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U. S. NAVAL PROVING GRO. NO.
D. HILGREN, VIRGINIA

REPORT NO. 1122

3"/70 CALIBER GUN BARRELS
TEST AND DEVELOPMENT

57th Partial Report

...COVERY AND RANGE TEST OF 3"15 AA PROJECTILES IN
3"15/67 CALIBER GUN, TYPE A MOD 0 SERIAL NO. 1

1st Partial
Report

Task
Assignment 4"4-Re5a-21-1-53

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~~CONFIDENTIAL~~ NPG REPORT NO. 1122

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

PART A

SYNOPSIS

1. A 3"15/67 barrel, Type A Mod O, and 3"15 AA Projectiles, Type EX 1 Mod O, were subjected to recovery and ranging tests. This barrel and projectile were designed as possible replacements for the 3"/70 barrel and projectile in 3"/70 gun systems, in view of difficulties experienced in the development of the latter.
2. The 3"15/67 barrel - projectile combination performed very satisfactorily, as judged by both recovery and ranging tests. The mean corrected D/R for twenty (20) 5-round groups was 0.37%.
3. The performance supports the hypothesis that difficulties with the 3"/70 barrel - projectile combinations, which have been manifested in low accuracy, body engraving, and spiral wear, are ultimately due to band failure caused by the relatively large ratio of band diameter to body diameter necessary in the 3"/70 design.
4. Preliminary tests of nylon rotating bands for the 3"15 projectile indicate that a workable design employing this material should not be a difficult problem.
5. It is recommended that the 3"15/67 barrel used in these tests be fired for at least 1000 rounds to obtain additional data and information on wear characteristics of the gun. At the end of this program, recovery tests should be fired with projectiles having standard and shortened rotating bands.

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NPG REPORT NO. 1122

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

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Recovery and Range Test of 3!15 AA Projectiles in
3!15/67 Caliber Gun, Type A Mod O Serial No. 1

PART B

INTRODUCTION

1. AUTHORITY:

This program was authorized by references (a), (b), (c) and (d) and conducted under Task Assignments NPG-Re5a-21-1-52 and NPG-Re5a-21-1-53.

2. REFERENCES:

- a. BUORD Conf ltr NP9 Re5a-FBW:cmj Ser 24896 of 27 Aug 1951 to NGF and NAVPROV
- b. BUORD Conf ltr NP9 Re5a-JHM:cmj Ser 38482 of 29 Apr 1952 to NGF and NAVPROV
- c. BUORD Conf ltr S74-1(3") Re5e-EOS:11h Ser 47851 of 18 Nov 1952 to NGF and NAVPROV
- d. BUORD Conf ltr Re5a-FBW:fl NP9 of 3 Jul 1952
- e. BUORD Conf ltr Re5a-FBW:cmj Ser 18945 of 3 Apr 1951 to NGF
- f. FONECON between BUORD (Mr. Weathersbee, Re5a) and NAVPROV (LCDR W. B. Robertson) of 17 Mar 1952
- g. BUORD Conf ltr Re5e-EOS:11h Ser 49062 of 12 Dec 1952 to NGF and NAVPROV
- h. FONECON between NAVPROV (Mr. R. B. Butler) and BUORD (Mr. E. O. Stengard, Re5e) of 8 Dec 1952
- i. BUORD Sk 232310, 3!15/67 Gun Barrel and Chamber Details
- j. BUORD Sk 328618, 3!15 AA Projectile Type EX 1 Mod O
- k. BUORD Sk 238911 Dummy Nose Plug
- l. NPG Ranging Data Sheet No. 1 of 12 Aug 1952
- m. NPG Ranging Data Sheet No. 2 of 16 Jan 1953
- n. NPG Report No. 896 of 29 Nov 1951

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

3. BACKGROUND:

The 3"/70 gun program throughout its course has been plagued with difficulties, the most crucial of which have been a strong tendency toward bad spiral wear of the barrel and a tendency toward poor accuracy. The belief has prevailed in some quarters, particularly at the Naval Proving Ground, that the basic cause of these difficulties was the unusually large diameter of the 3"/70 rotating band, as compared with the body diameter of the projectile, and that consequent band failure in the barrel at high velocity produced the observed phenomena.

Based on this hypothesis, the Bureau of Ordnance evolved the idea that a relatively small increase in projectile diameter, without a change in band diameter, would eliminate this possible cause of trouble. Such a projectile could be fired from a standard 3"/70 barrel bored to a slightly larger diameter, using the same cartridge case and other ammunition components as the 3"/70 gun. Furthermore, if the weight of the projectile were kept constant at 15 pounds, the increase in diameter would permit a corresponding decrease in length, which would increase the stability of the projectile in flight. Other advantages would be that, given the same fuze intrusion into the cavity as for the 3"/70, the larger projectile would permit loading more explosive around the fuze, which would tend to improve the fragmentation characteristics; and that the larger basal area of the modified projectile would permit a decrease of the service pressure without sacrifice of velocity.

As a result of these considerations, one (1) 3"15 gun barrel Type A Mod O and a supply of projectiles (EX-1 Mod O) were designed and manufactured for experimental testing.

4. OBJECT OF TEST:

This test was conducted to obtain information on the performance of the 3"15/67 barrel - projectile combination, as determined from recovery and range firings. A small number of rounds with nylon rotating bands were also fired to obtain design information.

5. PERIOD OF TEST:

- | | |
|------------------------|-----------------|
| a. Dates of Directives | 27 August 1951 |
| | 29 April 1952 |
| b. Date Test Commenced | 25 March 1952 |
| c. Date Test Completed | 16 January 1953 |

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod 0 Serial No. 1

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEMS UNDER TEST:

a. Gun: The 3"15/67 gun barrel Type A Mod 0 Serial No. 1, manufactured in accordance with reference (e), has uniform depth-rifling similar in contour to that in the 3"/70 barrel Type G Mod 8. The bore diameter is 3"15 and the groove diameter 3"24. The chamber is also the same as in the Type G Mod 8 barrel except that the length from breech face to forward edge of the shell centering cylinder was changed to 25"567 and the origin of bore located 3"0 forward of this position. These two (2) points are connected by a 37"5 radius tangent at the origin of bore. The bore and chamber are unplated. The exterior and breech face of the barrel are also the same as the Type G Mod 8 barrel. The twist is 1 turn in 23.8 calibers or one (1) turn in 75 inches. The rifling of the 3"/70 gun Type G Mod 8 also makes one (1) turn in 75 inches. By reference (a), proof pressure in this gun was set at 25 t.s.i.

b. Projectiles:

(1) 3"15 AA Projectile Type EX 1 Mod 0 in accordance with reference (j), (Figures 1 and 28), loaded to 15 pounds total weight.

(2) 3"15 AA Projectile Type EX 1 Mod 0 modified Type A, Figure 29, and modified Type B, Figure 30, loaded to 15 pounds total weight.

(3) 3"15 AA Projectile Type EX 1 Mod 0 modified with two (2) "75 nylon bands (Figures 1A and 32), loaded to 14.32 pounds total weight.

All projectiles were Epsom salts loaded and those fired for recovery were fitted with flat dummy nose plugs (Figure 33). All others were fired with standard pointed dummy nose plugs (reference (k)). The difference in weight between the nylon-banded and the standard projectiles represents the difference in weight between their bands.

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

7. PROCEDURE AND RESULTS:

a. The first firing conducted in this gun was a combination of the proof of the gun and a recovery firing test. Six (6) 3"15 Projectiles Type EX 1 Mod O were fired in this test. Spin was determined by the wire impression method (Appendix (D)), and recovery was in sawdust. Before inert loading, the projectiles were measured in the cavity under the bands, for comparison with after recovery firing measurements, to check deformation resulting from band pressure. The data for the proof firing are included as Table I and for the recovery firing as Table IV (Appendix (A)). Photographs of the recovered rounds are included as Figures 2 to 6 (inclusive). The band engraving was excellent for all rounds with no apparent fringing or band wear. All rounds acquired full spin and the deformation under the band was -0.007 for the round with the maximum pressure (25 t.s.i.). Flight to the recovery bin was excellent.

The gun was then returned to the Naval Gun Factory for complete post-proof examination, star gauging and bore photography.

b. The Bureau of Ordnance requested in reference (b) that a charge be established for this gun-projectile combination, with powder index HKPC-1, at a muzzle velocity of 3400 ft./sec.. Twelve (12) rounds were inert loaded and fitted with standard nose plugs for this test. The mean of a five (5) round uniformity check with a 9.75 pound powder charge gave a velocity of 3411 ± 9 ft./sec. and a crusher gauge pressure of 19.0 ± 0.4 t.s.i. Detailed data are included as Table II.

The HKPC-1 powder, tested in 3"/70 guns, had given large velocity variations and reference (c) requested that a charge determination be fired with EX 6802 powder. Ten (10) Type EX 1 Mod O rounds were fired. The mean of a five (5) round uniformity check with a charge of 9.60 pounds gave 3402 ± 4 ft./sec. velocity and 19.6 ± 0.2 t.s.i. (mean of 4 rounds) pressure. Detailed data are included as Table III (Appendix (A)). This was better uniformity than with HKPC-1 powder, but because the quantity of EX 6802 on hand was insufficient, it was not used in the subsequent range tests (reference (g)). Photographs of the recovered projectiles are included as Figures 21-25 (incl).

Recovery and Range Test of 3 1/2" AA Projectiles in
3 1/2"/67 Caliber Gun, Type A Mod O Serial No. 1

c. The standard EX 1 Mod O projectile appeared to have more working metal in its bands than necessary (volume of metal above 3 1/2" diameter, 0.617 cu.in.) and reference (b) requested the Naval Proving Ground to reduce the working metal and fire a recovery program for band study. Two (2) modifications were tested; Type A with .510 cu.in. and Type B with .578 cu.in. of working metal. These modifications consisted of shortening the length of the cylindrical part of the two (2) bands. (See Figures 29 and 30.) Five (5) rounds of each modified type and four (4) of the unmodified projectiles were fired for recovery in this test. The detailed results are given in Table V (Appendix (A)), and photographs of the recovered projectiles are shown in Figures 7 to 20. All rounds had full spin, no yaw, and good band engraving without sign of fringing or appreciable band wear. Deformation under the bands was small for all three (3) types, being of course smaller for the shortened bands. No other difference was observed between the shortened and standard bands.

d. One (1) each of the three (3) types of projectile described above was crimped in a steel case, with a hand-rolled 360° crimp, for a debulleting test. Later, after modification of a 3"/70 rubber-hydraulic crimping machine to also accommodate 3 1/2" projectiles, one (1) round each was crimped in this manner for a similar test. The bullet pull forces are shown in Table VII (Appendix (A)), and run from 9,000 to 12,000 pounds.

e. Seven (7) nylon-banded 3 1/2" projectiles were prepared in accordance with Figure 32, using for the two (2) 3/4" bands nylon rings (Figure 31) which had been procured for use on 3" projectiles. These projectiles were hand-crimped in steel cases with the mouth of the case flush with the forward edge of the forward band, and fired for recovery. Detailed data are given in Table VI (Appendix (A)) and typical photographs of the recovered projectiles are shown in Figures 26 and 27. This rather improvised test gave encouraging results as full spin without yaw was attained. Only one (1) projectile retained one (1) of its bands upon recovery, but this was not unexpected as a more secure attachment is required to retain nylon band than was possible in this test.

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

f. The detailed results for the two (2) 50 round ranging programs, fired with standard MX 1 Mod O projectiles, were reported in references (l) and (m). Summaries of these are shown in Tables VIII and IX (Appendix (A)). The average corrected D/R (5-round groups) for the first ranging program was 0.33%; for the second 0.41%.

g. Star gauge readings on the gun at several stages in the tests are included in Appendix (C). After 156 ESR, there is no enlargement of the lands, but the grooves are worn by 0"002 - 0"004 throughout the length of the bore. (Measurement after decoppering could increase both of these figures slightly.)

8. DISCUSSION:

The performance of the 3"15 barrel-projectile combination is considered to be most promising, and should receive serious consideration as a replacement for the 3"/70 barrel and projectile.

The appearance of the recovered projectiles indicated very satisfactory functioning of the bands, as regards to wear and centering, with the possibility that there may be more length of band than necessary. Spin was full, there was no body engraving, and the deformation of the projectile wall under the bands was small. The flight tests indicated very good accuracy. No 3"/70 barrel with twist as low as 1/25 has ever shown good range accuracy, except for the barrel fired with projectiles having an unconventional iron rotating band (reference (n)).

The fact that bands of shorter length showed as good behavior in the recovery firing as bands of full length may indicate that the band length on the 3"15 projectile can be safely reduced, but firings in a worn gun would be necessary before a definite conclusion could be reached.

The test with nylon bands indicated feasibility of a band design employing this material. No difficulty is anticipated in designing a band to obturate, impart spin, and be retained in flight; in fact, it is felt that the major problem with such a design might well be the development of a sufficiently strong case attachment. There would be little use, however, of initiating such a development until rapid-fire testing of the design became possible.

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

The groove wear observed in the gun is not surprising, considering that the diameter of the major portion of the band is 3"240 - 0"005, that the groove diameter at first gauging was 3"241, and that the deformation of the projectile under the band would increase the gap by another 0"005, approximately. Apparently the narrow high lip of this band acting alone does not furnish sufficient obturation at the bottom of the grooves. A decrease in groove diameter to 3"23 or 3"22 should be sufficient to correct this behavior, however.

PART D

CONCLUSIONS

9. It is concluded that:

a. The 3"15/67 barrel-projectile combination performed very satisfactorily, as judged by both recovery and ranging tests. The mean corrected D/R for twenty (20) 5-round groups was 0.37%.

b. The performance supports the hypothesis that difficulties with the 3"/70 barrel-projectile combination, which have been manifested in low accuracy, body engraving, and spiral wear, are ultimately due to band failure caused by the relatively large ratio of band diameter to body diameter necessary in the 3"/70 design.

c. Preliminary tests of nylon rotating bands for the 3"15 projectile indicate that a workable design employing this material should not be a difficult problem.

PART E

RECOMMENDATIONS

10. It is recommended that the 3"15/67 barrel used in these tests be fired for at least 1000 rounds, to obtain more range data and information on wear characteristics of the gun. At the end of this program, recovery tests should be fired with projectiles having standard and shortened rotating bands.

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NPG REPORT NO. 1122

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

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By direction

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NPG REPORT NO. 1122

~~U.~~ S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Fifty-seventh Partial Report
on
3"/70 Caliber Gun Barrels
Test and Development

First Partial Report
on

Recovery and Range Test of 3"15 A4 Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

Project No.: NPG-Re5a-21-1-53
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No. of Pages: 10

Date: MAY 18 1953

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FIRING REPORT
PRRC-SPC-49

NAVAL PROVING GROUND
DAHLGREN, VA.

TABLE I

From: Commander, Naval Proving Ground

To: Chief of the Bureau of Ordnance

OTF:RDC:lah
All/5001-1
Ser 20977

DATE

8 April 1952

Subject: Proof of 3"15/67 Inch Gun Barrel Type A Mod O No. 1

Reference: BUORD ltr. Re5a-FBW:cmj Ser 24896 of 27 August 1951

		FIRING OFFICER		
		R. D. Cromwell		
		USN		
UNIT	MAKER	MARK	MOD	NUMBER
GUN	NGF	A	0	1
HOUSING	NGF Previously Proved	1	3	486
MOUNT	Previously Proved	22	--	---
SLIDE	Rhode Island Arsenal Previously Proved	21	8	3507
CARRIAGE	NGF Previously Proved	25	24	4220
STAND	NGF Previously Proved	14	9	4095
HYDRAULIC RAMMER	None			

R	SHELL SEATING	ELEV.	RECOIL	C. R.	CHARGE		POWDER		PRESSURE	VELOCITY	HOW FIRED
					LBS.	GMS.	DESIGNATION	TEMP.			
1	CASE	0°	9"25	Full	9.0	--	HKPC-1	90°	15.4	3128	
2	"	"	9"75	"	10.0	--	"	"	18.8	3463	
3	"	"	9"75	"	10.7	--	"	"	22.2	3603	
4	"	"	9"75	"	11.2	--	"	"	23.8	3760	
5	"	"	10"0	"	11.4	--	"	"	25.0	3799	
6	"	"	9"75	"	10.4	--	"	"	21.4	3566	
7											
8											
9											
10											
11											
12											

DATE OF TEST 25 March 1952	DATE OF RECEIPT 13 February 1952	PREVIOUS ROUNDS 0
ROUNDS DURING THIS TEST 6	TOTAL ROUNDS ON STATION ACTUAL 6	EQUIV. SER. 9.70

NGF (12)

IRVING T. DUKE

R. T. RUBLE
By direction

APPENDIX (A)

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod C Serial No. 1

TABLE IICHARGE DETERMINATION FOR 3"15/67 CALIBER GUN - HKPC-1

GUN FIRING CONDITIONS:

Gun: Type A Mod O No. 1
 Projectiles: EX 1 Mod O (15.00 lbs.) Epsom Salts loaded
 Case: Ex. No. 5 Steel, Rubber Crimped
 Primer: Mk 46 (XC-M11)
 Wad and Spacer: Cardboard, NGF Dwg. No. 132664, Pc. Nos. 13 and 4
 Powder: HKPC-1
 Lead Foil: None
 Temperature: 90°F

CHARGE DETERMINATION:

Rd. No.	Charge (lbs.)	PPD (in.)	Velocity (ft./sec.)	Pressure (t.s.i.)	Flash (%)	Smoke (%)
1(a)	9.00	4.3	3206	16.4	0	150
2	"	"	3242	15.9	0	150
3	"	"	3228	16.3	0	150
4	"	"	3256	16.4	0	150
	Mean of 3 rounds		3242±14	16.2±0.2		
5	9.50	2.5	3355	19.0	0	150
6	9.75	2.1	3427	20.0	0	150
7	"	"	3417	18.9	0	150
8	"	"	3405	18.6	0	150
9	"	"	3396	18.7	0	150
10	"	"	3411	19.0	0	150
	Mean of 5 rounds		3411±9	19.0±0.4		
11	10.00	2.1	3475	20.5	0	150
12	9.00	4.3	3239	16.1	0	150

(a) Conditioning round - not used.

UNIFORMITY:

Charge (lbs.)	PPD (in.)	Velocity (ft./sec.)	Pressure (t.s.i.)	No. of Rds.
9.00	4.3	3242±14	16.2±0.2	3
9.75	2.1	3411±9	19.0±0.4	5

Charge obtained for 3400 ft./sec.

Charge (lbs.)	Velocity (ft./sec.)	Pressure (t.s.i.)
9.70	3400	18.80

TABLE III

CHARGE DETERMINATION FOR 3.15/67 CALIBER GUN - EX-6802

GUN FIRING CONDITIONS:

Gun: 3.15/67 Caliber, Type A, Mod O, No. 1
 Projectile: EX 1 Mod O (15.00 lbs.) Epsom Salts Loaded
 Case: Mk 10, Steel, Rubber Crimped
 Primer: Mk 46 (XC-M11)
 Wad and Spacer: Cardboard, NGF Dwg. 132664, Fc. Nos. 13 and 4
 Powder: EX-6802
 Lead Foil: None
 Powder Temp.: 90°F
 Date: 12-22-52

CHARGE DETERMINATION:

<u>Rd. No.</u>	<u>Charge (lbs.)</u>	<u>PPD (in.)</u>	<u>Velocity (ft./sec.)</u>	<u>Pressure (t.s.i.)</u>
1 (a)	9.00	5.4	3197	16.7
2	9.00	5.4	3237	16.1
3	"	"	3233	16.3
Mean of 2 rounds	9.00	5.4	3235±2	16.2±0.1
4	9.80	2.6	3466	20.3
5	10.00	2.2	3505	20.8
6	9.60	3.6	3408	19.6
7	9.60	"	3404	19.3
8	9.60	"	3403	19.9
9	9.60	"	3398	19.7
10	9.60	"	3396	-
Mean of 5 rounds	9.60	3.6	3402±4	19.6±0.2 (b)

(a) Conditioning round
 (b) Average of 4 rounds

UNIFORMITY:

<u>Powder</u>	<u>Charge (lbs.)</u>	<u>PPD (in.)</u>	<u>Velocity (ft./sec.)</u>	<u>Pressure (t.s.i.)</u>	<u>No. of Rds.</u>
EX-6802	9.00	5.4	3235±2	16.2±0.1	2
EX-6802	9.60	3.6	3402±4	19.6±0.2(b)	5

(b) Average of 4 rounds

RECOMMENDED CHARGE FOR 3400 FT./SEC. NOMINAL VELOCITY:

<u>Powder</u>	<u>Charge (lbs.)</u>	<u>PPD (in.)</u>	<u>Pressure (t.s.i.)</u>
EX-6802	9.59	3.6	19.5

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Recovery and Range Test of 3W15 AA Projectiles in 3W15/67 Caliber Gun, NPG REPORT NO. 1122
Type A Mod 0 Serial No. 1

TABLE IV

COMPLETE BEFORE AND AFTER RECOVERY FIRING DATATest of 3W15 Projectiles Type EX 1 Mod 0 in 3W15/67 Gun Type A Mod 0 No. 1

Proj. No.	Firing Order	3/25/52	Powder Charge (lbs.)	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	% Nominal Spin	Deformation (in.)			Remarks
							Overall Length	I.D. under edge of high lip in forward band	I.D. under forward band midway of flat	
1094	1		9.0	15.4	3128	99.6	-.002	-.006	-.006	No Yaw
1095	2		10.0	18.8	3463	100.2				No Yaw
1096	3		10.7	22.2	3603					No Yaw
										Broke in Recovery Bin.
1097	4		11.2	23.8	3760	100.4	.000	-.007	-.007	No Yaw
1098	5		11.4	25.0	3799	100.7	-.001	-.004	-.007	No Yaw
1099	6		10.4	21.4	3566	100.3	-.001	-.003	-.006	No Yaw

Gun Type A Mod 0 No. 1 had 0 ESR at start of this firing.
Standard Projectiles Type EX 1 Mod 0.CONFIDENTIAL
SECURITY INFORMATION

APPENDIX A

TABLE V

COMPLETE BEFORE AND AFTER RECOVERY FIRING DATA

Test of 3in15 Projectiles Type EX 1 Mod O in 3in15/67 Gun Type A Mod O No. 1

Proj. No.	Firing Order 7/1/52	Proj. Type & Mod	Powder Charge (lbs.) HKPC-1	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	% Nominal Spin	Deformation (in.)	
							I.D. under edge of high lip in forward band	I.D. under center of hoist clamp groove
1408	1	Standard	9.7	18.1	3326	100.3	-.006	-.001
1409	2	A	10.6	20.9	3573	100.7	-.002	.000
1410	3	A	10.6	21.8	3601	100.4	+.001	+.003
1411	4	B	10.6	22.2	3576	100.4	-.001	+.002
1412	5	B	10.6	21.7	3557	100.2	-.005	-.003
1413	6	Standard	9.7	19.8	3405	100.3	-.009	-.006
1414	7	Standard	9.7	17.9	3350	100.5	-.008	-.006
1415	8	Standard	9.7	18.2	3354	100.5	-.007	-.007
1416	9	A	9.7	19.1	3398	100.3	-.001	-.001
1417	10	A	9.7	18.4	3361	100.3	-.003	-.001
1418	11	A	9.7	18.4	3363	101.3	+.002	+.001
1419	12	B	9.7	18.6	3365	100.8	-.004	-.004
1420	13	B	9.7	17.5	3344	100.5	-.006	-.002
1421	14	B	9.7	18.3	3366	99.9	-.002	-.001

Gun Type A Mod O No. 1 had 9.7 ESR at start of this firing.
Standard - Type EX 1 Mod O Projectiles.
Mod A - Projectiles Type EX 1 Mod O Modified according to APL-342.
Mod B - Projectiles Type EX 1 Mod O Modified according to APL-343.

TABLE VI

COMPLETE BEFORE AND AFTER RECOVERY FIRING DATATest of 3W15 Projectiles Type EX 1 Mod 0 in 3W15/67 Gun Type A Mod 0 No. 1

Proj. No.	Firing Order 12/22/52	Proj. Type & Mod	Powder Charge (lbs.)	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	Nominal Spin %	Deformation (in.)	
							I.D. under edge of high lip in forward band	I.D. under forward band midway of flat
2013	6	Standard	9.60	19.6	3408	99.2	-.004	-.006
2014	7	Standard	9.60	19.3	3404	98.3	-.003	-.005
2015	8	Standard	9.60	19.9	3403	98.4	-.005	-.007
2016	9	Standard	9.60	19.7	3398	99.5	-.005	-.009
2017	10	Standard	9.60	17.7	3396	97.6	-.004	-.006
2018	11	Nylon Banded	HKC-1	16.1	3343	Fired down river		
2019	12	"	9.50					
2020	13	"	9.75	17.3	3377	98.3		
2021	14	"	10.0	17.5	3467	97.4		
2022	15	"	10.0	16.7	3359	98.9		
2023	16	"	10.0	18.5	3469	97.4		
2024	17	"	10.0	16.0	3403	98.3		
				16.0	3388	97.0		

Gun Type A Mod 0 No. 1 had 88 ESR at start of this firing.
Rounds 1 thru 5 were fired down river for charge determination.
Standard Type EX 1 Mod 0 Projectiles.
Nylon Banded Type EX 1 Mod 0 Projectiles according to APL-424.

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NPG REPORT NO. 1122

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE VII

DEBULLETING TESTS RESULTS

<u>Projectile</u>	<u>Bullet pull (lbs.)</u>	
	<u>Hand Crimped</u>	<u>Rubber-hydraulic Crimped</u>
EX 1 Mod O	12,080	11,820
EX 1 Mod O (A modification)	11,900	10,440
EX 1 Mod O (B modification)	11,340	9,260

CONFIDENTIAL
SECURITY INFORMATION

APPENDIX A

TABLE VIII

RANGE AND EROSION TEST OF 3.15/67 CALIBER GUN TYPE A MOD 0 SERIAL NO. 1

Summary of Results of Ranging and Erosion Tests of 3.15/67 Caliber Gun Type A Mod 0
Serial No. 1 using Projectiles Type EX 1 Mod 0, Reported in Detail on NPG Ranging
Data Sheet No. 1 of 12 August 1952

Elevation: 15 degrees
Propellant: 9.70 lbs. Index HKPC-1
Projectile Loading: Epsom Salts
Nose: DNP 238911
Projectile: Type EX 1 Mod 0

Gum Data: 3.15/67 Caliber Type A Mod 0 Serial No. 1
Rifling - 1 turn in 23.81 Calibers, Uniform Twist.
Rounds before test: 32 actual rounds
37.20 ESR
 Δ Do C¹CC6 ESR: 9.84

Rds. Fired	Rds. Ranged	Rd. Nos. in Program	Muzzle Velocity (ft./sec.)	Uncorrected		Corrected		Uncorrected		Corrected	
				Range (yds.)	Drift (yds.)	Range (yds.)		D/R (%)		D/R (%)	
5	5	2-6	3422±7	13979±38	-15±11	13469±23		0.27		0.17	
5	5	7-11	3433±23	14023±100	- 5±10	13462±14		0.71		0.10	
5	5	12-16	3421±20	13984±80	- 4±5	13476±33		C.57		0.24	
5	5	17-21	3410±14	13877±73	- 2±17	13420±38		C.53		0.28	
5	5	22-26	3414±21	13921±87	16±6	13445±34		0.62		0.25	
5	5	27-31	3414±7	13849±39	2±11	13372±42		0.28		C.31	
5	5	32-36	3425±21	13838±74	0±9	13319±57		C.53		C.43	
5	5	37-41	3428±15	13838±37	12±15	13300±35		0.27		C.26	
5	5	42-46	3414±8	13790±75	25±9	13312±45		0.54		C.34	
5	5	47-51	3443±24	13769±29	36±21	13161±122		0.21		C.93	

Note: Rd. #50 had a muzzle velocity of 3483 ft./sec. and a corrected range of 12906 yds. causing the corrected D/R (%) for this 5 rd. group to be C.93.

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Recovery and Range Test of 3W15 44 Projectiles in 3W15/67 Caliber Gun, NPG REPORT NO. 1122
Type A Mod O Serial No. 1

TABLE IX

RANGE AND EROSION TEST OF 3W15/67 CALIBER GUN TYPE A MOD O SERIAL NO. 1

Summary of Results of Ranging and Erosion Tests of 3W15/67 Caliber Gun Type A Mod C
Serial No. 1 using Projectile Type EX 1 Mod O, reported in detail on NPG Ranging
Data Sheet No. 2 of 16 January 1953.

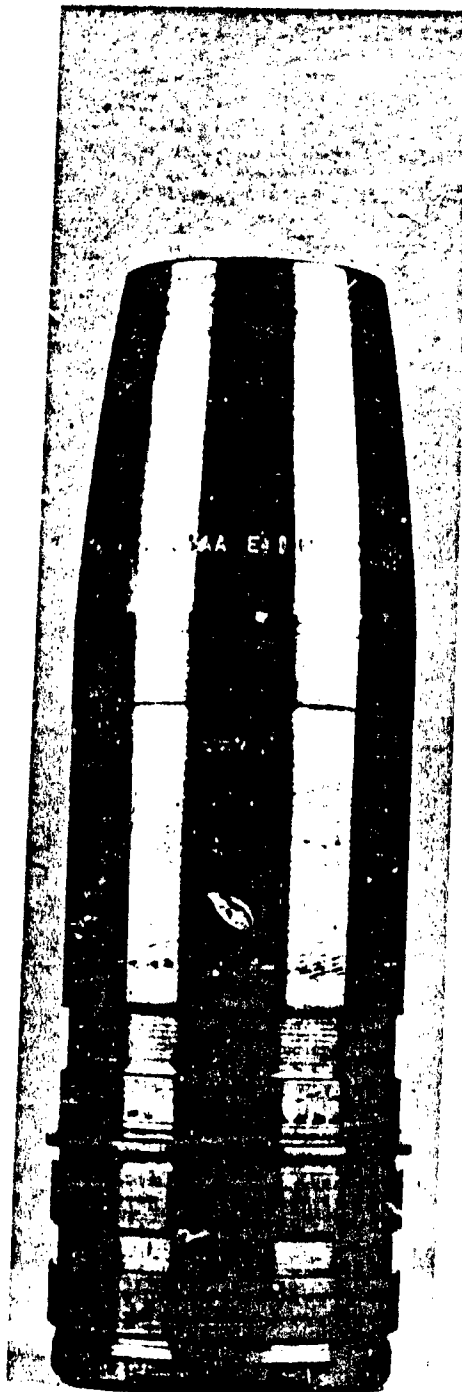
Elevation: 15 degrees
 Propellant: 9.7C lbs. Index HKPC-1
 Projectile loading: Epsom Salts
 Nose: DNP 238911
 Projectile: Type EX 1 Mod O

Gun Data: 3W15/67 Caliber Type A Mod O Serial No. 1
 Rifling - 1 turn in 23.81 Calibers, Uniform Twist.
 Rounds before test: 100 actual rounds
 105.53 ESR
 Δ Do 0.0005 ESR: 105.53

Rds. Fired	Rds. Ranged	Ad. Nos. in Program	Muzzle Velocity (ft./sec.)	Uncorrected Range (yds.)	Uncorrected Drift (yds.)	Corrected Range (yds.)	Uncorrected D/R (%)	Corrected D/R (%)
5	5	2-6	3398±14	13644±30	-40±7	13471±42	C.22	C.31
5	5	7-11	3413±22	13677±69	-25±6	13445±24	C.50	C.18
5	5	12-16	3421±19	13668±92	-45±7	13407±45	0.67	C.34
5	5	17-21	3390±20	13555±94	-35±5	13424±26	C.69	C.19
5	5	22-26	3408±22	13612±79	-46±7	13411±32	0.58	C.24
5	5	27-31	3410±14	13543±89	-55±10	13322±59	C.66	C.44
5	5	32-36	3418±17	13621±46	-51±11	13354±88	0.34	C.66
5	5	37-41	3416±8	13577±54	-59±17	13319±69	0.40	C.52
5	5	42-46	3400±12	13509±34	-57±16	13332±68	C.25	C.51
5	5	47-51	3427±24	13524±50	-68±27	13220±103	C.37	C.78

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SECURITY INFORMATION

APPENDIX A



NP9-50939

25 March 1952

3"15 AA Projectile Type EX 1 Mod 0 before firing.
Figure 1

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SECURITY INFORMATION



NP9-51579

22 December 1952

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SECURITY INFORMATION

3.5 AA Projectile with two 0.75 Nylon Bands before Firing.
Figure 1A

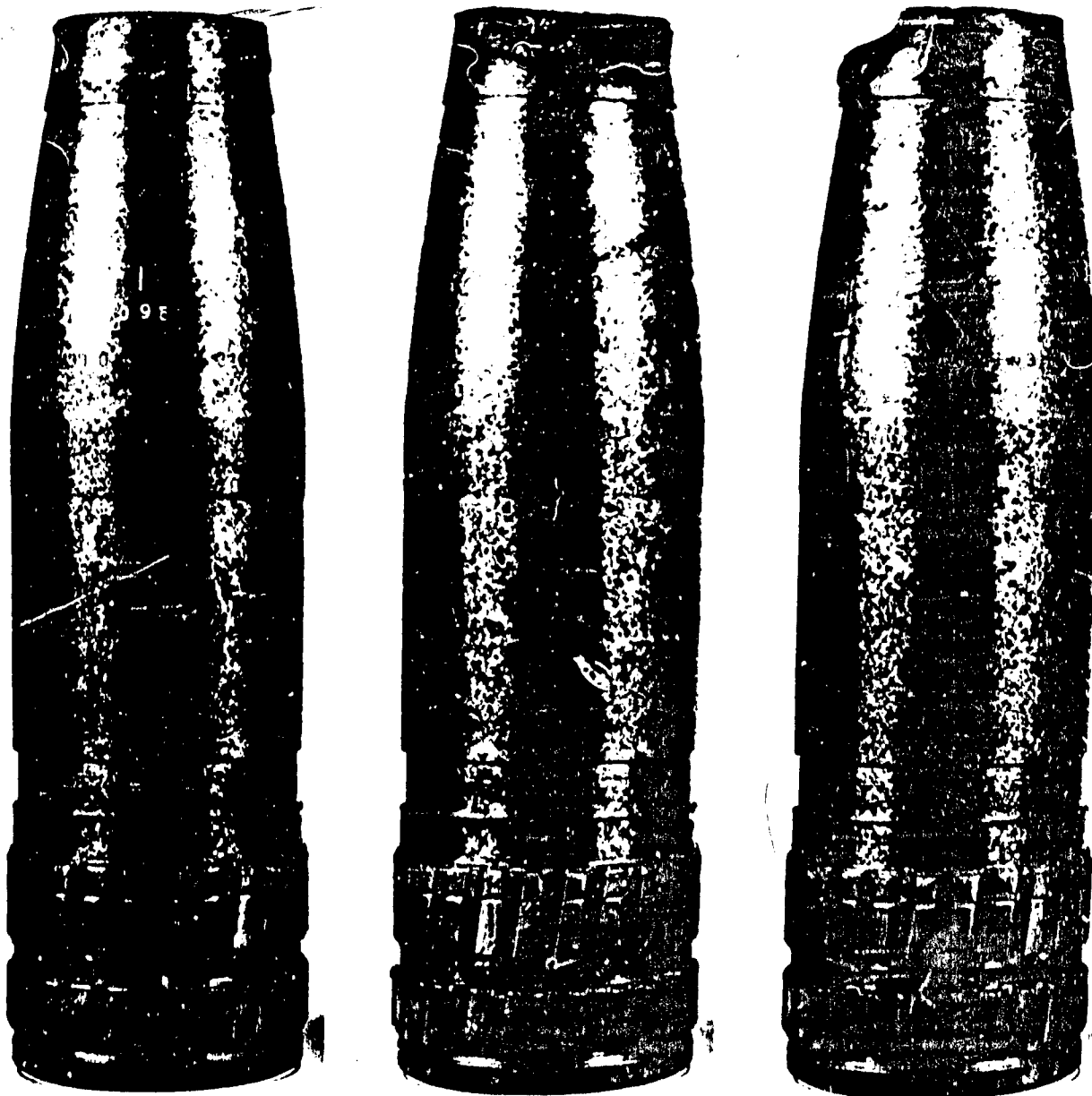


NP9-50940

25 March 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1094 (muzzle velocity 3128 ft./sec.).
Figure 2

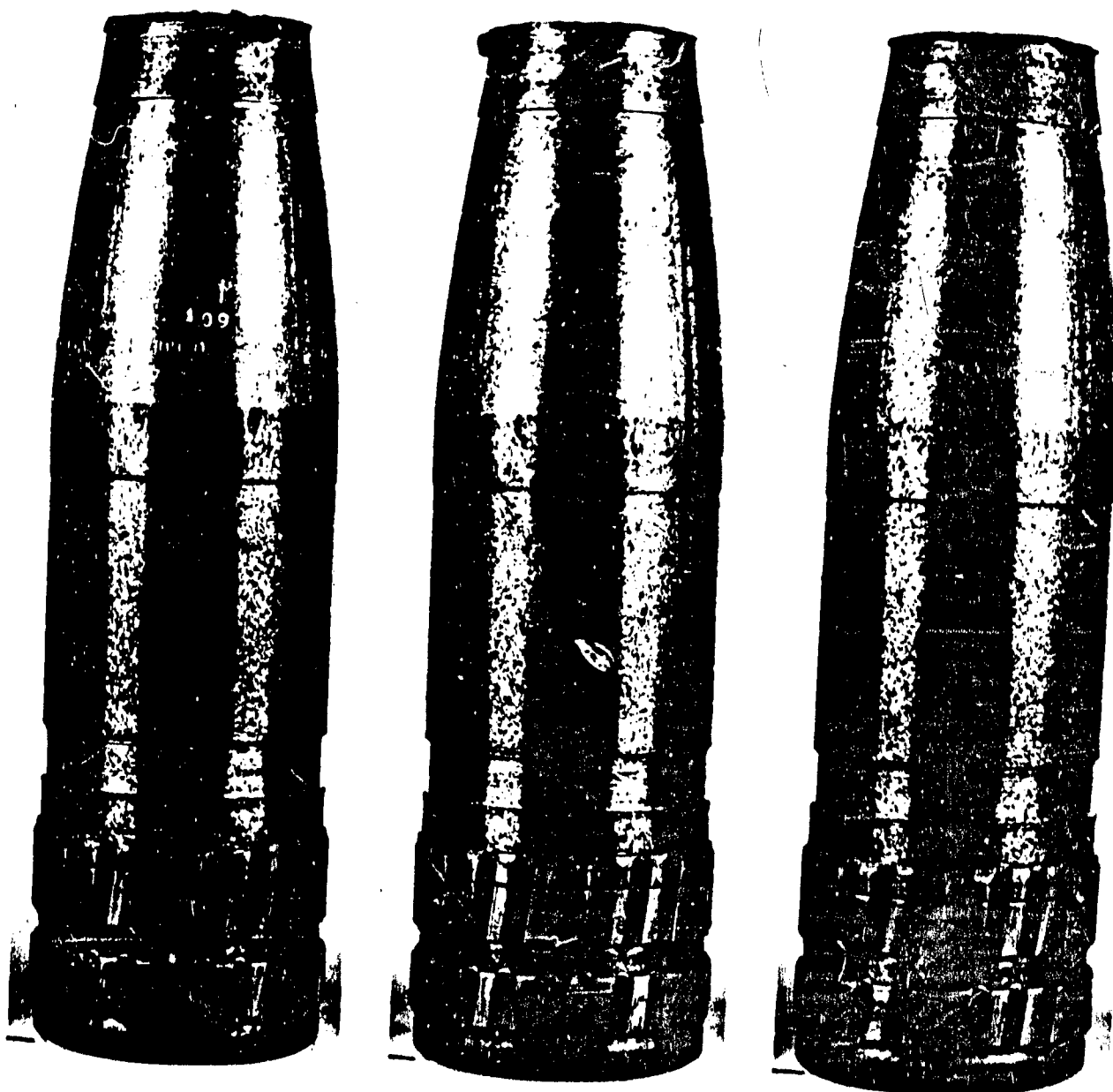


NP9-50941

25 March 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1095 (muzzle velocity 3463 ft./sec.)
Figure 3

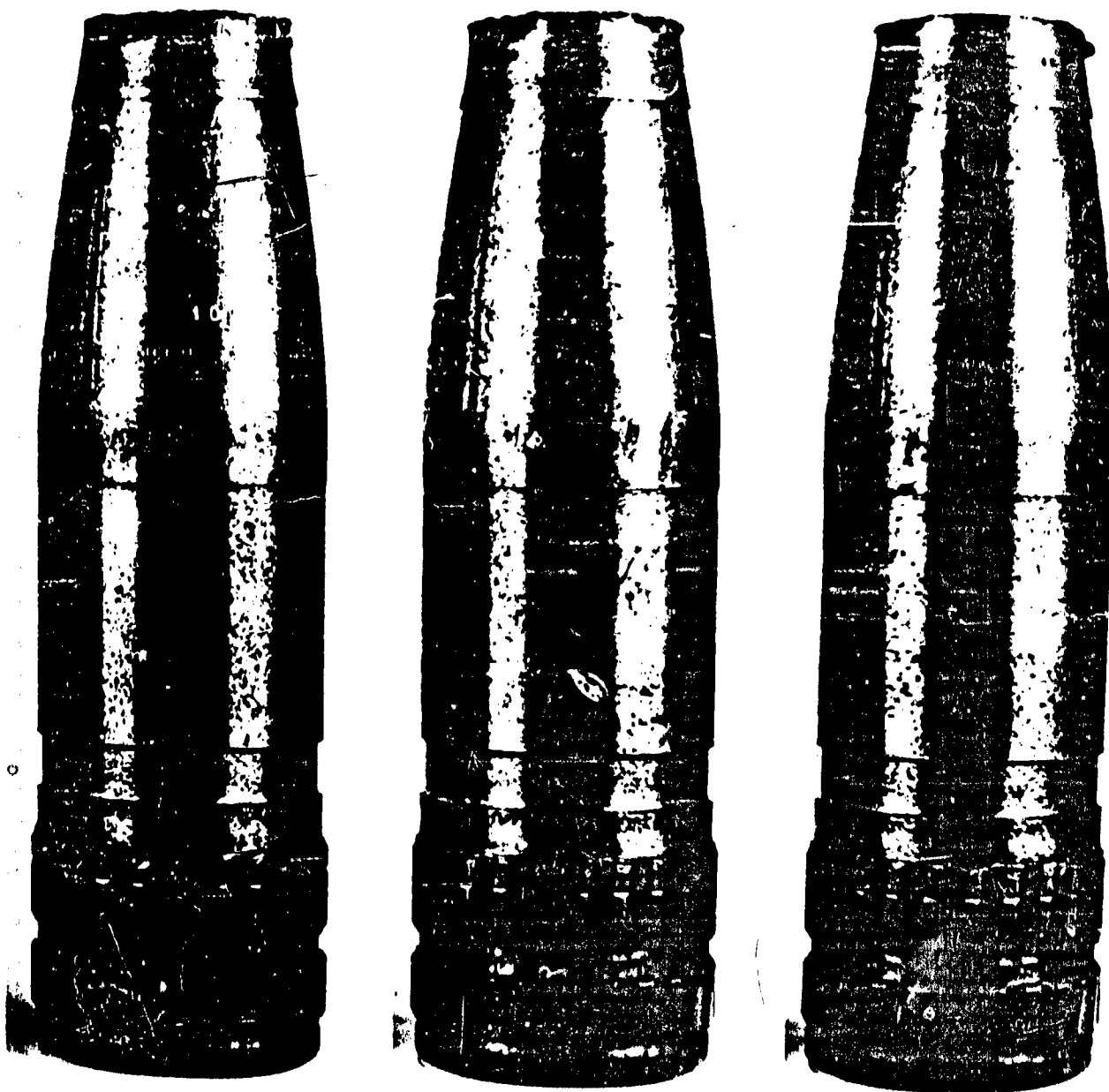


NP9-50942

25 March 1952

Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1097 (muzzle velocity 3760 ft./sec.).
Figure 4

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SECURITY INFORMATION



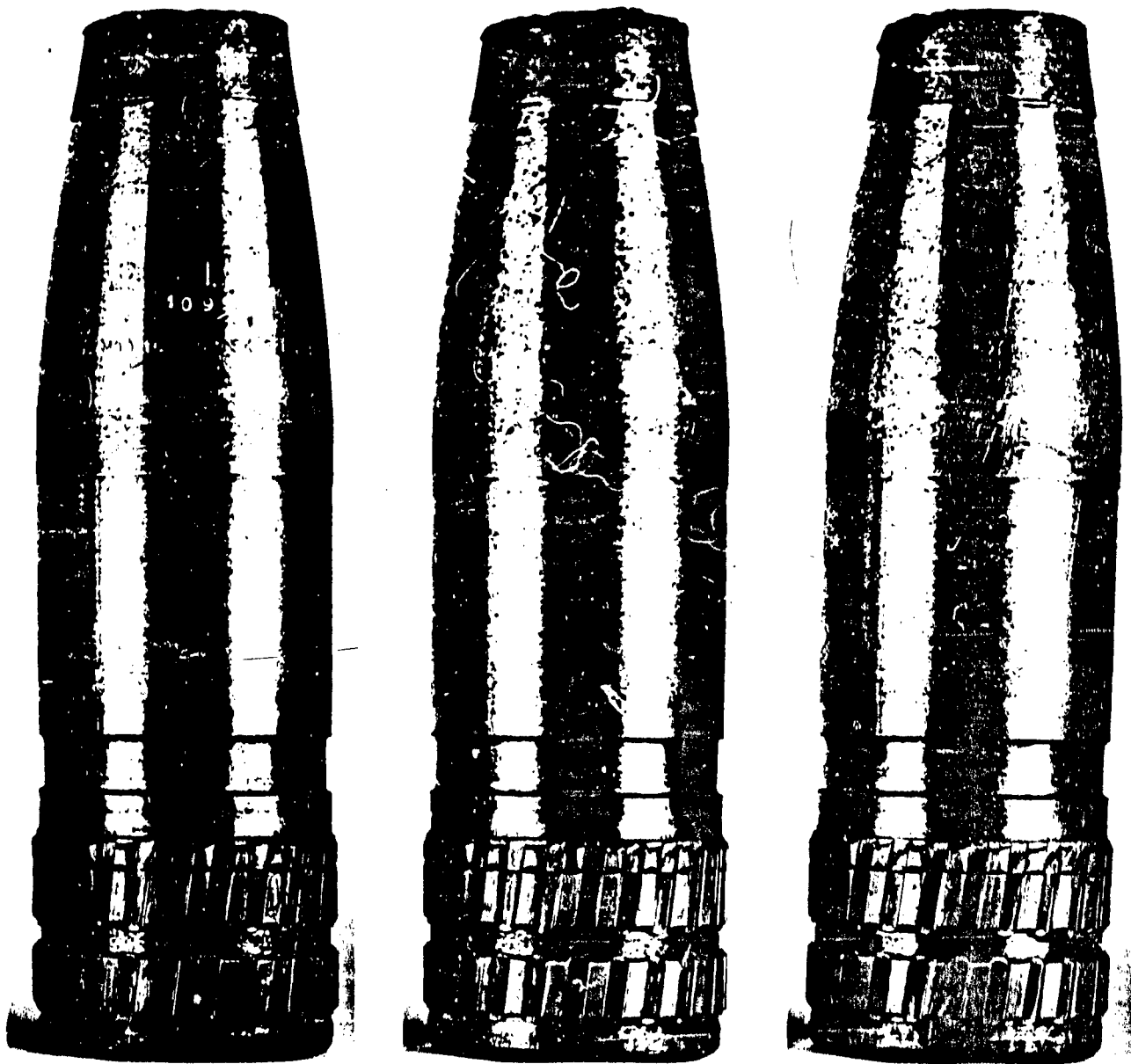
NP9-50943

25 March 1952

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Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1098 (muzzle velocity 3709 ft./sec.).
Figure 5

SECURITY INFORMATION

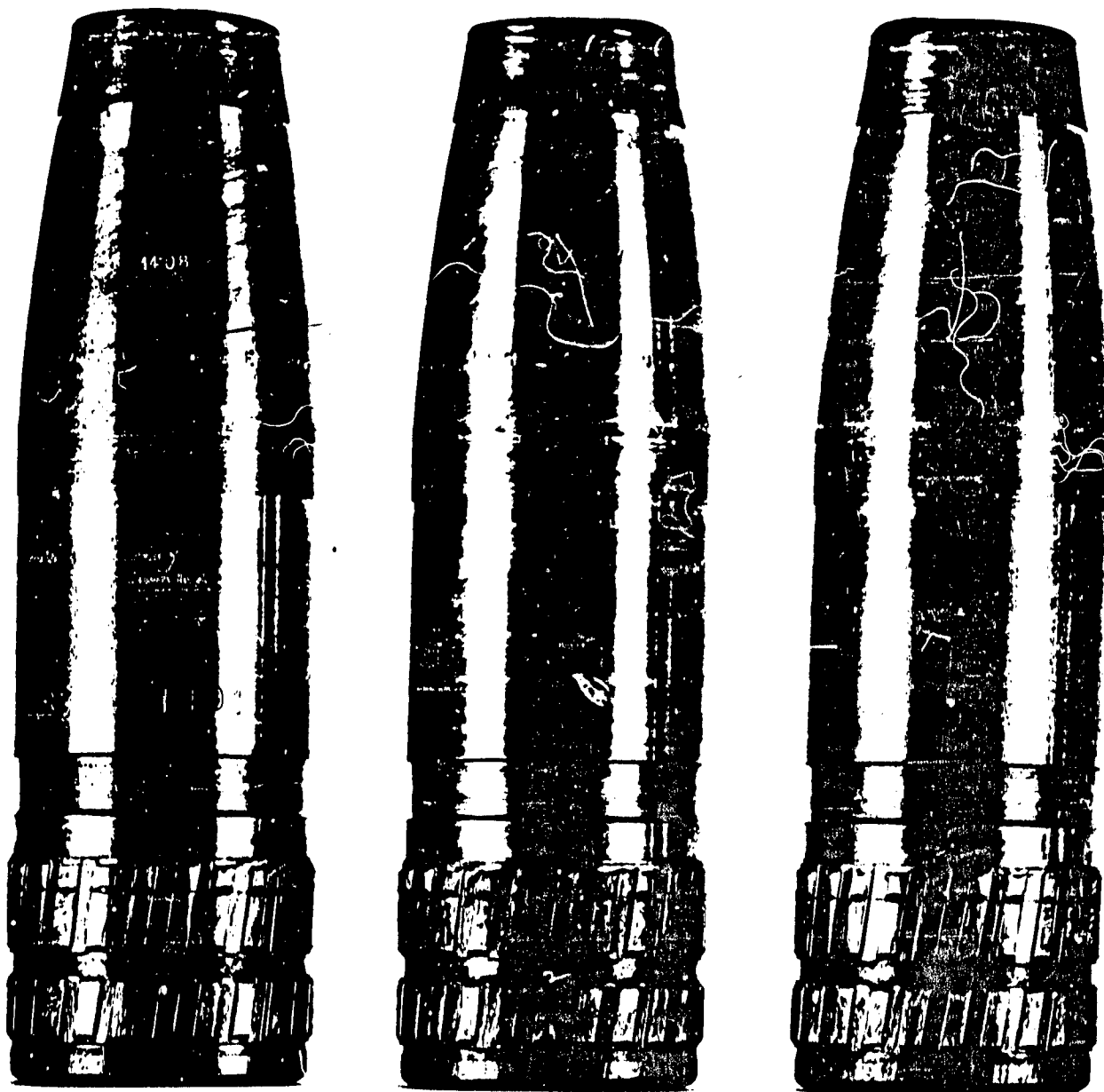


NP9-50944

25 March 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1099 (muzzle velocity 3566 ft./sec.).
Figure 6



NP9-50945

1 July 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod O. Projectile No. 1408 (muzzle velocity 3326 ft./sec.).
Figure 7



NP9-50946

1 July 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type A Modification). Projectile No. 1409 (muzzle velocity 3573 ft./sec.).

Figure 8



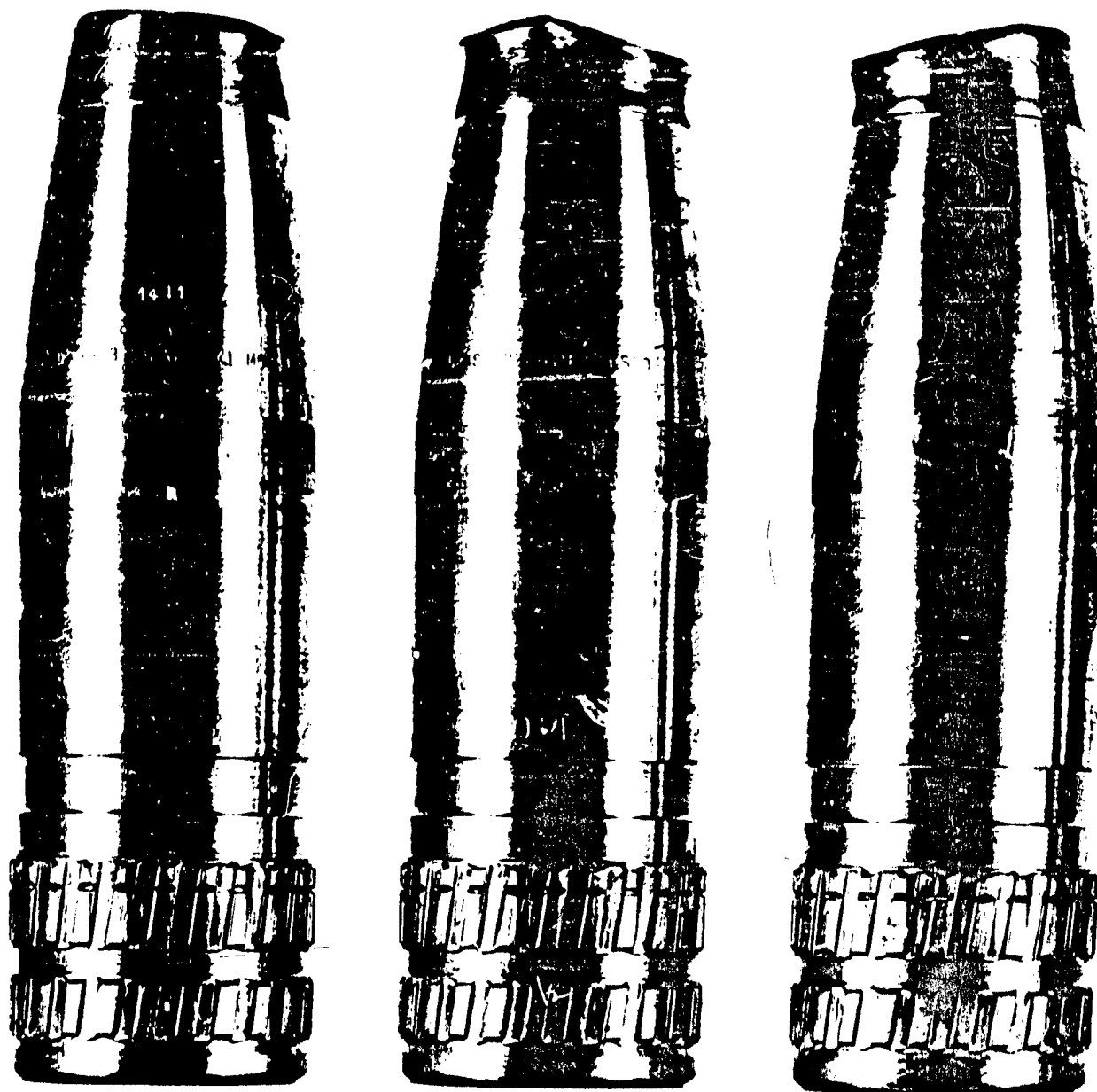
NP9-50947

1 July 1952

Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type A Modification). Projectile No. 1410 (muzzle velocity 3601 ft./sec.).

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Figure 9



NP9-50948

1 July 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type B Modification). Projectile No. 1411 (muzzle velocity 3576 ft./sec.).

Figure 10



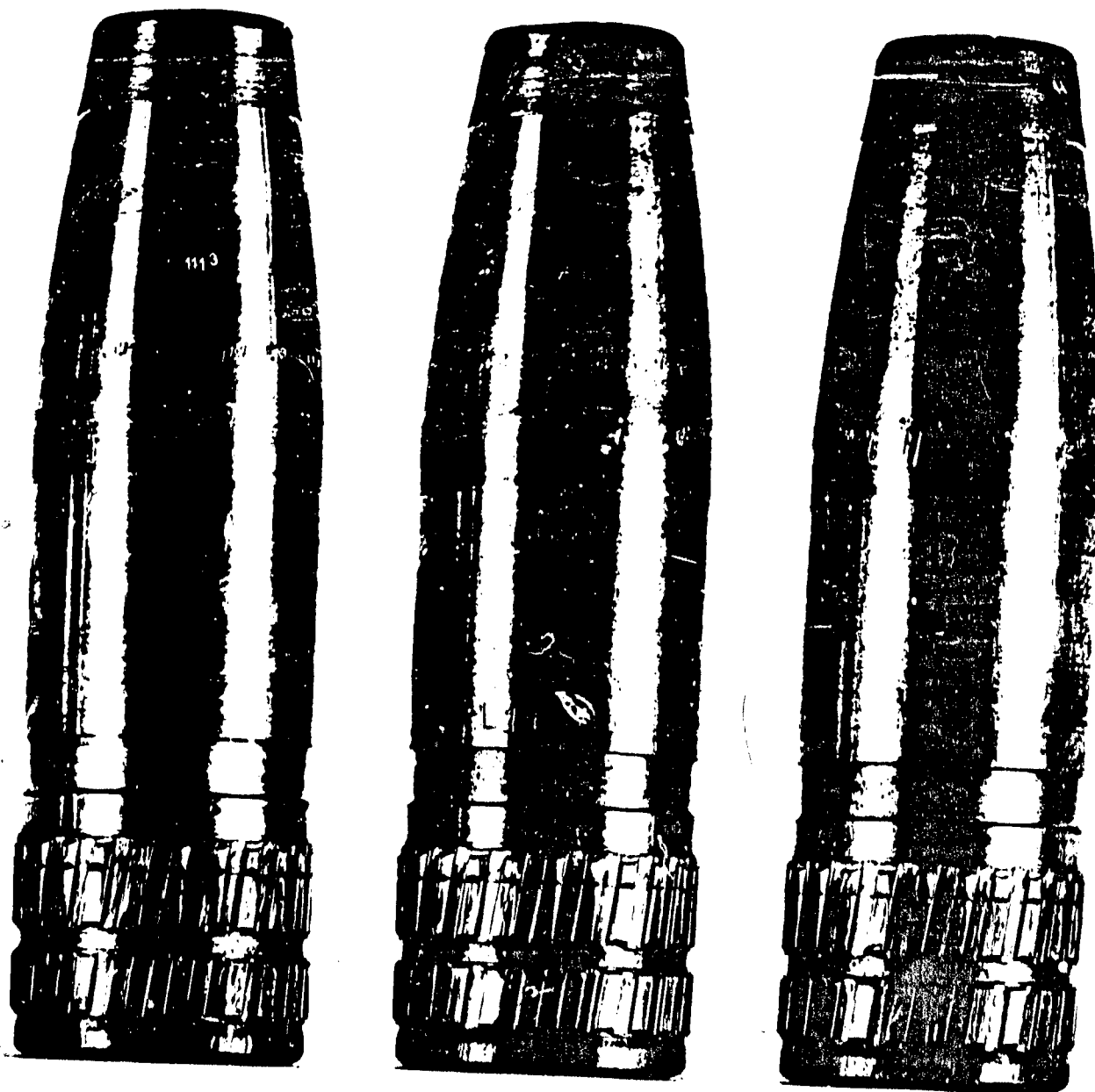
NP9-50949

1 July 1952

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Three views (120° apart) of recovered 3.5 AA Projectile Type EX 1 Mod 0 (Type B Modification). Projectile No. 1412 (muzzle velocity 3557 ft./sec.).

Figure 11



NP9-50950

1 July 1952

Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1413 (muzzle velocity 3405 ft./sec.).
Figure 12

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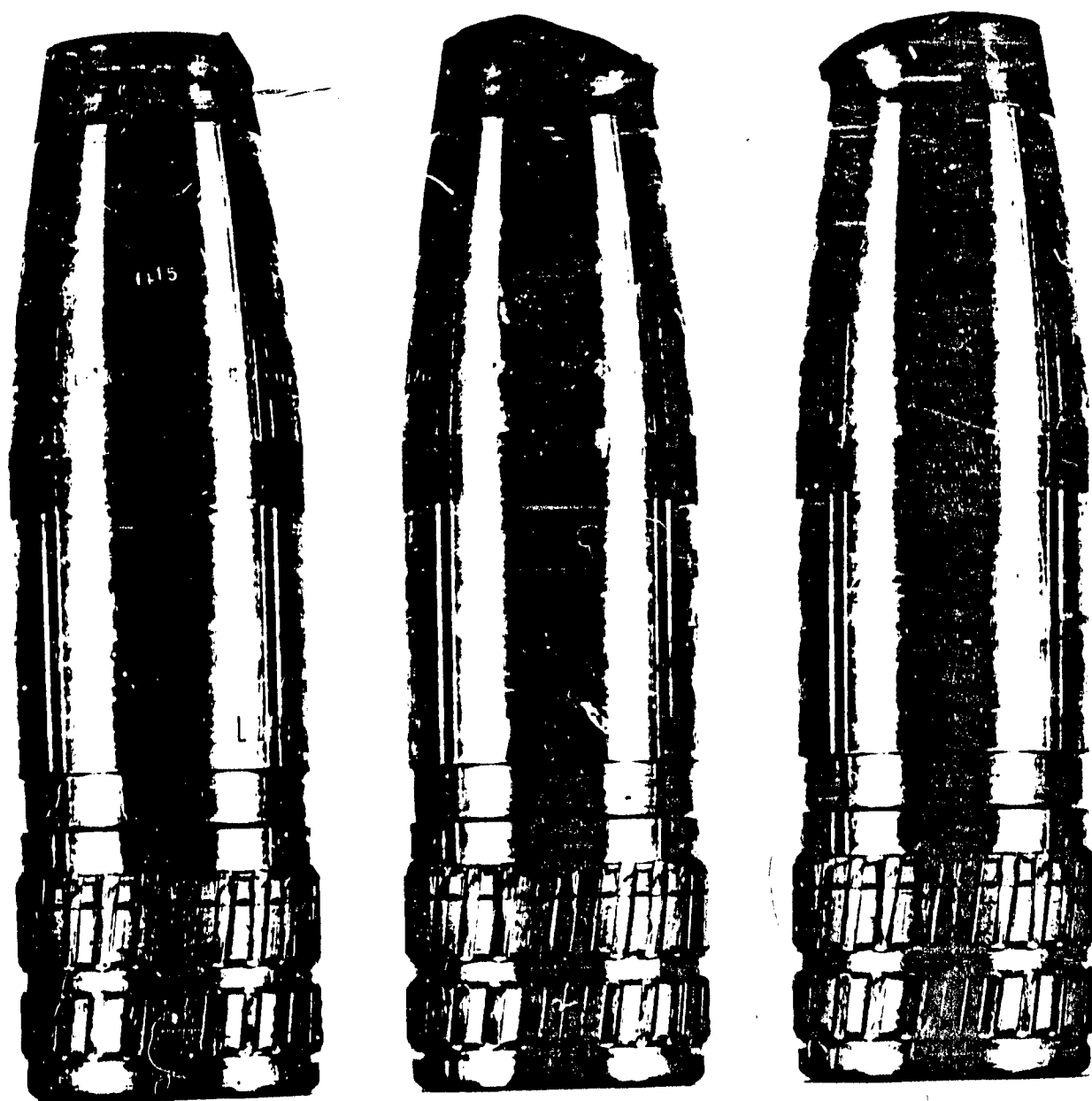


NP9-50951

1 July 1952

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Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1414 (muzzle velocity 3350 ft./sec.).
Figure 13



NP9-50952

1 July 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type
EX 1 Mod 0. Projectile No. 1415 (muzzle velocity 3354 ft./sec.).
Figure 14



NP9-50953

1 July 1952

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Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type A Modification). Projectile No. 1416 (muzzle velocity 3398 ft./sec.)

Figure 15



NP9-50954

1 July 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type A Modification). Projectile No. 1417 (muzzle velocity 3361 ft./sec.).

Figure 16



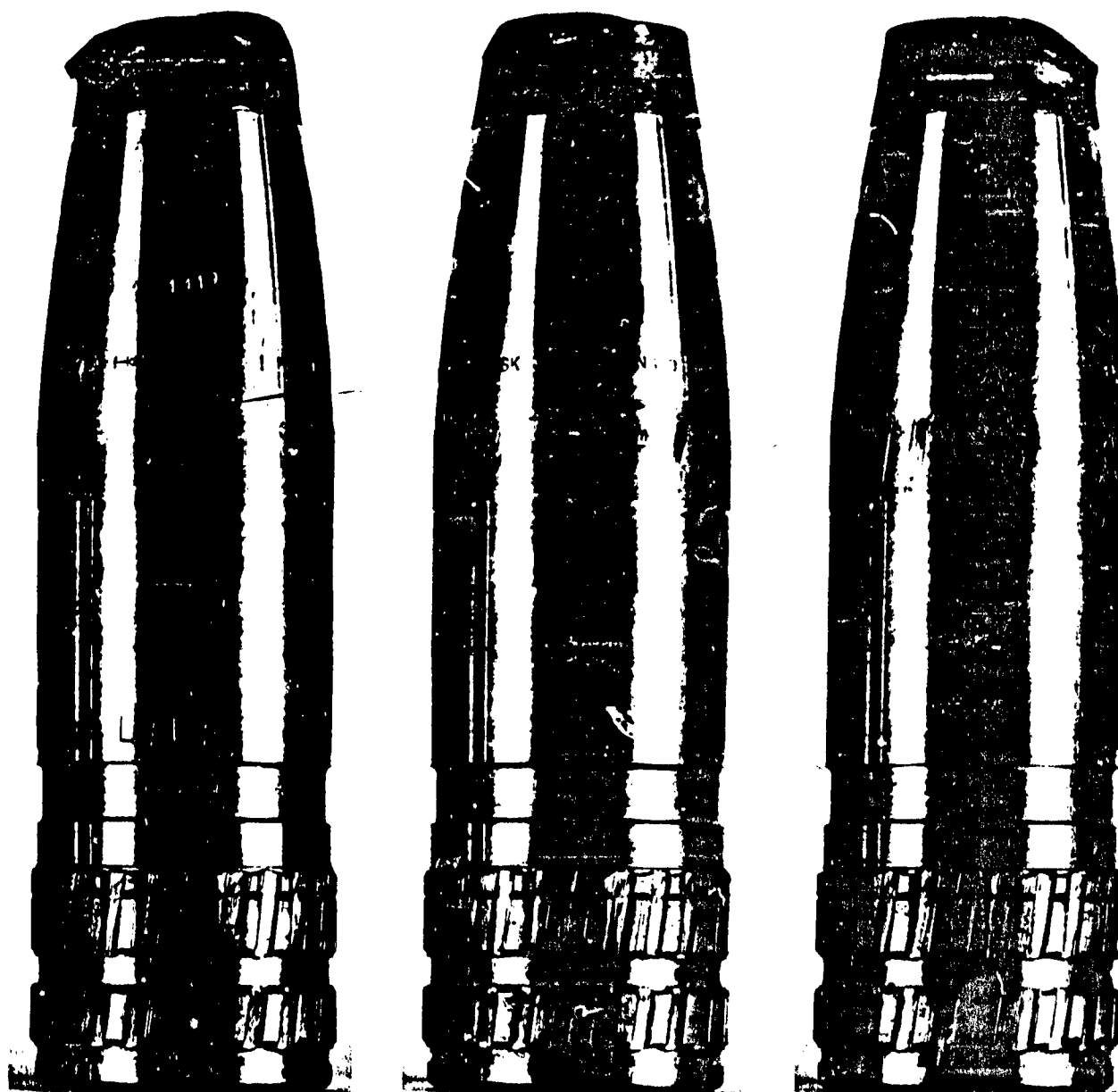
NP9-50955

1 July 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type A Modification). Projectile No. 1418 (muzzle velocity 3363 ft./sec.).

Figure 17



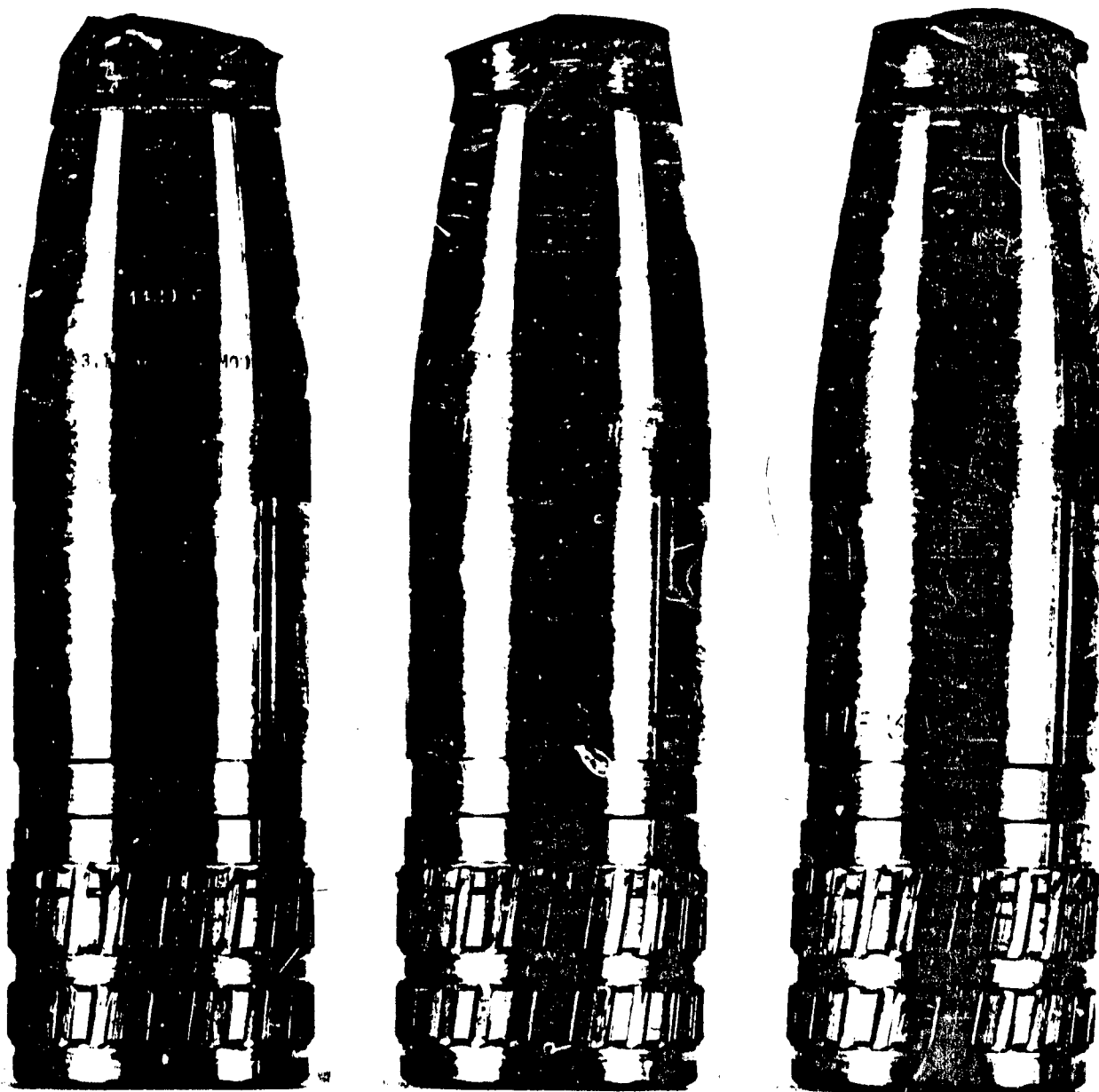
NP9-50956

1 July 1952

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Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type B Modification). Projectile No. 1419 (muzzle velocity 3365 ft./sec.).

Figure 18



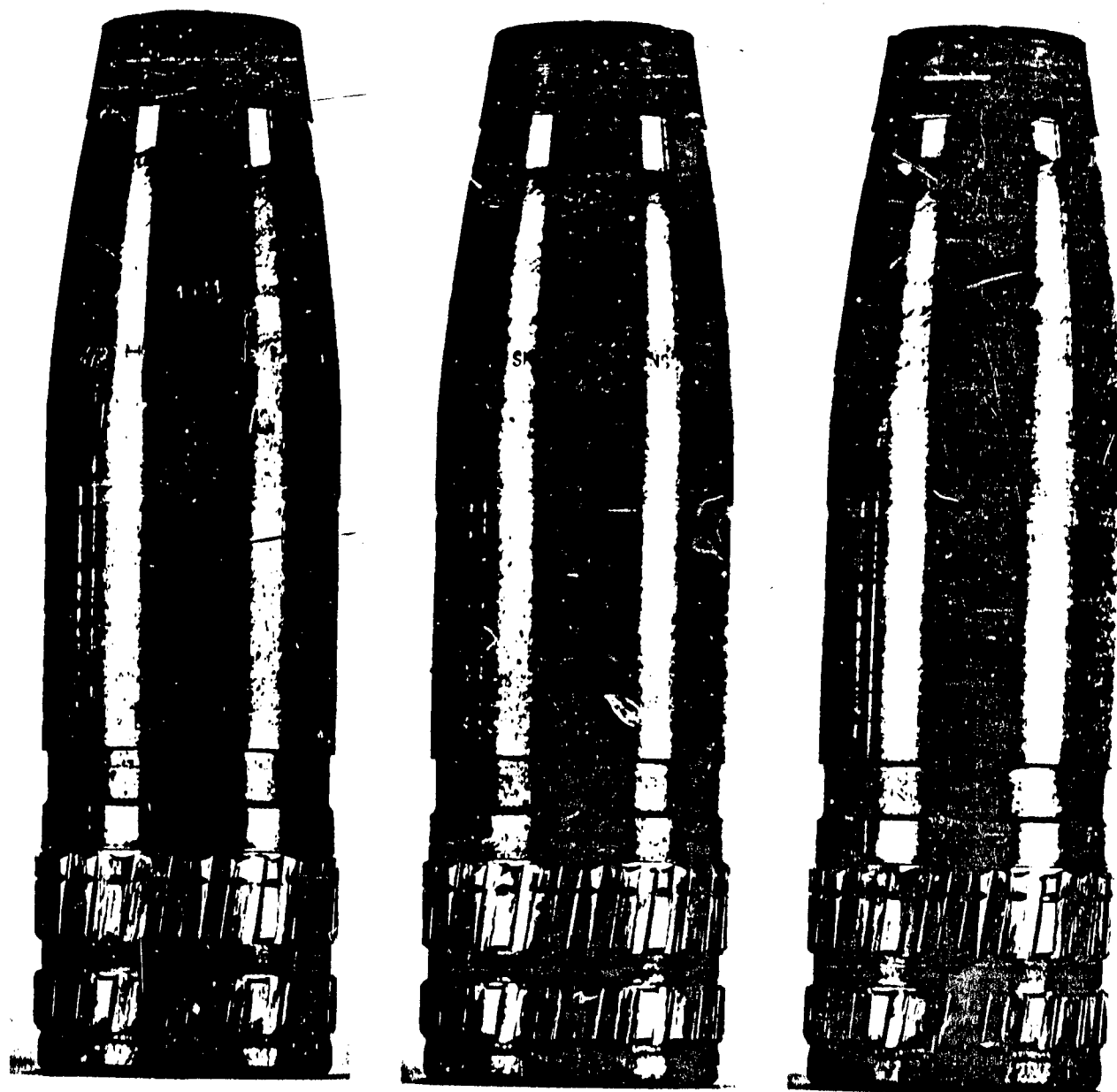
NP9-50957

1 July 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile Type EX 1 Mod 0 (Type B Modification). Projectile No. 1420 (muzzle velocity 3344 ft./sec.).

Figure 19



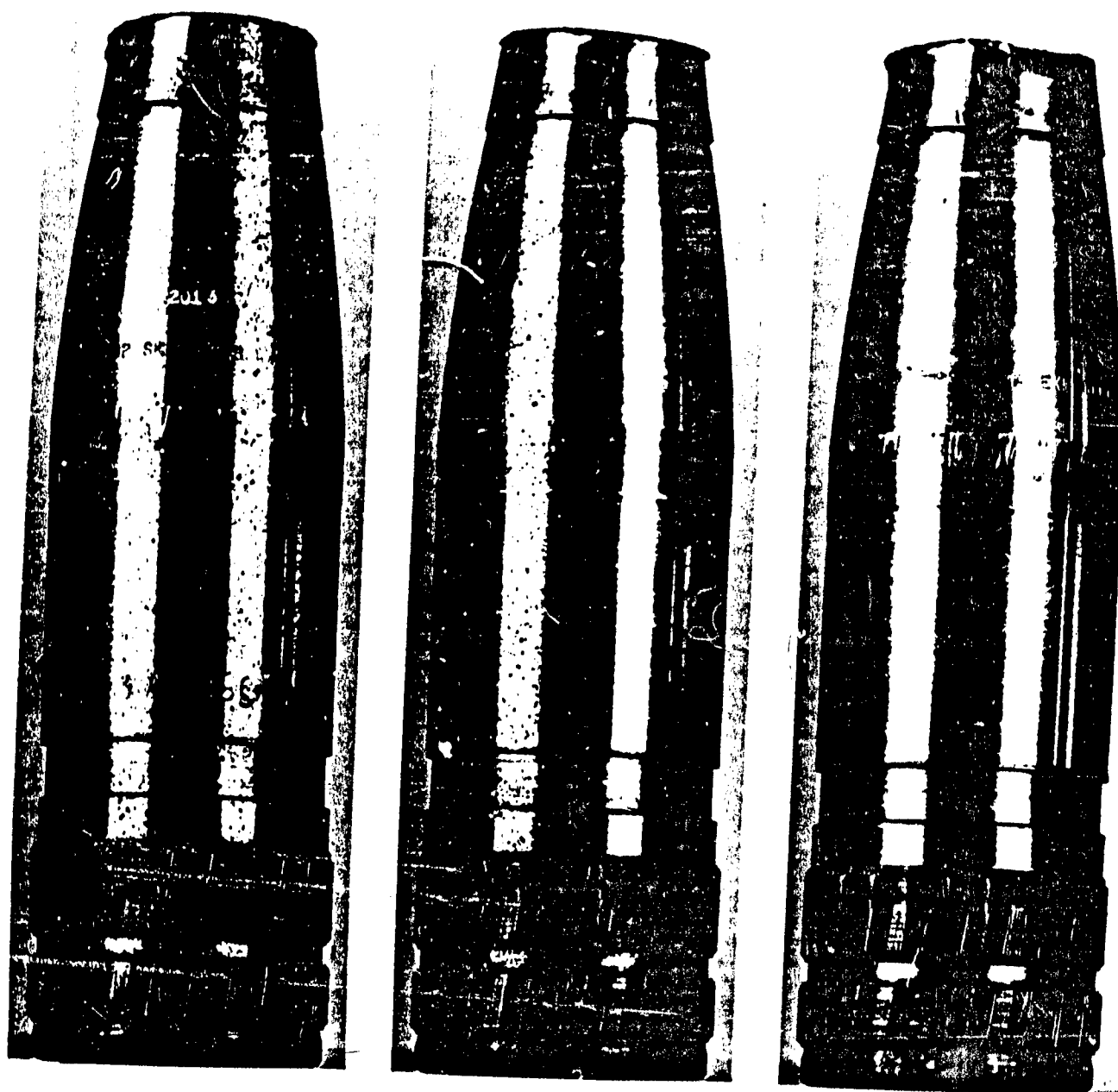
NP9-50958

1 July 1952

Three views (120° apart) of recovered 3.15 AA
EX 1 Mod 0 (Type B Modification). Projectile
velocity 3366 ft./sec.).

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Projectile Type
No. 1421 (muzzle

Figure 20



NP9-51562

22 December 1952

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Three views (120° apart) of recovered 3.15 AA Projectile
Type EX 1 Mod 0. Projectile No. 2013 (muzzle velocity
3408 ft./sec.).

Figure 21



NP9-51563

22 December 1952

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Three views (120° apart) of recovered 3.15 AA Projectile
Type EX 1 Mod 0. Projectile No. 2014 (muzzle velocity
3404 ft./sec.).

Figure 22



NP9-51564

22 December 1952

Three views (120°
Type EX 1 Mod 0.
3403 ft./sec.).

apart) of recovered 3.15 AA Projectile
Projectile No. 2015 (muzzle velocity

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Figure 23



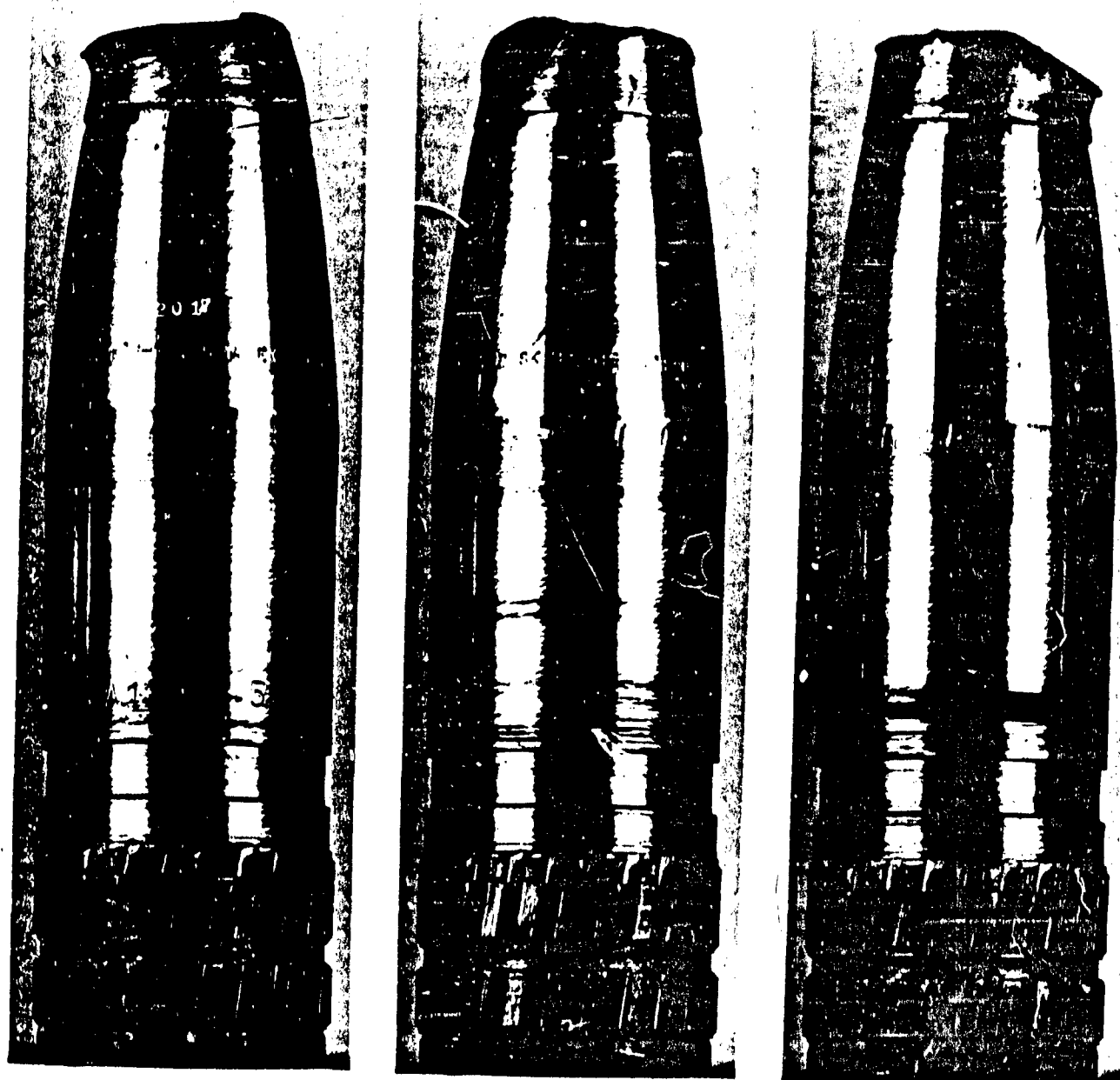
NP9-51565

22 December 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile
Type EX 1 Mod 0. Projectile No. 2016 (muzzle velocity
3398 ft./sec.).

Figure 24



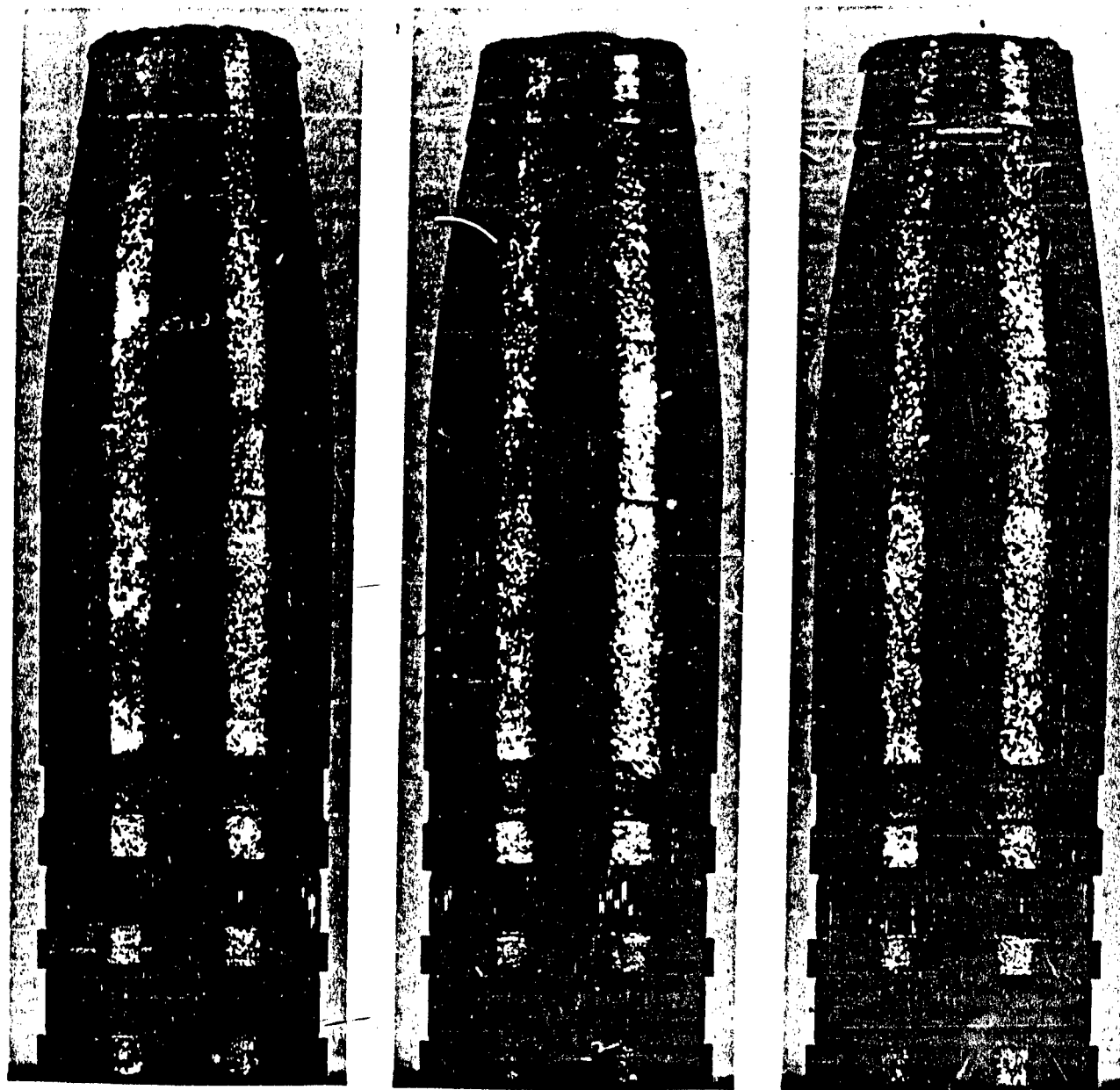
NP9-51566

22 December 1952

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SECURITY INFORMATION

Three views (120° apart) of recovered 3.15 AA Projectile
Type EX 1 Mod 0. Projectile No. 2017 (muzzle velocity
3396 ft./sec.).

Figure 25



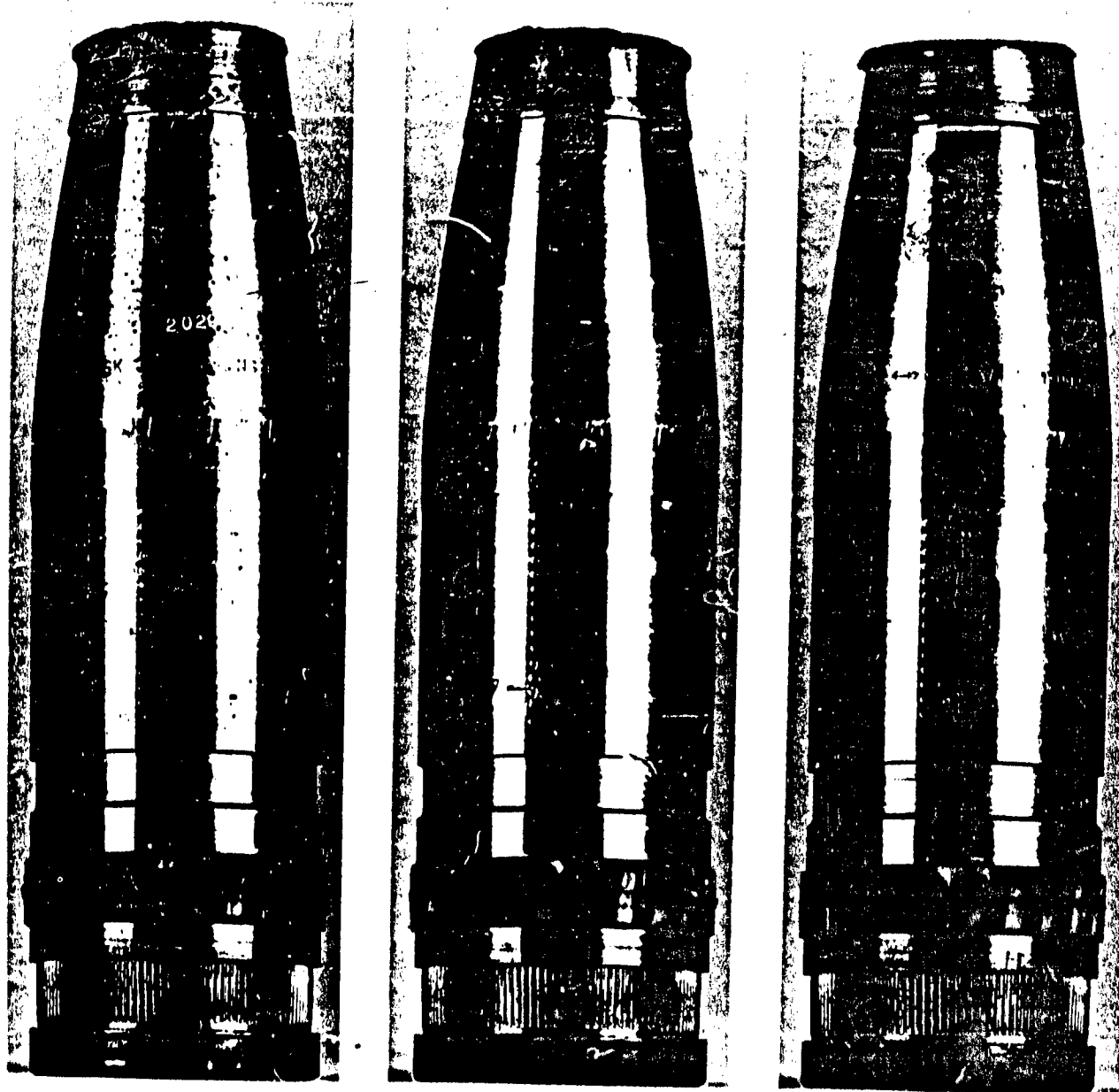
NP9-51955

22 December 1952

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Three views (120° apart) of recovered 3.15 AA Projectile fired with two O.75 Nylon Bands. Projectile No. 2019 (muzzle velocity 3377 ft./sec.).

Figure 26



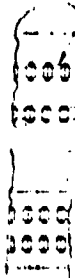
NP9-51956

22 December 1952

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Three views (120° apart) of recovered 3.15 AA Projectile
fired with two 0.75 Nylon Bands. Projectile No. 2020
(muzzle velocity 3467 ft./sec.).

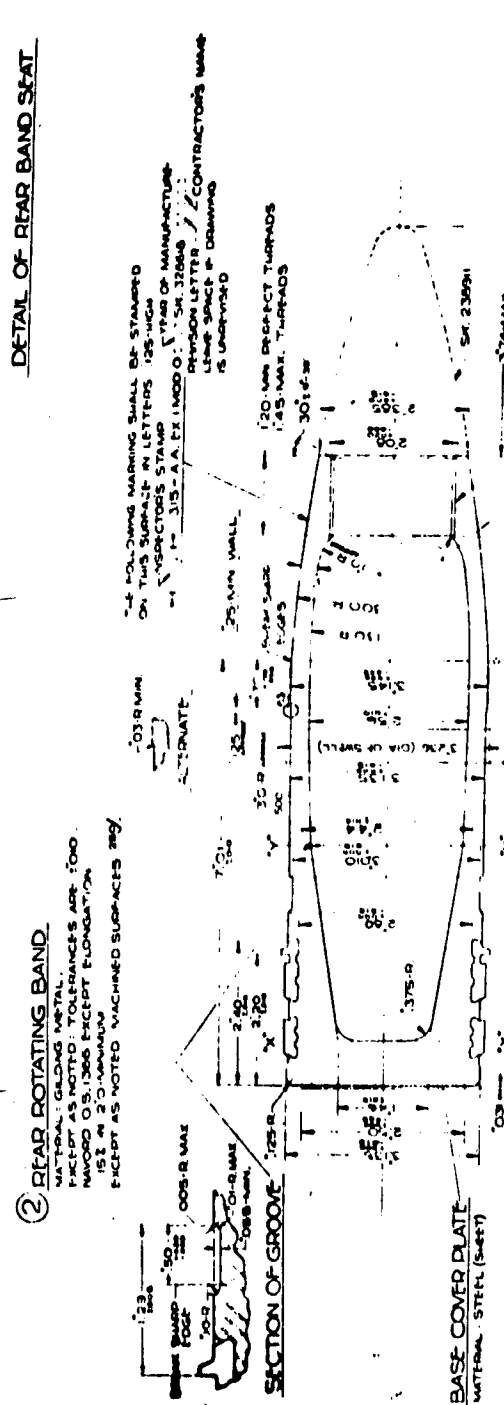
Figure 27



- SCREWS APPROX. 8-10 INCH.
SCREWS SHALL BE THE DEPTH OF RIB.
SCREW NUTS ON CYLINDRICAL SURFACES
ARE ACCEPTABLE.



DETAIL OF REAR BAND SEAT



Category	Amount
DECEASED BODY	5.00
ROTATING MACHINES	5.00
SIZE CONTROL	5.00
PRODUCTIVITY	10.00
BURNING CHARGE (S.D.)	1.00
PUMP	2.00
CANITY LANE	0.02
DECEASED COMPLET	15.00

7-57-675 Small Paper

BODY

FOR NATIONAL SET NOTE.

EXCEPT AS NOTED: MACHINED BY DEANKE 250/

CONCENTRICITY REQUIREMENTS
WITH THE PROJECTILE ROTATING ON SUBPROJECT AND SUBJECT AT HEAD OF
BANDS. FOLLOWING MAXIMUM ECCENTRICITIES WITH RESPECT TO THESE
SUBJECTS WILL BE ALLOWED:

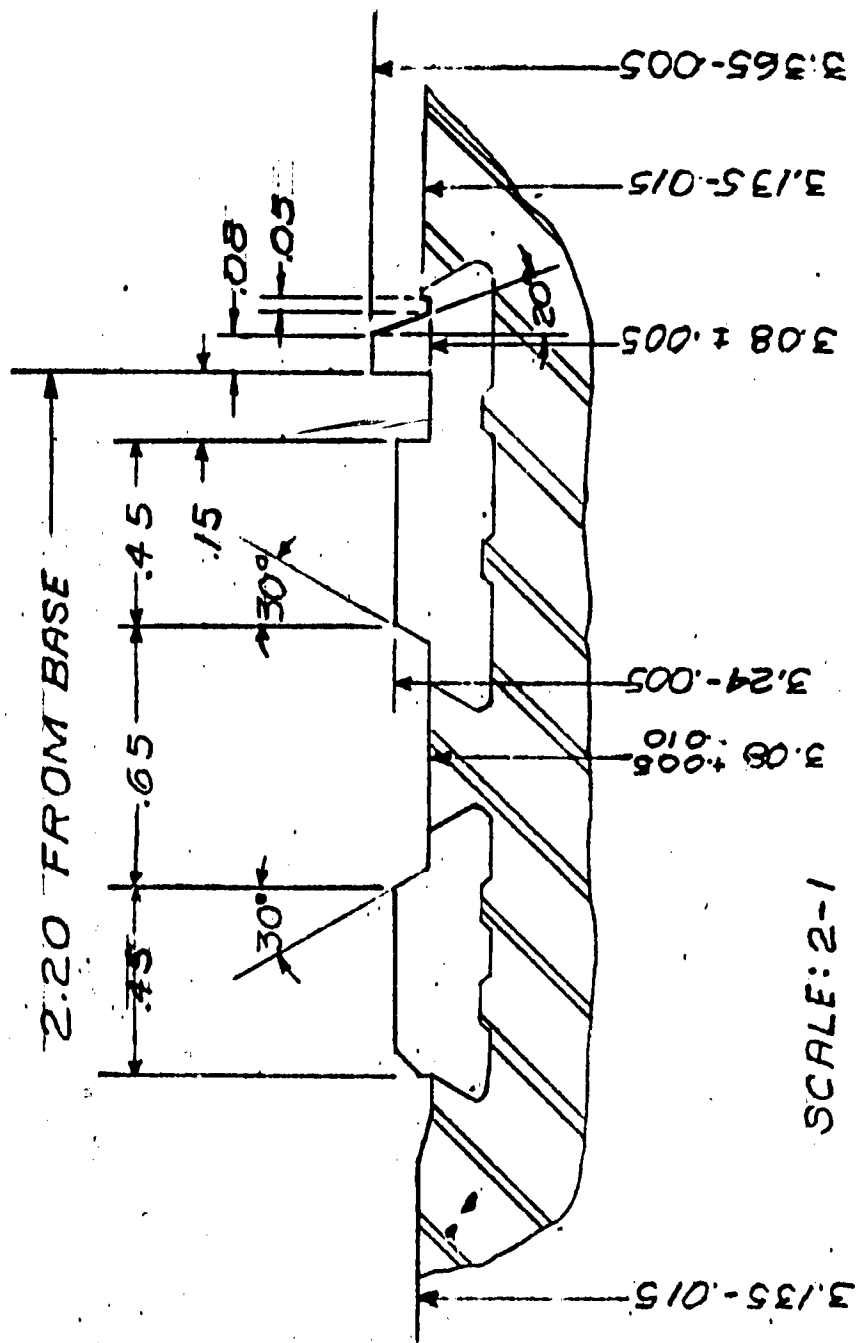
1. HEAD POINTING BANDS005
2. 4-1/2" TURNING BANDS010 (SEE NOTE-1)
3. NOSE END (2.345 DIA)005
NOTE-1) ECCENTRICITY OF FUEL HOLE SHALL BE MEASURED 2.0" FORWARD OF NOSE
ON AN ADAPTER ENDGAGE - 2.0" TURNING AND BEARING HARD AGAINST THE
FACE OF THE PROJECTILE BODY TURNING AND BEARING HARD AGAINST THE
FACE PHYSICAL PROPERTIES OF THE STEEL USED FOR PROJECTILE BODY:
TENSILE STRESS 70,000 P.S.I. MINIMUM.
TENSILE STRENGTH 105,000 P.S.I.
ELONGATION 10% MIN.
REDUCTION IN AREA 35% MIN.
ABOVE THE CRACKING SHALL NOT BE QUENCHED IN WATER FROM

THE CAPACITY OF THE CAVITY AS MEASURED TO MOST
AND IS AS FOLLOWS.

ITEM	MEASUREMENT
TOTAL VOLUME OF CAVITY	... 38.20-CU. IN.

315-PROJECTILE (AA) TYPE EX 140010 (See 315-DETAILS) BODY DETAILS		328615 328615	
315-PROJECTILE (AA) TYPE EX 140010 (See 315-DETAILS) BODY DETAILS		328615 328615	

328618



REAR ROTATING BAND

3.15 PROJECTILE TYPE EX1 MOD.0

MODIFIED TYPE A

VOLUME WORKING METAL = $.510 \text{ IN}^3$

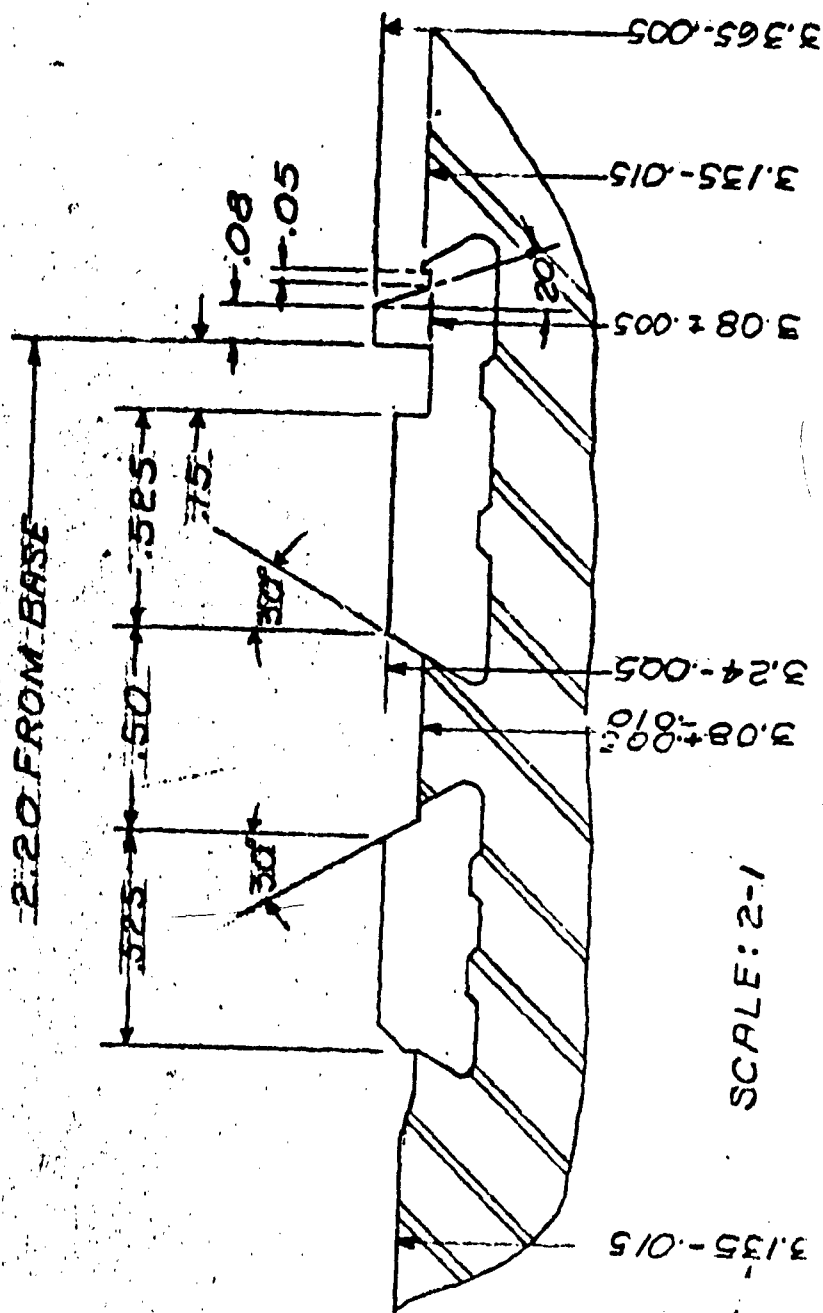
SCALE: 2-1

FIGURE 29

REF: SKETCH R23D 4-17-52 MAS
BUORD SK. NO. 328618

5-6-52 CWM

DWB NO.
001-348



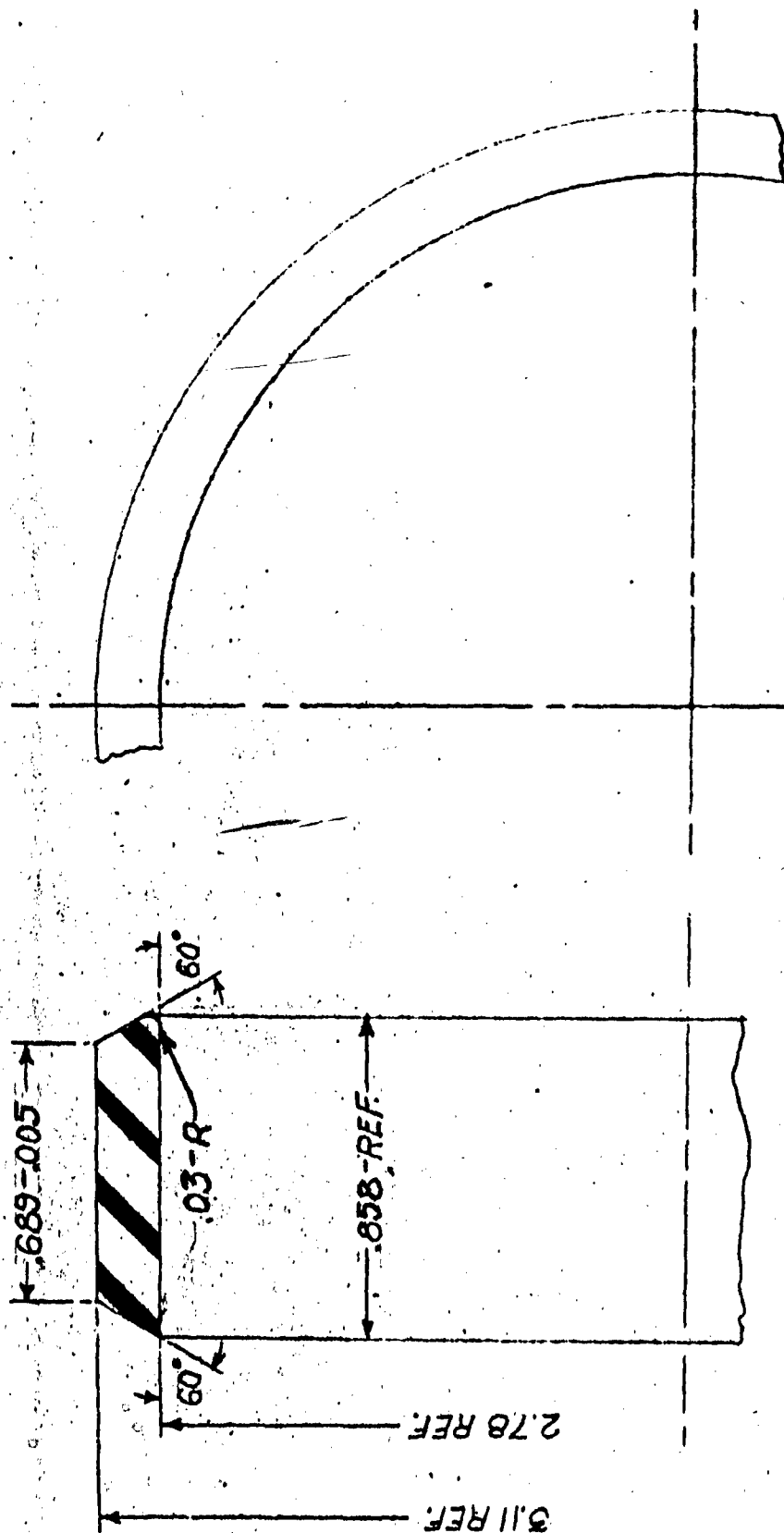
SCALE: 2-1

REAR ROTATING BAND
3.15 PROJECTILE TYPE EXI MOD. O
MODIFIED TYPE B
 VOLUME WORKING METAL = .578 IN³

REF: SKETCH R236 4-17-52 MAS.
 BUOED SK. NO. 328618

5-6-52 Cwm

FIGURE 30



NOTE:
BAND MADE FROM BAND
BLANK A.P.L.-200

NYLON BAND FOR 3.15 PROJECTILE

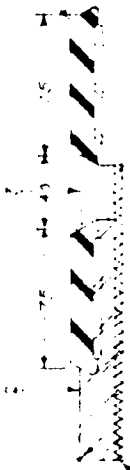
CR. NO.
APL-410

11/19/52 SCALE 2/1 234

FIGURE 31

REVISIONS		
SYM.	DESCRIPTION	DATE

BANDS AS PER APL-410

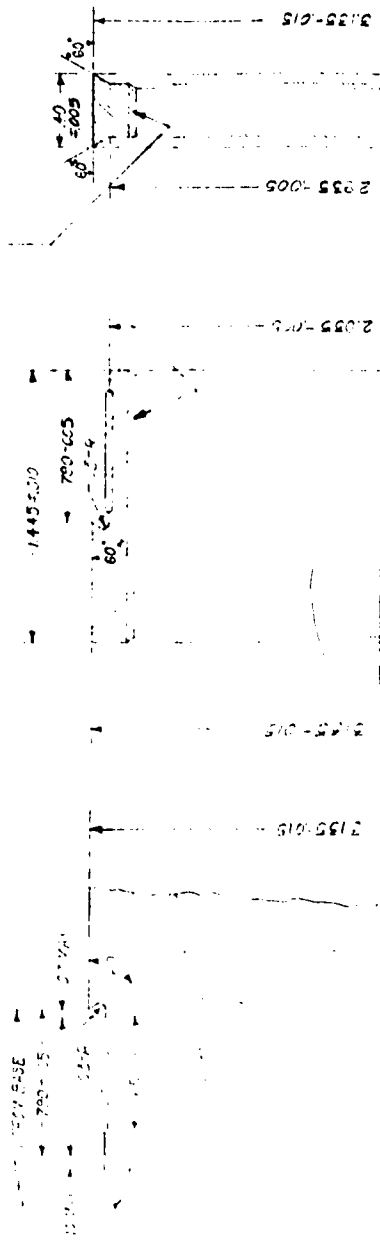


200-1443-2

200-1443-2

ASSEMBLY DETAIL

200-1443-2
VAL. SA - 275-244
PITCH-04 - 370360068
VAL. SA - 267270077



3. FORWARD BAND RETAINER
MATERIAL STEEL

2. AFTER BAND RETAINER
MATERIAL STEEL

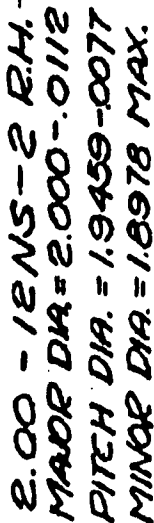


ON PITCH
12 1/2 SLOPES PER INCH

NOTE: ILLUSTRATION OF BANDS IS 654 IN.
PROJECTILE DIMENSIONS AND NOTES
REFERENCE BUDG. SKETCH 10-322619.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS: DECIMALS: .0005 ANGLES: .5		APPROVED		19		3'15 AA PROJECTILE TYPE EX 1 MOD 0 MODIFIED (NYLON BANDS)		BUREAU OF ORDNANCE DEPARTMENT OF THE NAVY NAVAL PROVING GROUND DAHLGREN, VA.	
DO NOT SCALE THIS DRAWING		BY DIRECTION OF THE CHIEF OF BUREAU		U.S.N.		SCALE		DRAWING NO.	
MATERIAL		CHECKED		DRAWN		UNIT WT.		FOR ORDER	

9/27/49 waf



DUMMY NOSE PLUG

MATERIAL: STEEL, FORGED
OR ROLLED STOCK.

WEIGHT: 2.68 ± 0.05 LB5

NOTE: BREAK SHARP EDGES

REF: SEE BUORD SK. NO. 239269

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SECURITY INFORMATION

FIGURE 33

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE X

STAR GAUGE DATA

Lands

Caliber: 3"15
Type: A
Mod: O
Gun No.: 1

Measurement Taken from
Muzzle Face

	<u>Distance</u>	<u>X</u>	<u>Y</u>		<u>Distance</u>	<u>X</u>	<u>Y</u>
	183"92	3"310	3"310		35"	3"153	
	183"42	.250	.248		30"	.153	
	182"92	.208	.208		28"	.153	
	182"42	.178	.178		26"	.153	
	181"92	.157	.157		24"	.153	
Origin, O. B.	181"42	.155	.156		22"	.153	
1"0 fwd.	180"42	.155	.155		20"	.153	
	179"42	.154	.154		18"	.153	
	178"42	.154	.154		16"	.153	
	177"42	.154	.154		14"	.153	
	176"42	.154	.154		12"	.153	
	175"42	.154	.154		10"	.153	
	174"42	.154	.154		9"	.153	
	173"42	.154	.154		8"	.153	
	172"42	.154	.154		7"	.153	
	171"42	.154	.154		6"	.153	
12" fwd.	170"42	.154	.154		5"	.153	
	169"42	.154	.154		4"	.153	
	165"	.153			3"	.153	
	160"	.153			2"	.153	
	155"	.152			1"	.153	
	150"	.153		Muzzle		.153	
	145"	.153					
	140"	.152					
	135"	.152					
	130"	.152		Origin	3"155	3"156	
	125"	.152		1" fwd.	.155	.155	
	120"	.152		12" fwd.	.154	.154	
	115"	.151					
	110"	.151		Muzzle	.153	.153	
	105"	.152		1" aft.	.153	.152	
	100"	.152		12" aft.	.153	.153	
	95"	.152					
	90"	.152					
	85"	.152					
	80"	.152					
	75"	.152		Eq. Sor. Rounds:	20.32		
	70"	.152		Date:	1 July 1952		
	65"	.152		Small Diameter:	3"151		
	60"	.152		Distance:	115"0		
	55"	.152		Gauged By.	B. H. W.		
	50"	.152					
	45"	.152					
	40"	.152					

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE XISTAR GAUGE DATALands

Caliber: 3"15
Type: A
Mod: O
Gun No.: 1

Measurements Taken from
Muzzle Face

	<u>Distance</u>	<u>X</u>	<u>Y</u>		<u>Distance</u>	<u>X</u>	<u>Y</u>
Origin, O. B. 1"0	183"92	3"310	3"308		35"	3"150	3"150
	183"42	.250	.247		30"	.151	.151
	182"92	.207	.208		28"	.151	.150
	182"42	.175	.177		26"	.151	.150
	181"92	.158	.158		24"	.151	.151
	181"42	.153	.152		22"	.151	.151
	180"42	.151	.151		20"	.151	.151
	179"42	.151	.151		18"	.152	.151
	178"42	.151	.150		16"	.152	.151
	177"42	.150	.150		14"	.150	.150
	176"42	.150	.150		12"	.150	.151
	175"42	.150	.150		10"	.150	.151
	174"42	.150	.150		9"	.151	.151
	173"42	.150	.151		8"	.151	.151
	172"42	.150	.150		7"	.152	.151
	171"42	.150	.150		6"	.152	.151
	170"42	.150	.151		5"	.152	.151
	169"42	.150	.150		4"	.152	.150
	165"	.150	.150		3"	.151	.151
	160"	.151	.151		2"	.151	.150
12"0	155"	.150	.150		1"	.151	.150
	150"	.150	.150	Muzzle		.151	.151
	145"	.150	.150				
	140"	.150	.150				
	135"	.150	.150				
	130"	.150	.150				
	125"	.150	.150				
	120"	.150	.150				
	115"	.150	.150				
	110"	.150	.150				
	105"	.150	.150				
	100"	.150	.150				
	95"	.150	.150				
	90"	.150	.150				
	85"	.150	.150				
	80"	.150	.150				
	75"	.150	.150				
	70"	.150	.150				
	65"	.150	.149				
	60"	.150	.149				
	55"	.150	.149				
	50"	.150	.149				
	45"	.150	.149				
	40"	.150	.149				

Eq. Ser. Rounds: 88.20
Date: 13 August 1952
Small Diameter: 3"149
Distance: 65"
Gauged By: A. D. B.

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE XII

STAR GAUGE DATAGrooves

Caliber: 3"15
Type: A
Mod: O
Gun No.: 1

Measurements Taken from
Muzzle Face

	<u>Distance</u>	<u>X</u>	<u>Y</u>		<u>Distance</u>	<u>X</u>	<u>Y</u>
	183"92	3"312			35"	3"240	
	183"42	.250			30"	.240	
	182"92	.241			28"	.241	
	182"42	.241			26"	.241	
	181"92	.241			24"	.241	
Origin O. B.	181"42	.241			22"	.240	
1"0	180"42	.241			20"	.240	
	179"42	.241			18"	.240	
	178"42	.241			16"	.240	
	177"42	.241			14"	.240	
	176"42	.241			12"	.240	
	175"42	.241			10"	.240	
	174"42	.241			9"	.240	
	173"42	.241			8"	.240	
	172"42	.241			7"	.240	
	171"42	.241			6"	.240	
	170"42	.241			5"	.240	
12"0	169"42	.241			4"	.240	
	165"	.242			3"	.240	
	160"	.242			2"	.240	
	155"	.242			1"	.240	
	150"	.242		Muzzle		.240	
	145"	.241					
	140"	.241					
	135"	.241					
	130"	.241					
	125"	.241					
	120"	.241					
	115"	.241					
	110"	.241					
	105"	.240					
	100"	.240					
	95"	.240					
	90"	.240					
	85"	.240					
	80"	.240					
	75"	.240					
	70"	.240					
	65"	.241					
	60"	.240					
	55"	.240					
	50"	.240					
	45"	.240					
	40"	.240					

Eq. Ser. Rounds: 88.20
Date: 13 August 1953
Small Diameter: 3"240
Distance: 105"0
Gauged By: A. D. B.

Recovery and Range Test of 3#15 AA Projectiles in
3#15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE XIII

STAR GAUGE DATALands

Caliber: 3#15
Type: A
Mod: O
Gun No.: 1

Measurements Taken from
Muzzle Face

	<u>Distance</u>	<u>X</u>	<u>Y</u>		<u>Distance</u>	<u>X</u>	<u>Y</u>
Origin, O. B. 1#0	183#92	3#310	3#310		35"	3#150	3#151
	183#42	.251	.250		30"	.152	.151
	182#92	.209	.208		28"	.152	.152
	132#42	.180	.179		26"	.152	.152
	181#92	.160	.159		24"	.152	.151
	131#42	.155	.154		22"	.152	.152
	180#42	.153	.153		20"	.152	.152
	179#42	.152	.152		18"	.153	.151
	178#42	.152	.152		16"	.152	.151
	177#42	.152	.152		14"	.152	.152
	176#42	.152	.152		12"	.153	.152
	175#42	.152	.151		10"	.152	.152
	174#42	.152	.151		9"	.152	.152
	173#42	.152	.152		8"	.152	.152
	172#42	.152	.151		7"	.152	.152
	171#42	.152	.151		6"	.152	.152
	170#42	.152	.151		5"	.152	.152
	169#42	.152	.151		4"	.152	.151
	165#	.152	.151		3"	.151	.151
	160#	.152	.152		2"	.152	.151
	155#	.151	.151		1"	.152	.151
	150#	.151	.151		Muzzle	.152	.152
	145#	.151	.151				
	140#	.151	.151				
	135#	.151	.150				
	130#	.151	.150				
	125#	.151	.151				
12#0	120#	.151	.151				
	115#	.151	.151				
	110#	.151	.151				
	105#	.151	.151				
	100#	.151	.151				
	95#	.152	.151				
	90#	.151	.151				
	85#	.151	.151				
	80#	.152	.151				
	75#	.151	.151				
	70#	.151	.151				
	65#	.151	.151				
	60#	.151	.151				
	55#	.151	.150				
	50#	.151	.150				
	45#	.151	.150				
	40#	.151	.151				

Eq. Ser. Rounds: 105.53
Date: 2 January 1953
Small Diameter: 3#150
Distance: 55"
Gauged By: A. D. B.

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE XIVSTAR GAUGE DATAGrooves

Caliber: 3"15
Type: A
Mod: O
Gun No.: 1

Measurements Taken from
Muzzle Face

	<u>Distance</u>	<u>X</u>
	183"92	3"320
	183"42	.256
	182"92	.244
	182"42	.244
	181"92	.244
Origin, O. B.	181"42	.244
1"0	180"42	.244
	179"42	.244
	178"42	.243
	177"42	.244
	176"42	.244
	175"42	.244
	174"42	.244
	173"42	.243
	172"42	.243
	171"42	.242
12"0	170"42	.242
	169"42	.242
	165"	.244
	160"	.244
	155"	.243
	150"	.243
	145"	.243
	140"	.242
	135"	.242
	130"	.243
	125"	.244
	120"	.243
	115"	.243
	110"	.243
	105"	.243
	100"	.244
	95"	.242
	90"	.242
	85"	.243
	80"	.243
	75"	.242
	70"	.242
	65"	.242
	60"	.242
	55"	.242
	50"	.242
	45"	.242
	40"	.242

<u>Distance</u>	<u>X</u>
35"	3"242
30"	.242
28"	.243
26"	.242
24"	.242
22"	.242
20"	.242
18"	.242
16"	.242
14"	.242
12"	.242
10"	.242
9"	.242
8"	.242
7"	.242
6"	.242
5"	.242
4"	.242
3"	.242
2"	.242
1"	.242
Muzzle	.242

Eq. Ser. Rounds: 105.53
Date: 2 January 1952
Small Diameter: 3"042
Distance: 171"42
Gauged By: A. D. B.

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE XV

STAR GAUGE DATALands

Caliber: 3"15
Type: A
Mod: O
Gun No.: 1

Measurements Taken from
Muzzle Face

	<u>Distance</u>	<u>X</u>	<u>Y</u>	<u>Distance</u>	<u>X</u>	<u>Y</u>
Origin, O. B. 1"0	183"92	3"309	3"309	35"	3"151	3"151
	183"42	.249	.248	30"	.151	.151
	182"92	.208	.208	28"	.152	.152
	182"42	.178	.177	26"	.152	.152
	181"92	.160	.158	24"	.152	.152
	181"42	.155	.154	22"	.152	.152
	180"42	.153	.154	20"	.152	.152
	179"42	.153	.153	18"	.152	.152
	178"42	.153	.152	16"	.152	.152
	177"42	.153	.153	14"	.152	.152
	176"42	.153	.152	12"	.153	.153
	175"42	.152	.152	10"	.152	.153
	174"42	.152	.152	9"	.152	.153
	173"42	.152	.152	8"	.153	.153
	172"42	.152	.152	7"	.153	.153
	171"42	.152	.152	6"	.152	.152
	170"42	.152	.152	5"	.152	.152
	169"42	.152	.152	4"	.152	.152
	165"	.152	.152	3"	.152	.152
	160"	.152	.152	2"	.152	.152
12"0	155"	.152	.151	1"	.152	.152
	150"	.151	.151	Muzzle	.152	.153
	145"	.151	.151			
	140"	.151	.151			
	135"	.151	.151			
	130"	.151	.151			
	125"	.151	.151			
	120"	.151	.151			
	115"	.151	.151			
	110"	.151	.151			
	105"	.152	.151			
	100"	.151	.151			
	95"	.151	.151			
	90"	.151	.151			
	85"	.151	.151			
	80"	.152	.151			
	75"	.151	.151			
	70"	.151	.151			
	65"	.151	.151			
	60"	.151	.151			
	55"	.152	.151			
	50"	.151	.151			
	45"	.151	.151			
	40"	.151	.151			

Eq. Ser. Rounds: 156.53
Date: 19 January 1953
Small Diameter: 3"151
Distance: 155"
Gauged By: B. H. W.

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Recovery and Range Test of 30.15 AA Projectiles in
30.15/67 Caliber Gun, Type A Mod O Serial No. 1

TABLE XVI

STAR GAUGE DATA

Grooves

Caliber: 30.15
Type: A
Mod: O
Gun No.: 1

Measurements Taken from
Muzzle Face

Distance	X	Distance	X
183.92	30.322	35.0	30.244
183.42	.257	30.0	.244
182.92	.244	28.0	.244
182.42	.243	26.0	.244
181.92	.243	24.0	.244
181.42	.242	22.0	.244
180.42	.242	20.0	.244
179.42	.243	18.0	.243
178.42	.243	16.0	.243
177.42	.243	14.0	.244
176.42	.242	12.0	.244
175.42	.242	10.0	.244
174.42	.243	9.0	.244
173.42	.242	8.0	.244
172.42	.243	7.0	.243
171.42	.243	6.0	.244
170.42	.243	5.0	.243
169.42	.243	4.0	.243
165.0	.243	3.0	.242
160.0	.243	2.0	.242
155.0	.243	1.0	.243
150.0	.242	Muzzle	.242
145.0	.242		
140.0	.242		
135.0	.242		
130.0	.243		
125.0	.243		
120.0	.242		
115.0	.242		
110.0	.243		
105.0	.242		
100.0	.242		
95.0	.242		
90.0	.242		
85.0	.242		
80.0	.243		
75.0	.242		
70.0	.242		
65.0	.243		
60.0	.243		
55.0	.243		
50.0	.244		
45.0	.244		
40.0	.244		

Eq. Ser. Rounds: 156.53
Date: 19 January 1953
Small Diameter: 30.242
Distance: 181.42
Gauged By: A. D. B.

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IPG REPORT NO. 1122

Recovery and Range Test of 3"15 AA Projectiles in
3"15/67 Caliber Gun, Type A Mod O Serial No. 1

Wire Impression Method of Determining Spin

Two (2) screens are set up 41"5 apart, each screen consisting of a metal frame with wood inserts, holding an array of parallel equidistant vertical copper wires. The spacing of the wires is 1/2" for the first screen and 3/4" for the second. The projectile is fitted with a flat-nosed dummy nose plug or the equivalent, so that after passing through the screens it bears two (2) sets of impressions of the wires. The angle between the two (2) sets of impressions is measured and from this measurement the rifling of the gun, the muzzle velocity, and the velocity at the spin screens, is computed the percentage of nominal spin. It is assumed that over the short distances involved the spin retardation is negligible.

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Recovery and Range Test of 3"15 AA Projectile
3"15/67 Caliber Gun, Type A Mod O Serial P

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