

UNCLASSIFIED

AD NUMBER	
AD025027	
CLASSIFICATION CHANGES	
TO:	unclassified
FROM:	confidential
LIMITATION CHANGES	
TO:	Approved for public release, distribution unlimited
FROM:	Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; OCT 1953. Other requests shall be referred to Naval Proving Ground, Dahlgren, VA.
AUTHORITY	
USNSWC Notice, 2 Jun 1978; USNSWC Notice, 2 Jun 1978	

THIS PAGE IS UNCLASSIFIED

Armed Services Technical Information Agency

AD

PLEASE RETURN THIS COPY TO:

ARMED SERVICES TECHNICAL INFORMATION AGENCY
DOCUMENT SERVICE CENTER
Knott Building, Dayton 2, Ohio

Because of our limited supply you are requested to return this copy as soon as it has served your purposes so that it may be made available to others for reference use. Your cooperation will be appreciated.

25027

NOTICE: WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U. S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

Reproduced by

DOCUMENT SERVICE CENTER

KNOTT BUILDING, DAYTON, 2, OHIO

CONFIDENTIAL

NOTICE: THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 and 794. THE TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

AD No. 25027

ASTIA FILE COPY

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1190

PROJECTILE ROTATING BANDS AND RELATED COMPONENTS

10th Partial Report

FRAGMENTATION TEST OF 3"/50 PROJECTILES MK 33
HAVING WELDED-OVERLAY ROTATING BANDS

FINAL Report

Task

Assignment NPG-Re3b-225-1-53

Copy No. 12

Classification CONFIDENTIAL
SECURITY INFORMATION

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

PART A

SYNOPSIS

1. This test was conducted to determine the effect of a welded-overlay rotating band on the fragmentation characteristics of the 3"/50 AA Projectile Mk 33.

2. a. The fragmentation characteristics of the projectile, Composition A-3 loaded and assembled with VT Fuze Mk 72, did not change significantly when the welded-overlay rotating band was substituted for the standard copper rotating band.

b. The comparative characteristics are as follows:

	<u>Welded-Overlay band</u>	<u>Standard copper band</u>
Average number of effective beam spray hits in total zone 45°-120°	334	318
Beam spray median velocity (ft/sec)	3090	3140
Average Number of fragments (1-1/4 - 205 grams)	517	510

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE OF CONTENTS

	<u>Page</u>
SYNOPSIS	1
TABLE OF CONTENTS.	2
AUTHORITY.	3
REFERENCES	3
BACKGROUND	3
OBJECT OF TEST	3
PERIOD OF TEST	3
DESCRIPTION OF ITEM UNDER TEST	4
PROCEDURE.	4
RESULTS AND DISCUSSION	5
CONCLUSIONS.	6
APPENDIX A - FRAGMENT SPACE DISTRIBUTION	TABLE I 1-2 (Incl)
APPENDIX B - FRAGMENT VELOCITY DATA.	TABLE II 1-3 (Incl)
APPENDIX C - FRAGMENT MASS DISTRIBUTION DATA	TABLE III FIGURES 1-3 (Incl)
APPENDIX D - DISTRIBUTION.	1-2 (Incl)

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3b-225-1-53, reference (b).

2. REFERENCES:

- a. BUORD Rest ltr S78-1(54) Re3b-MRH/MAS:mt of 15 August 1952
- b. BUORD Conf ltr NP9 Re3b-MRH:mt Ser 42696 of 29 July 1952
- c. NPG Conf Report No. 1155 of 26 August 1953
- d. NPG Conf Report No. 1077 of 2 February 1953
- e. NPG Conf Report No. 468 of 31 January 1950

3. BACKGROUND:

a. References (c) and (d) reported the metallurgical and physical properties and ballistic performance of 3"/50 Mk 33 Mod O AA Projectiles having copper welded-overlay rotating bands. The welded-overlay method consists of applying an electric weld bead of band material to the periphery of the projectile, under an inert atmosphere, and machining the bead to the desired band contour. Its advantages include a considerable saving in band material and the elimination of the band seat.

b. The Bureau requested the Naval Proving Ground, in reference (a), to determine if the change in rotating bands would effect the projectile's fragmentation characteristics. The same type of projectile having the conventional copper rotating band was tested previously and reported in reference (e).

4. OBJECT OF TEST:

This test was conducted to determine the effect of a welded-overlay rotating band on the fragmentation characteristics of the 3"/50 AA Projectile Mk 33.

5. PERIOD OF TEST:

- | | |
|---|------------------|
| a. Date Project Letter | 15 August 1952 |
| b. Date All Necessary Material Received | 13 November 1952 |
| c. Date Commenced Test | 16 July 1953 |
| d. Test Completed | 14 August 1953 |

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEM UNDER TEST:

3"/50 Mk 33 Mod 0 Projectile with experimental copper welded-overlay rotating band, Lot W-1, Composition A-3 loaded, and assembled with VT Fuze Mk 72 (26 gram booster) modified for static detonation. The average weights of the ten (10) projectiles tested in pounds are as follows:

<u>Proj. Band</u>	<u>Empty</u>	<u>Filler</u>	<u>Fuze</u>	<u>Total</u>
experimental	9.41	0.83	2.48	12.72
* standard	9.45	0.81	2.48	12.74

* Standard copper band, reference (e) data.

7. PROCEDURE:

a. Mass Distribution Test (3 rounds):

The determination of fragment mass distribution was conducted in a sawdust-filled chamber. Each projectile was supported on its side in a cane fiberboard box. After each detonation, the sawdust was sifted and the fragments collected, cleaned, classified, and photographed.

b. Velocity Test (3 rounds):

Fragment velocity measurements were obtained by the usual high-speed photographic technique using a 35mm Fastax camera. Fragment velocities obtained are the mean velocities over the first 30 feet of travel. The 30' radius velocity plates cover 1/3 of the total solid angle in polar zone 80°-108°.

c. Space Distribution Test (4 rounds):

Fragment space distribution measurements were made in an arena consisting of a complete circle twenty (20) feet in radius. The arena panels were 1/8" mild steel plate, five (5) feet high and marked off in 5° polar angle zones about the axis of the projectile with the nose pointed toward 0°. Complete fragment penetrations of the panels were counted.

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

8. RESULTS AND DISCUSSION:

For comparative purposes the fragmentation data for the 3"/50 Mk 33-0 projectile, having the standard copper rotating band, reported in reference (e), will be included in this report.

a. Space Distribution:

Detailed space distribution data are listed in Table I and the average fragment hits per round are summarized as follows:

<u>Polar Zone</u>	<u>Average Number Hits on Total Zone</u>	
	<u>Welded-overlay</u>	<u>*Standard</u>
0°-45°	3	2
45°-120°	334	318
120°-180°	<u>7</u>	<u>4</u>
Total	344	324

* Standard copper band, reference (e).

b. Fragment Velocity:

Detailed fragment velocity data are listed in Table II. The average median beam spray (80°-108°) velocities are as follows:

<u>Beam Spray Median Velocities (ft/sec)</u>	
<u>Welded-overlay</u>	<u>*Standard</u>
3090	3140

* Standard copper band, reference (e).

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

c. Mass Distribution:

Detailed fragment mass distribution data are listed in Table III. Photographs of the fragments are shown in Figures 1-3. The mass data are summarized as follows:

<u>Mass Group (grams)</u>	<u>Average Number of Fragments</u>	
	<u>Welded-overlay</u>	<u>*Standard</u>
1-1/4 - 2-1/2	204	183
2-1/2 - 5	141	154
5 - 10	82	90
10 - 20	54	55
20 - 40	23	15
40 - 80	7	5
80 - 205	6	8
Total (1-1/4 - 205)	517	510

* Standard copper band, reference (e) data.

PART D

CONCLUSIONS

9. a. The fragmentation characteristics of the 3"/50 Mk 33 Mod 0 Projectiles, Composition A-3 loaded and assembled with VT Fuze Mk 72, did not change significantly when the welded-overlay rotating band was substituted for the standard copper rotating band.

b. The comparative characteristics are as follows:

	<u>Welded-Overlay band</u>	<u>Standard copper band</u>
Average number of effective beam spray in total zone 45°-120°	334	318
Beam spray median velocity (ft/sec)	3090	3140
Average Number of fragments (1-1/4 - 205 grams)	517	510

CONFIDENTIAL

NPG REPORT NO. 1190

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

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
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
Commander, Naval Proving Ground



E. A. RUCKNER
Captain, USN
Ordnance Officer
By direction

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL

NPG REPORT NO. 1190

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Tenth Partial Report
on
Projectile Rotating Bands
and Related Components

Final Report
on
Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

Project No.: NPG-Re3b-225-1-53
Copy No.: 12
No. of Pages: 7

Date: OCT 12 1953

CONFIDENTIAL
SECURITY INFORMATION

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE I

SPACE DISTRIBUTION DATA

3"/50 Projectiles Mk 33-0 with Welded-Overlay Rotating Bands

20 ft. Radius Circular Space Arena

1/8" MS panels 5' high

<u>Zone Degrees</u>	<u>Rd. 1</u>			<u>Rd. 2</u>			<u>Rd. 3</u>		
	<u>R.</u>	<u>L.</u>	<u>Avg.</u>	<u>R.</u>	<u>L.</u>	<u>Avg.</u>	<u>R.</u>	<u>L.</u>	<u>Avg.</u>
0-5	1/2	1/2	0.5	1/2	1/2	0.5	1/2	1/2	0.5
5-10									
10-15									
15-20									
20-25									
25-30									
30-35									
35-40									
40-45					1	0.5			
45-50									
50-55					2	1.0		1	0.5
55-60	1	2	1.5	2		1.0			
60-65									
65-70		1	0.5						
70-75							1	1	1.0
75-80		1	0.5		1	0.5			
80-85	2		1.0	1	2	1.5			
85-90	2	3	2.5		3	1.5			
90-95	1	7	4.0	2	5	3.5	4	4	4.0
95-100	5	2	3.5	7	2	4.5	4	2	3.0
100-105	1	1	1.0	4	2	3.0			
105-110	2		1.0					2	1.0
110-115	1	1	1.0	3		1.5			
115-120									
120-125									
125-130									
130-135									
135-140									
140-145									
145-150									
150-155									
155-160									
160-165									
165-170									
170-175									
175-180	3	3	3.0	3	4	3.5	3	4	3.5

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE I (Continued)

20 ft. Radius Circular Space Arena

1/8" MS panels 5' high

Zone Degrees	Rd. 4			Avg. Impacts Per 5° Zone on Panel	Avg. Impacts Per Total 5° Zone on Panel	Avg. Impacts Per Unit Solid Angle
	R.	L.	Avg.			
0-5	1/2	1/2	0.5	0.5	1	40
5-10						
10-15						
15-20						
20-25						
25-30						
30-35						
35-40						
40-45				0.1	1.7	5
45-50						
50-55				0.4	8	18
55-60				0.6	13	30
60-65	1		0.5	0.1	2	5
65-70				0.1	2	5
70-75	1		0.5	0.4	10	18
75-80				0.3	7	14
80-85				0.6	15	30
85-90	2	1	1.5	1.4	35	65
90-95	5	3	4.0	3.9	98	180
95-100	5	1	3.0	3.5	88	161
100-105				1.0	20	50
105-110		1	0.5	0.6	14	30
110-115	2		1.0	0.9	20	40
115-120		1	0.5	0.1	2	5
120-125						
125-130						
130-135						
135-140						
140-145						
145-150						
150-155						
155-160						
160-165						
165-170						
170-175						
175-180	6	3	4.5	3.6	7.2	300

Fragmentation Test of 3"/50 Projectiles Mk 33
 Having Welded-Overlay Rotating Bands

TABLE II

FRAGMENT VELOCITY DATA

30 ft. Radius Velocity Arena	2900 frames per second
35mm Fastax Camera No. 1	Fuze: Mk 72 VT (Modified)
Rd. No. 1, 3"/50 AA Mk 33-0 Projectile	Total weight: 12.70 lbs.
with welded-overlay band	Filler weight: .83 lbs.
Filler: Comp. A-3	Date: 16 July 1953

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Velocity (f/s)</u>
25	2	3480
26	6	3350
27	5	3220
28	11	3110
29	3	3000
30	6	2900
31	6	2810
32	2	2720
33	2	2640
Median		3110
Average		3050

Fragmentation Test of 3"/50 Projectiles Mk 33
 Having Welded-Overlay Rotating Bands

TABLE II (Continued)

30 ft. Radius Velocity Arena
 35mm Fastax Camera No. 1
 Rd. No. 2, 3"/50 AA Mk 33-0 Projectile
 with welded-overlay band
 Filler: Comp. A-3

3250 frames per second
 Fuze: Mk 72 VT (Modified)
 Total weight: 12.72 lbs.
 Filler weight: .83 lbs.
 Date: 16 July 1953

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Velocity (f/s)</u>
29	3	3360
30	10	3250
31	4	3150
32	9	3050
33	3	2950
34	2	2870
35	3	2790
36	4	2710
37	4	2640
38	2	2570
Median		3070
Average		3000

Fragmentation Test of 3"/50 Projectiles Mk 33
 Having Welded-Overlay Rotating Bands

TABLE II (Continued)

30 ft. Radius Velocity Arena	3250 frames per second
35mm Fastax Camera No. 1	Fuze: Mk 72 VT (Modified)
Rd. No. 3, 3"/50 AA Mk 33-0 Projectile	Total weight: 12.72 lbs.
with welded-overlay band	Filler weight: .83 lbs.
Filler: Comp. A-3	Date: 16 July 1953

<u>Frame in Which Hit Occurred</u>	<u>No. Fragments</u>	<u>Velocity (f/s)</u>
29	2	3360
30	9	3250
31	7	3150
32	3	3050
33	3	2950
34	2	2870
35	2	2790
36	1	2710
37	4	2640
38	2	2570
Median		3090
Average		3020

CONFIDENTIAL

Fragmentation Test of 3"/50 Projectiles Having Welded-Overlay Rotating Bands

NPG REPORT NO. 1190

TABLE III

MASS DISTRIBUTION DATA

Fuze: Mk 72 VT

Fragment Mass Distribution of 3"/50 Projectiles Mk 33, Comp. A-3 Loaded, Having Welded-Overlay Rotating Bands
NUMBER AND WEIGHT OF RECOVERED FRAGMENTS

Rd. No.	Comp. Wt. lb.	Filler Wt. lb.	0-0.625		0.625-1.25		1.25-2.5		2.5-5		5-10		10-20		20-40		40-80		80-160		160-320		Fuze	Total No. Gms.	Photo. No. NP9	
			grams	Wt.	grams	Wt.	grams	Wt.	grams	Wt.	grams	Wt.	grams	Wt.	grams	Wt.	grams	Wt.	grams	Wt.	grams	Wt.				grams
1	12.66	0.83	148	147	175	325	188	417	120	624	91	711	50	680	25	349	6	715	6	--	--	1024	202	863	5140	63813
2	12.75	0.83	181	206	236	326	190	530	155	472	71	871	60	546	22	414	7	635	6	--	--	1013	231	978	5194	63838
3	12.74	0.83	178	189	209	407	235	512	148	573	85	723	52	585	23	405	7	597	6	--	--	1005	222	987	5174	63905
Avg.	12.72	0.83	169	181	207	353	204	486	141	556	82	768	54	604	23	389	7	649	6	--	--	1014	218	943	5169	
***	12.74	0.81	**	**	**	327	183	540	154	617	90	739	55	386	15	254	5	785	7	204	1	1025	114	* 624	5213	

* Total number does not include 0.625-1.25 gram group.

** 0-1.25 gram group, weight was 336 grams.

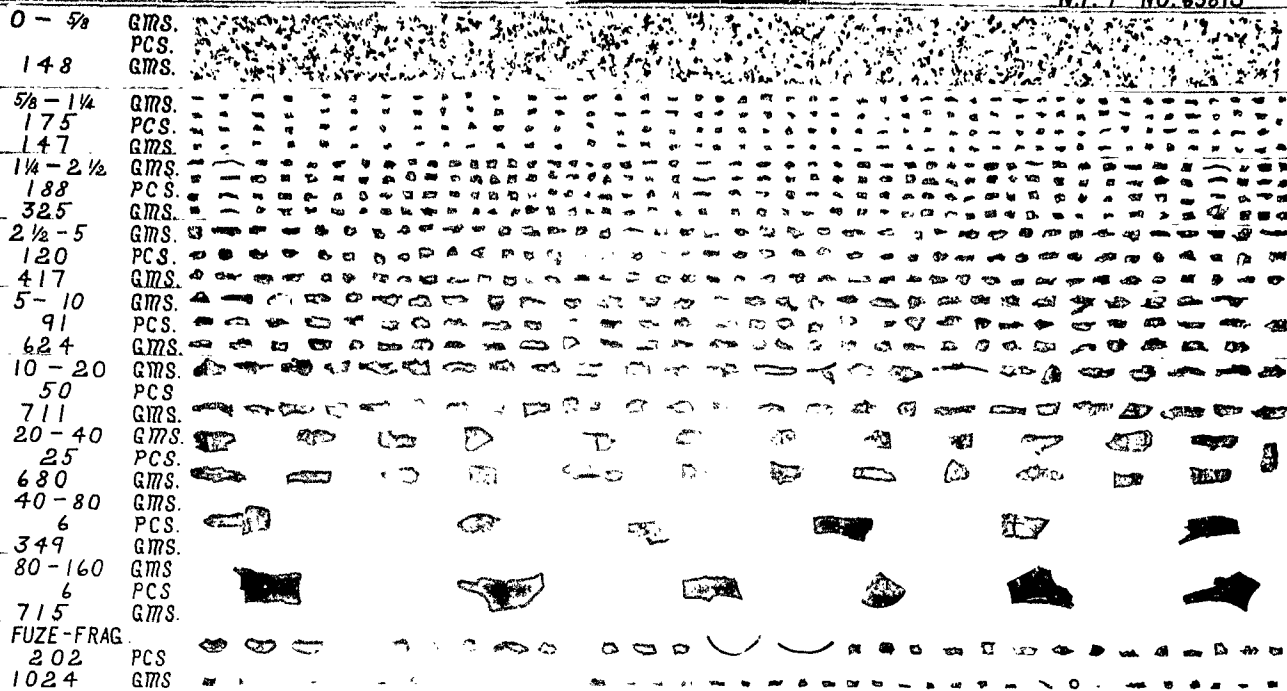
*** Reference (e) data, 5 round average of 3"/50 Mk 33 Projectiles, Comp. A-3 loaded, having standard copper rotating bands.

CONFIDENTIAL
SECURITY INFORMATION

APPENDIX C

FRAG NO. 1765

N.P.9 NO. 63813



NP9-63813

21 July 1953

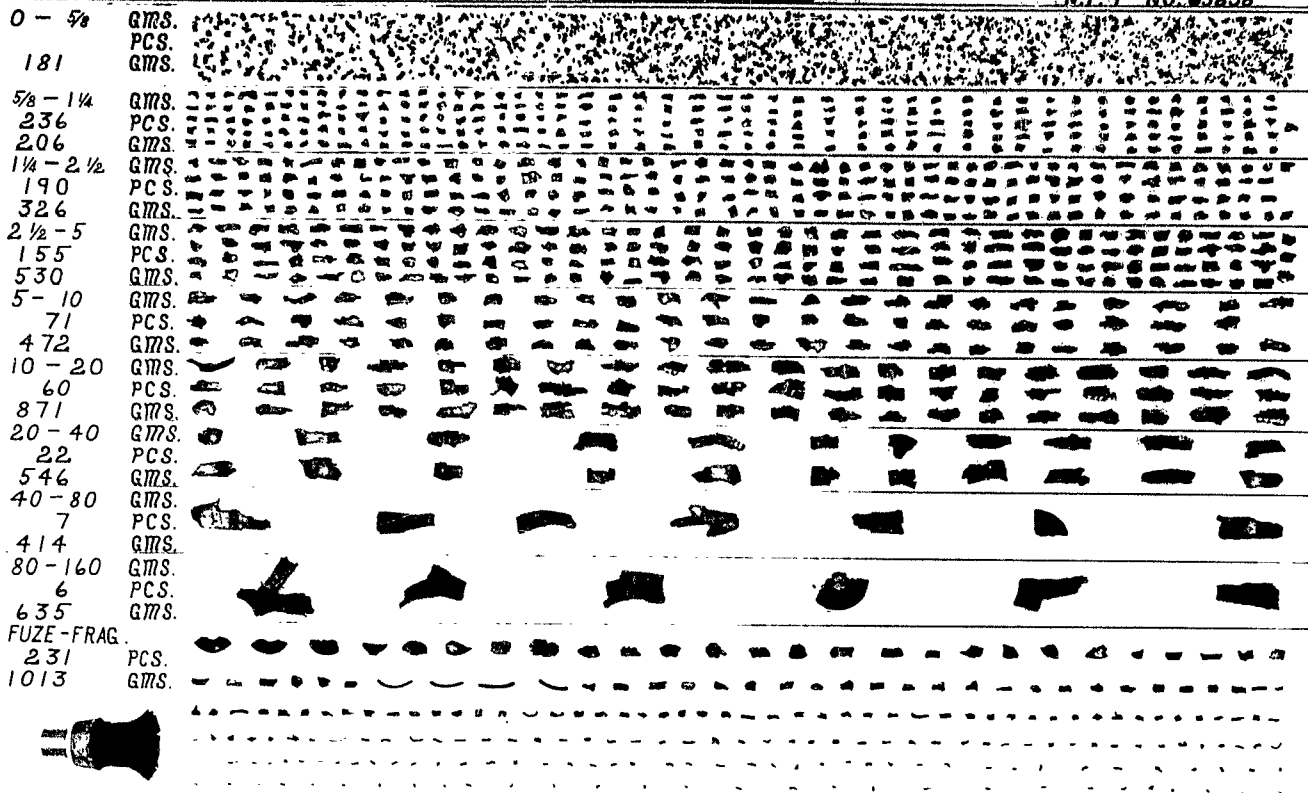
CONFIDENTIAL
SECURITY INFORMATION

Rd. 1. Fragment mass distribution of 3"/50 Projectile Mk 33, Composition A-3 loaded, having welded-overlay rotating band.

FIGURE 1

FRAG. NO. 1744

N.P.9 NO. 63838



SCALE 1"

NP9-63838

23 July 1953

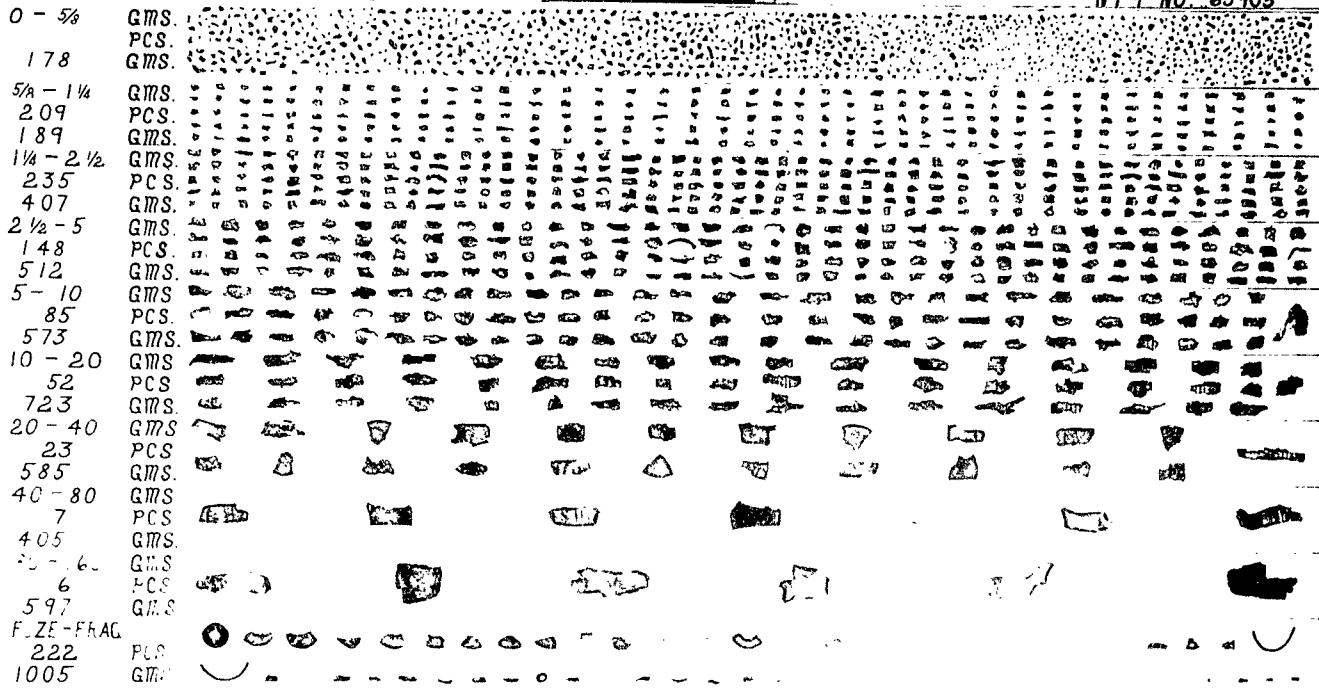
CONFIDENTIAL
SECURITY INFORMATION

Rd. 2. Fragment mass distribution of 3"/50 Projectile Mk 33, Composition A-3 loaded, having welded-overlay rotating band.

FIGURE 2

FRAG NO. 1769

NP9 NO. 63905



NP9-63905

3 August 1953

CONFIDENTIAL
SECURITY INFORMATION

Rd. 3. Fragment mass distribution of 3"/50 Projectile Mk 33, Composition A-3 loaded, having welded-overlay rotating band.

FIGURE 3