the projectiles.

The 6" and 8" projectiles were placed 60 feet from a 1/8" mild steel panel, 24 feet high and 20 feet wide, with the base of the projectile pointed at the geometric center. On the ground in front of the 1/8" plates, cane fiberboard packs three feet thick, four feet high and 16 feet long were placed. These were faced with aluminum foil so that visible flashes made by the fragments could be recorded by a high speed camera.

The 12", 14" and 16" projectiles were placed on a platform ten feet high and 60 feet from a 1/8" mild steel panel 12 feet high and 20 feet wide. Cane fiberboard packs eight feet high, eight feet wide, and four feet thick were placed on the ground behind the center of the panel.

Base Fragment Velocities of Service Navy Projectiles

b. Fragments were recovered from the cane fiberboard packs and weighed. Their velocities were recorded by photographing hits on the plates with 35mm Fastax cameras.

8. RESULTS AND DISCUSSION:

a. Below is a summary of the base fragment velocities from the projectiles tested: Detailed velocity data are given in Tables I-VII.

Proj.	Muzzle Velocity for Reduced Charges	Service Muzzle Velocity at end of gun life	Base Fragment Velocities		Maximum Rearward Velocity (ft/sec)		Mass of Fastest Fragments
	(ft/sec)	(ft/sec)	Median	Maximum	(Service)	(Reduced)	
3"/50	---	2600	1940	2040	---	---	
5"/38	1200	2420	2060	2560	140	1360	340 grams
6"/47	2225	2415	1780	2030	---	---	
8"/55	2220	2565	1240	1240	---	---	
12"/50	1965	2540	1900	2440	---	475	
14"/50	2065	2655	2560	6190	3435	4025	450* grams
16"/50	2075	2465	2120	5090	2625	3015	36 grams (fuze frag.)

* Estimated from size of plate hole and other recovered fragments.

b. The 5"/38, 14"/50 and 16"/50 projectiles produced base fragments which had velocities in static firing exceeding the projectile's service muzzle velocity. Therefore, in the event of premature detonation at close range, base fragments from these three projectiles might constitute a hazard to the firing ship.

c. For each of the three 5"/38 projectiles fired, only one base fragment attained a velocity above the service muzzle velocity of a worn gun. These fragments, the base plugs weighing 340 grams each, were therefore the only ones which would present a hazard.

The 3", 6", 8", and 12" projectiles produced no base fragments with velocities higher than the service muzzle velocity of the projectile. The base fragments from these projectiles would all have forward motion in the event of premature detonation.

From the 14" and 16" projectiles tested a large number of base fragments attained velocities higher than the muzzle velocities and would therefore present a hazard. The high velocity fragments from the 16" projectiles were from the base fuze, while those from the 14" projectiles were from both the base plug and the base fuze with some weighing about one pound.

Base Fragment Velocities of Service Navy Projectiles

PART D

CONCLUSIONS

9. a. If fired at service charge from new or worn guns, only the 5", 14", and 16" projectiles will produce dangerous base fragments. If fired at reduced charge, the 5", 12", 14", and 16" projectiles will produce dangerous base fragments.

b. The static base fragment velocities for the projectiles tested are as follows:

<u>Proj.</u>	<u>Mk</u>	<u>Filler</u>	<u>Base Fragment Velocity (ft/sec)</u>	
			<u>Median</u>	<u>Maximum</u>
3" AA	33	Comp. A-3	1940	2040
5" AAC	35	Comp. A-3	2060	2560
6" HC	39	Expl. "D"	1780	2030
8" HC	24	Expl. "D"	1240	1240
12" HC	17	Expl. "D"	1900	2440
14" HC	19	Expl. "D"	2560	6190
16" HC	13	Expl. "D"	2120	5090

Base Fragment Velocities of Service Navy Projectiles

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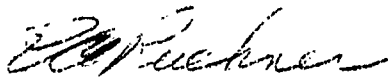
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FRAG NO. 1657

N.P.9 49365

BASE FRAGMENTS.

6"/47 MK 39-0 "D" LOADED.

RD 1

FRAGMENT A
240 Gms.



FRAGMENT B
63 Gms.



FRAGMENT C
27 Gms.



FRAGMENT D
543 Gms.



FRAGMENT E
133 Gms.



RD 2

FRAGMENT A
382 Gms.



FRAGMENT B
211 Gms.



FRAGMENT C
27 Gms.



FRAGMENT D
539 Gms.



8"/55 MK 24-5 "D" LOADED.

RD 1

FRAGMENT A
385 Gms.



FRAGMENT B
13 Gms.

RD 2

FRAGMENT A
144 Gms.



SCALE 1"

NP9-49365

5 June 1952

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Sample Base fragments recovered from 6" HC Mk 39 and 8" HC Mk 24 Projectiles,
explosive "D" loaded.

FIGURE 1

12" HC MK 17 MOD 2 ROUND - 1

BASE FRAGMENTS FIBERBOARD RECOVERY

FRAGMENT A



1002.3 GMS.

FRAGMENT D



12.0 GMS.

BASE FRAGMENTS FIELD RECOVERY



1016.5 GMS.



554.9 GMS.



469.4 GMS.



291.1 GMS.



254.3 GMS.



121.6 GMS.



106.9 GMS.



102.1 GMS.



84.3 GMS.



75.0 GMS.



62.3 GMS.



60.0 GMS.



59.2 GMS.



55.1 GMS.

BEAM SPRAY FRAGMENTS FIELD RECOVERY



1051.5 GMS.



668.5 GMS.



449.5 GMS.



371.7 GMS.



363.9 GMS.



269.8 GMS.



251.4 GMS.



212.7 GMS.



179.7 GMS.



148.4 GMS.



141.8 GMS.



127.2 GMS.



107.5 GMS.



80.8 GMS.



21.7 GMS.



SCALE 1"

NP - 16652

9 JUL 1953

Rd. 1. Sample base fragments recovered from 12" HC 1k 17 Projectile, explosive "D" loaded.

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FIGURE 2

FRAG NO. 1761

NP9 NO. 63785

12" HC MK 17 MOD 2 ROUND-2
BASE FRAGMENTS FIBERBOARD RECOVERY

FRAGMENT - A

12.9 GMS.

FRAGMENT - B


18.2 GMS.

FRAGMENT - C

112.0 GMS.


FRAGMENT - D


24.3 GMS.

FRAGMENT - F

17.5 GMS.

FRAGMENT - H

81.5 GMS.

FRAGMENT - I

13.5 GMS.

FRAGMENT - J

10.9 GMS.

BASE FRAGMENTS FIELD RECOVERY



612.5 GMS.



564.5 GMS.



500.5 GMS.


417.6 GMS.


344.0 GMS.


106.4 GMS.


268.2 GMS.


50.9 GMS.



29.1 GMS.


26.7 GMS.



18.5 GMS.


1.1 GMS.

BEAM SPRAY FRAGMENTS FIELD RECOVERY



401.3 GMS.


362.7 GMS.


352.5 GMS.


347.5 GMS.


329.7 GMS.


327.1 GMS.


245.2 GMS.


192.4 GMS.


185.1 GMS.


160.1 GMS.


157.1 GMS.


136.7 GMS.


127.5 GMS.


111.4 GMS.


100.2 GMS.


98.1 GMS.

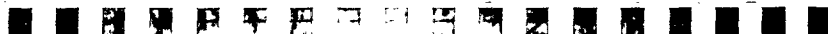

92.9 GMS.


89.8 GMS.


88.6 GMS.


64.0 GMS.


46.8 GMS.



SCALE 1

NP9-63785

10 July 1953

Rd. 2. Sample base fragments recovered from 12" HC Mk 17 Projectile, explosive "D" loaded.

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FIGURE 3

FRAG NO. 1683

14" H.C. MK 19-4 SAMPLE BASE FRAGMENTS.

N.P.9 51288

WEIGHTS BELOW FRAGMENTS IN GRAMS.



223



409



560



610



901



SCALE 1"

NP9-51288

2 October 1952

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Rd. 1. Sample base fragments recovered from 14" HC Mk 19 Projectile, explosive "D" loaded.

FIGURE 4

FRAG NO. 1695

14" HC MK 19-4 RECOVERED BASE FRAGMENTS, RD 2

NP9 NO. 51813

FRAGMENT A
20 Gms.



FRAGMENT B
5 Gms.



FRAGMENT F
52 Gms.



FRAGMENT G
152 Gms.



FRAGMENT H
15 Gms.



SCALE 1"

NP9-51813

17 October 1952

Rd. 2. Sample-base fragments recovered from 14" HC Mk. 17 Projectile, explosive "D" loaded.

FIGURE 5

FRAG NO. 1688

51625

16" HC MK 13 "D" LOADED PROJECTILE SAMPLE BASE FRAGMENTS.
WEIGHTS BELOW FRAGMENTS IN GRAMS.

SAMPLE - B



189.4

SAMPLE - D



2093

SAMPLE - E



24.8



SCALE 1"

NP9-51625

6 November 1952

SECURITY INFORMATION

Rd. 1. Sample base fragments recovered from 16" HC Mk 13 Projectile, explosive "D" loaded.

FIGURE 6

FRAG NO 51489

16" HC MK 13 - 4 "D" LOADED

51489

RECOVERED BASE FRAGMENTS.

FRAGMENT AA.
36 Gms.

FRAGMENT A.
368.3 Gms.

FRAGMENT BB.
100.7 Gms.

FRAGMENT CC.
23.6 Gms.

FRAGMENT D.
112.8 Gms.

FRAGMENT F.
18.7 Gms.

FRAGMENT G.
958 Gms.

FRAGMENT H.
996.4 Gms.

FRAGMENT I.
74.9 Gms.

FRAGMENT PP.
1322.4 Gms.



SCALE 1"

MP9-51489

19 November 1950

COMPLIANCE
SECURITY INFORMATION

Rd. 2. Sample base fragments recovered from 16" HC Mk 13 Projectile, explosive "D" loaded.

FIGURE 7

Base Fragment Velocities of Service Navy Projectiles

TABLE I

BASE FRAGMENT VELOCITY DATA

30 Ft. Base Line
 35mm Fastax Camera
 Rd. 1, 3"/50 Mk 33-0
 Total Weight 12.10 lbs.

2850 Frames per sec.
 Comp. A-3
 Filler Weight 0.83 lbs.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
45	1)	Estimated at 20-50 each	1900
46	1)		1860
48	1)		1780
Median			1880
Average			1850

Base Fragment Velocities of Service Navy Projectiles

TABLE I (Continued)

30 Ft. Base Line
35mm Fastax Camera
Rd. 2, 3"/50 Mk 33-0
Total Weight 12.05 lbs.

2820 Frames per sec.
Comp. A-3
Filler Weight 0.83 lbs.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
43	1)	Estimated at 20-50 each	1970
44	2)		1920
46	1)		1840
47	1)		1800
Median			1920
Average			1890

Base Fragment Velocities of Service Navy Projectiles

TABLE I (Continued)

30 Ft. Base Line
35mm Fastax Camera
Rd. 3, 3"/50 Mk 33-0
Total Weight 12.05 lbs.

2850 Frames per sec.
Comp. A-3
Filler Weight 0.83 lbs.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
42	1)	Estimated at 20-50 each	2040
44	2)		1940
45	1)		1900
Median			2000
Average			1960

Base Fragment Velocities of Service Navy Projectiles

TABLE II

BASE FRAGMENT VELOCITY DATA

30 ft. Base Line
 35mm Fastax Camera
 Rd. 1, 5"/38 Mk 35-10
 Total Weight 53.32 lbs.

2820 Frames per sec.
 Comp. A-3
 Filler Weight 7.25 lbs.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
34	1	340	2490
34	1)		2490
44	2)	Estimated at 40-200 grams each	1920
45	2)		1880
46	1)		1840
Median			2120
Average			2060

Base Fragment Velocities of Service Navy Projectiles

TABLE II (Continued)

30 ft. Base Line
 35mm Fastax Camera
 Rd. 2, 5"/38 Mk 35-10
 Total Weight 53.28 lbs.

2820 Frames per sec.
 Comp. A-3
 Filler Weight 7.25 lbs.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
34	1	340	2490
41	1)	Estimated at 40-200 grams each	2060
43	1)		1970
44	2)		1920
47	1)		1800
Median			
Average			2030

Base Fragment Velocities of Service Navy Projectiles

TABLE II (Continued)

30 Ft. Base Line
 35mm Fastax Camera
 Rd. 3, 5"/38 Mk 35-10
 Total Weight 53.60 lbs.

2820 Frames per sec.
 Comp. A-3
 Filler Weight 7.25 lbs.

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
33	1	340	2560
34	1)	Estimated at 40-200 each	2490
41	3)		2060
42	4)		2010
Median			2270
Average		2140	

Base Fragment Velocities of Service Navy Projectiles

TABLE III

BASE FRAGMENT VELOCITY DATA

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 1, 6"/47 Mk 39-0
 Total Weight 101.2 lbs.

2460 frames per sec.
 Expl. "D"
 Filler Weight 14.09 lbs.
 Date: 5 June 1952

<u>Frame in Which Hit Occurred</u>	<u>Base Line (feet)</u>	<u>Fragment No.</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
73	60'	D	543	2020
95	60'	E	123	1550
111	57'	B	63	1260
114	57'	C	27	1230
114	60'	F	300*	1290
115	57'	A	240	1220
Median				1570
Average				1430

* Estimated weight

Base Fragment Velocities of Service Navy Projectiles

TABLE III (Continued)

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 2, 6"/47 Mk 39-0
 Total Weight 101.2 lbs.

3420 frames per sec.
 Expl. "D"
 Filler Weight 14.09 lbs.
 Date: 5 June 1952

<u>Frame in Which Hit Occurred</u>	<u>Base Line (feet)</u>	<u>Fragment No.</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
101	60'	D	539	2030
102	60'	E	200*	2010
133	60'	G	300*	1540
134	60'	F	150*	1530
Median				1870
Average				1780

* Estimated weight

Base Fragment Velocities of Service Navy Projectiles

TABLE IV

BASE FRAGMENT VELOCITY DATA

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 1, 8"/55 Mk 24
 Total Weight 258.0 lbs.

3420 frames per sec.
 Expl. "D"
 Filler Weight 21.34 lbs.
 Date: 5 June 1952

<u>Frame in Which Hit Occurred</u>	<u>Base Line (feet)</u>	<u>Fragment No.</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
166	60'	C	*8000	1240
166	60'	D	100	1240
Median				1240
Average				1240

Note: Other base fragment velocities were less than 1240 f/s.

* Base Plug

 Base Fragment Velocities of Service Navy Projectiles

TABLE IV (Continued)

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 2, 8"/55 Mk 24
 Total Weight: 258.0 lbs.

3360 Frames per sec.
 Expl. "D"
 Filler Weight 21.34 lbs.
 Date: 5 June 1952

<u>Frame in Which Hit Occurred</u>	<u>Base Line (feet)</u>	<u>Fragment No.</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
167	60'	B Base Plug	*8000	1210
167	60'	C	200	1210
Median				1210
Average				1210

Note: Other base fragment velocities were less than 1210 f/s.

* Base Plug

Base Fragment Velocities of Service Navy Projectiles

TABLE V

BASE FRAGMENT VELOCITY DATA

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 1, 12" H.C. #6891 Mk 17 Mod 2
 Total Weight 940.0 lbs.

2600 Frames per sec.
 Expl. "D"
 Filler Weight 79.44 lbs.
 Fuze: PDF Mk 29
 Date: 9 July 1953

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. No.</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
66	1	(H)		2360
67	1	(G)		2330
75	1	(O)		2080
79	1	(B)		1970
80	1	(C)		1950
82	2	1-(E)) 1-(F))		1900
84	2	1-(A)) 1-(S))	1002	1860
87	1	(R)		1790
88	1	(M)		1770
Median				1960
Average				1980

Base Fragment Velocities of Service Navy Projectiles

TABLE V (Continued)

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 1, 12" H.C. #6891 Mk 17 Mod 2
 Total Weight 940.0 lbs.

2800 Frames per sec.
 Expl. "D"
 Filler Weight 79.44 lbs.
 Fuze: PDF Mk 29
 Date: 9 July 1953

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. No.</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
72	2	1-(H) 1-(G)		2330
81	1	(O)		2070
86	2	1-(E) 1-(N)		1950
91	1	(A)	1002	1850
92	1	(J)		1830
94	1	(R)		1790
95	1	(M)		1770
100	2	1-(T) 1-(S)		1680
Median				1920
Average				1930

Base Fragment Velocities of Service Navy Projectiles

TABLE V (Continued)

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 2, 12" H.C. #6731 Mk 17 Mod 2
 Total Weight 939.50 lbs.

2850 Frames per sec.
 Expl. "D"
 Filler Weight 79.44 lbs.
 Fuze: PDF Mk 29
 Date: 10 July 1953

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. No.</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
70	1	(C)	112.0	2440
78	1	(H)	81.5	2190
83	1	(D)	24.3	2060
84	4	1-(R) 1-(I) 1-(A) 1-(B)	13.5 12.9 18.2	2040
90	1	(E)		1900
92	1	(P)		1860
93	1	(W)		1840
94	2	1-(M) 1-(O)		1820
96	2	1-(V) 1-(X)		1780
98	1	(L)		1740
Median				1940
Average				1960

Base Fragment Velocities of Service Navy Projectiles

TABLE VI

BASE FRAGMENT VELOCITY DATA

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 1, 14" H.C. Mk 19-4
 Total Weight 1276 lbs.

2280 Frames per sec.
 Expl. "D"
 Filler Weight 104.21 lbs.
 Date: 2 October 1952

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
32	3)	Estimated at 10-500 each	4280
33	1)		4150
34	1)		4020
35	1)		3910
62	2)		2210
70	3)		1950
72	2)		1900
74	1)		1850
78	3)		1750
Median			2630
Average			2710

Base Fragment Velocities of Service Navy Projectiles

TABLE VI (Continued)

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 2, 14" H.C. Mk 19-4
 Total Weight 1273.50 lbs.

1650 Frames per sec.
 Expl. "D"
 Filler Weight 104.21 lbs.
 Date: 17 December 1952

<u>Frame in Which Hit Occurred</u>	<u>Frag. No.</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
16	X-	1	*450	6190
19	H-1-) A-1)	2	15 20	5210
30	N	1		3300
34	E-1-) O-1-) CC-1-	3		2910
37	L	1		2680
39	S-1-) DD-1-)	2		2540
41	V	1		2410
46	C-	1		2150
47	AA-	1		2110
52	B	1	5	1900
54	Z	1		1830
Median				2830
Average				3120

* Estimated

Base Fragment Velocities of Service Navy Projectiles

TABLE VI (Continued)

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 2, 14" H.C. Mk 19-4
 Total Weight 1273.50 lbs.

2000 Frames per sec.
 Expl. "D"
 Filler Weight 104.21 lbs.
 Date: 17 December 1952

<u>Frame in Which Hit Occurred</u>	<u>Frag. No.</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
20	X-	1	*450	6000
24	H-	1	15	5000
33	G	1	152	3640
39	F	1	52	3080
42	E-1-) O-1-) CC-1-)	3		2860
43	BB	1		2790
44	EE	1		2730
46	T	1		2610
48	S-1-) DD-1-)	2		2500
51	U	1		2350
55	AA-1-) V-1) Q-1)	3		2180
56	R	1		2140
57	C-	1		2110
58	Y	1		2070
64	D	1		1880
Median				2630
Average				2830

* Estimated

Base Fragment Velocities of Service Navy Projectiles

TABLE VII

BASE FRAGMENT VELOCITY DATA

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 1, 16" H.C. Mk 13-3
 Total Weight 1893 lbs.

2820 Frames per sec.
 Expl. "D"
 Filler Weight 153.6 lbs.
 Date: 6 November 1952

<u>Frame in Which Hit Occurred</u>	<u>Frag. No.</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
49	(N)	1)	Estimated at 10-50 each	3450
60	(M)-1) (L)-1)	2)		2820
76	(D)	1	209	2230
77	(C)	1		2200
82	(H)-1) (F)-1)	2		2060
83	(I)	1		2040
87	(A)	1		1940
92	(J)	1		1840
96	(K)	1		1760
100	(B)	1	189	1690
Median				2140
Average				2240

Base Fragment Velocities of Service Navy Projectiles

TABLE VII (Continued)

60 Ft. Base Line
35mm Fastax Camera
Rd. 1, 16" H.C. Mk 13-3
Total Weight 1893 lbs.

2250 Frames per sec.
Expl. "D"
Filler Weight 153.6 lbs.
Date: 6 November 1952

<u>Frame in Which Hit Occurred</u>	<u>Frag. No.</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
38	(N)	1)	Estimated at 10-50 each	3550
47	(M)	1)		2870
48	(L)	1)		2810
60	(D)	1	209	2250
61	(C)	1		2210
65	(H)-1) (F)-1)	2		2080
66	(I)	1		2050
69	(A)	1		1960
73	(J)	1		1850
76	(K)	1		1780
79	(B)	1	189	1710
Median				2150
Average				2270

Base Fragment Velocities of Service Navy Projectiles

TABLE VII (Continued)

60 Ft. Base Line
 35mm Fastax Camera
 Rd. 2, 16" H.C. Mk 13-4
 Total Weight 1897 lbs.

3390 Frames per sec.
 Expl. "D"
 Filler Weight 153.6 lbs.
 Date: 19 November 1952

<u>Frame in Which Hit Occurred</u>	<u>Frag. No.</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
40	(AA)	1	36.0	5090
61	(KK)	1		3330
69	(NN)	1		2950
75	(MM)	1		2710
85	(P)	1		2390
86	(H)	1	996	2370
87	(S)	1		2340
87	(Z)	1		2340
88	(T)	1		2310
91	(O)	1		2240
92	(J)	1		2210
96	(C)	1		2120
96	(CC)	1	23.6	2120
97	(Q)	1		2100
97	(N)	1		2100
98	(JJ)	1		2080

Base Fragment Velocities of Service Navy Projectiles

TABLE VII (Continued)

Rd. 2, 16" H. C. Mk 13-4 (Continued)

<u>Frame in Which Hit Occurred</u>	<u>Frag. No.</u>	<u>No. Fragments</u>	<u>Frag. wt. (grams)</u>	<u>Velocity (f/s)</u>
99	(M)	1		2050
103	(X)	1		1970
103	(Y)	1		1970
104	(D)	1	113	1960
104	(A)	1	368	1960
104	(U)	1		1960
105	(I)	1	74.9	1940
111	(B)	1		1830
115	(R)	1		1770
Median				2150
Average				2330