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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

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REPORT NO. 968

FRAGMENTATION OF PROJECTILES AND WARHEADS

18th Partial Report

STATIC FRAGMENTATION OF BRANDT 120mm MORTAR AMMUNITION

FINAL Report

Copy No. 9

Task Assignment NPG-Re2c-35-1-52

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55AA 21153

CONFIDENTIAL

NPG REPORT NO. 968

Static Fragmentation of Brandt 120mm Mortar Ammunition

PART A

SYNOPSIS

1. This test was conducted to determine the fragmentation characteristics of Light and Heavy Brandt 120mm mortar ammunition.

2. The fragmentation characteristics of the Light and Heavy 120mm Brandt Mortars were as follows:

	Light	Heavy
No. Hits in total polar zone 50° - 140°	873	1340
Median Fragment Velocity (ft/sec) in polar zone 80° - 110°	3930	4900
No. Head Fragments in weight Groups: 5/8 - 2 1/2 grams	768	1236
2 1/2 - 10 grams	564	715
10 - 40 grams	237	188
40 - 160 grams	7	29

JUN 7 1955

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Static Fragmentation of Brandt 120mm Mortar Ammunition

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Static Fragmentation of Brandt 120mm Mortar Ammunition

PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re2c-35-1-52, reference (b).

2. REFERENCES:

a. BUORD Conf ltr NP9 Re2c-HRK:bac Ser 28034 of 7 Nov 1951
b. BUORD Conf ltr NP9 Re2c-HRK:saw Ser 23964 of 4 Aug 1951
c. CMC Restr ltr A0-11-mlb to BUORD of 23 July 1951
d. Picatinny Arsenal Restr Report Serial No. 1823 of 14 Aug 1951

3. BACKGROUND:

The Commandant of the Marine Corps requested the Bureau of Ordnance in reference (c) to give standard Navy tests for storage compatibility, handling, shipment, and fragmentation of Brandt 120mm mortar ammunition. Reference (a) requested the Proving Ground to determine the fragmentation characteristics of light and heavy Brandt 120mm mortar ammunition.

4. OBJECT OF TEST:

This test was conducted to determine the fragmentation characteristics of light and heavy Brandt 120mm mortar ammunition.

5. PERIOD OF TEST:

a.	Date Project Letter	7 November 1951
b.	Date All Necessary Material Received	3 January 1952
c.	Date Commenced Test	8 January 1952
d.	Test Completed	18 February 1952

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEMS UNDER TEST:

Two types of Brandt 120mm Mortars, light and heavy, were tested. Reference (d) contained examination data of both types which were obtained by Picatinny Arsenal. Some of these data are included in the following descriptions.

a. Light Mortar	Approx. Wt. and Dimensions
Empty shell, w/o Fin Assembly	18.9 lbs.
Nose Fuze, modified at NOL	.4 lbs.
Fin Assembly (empty)	3.2 lbs.
*Explosive Load	5.9 lbs.
Total Weight before fragmentation	28.4 lbs.
Length of Shell with adapter	16.15 inches
Diameter at Bourrelet	4.682 inches
Wall thickness at forward bourrelet	0.478 inches
Wall thickness 1" forward of base cavity	0.329 inches

b. Heavy Mortar	Approx. Wt. and Dimensions
Empty shell, w/o Fin Assembly	24.0 lbs.
Nose Fuze, modified at NOL	.4 lbs.
Fin Assembly (empty)	3.2 lbs.
*Explosive Load	9.7 lbs.
Total Weight before fragmentation	37.3 lbs.
Length of shell with adapter	21.91 inches
Diameter at Bourrelet	4.684 inches
Wall thickness at forward bourrelet	0.381 inches
Wall thickness 1" forward of base cavity	0.244 inches

* The explosive loads of these mortars were as follows:

Charge	Explosive	Weight (lbs) Light	Heavy
Booster	Picric Acid	.04	.05
Core	TNT	.23	1.12
Bursting	TNT	5.68	8.54
Total explosive charge weight:		5.95	9.71

All mortars detonated in these tests were with empty fin assemblies. All fuzes were combination point detonating or delay, Type V18-1-R, and were modified by the Naval Ordnance Laboratory for static detonation. Photographs of these mortars are shown in Figures 1, 2, and 3.

7. PROCEDURE:

a. Space distribution data were obtained in a 30' radius semi-circular space distribution arena having 1/8" mild steel panels 5' high, marked off into 5° polar angle zones about the axis of the mortar with the nose pointing toward 0°. Complete penetrations of the panels were recorded.

b. Fragment velocity determinations were obtained by the usual high speed photographic technique in a 30 foot radius arena. The camera used was a 35mm Fastax. Fragment velocities obtained are the mean velocities over the first thirty feet of travel of beam spray (polar angle 80° - 110°) fragments.

c. The determination of fragment mass distribution was conducted in a sawdust-filled chamber. Each mortar was supported on its side in a cane fiberboard box. After each detonation, the sawdust was sifted and the fragments collected with the tail (fin) assembly fragments and the fuze fragments separated and classified separately from the mortar body fragments.

d. The forty rounds of mortars were fired as follows:

Mortar Type	No. of Rounds		
	Mass	Space	Velocity
Heavy	5	9	6
Light	5	9	6

8. RESULTS AND DISCUSSION:

a. Space Distribution:

Detailed space distribution data are listed in Tables I and II and the nine (9) round average of fragment hits per total zones are summarized as follows:

Polar Zone	Light Mortar	Heavy Mortar
0°-50°	4	8
50°-90°	232	293
90°-110°	590	928
110°-140°	51	119
140°-180°	0	0
Totals (0°-180°)	877	1348

The heavy 120mm mortar produced an average of approximately 50% more fragment hits than the light mortar.

b. Fragment Velocity:

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

Mortar Type	6 Rd. Average Median Fragment Velocity Polar Angle Zone (80°-110°)
Light	3930 ft./sec.
Heavy	4900 ft./sec.

The average median fragment velocity of the heavy 120mm mortar was approximately 25% higher than that of the light 120mm mortar.

c. Mass Distribution:

Detailed fragment mass distribution data are listed in Tables V and VI and photographs of each round are shown in Figures 4 to 13 inclusive. The data are summarized as follows.

Mortar Type	5 Rd. Average Number of Fragments					
	5/8-2 1/2 grams	2 1/2-10 grams	10-40 grams	40-160 grams	160-640 grams	640+ grams
Light	768	564	237	7	0	0
Heavy	1236	715	183	29	1	0

PART D

CONCLUSIONS

9. The fragmentation characteristics of the Light and Heavy 120mm Brandt Mortars were as follows:

	Light	Heavy
No. Hits in total polar zone 50° - 140°	873	1340
Median Fragment Velocity (ft/sec) in polar zone 80° - 110°	3930	4900
No. Head Fragments in weight Groups: 5/8 - 2 1/2 grams	768	1236
2 1/2 - 10 grams	564	715
10 - 40 grams	237	188
40 - 160 grams	7	29

Static Fragmentation of Brandt 120mm Mortar Ammunition

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NPG REPORT NO. 968

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Eighteenth Partial Report

on

Fragmentation of Projectiles and Warheads

- -

Final Report

on

Static Fragmentation of

Brandt 120mm Mortar Ammunition

JUN 7 1955

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Light and Heavy Brandt 120mm Mortar Ammunition

Figure 1

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NPG-47541

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Sectioned View of Light Brandt 120mm Mortar.

1. Bursting Charge
2. Core
3. Shell Body
4. Booster Cup
5. Booster Charge
6. Fuze Well Cup
7. Adapter

Figure 2

NP9-47542

8 JANUARY 1952

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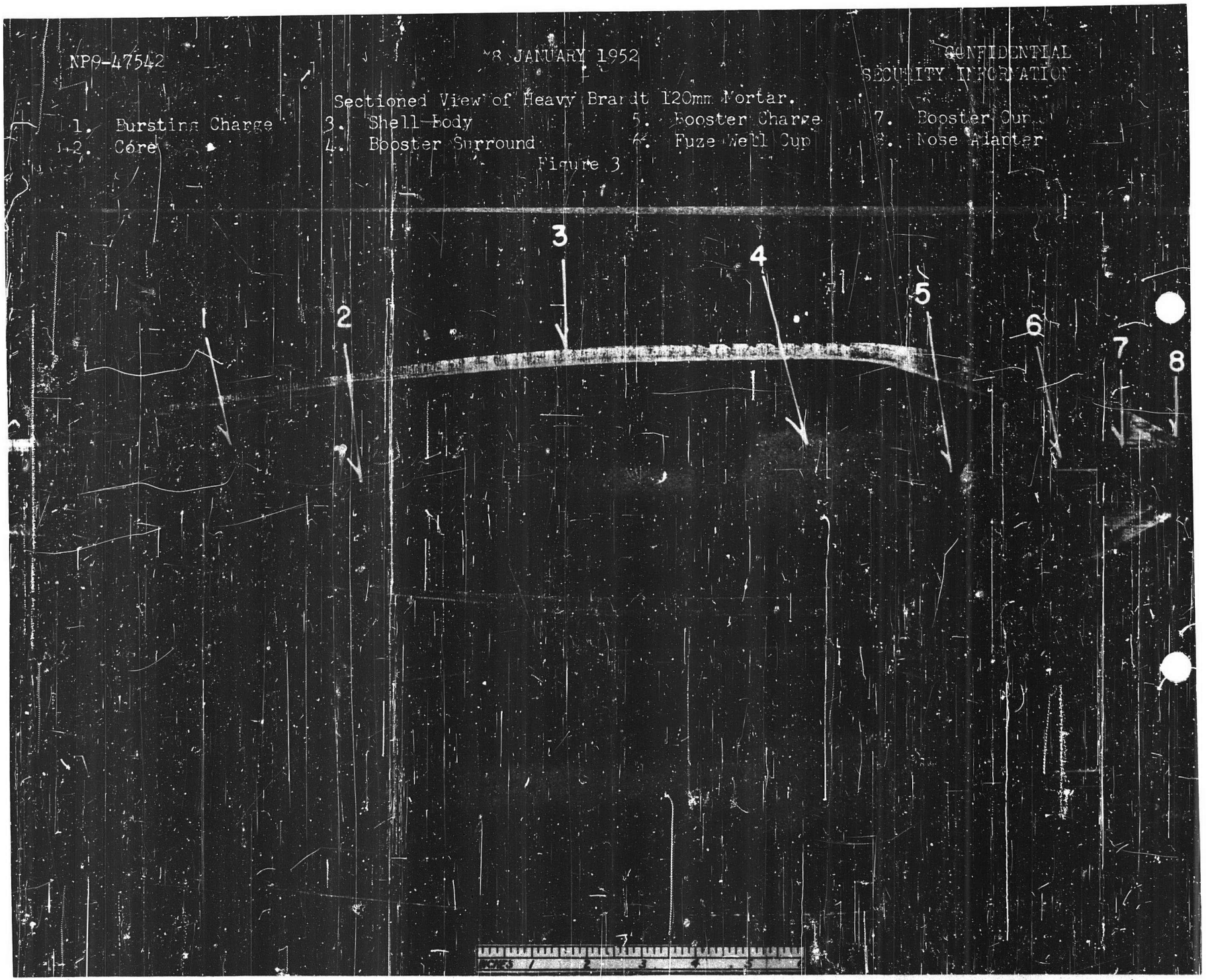
Sectioned View of Heavy Brandt 120mm Mortar.

1. Bursting Charge
2. Core
3. Shell Body
4. Booster Surround
5. Booster Charge
6. Fuze Well Cup
7. Booster Cup
8. Nose Adapter

Figure 3



Static Fragmentation of Brandt 120mm Mortar Ammunition

TABLE I

SPACE DISTRIBUTION DATA

30' Radius Space Arena
1/8" MS panels 5" high
120mm Light Brandt Mortars

8 January 1952

Zone, Degrees	Rd. 1	Rd. 2	Rd. 3	Rd. 4	Rd. 5	Rd. 6	Rd. 7	Rd. 8	Rd. 9
0-5	.5	.5		.5			.5		
5-10									
10-15									
15-20									
20-25									
25-30									
30-35								1	1
35-40									
40-45									
45-50									
50-55				1					
55-60	1	1		2	1	1		1	
60-65	3		1	1	3	1	1		2
65-70	1	2	1		1			2	1
70-75	3	1	1	1		1			1
75-80	1	3				1		1	1
80-85	1	1	1		1		2		
85-90		4			2			2	1
90-95	4	1	6	3	4	8	2	5	3
95-100	3	4	7	4		2	4	2	3
100-105	5	6	6	5	3	5	4	3	9
105-110	4	3	3	4	5	2	7	1	4
110-115			1		1			1	1
115-120				1	2	1			
120-125					1	1			
125-130			1			1	1		1
130-135			1				1	1	
135-140									
140-145									
145-150									
150-155									
155-160									
160-165									
165-170									
170-175									
175-180									

Static Fragmentation of Brandt 120mm Mortar Ammunition

TABLE I (Continued)

SPACE DISTRIBUTION DATA

30' Radius Space Arena
1/8" MS panels 5" high
120mm Light Brandt Mortars

8 January 1952

Zone, Degrees	Average Impacts Per 5° Zone on Panel	Average Impacts Per Total 5° Zone	Average Impacts Per Unit Solid Angle
0-5	0.2	.4	17
5-10			
10-15			
15-20			
20-25			
25-30			
30-35	0.2	4	14
35-40			
40-45			
45-50			
50-55	0.1	3	7
55-60	0.8	25	60
60-65	1.3	44	89
65-70	0.9	30	60
70-75	0.9	30	60
75-80	0.8	30	60
80-85	0.7	30	50
85-90	1	40	70
90-95	4	150	300
95-100	3.2	119	220
100-105	5.1	188	350
105-110	3.7	133	250
110-115	0.4	13	30
115-120	0.4	13	30
120-125	0.2	6	14
125-130	0.4	11	30
130-135	0.3	8	20
135-140			
140-145			
145-150			
150-155			
155-160			
160-165			
165-170			
170-175			
175-180			

Static Fragmentation of Brandt 120mm Mortar Ammunition

TABLE II

SPACE DISTRIBUTION DATA

30' Radius Space Arena
1/8" MS panels 5" high
120mm Heavy Brandt Mortars

8 January 1952

Zone, Degrees	Rd. 1	Rd. 2	Rd. 3	Rd. 4	Rd. 5	Rd. 6	Rd. 7	Rd. 8	Rd. 9
0-5	.5	.5			.5	.5		.5	.5
5-10									
10-15									
15-20			1	1					
20-25	1								
25-30									
30-35									
35-40				1					
40-45									
45-50									
50-55									
55-60			1						
60-65	1	2	1		1		4	2	
65-70	2	2	1	1	3	1	3	3	2
70-75	1	2	2	4	1	2	2	2	2
75-80		1	1	4		1	2		1
80-85		1	2	3		8			
85-90	1		4						
90-95	7	3	1	3	3	3	3	2	6
95-100	11	4	5	6	4	7	9	6	9
100-105	2	8	7	7	13	6	6	10	6
105-110	6	10	9	6	9	6	7	7	9
110-115	4	2	2	2	2	3		1	1
115-120					2		1	4	1
120-125	1	1			1		1		
125-130		1							
130-135				1					
135-140	1	1							
140-145									
145-150									
150-155									
155-160									
160-165									
165-170									
170-175									
175-180									

TABLE II (Continued)

SPACE DISTRIBUTION DATA

30' Radius Space Arena
1/8" MS panels 5" high
120mm Heavy Brandt Mortars

8 January 1952

Zone, Degrees	Average Impacts Per 5° Zone on Panel	Average Impacts Per Total 5° Zone	Average Impacts Per Unit Solid Angle
0-5	0.3	.6	30
5-10			
10-15			
15-20	0.2	2	13
20-25	0.2	3	13
25-30			
30-35			
35-40	0.1	2	7
40-45			
45-50			
50-55			
55-60	0.1	3	7
60-65	1	30	70
65-70	2	70	140
70-75	2	70	140
75-80	1	40	70
80-85	1.6	60	110
85-90	0.6	20	40
90-95	3.4	128	230
95-100	6.8	250	470
100-105	7.2	270	500
105-110	7.7	280	530
110-115	1.9	66	130
115-120	0.9	30	60
120-125	0.4	12	30
125-130	0.1	3	7
130-135	0.1	3	7
135-140	0.2	5	13
140-145			
145-150			
150-155			
155-160			
160-165			
165-170			
170-175			
175-180			

TABLE III

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3270 frames per sec.

Rd. 1, Light 120mm — TNT Filler

Total Weight 28.34 Lbs. — Filler Weight 5.95 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
21	5	4670
22	5	4460
23	12	4270
24	4	4090
25	5	3920
26	9	3770
27	7	3630
28	3	3500
29	4	3380
30	7	3270
31	5	3160
33	2	2970
Median		3900
Average		3840

TABLE III (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3270 frames per sec.

Rd. 2, Light 120mm — TNT Filler

Total Weight 28.44 Lbs. — Filler Weight 5.95 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
21	3	4670
22	7	4460
23	14	4270
24	9	4090
25	7	3920
26	9	3770
27	8	3630
28	8	3500
29	7	3380
30	5	3270
31	3	3160
33	1	2970
Median		3950
Average		3860

TABLE III (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3240 frames per sec.

Rd. 3, Light 120mm — TNT Filler

Total Weight 28.23 Lbs. — Filler Weight 5.95 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
22	13	4420
23	9	4230
24	7	4050
25	6	3890
26	7	3740
27	8	3600
28	14	3470
29	6	3350
30	5	3240
31	1	3140
32	1	3040
Median		3800
Average		3810

TABLE III (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3210 frames per sec.

Rd. 4, Light 120mm — TNT Filler

Total Weight 28.24 Lbs. — Filler Weight 5.95 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
20	1	4820
21	15	4590
22	10	4380
23	7	4190
24	12	4010
25	12	3850
26	14	3700
27	11	3570
28	9	3440
29	4	3320
31	1	3110
Median		4010
Average		3950

TABLE III (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3090 frames per sec.

Rd. 5, Light 120mm — TNT Filler

Total Weight 28.28 Lbs. — Filler Weight 5.95 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
20	5	4640
21	10	4410
22	13	4210
23	14	4030
24	8	3860
25	10	3710
26	11	3570
27	15	3430
28	8	3310
29	1	3200
30	2	3090
Median		3950
Average		3850

TABLE III (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3125 frames per sec.

Rd. 6, Light 120mm — TNT Filler

Total Weight 28.27 Lbs. — Filler Weight 5.95 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
21	5	4460
22	13	4260
23	9	4080
24	8	3910
25	11	3750
26	12	3610
27	6	3470
28	13	3350
29	7	3230
30	6	3130
Median		3940
Average		3730

Static Fragmentation of Brandt 120mm Mortar Ammunition

TABLE IV

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3225 frames per sec.

Rd. 1, Heavy 120mm — TNT Filler

Total Weight 36.91 Lbs. — Filler Weight 9.71 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
17	1	5690
18	6	5380
19	23	5090
20	38	4840
21	23	4610
22	12	4400
23	4	4210
Median		4920
Average		4810

TABLE IV (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3240 frames per sec.

Rd. 2, Heavy 120mm — TNT Filler

Total Weight 37.49 Lbs. — Filler Weight 9.71 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
18	15	5400
19	21	5120
20	26	4860
21	25	4630
22	18	4420
23	8	4230
24	4	4050
25	2	3890
Median		4900
Average		4770

TABLE IV (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3240 frames per sec.

Rd. 3, Heavy 120mm — TNT Filler

Total Weight 37.18 Lbs. — Filler Weight 9.71 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
16	1	6080
17	1	5720
18	9	5400
19	30	5120
20	34	4860
21	10	4630
22	6	4420
23	1	4230
24	3	4050
Median		5050
Average		4930

TABLE IV (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3240 frames per sec.

Rd. 4, Heavy 120mm — TNT Filler

Total Weight 36.68 Lbs. — Filler Weight 9.71 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
18	6	5400
19	18	5120
20	27	4860
21	24	4630
22	12	4420
23	5	4230
24	2	4050
25	2	3890
26	1	3740
27	3	3600
Median		4860
Average		4720

TABLE IV (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3210 frames per sec.

Rd. 5, Heavy 120mm — TNT Filler

Total Weight 37.20 Lbs. — Filler Weight 9.71 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
18	17	5350
19	12	5070
20	18	4820
21	31	4590
22	11	4380
23	2	4190
Median		4940
Average		4810

TABLE IV (Continued)

FRAGMENT VELOCITY DATA

35mm Fastax Camera — 3240 frames per sec.

Rd. 6, Heavy 120mm — TNT Filler

Total Weight 37.33 Lbs. — Filler Weight 9.71 Lbs.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
19	8	5120
20	25	4860
21	28	4630
22	17	4420
23	8	4230
24	2	4050
Median		4750
Average		4650

TABLE V

MASS DISTRIBUTION DATA

FRAGMENTATION OF LIGHT 120mm BRANDT MORTARS:
NUMBER AND WEIGHT OF RECOVERED FRAGMENTS

Rd. No.	Comp. Wt. lb.	Filler Wt. lb.	0-0.625 Grams Wt. Gms.	0.625-1.25 Grams Wt. Gms.	1.25-2.5 Grams Wt. Gms.	No.	2.5-5 Grams Wt. Gms.	No.	5-10 Grams Wt. Gms.	No.	10-20 Grams Wt. Gms.	No.	20-40 Grams Wt. Gms.	No.	40-80 Grams Wt. Gms.	No.	640+ Grams Wt. Gms.	No.	Fuze Frags. Total Wt. Gms.	No.	TOTAL Wt. Gms.	No.	Photo. No. NPG
HEAD																							
1	28.29	5.95	564	418	485	722	412	1159	329	1581	236	2261	163	1754	70	83	2	--	--	217	90	8759	1787	48314
2	28.65	5.95	461	392	472	668	389	1129	325	1555	235	2298	168	2097	79	315	7	--	--	187	82	9102	1757	48518
3	28.33	5.95	367	278	324	605	354	1154	320	2052	293	2090	152	1687	62	247	9	--	--	223	88	8703	1602	48540
4	28.35	5.95	382	320	365	574	327	1013	284	1584	226	2458	182	1824	67	594	13	--	--	154	127	8903	1591	48644
5	28.31	5.95	374	328	387	555	323	1100	308	1809	263	2209	164	2027	77	290	6	--	--	207	107	8897	1635	48645
TAIL																							
1	--	--	--	--	--	3	2	7	2	6	1	12	1	58	2	42	1	1019	1	--	--	1147	10	48314
2	--	--	--	--	--	2	1	3	1	12	2	24	2	75	3	--	--	1131	1	--	--	1247	10	48518
3	--	--	--	--	--	--	--	--	--	9	1	11	1	94	3	--	--	1129	1	--	--	1243	6	48540
4	--	--	--	--	--	--	--	4	1	--	--	47	4	65	2	--	--	1116	1	--	--	1232	8	48644
5	--	--	--	--	--	--	--	8	2	7	1	42	3	53	2	--	--	1122	1	--	--	1232	9	48645
AVERAGE HEAD																							
	28.39	--	430	347	407	625	361	1111	313	1716	251	2263	166	1878	71	306	7.4	--	--	198	99	8873	1674	--
AVERAGE TAIL																							
		--	--	--	--	1	.6	4.4	1.2	7	1	27	2.2	69	24	8.4	.2	1103	1	--	--	1220	9	--

TABLE VI

MASS DISTRIBUTION DATA

FRAGMENTATION OF HEAVY 120mm BRANDT MORTARS.
NUMBER AND WEIGHT OF RECOVERED FRAGMENTS

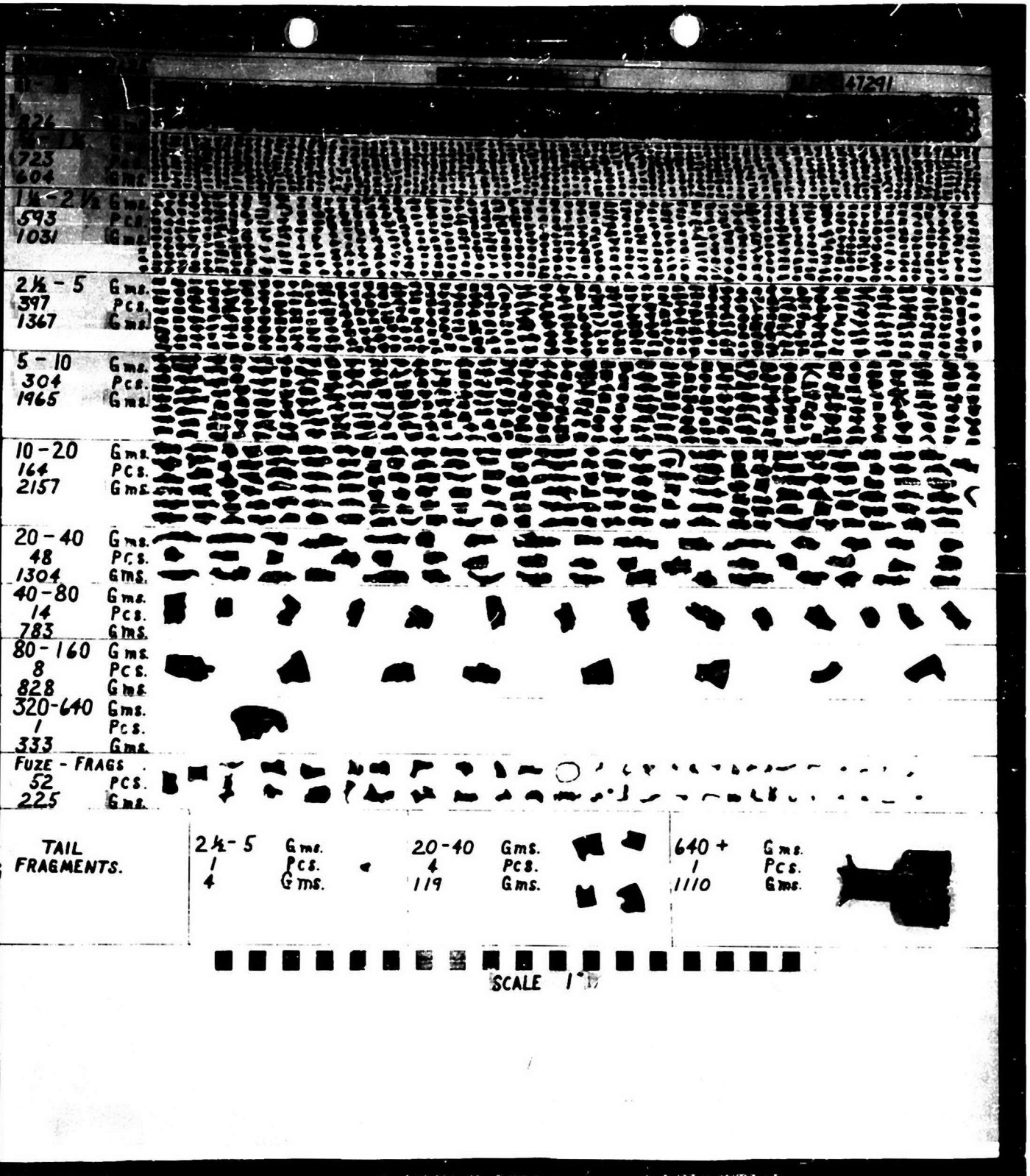
ll-er t. o.	0-0.625 Grams Wt. Gms.	0.625-1.25 Grams Wt. Gms.	1.25-2.5 Grams No.	Wt. Gms.	2.5-5 Grams No.	Wt. Gms.	5-10 Grams No.	Wt. Gms.	10-20 Grams No.	Wt. Gms.	20-40 Grams No.	Wt. Gms.	40-80 Grams No.	Wt. Gms.	80-160 Grams No.	Wt. Gms.	160-320 Grams No.	Wt. Gms.	320-640 Grams No.	Wt. Gms.	640+ Grams No.	Wt. Gms.	Fuze Frags. Total No.	Wt. Gms.	TOTAL No.	Wt. Gms.	Photo. No. NPG
.71	826	604	723	1031	593	1367	397	1965	304	2157	164	1304	48	783	14	828	8	-	-	333	1	----	-	225	52	11423	2304	47291
.71	847	571	679	976	570	1495	442	1940	287	1583	118	1403	49	1282	23	976	8	171	1	-	-	----	-	218	46	11459	2223	47422
.71	704	528	611	930	536	1505	427	1710	253	2020	148	1576	60	1084	19	943	9	228	1	-	-	----	-	234	50	11462	2114	47481
.71	836	607	698	1026	593	1425	404	1838	263	1773	128	1016	35	1221	24	1133	11	204	1	-	-	----	-	236	55	11315	2212	47539
.71	701	511	581	1040	596	1660	483	2072	314	1975	149	1034	41	1170	22	736	7	167	1	-	-	----	-	234	58	11300	2252	47570
-	-	-	-	-	-	4	1	-	-	-	-	119	4	-	-	-	-	-	-	-	-	1110	1	-	-	1233	6	47291
-	-	-	-	-	-	-	-	-	-	29	2	-	-	113	2	-	-	-	-	-	-	1093	1	-	-	1235	5	47422
-	-	1	1	-	-	6	2	7	1	58	4	-	-	64	1	-	-	-	-	-	-	1097	1	-	-	1233	10	47481
-	-	-	-	-	-	-	-	6	1	38	3	-	-	66	1	-	-	-	-	-	-	1128	1	-	-	1238	6	47539
-	-	-	-	-	-	5	2	18	3	-	-	43	2	-	-	88	1	-	-	-	-	1086	1	-	-	1240	9	47570
.71	783	564	658	1001	578	1490	431	1905	284	1902	141	1267	47	1108	20	923	9	154	0.8	67	0.2	----	-	229	52	11392	2221	--
-	-	0.2	0.2	-	-	3	1	6	1	25	2	32	1.2	49	0.8	18	0.2	-	-	-	-	1102	1	-	-	1236	7	--

TABLE VI

MASS DISTRIBUTION DATA

FRAGMENTATION OF HEAVY 120mm BRANDT MORTARS:
NUMBER AND WEIGHT OF RECOVERED FRAGMENTS

Rd. No.	Comp. Wt. lb.	Filler Wt. lb.	0-0.625 Grams Wt. Gms.	0.625-1.25 Grams Wt. Gms.	1.25-2.5 Grams No.	Wt. Gms.	2.5-5 Grams No.	Wt. Gms.	5-10 Grams No.	Wt. Gms.	10-20 Grams No.	Wt. Gms.	20-40 Grams No.	Wt. Gms.	40-80 Grams No.	Wt. Gms.	80-160 Grams No.	Wt. Gms.	160-320 Grams No.	Wt. Gms.	320-640 Grams No.	Wt. Gms.	640+ Grams No.	Wt. Gms.	Fuze Frags. Total No.	Wt. Gms.	TOTAL No.	Wt. Gms.	Pl
HEAD																													
1	37.38	9.71	826	604	723	1031	593	1367	397	1965	304	2157	164	1304	48	783	14	828	8	-	-	333	1	----	- 225	52	11423	2304	4
2	37.49	9.71	847	571	679	976	570	1495	442	1940	287	1583	118	1403	49	1282	23	976	8	171	1	-	-	----	- 218	46	11459	2223	4
3	37.54	9.71	704	528	611	930	536	1505	427	1710	253	2020	148	1576	60	1084	19	943	9	228	1	-	-	----	- 234	50	11462	2114	4
4	37.10	9.71	836	607	698	1026	593	1425	404	1838	263	1773	128	1016	35	1221	24	1133	11	204	1	-	-	----	- 236	55	11315	2212	4
5	37.37	9.71	701	511	581	1040	596	1660	483	2072	314	1975	149	1034	41	1170	22	736	7	167	1	-	-	----	- 234	58	11300	2252	4
TAIL																													
1	-	-	-	-	-	-	-	4	1	-	-	-	-	119	4	-	-	-	-	-	-	-	-	1110	1 -	-	1233	6	4
2	-	-	-	-	-	-	-	-	-	-	-	29	2	-	-	113	2	-	-	-	-	-	-	1093	1 -	-	1235	5	4
3	-	-	-	1	1	-	-	6	2	7	1	58	4	-	-	64	1	-	-	-	-	-	-	1097	1 -	-	1233	10	4
4	-	-	-	-	-	-	-	-	-	6	1	38	3	-	-	66	1	-	-	-	-	-	-	1128	1 -	-	1238	6	4
5	-	-	-	-	-	-	-	5	2	18	3	-	-	43	2	-	-	88	1	-	-	-	-	1086	1 -	-	1240	9	4
AVERAGE HEAD																													
	37.38	9.71	783	564	658	1001	578	1490	431	1905	284	1902	141	1267	47	1108	20	923	9	154	0.8	67	0.2	----	- 229	52	11392	2221	
AVERAGE TAIL																													
	-	-	-	0.2	0.2	-	-	3	1	6	1	25	2	32	1.2	49	0.8	18	0.2	-	-	-	-	1102	1 -	-	1236	7	



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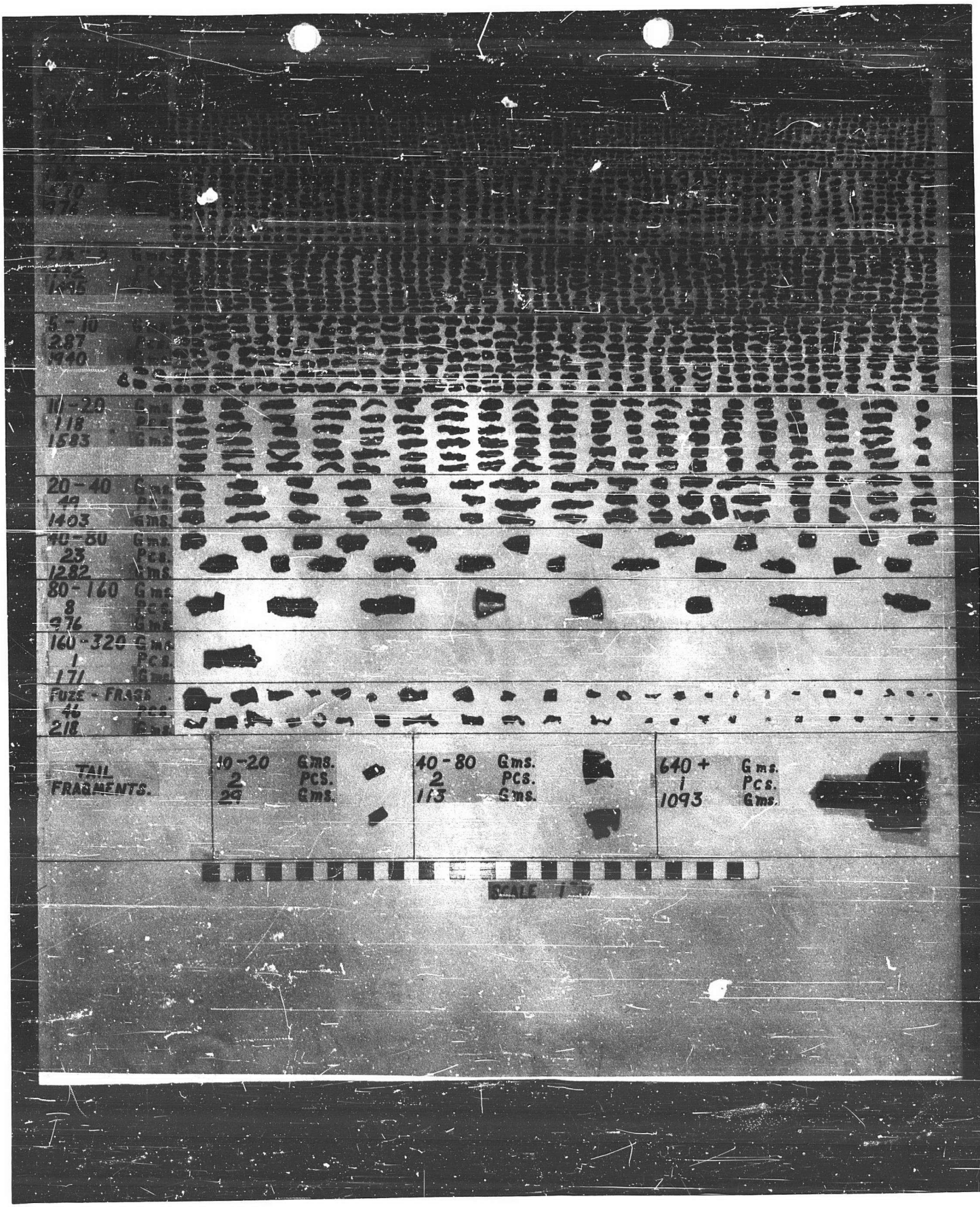
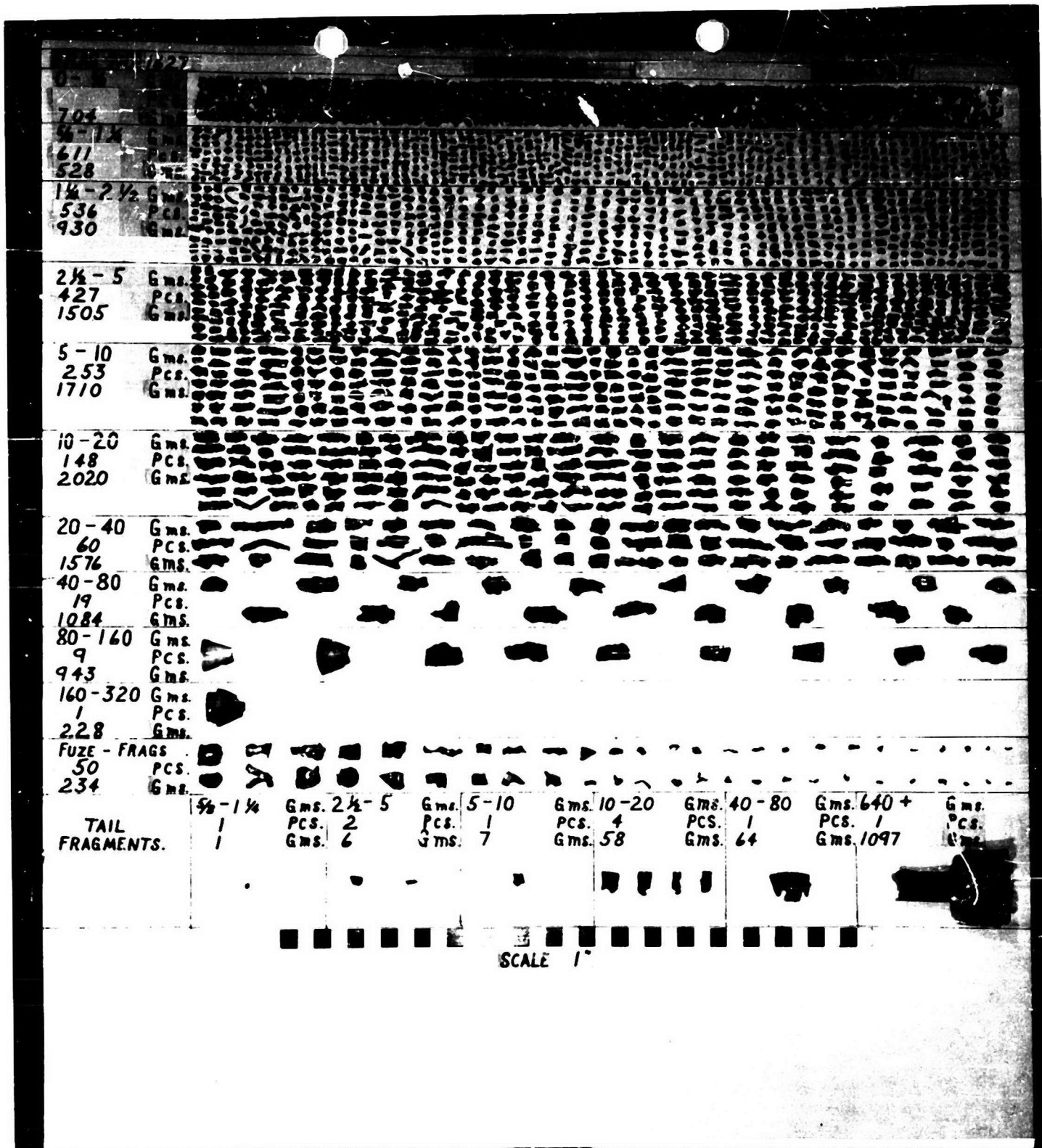
Round No. 1, Mass Distribution of Heavy 105mm Pratt Porter.
Figure 4


5 - 10 Gms.
287 Pcs.
1940 Gms.
10 - 20 Gms.
118 Pcs.
1593 Gms.
20 - 40 Gms.
49 Pcs.
1403 Gms.
40 - 80 Gms.
23 Pcs.
1282 Gms.
80 - 160 Gms.
8 Pcs.
976 Gms.
160 - 320 Gms.
1 Pcs.
171 Gms.
FUZE - FRAGS.
46 Pcs.
218 Gms.
TAIL FRAGMENTS.
10 - 20 Gms.
2 Pcs.
29 Gms.
40 - 80 Gms.
2 Pcs.
113 Gms.
640 + Gms.
1 Pcs.
1093 Gms.
SCALE 1"



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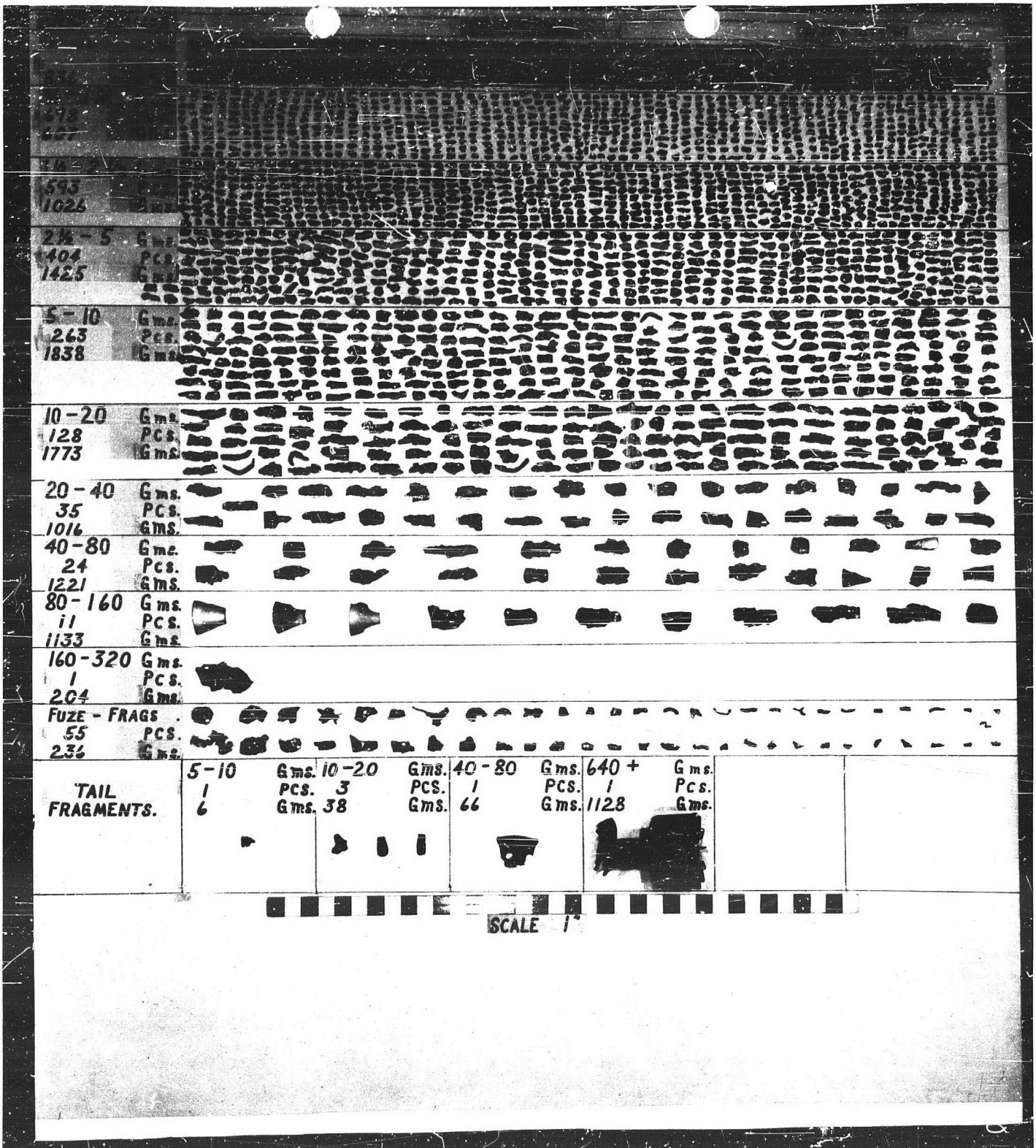
Round No. 3, Mass Distribution of Heavy 120mm Brandt Mortar.
Figure 6



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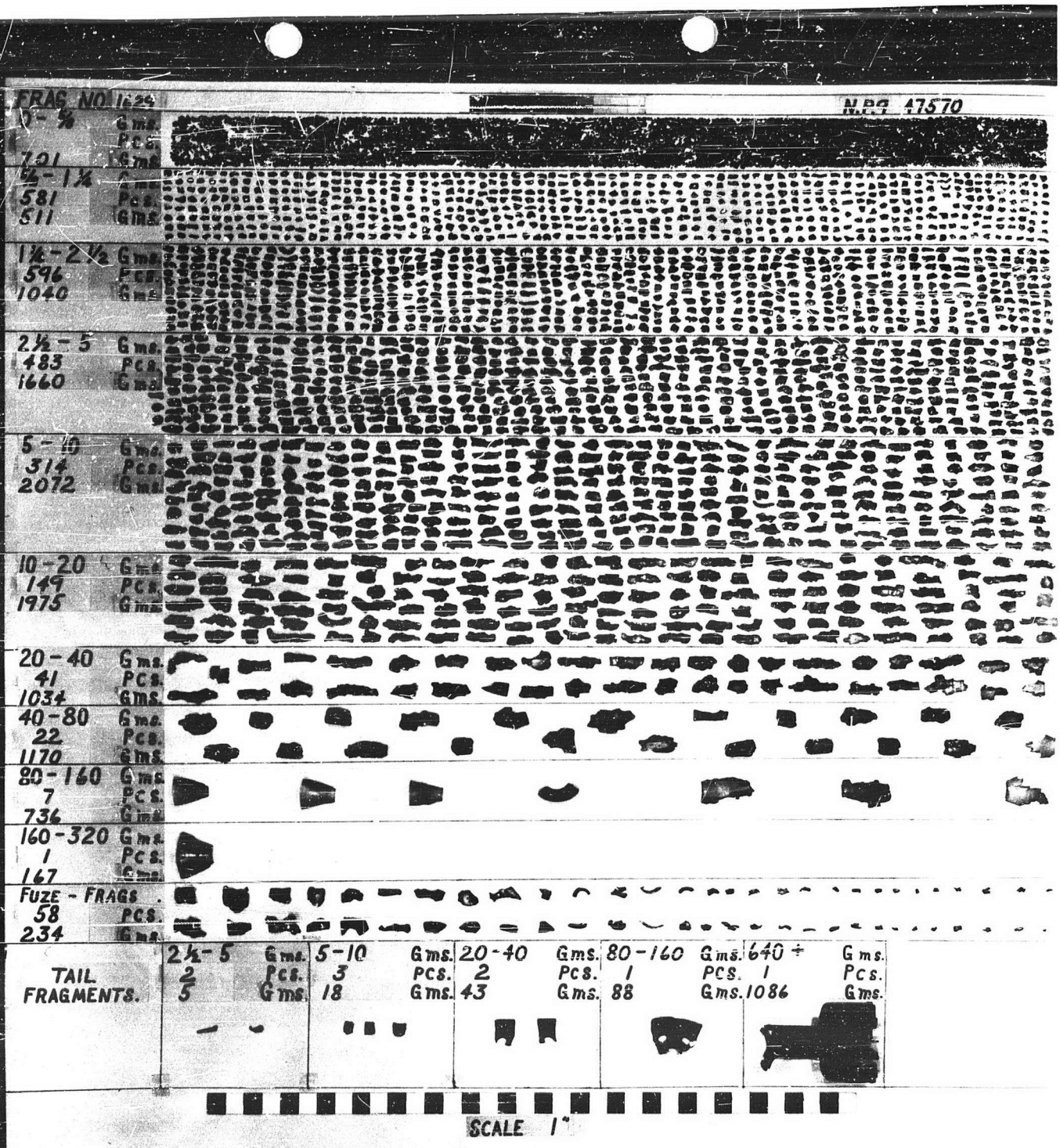
Round No. 4, Mass Distribution of Heavy 120mm Brandt Mortar.

Figure 7



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Round No. 5, Mass Distribution of Heavy 120mm Brandt Mortar.

Figure 8

FRAG AND 1630

N.P.9 48314

0 - ⅛	Gms.	
	Pcs.	
564	Gms.	
⅛ - 1¼	Gms.	
485	Pcs.	
418	Gms.	
1¼ - 2½	Gms.	
412	Pcs.	
722	Gms.	
2½ - 5	Gms.	
329	Pcs.	
1159	Gms.	
5 - 10	Gms.	
236	Pcs.	
1581	Gms.	
10 - 20	Gms.	
163	Pcs.	
2261	Gms.	
20 - 40	Gms.	
70	Pcs.	
1754	Gms.	
40 - 80	Gms.	
2	Pcs.	
83	Gms.	
FUZE - FRAGS		
90	PCS.	
217	Gms.	

TAIL FRAGMENTS.

1¼ - 2½	Gms.	5 - 10	Gms.	20 - 40	Gms.	640 +	Gms.	
2	Pcs.	1	Pcs.	2	Pcs.	1	Pcs.	
3	Gms.	6	Gms.	58	Gms.	1019	Gms.	
2½ - 5	Gms.	10 - 20	Gms.	40 - 80	Gms.			
2	Pcs.	1	Pcs.	1	Pcs.			
7	Gms.	12	Gms.	42	Gms.			

SCALE 1"

FRAG NO 1631

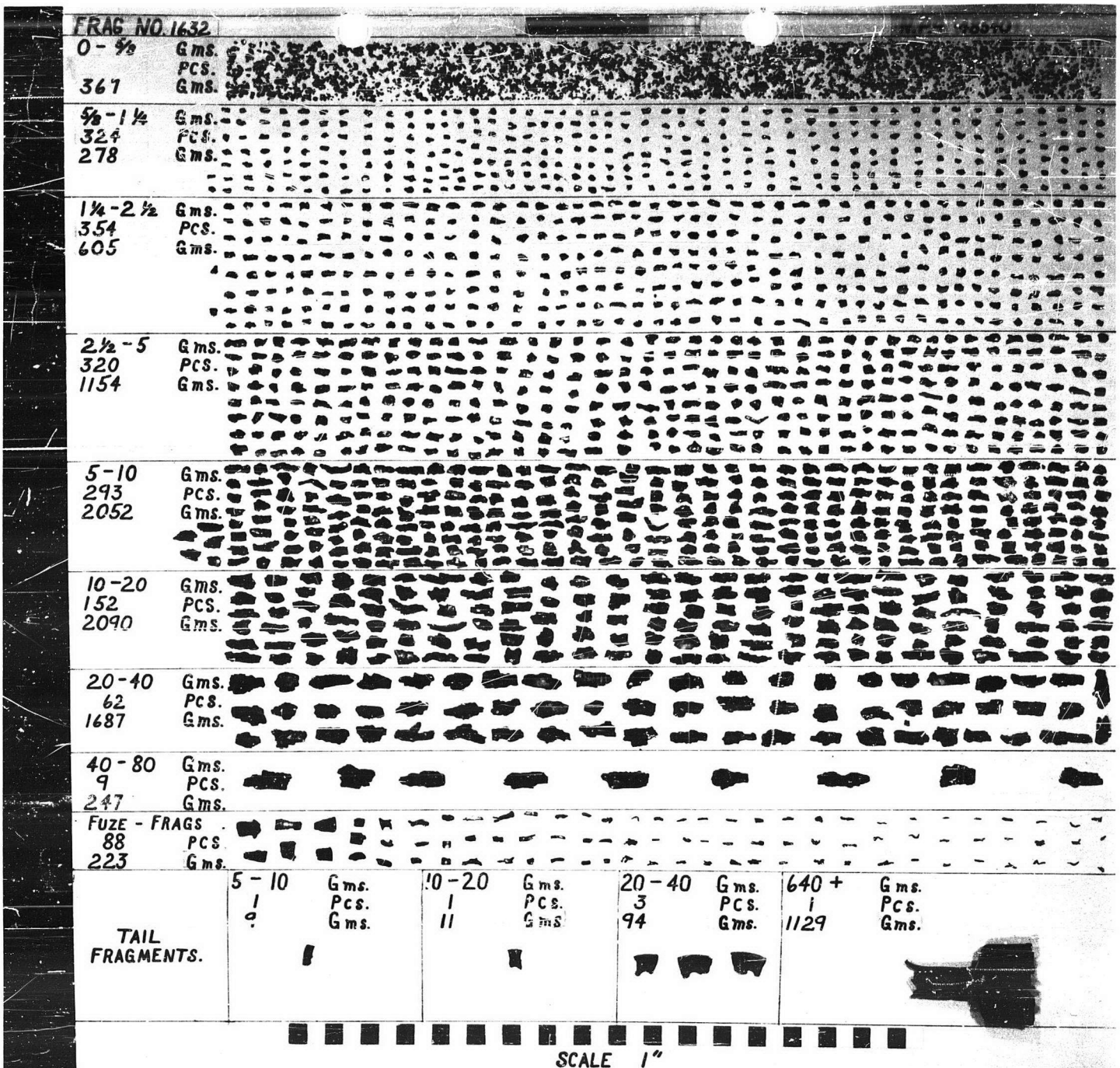
N.P.G. 48518

0 - ½	Gms.										
	PCS.										
461	Gms.										
½ - 1 ½	Gms.										
472	PCS.										
392	Gms.										
1½ - 2 ½	Gms.										
389	PCS.										
668	Gms.										
2½ - 5	Gms.										
325	PCS.										
1129	Gms.										
5 - 10	Gms.										
235	PCS.										
1555	Gms.										
10 - 20	Gms.										
168	PCS.										
2298	Gms.										
20 - 40	Gms.										
79	PCS.										
2097	Gms.										
40 - 80	Gms.										
7	PCS.										
315	Gms.										
FUZE - FRAGS											
82	PCS.										
187	Gms.										

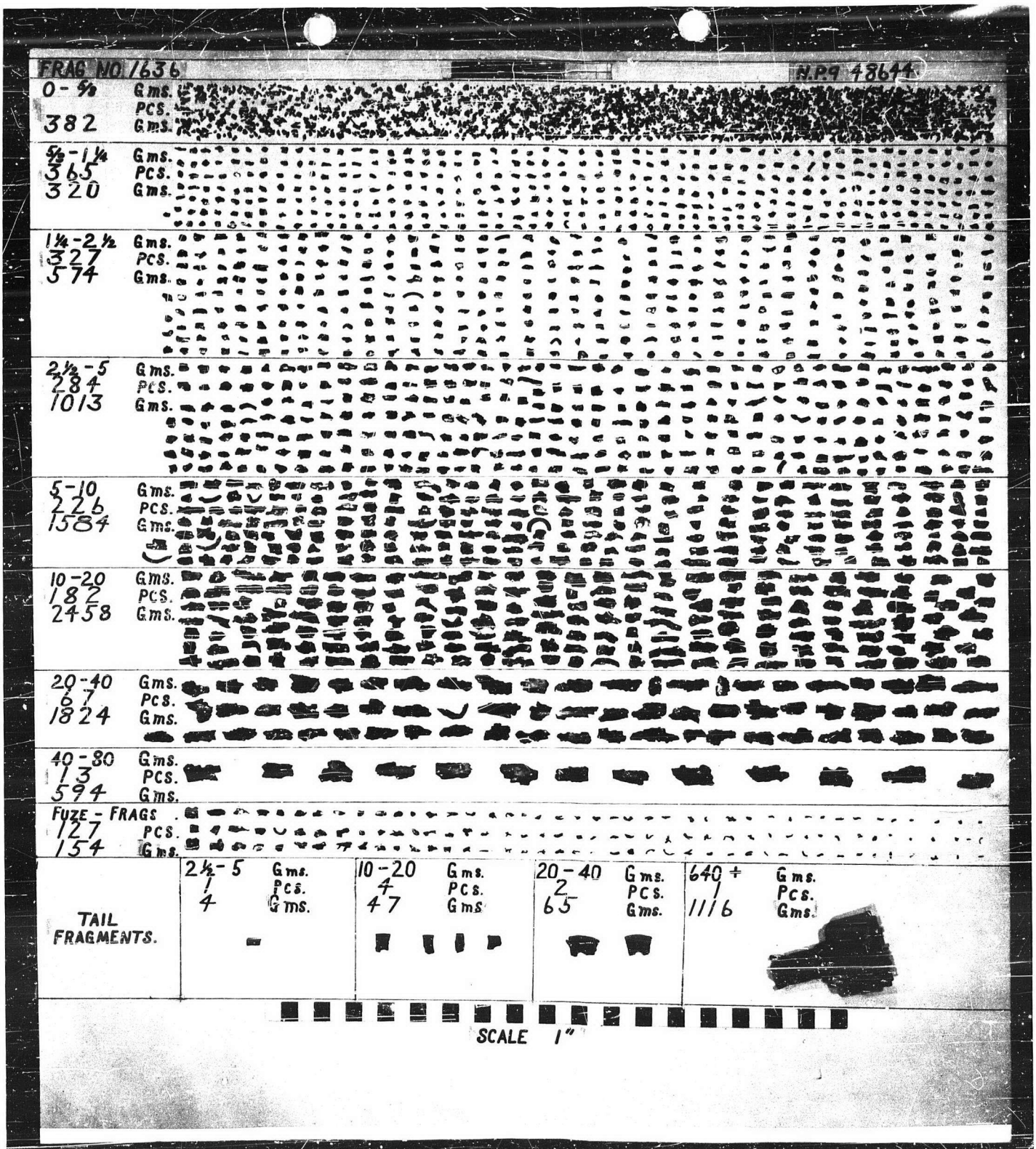
TAIL FRAGMENTS.

1½ - 2½	Gms.	-	5 - 10	Gms.		20 - 40	Gms.		640 +	Gms.	
1	PCS.		2	PCS.		3	PCS.		1	PCS.	
2	Gms.		12	Gms.		75	Gms.		1131	Gms.	
2½ - 5	Gms.	-	10 - 20	Gms.							
1	PCS.		2	PCS.							
3	Gms.		24	Gms.							

SCALE 1"



Round 1. 3. Mass Distribution of Light 120mm Brandt Mortar.
Figure 11



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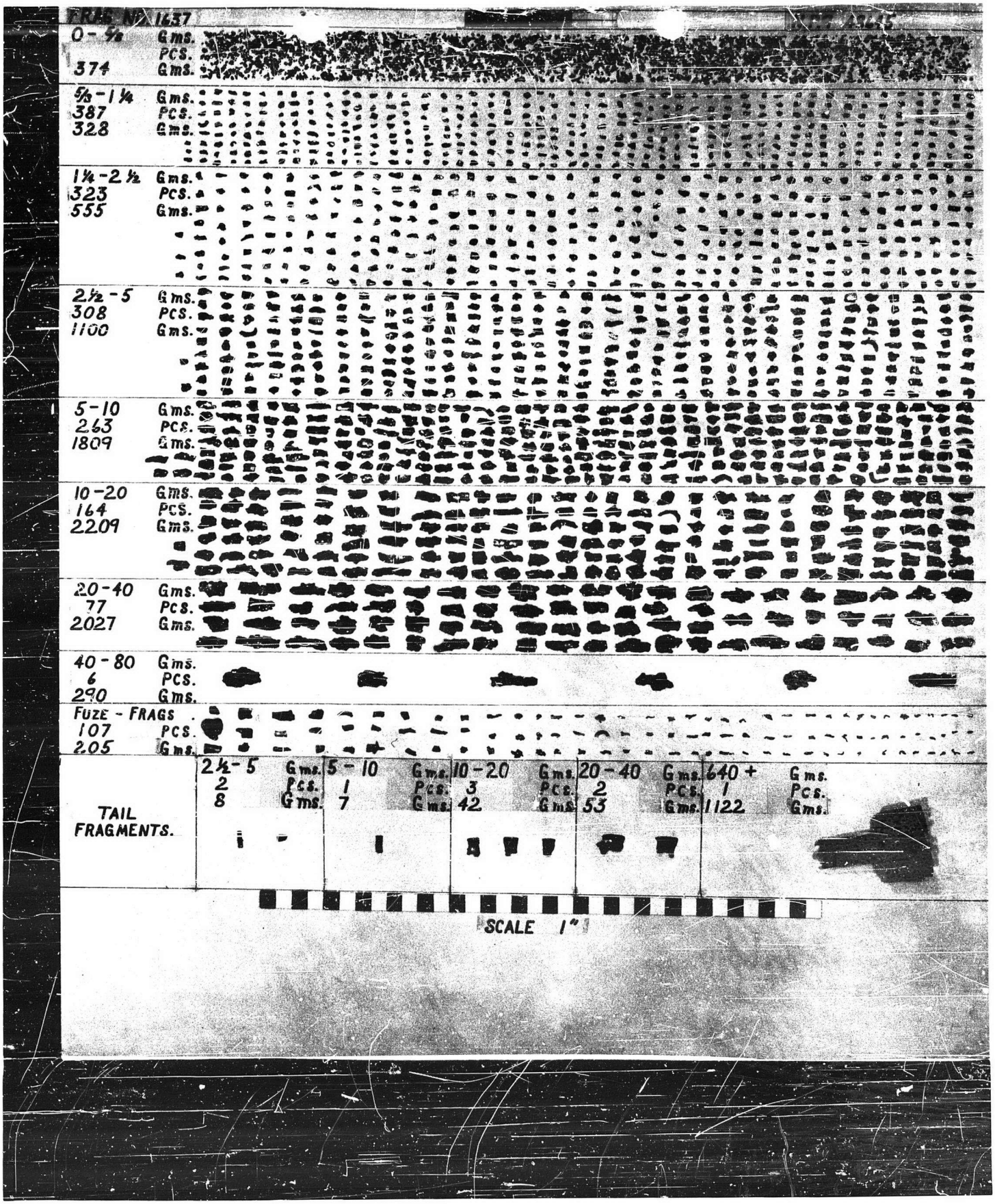
Round No. 4, Mass Distribution of Light 120mm Brandt Mortar.

Figure 12


FRAG. N. 1637
0 - 5/8 Gms.
PCS.
374 Gms.
5/8 - 1 1/4 Gms.
387 PCS.
328 Gms.
1 1/4 - 2 1/2 Gms.
323 PCS.
555 Gms.
2 1/2 - 5 Gms.
308 PCS.
1100 Gms.
5 - 10 Gms.
263 PCS.
1809 Gms.
10 - 20 Gms.
164 PCS.
2209 Gms.
20 - 40 Gms.
77 PCS.
2027 Gms.
40 - 80 Gms.
6 PCS.
290 Gms.
FUZE - FRAGS .
107 PCS.
205 Gms.
TAIL FRAGMENTS.
2 1/2 - 5 Gms. 2 PCS. 8 Gms.
5 - 10 Gms. 1 PCS. 7 Gms.
10 - 20 Gms. 3 PCS. 42 Gms.
20 - 40 Gms. 2 PCS. 53 Gms.
640 + Gms. 1 PCS. 1122 Gms.
SCALE 1"

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