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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1065

TEST AND DEVELOPMENT OF 3"/70 AA PROJECTILES

47th Partial Report

- -

TEST OF 3"/70 AA PROJECTILES
FOR EFFECTIVENESS OF BASE COVER PLATES

FINAL Report

Copy No. 11

Task Assignment NPG-Re3b-210-1-52

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Test of 3"/70 AA Projectiles
for Effectiveness of Base Cover Plates

PART A

SYNOPSIS

1. Forty-five (45) 3"/70 AA projectiles Type EX 24 Mod 9 were fired for recovery in gun Type G Mod 14, Serial No. 24934. The projectiles were modified by drilling holes of various sizes in the bases, covered with standard and thicker-than-standard base cover plates and fired at service and proof pressure, to determine the effectiveness and limitations of base cover plates.

2. On the 3"/70 projectile a standard base cover plate (.0031 thick) will afford adequate protection against powder gasses at proof or service pressure for any hole in the projectile base up to and including 3/32" in diameter. An 18 gage base cover plate (.0478 thick) will afford protection when fired at service pressure for any hole up to and including 3/16" in diameter and at proof pressure for any hole up to and including 1/8" in diameter.

Test of 3"/70 AA Projectiles
for Effectiveness of Base Cover Plates

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Test of 3"/70 AA Projectiles
for Effectiveness of Base Cover Plates

PART B

INTRODUCTION

1. AUTHORITY:

This program was authorized by reference (a).

2. REFERENCES:

a. BUORD ltr Re3b-PAB:mt Ser 14225 of 23 Jan 1952 to NAVPROV
b. BUORD SK. No. 328486 3"/70 AA Projectile Type EX 24 Mod 9

3. OBJECT OF TEST:

The object of this test was to determine the effectiveness and limitations of base cover plates on 3"/70 AA projectiles.

4. PERIOD OF TEST:

a.	Date of Directive	23 January 1952
b.	Date Test Commenced	25 January 1952
c.	Date Test Completed	16 May 1952

PART C

DETAILS OF TEST

5. DESCRIPTION OF ITEMS UNDER TEST:

a. Projectile: 3"/70 AA projectiles EX 24 Mod 9 in accordance with reference (b) were modified by the Lansdowne Steel and Iron Co. Fifty (50) EX 24-9 projectiles were divided into ten (10) groups of five (5) each. Modifications, as shown in Figure 10, are as follows:

Test of 3"/70 AA Projectiles
for Effectiveness of Base Cover Plates

Variation	Drill Size	Cover Plate Thickness
"A"	1/4"	Standard (#031)
"B"	3/16"	"
"C"	1/8"	"
"D"	3/36"	"
"E"	1/16"	"
"AF"	1/4"	18 gage (#0478)
"BG"	3/16"	"
"CH"	1/8"	"
"DJ"	3/32"	"
"EK"	1/16"	"

Projectiles marked "E" and "EK" had a 1/32" slitting saw cut located off center on the base of the projectile in addition to the holes (Figure 10).

Projectiles of variation "B" were not fired based on the firing results of variation "C".

b. Gun: The 3"/70 gun Type G Mod 14 No. 24934 has a short run-up, 1 in 20 caliber twist, and disappearing rifling. At the start of this test the subject gun had 23.38 ESR.

6. PROCEDURE:

All projectiles were prepared for recovery firing in the gun Type G Mod 14 by stripping the forward bands, epson salt loading to a total weight of 15 pounds, and fitting with flat dummy nose plugs (Figure 11). Two projectiles of each variation tested were fired at proof pressure and three of each variation at service pressure. After recovery, the positions on the base plates corresponding to the holes in the projectile bases were examined and a typical example was photographed either with the base plate in position or machined off (Figures 2-9). When deformation was present, the base plates were removed and gaged (Tables II, III, IV and V, Appendix (A)). Hardness readings were taken on two plates of each type after firing. The average hardness (Rc T-15 scale) for the standard plates was 78.9 and for the 18 gage plates 79.9.

All rounds were crimped in EX 5 cases.

7. RESULTS AND DISCUSSION:

Complete before and after firing data are given for each round in Tables I-V, inclusive, Appendix (A); a summary of the firing data is included as Table VI, Appendix (B); a photograph of an unfired EX 24-9 projectile is shown as Figure 1; and photographs of the cover plates are included as Figures 2-9, inclusive. If one base plate in any variation had a through hole upon recovery, that variation was considered to have failed. The condition of each plate after recovery is given in Tables I through V, and a summary of the condition for each variation is given in Table VI.

All standard thickness (.031) base cover plates fired at service or proof pressure passed with holes in the projectile base of 3/32" in diameter. Plates of the 18 gage (.0478) thickness fired at service pressure passed with holes of 3/16" in diameter and at proof pressure with holes of 1/8" in diameter. In each case the next larger hole size caused a failure of the base plate.

The slot modification in the projectile bases combined with 1/16" diameter holes (variations "E" and "EK") had no additional effect on the base plate. Upon recovery, some plates of these variations had the metal of the plates raised in positions corresponding to the 1/16" holes and the ends of the slots. The raised portions of the base plates can be attributed to small quantities of metal having been left around the rims of the holes on the projectile bases, evidently due to these positions having been punch-marked.

PART D

CONCLUSIONS

8. It is concluded that:

a. On the 3"/70 projectile a standard base cover plate (.031 thick) will afford adequate protection against powder gasses at proof or service pressure, for any hole in the projectile base up to and including 3/32" in diameter. An 18 gage base cover plate (.0478 thick) will afford protection when fired at service pressure for any hole up to and including 3/16" in diameter and at proof pressure for any hole up to and including 1/8" in diameter.

Test of 3"/70 AA Projectiles
for Effectiveness of Base Cover Plates

- -

The tests upon which this report is based were conducted by:
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NPG REPORT NO. 1065

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Forty-seventh Partial Report

on

Test and Development of 3"/70 AA Projectiles

- -

Final Report

on

Test of 3"/70 AA Projectiles

for Effectiveness of Base Cover Plates

Project No.: NPG-Re3b-210-1-52

Date: DEC 1 - 1952

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No. of Pages: 6

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TABLE I

COMPLETE BEFORE AND AFTER FIRING DATA

Base Cover Plate Test of 3"/70 EX 24-9 Projectiles in Gun Type G Mod 14 No. 24934

Proj. No.	Variation	Firing Order 2/25/52	Hole Size	Base Plate Thickness (in.)	Powder Charge (lbs.) HKPC-1	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	Visible Deformation of Base Plate after firing
1074	A	1	1/4"	.031	9.96	19.8	3311	3 Thru Holes
1075	A	6	1/4"	.031	9.96	20.5	3379	3 Thru Holes
1076	A	7	1/4"	.031	9.96	19.8	3366	3 Thru Holes
1077	A	2	1/4"	.031	11.35	24.5	3698	3 Thru Holes
1078	A	3	1/4"	.031	11.35	25.6	3676	3 Thru Holes
1079	AF	4	1/4"	.0478	11.35	25.4	3679	3 Thru Holes
1080	AF	5	1/4"	.0478	11.35	24.9	3670	3 Thru Holes
1081	AF	8	1/4"	.0478	9.96	21.0	3374	3 Thru Holes
1082	AF	9	1/4"	.0478	9.96	18.8	3365	3 Thru Holes
1083	AF	10	1/4"	.0478	9.96	19.8	3379	3 Thru Holes

TABLE II

COMPLETE BEFORE AND AFTER FIRING DATA

Base Cover Plate Test of 3"/70 EX 24-9 Projectiles in Gun Type G Mod 14 No. 24934

Proj. No.	Variation	Firing Order 4/1/52	Hole Size	Base Plate Thickness (in.)	Powder Charge HKPC-1	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	Visible Deformation of Base Plate after firing	Deformation (in.) Depth of Indentations in Base Plate in position relative to holes in Proj.		
1149	BG	4	3/16"	.0478	11.35	25.5	3741	Proj. Not Recovered			
1150	BG	5	3/16"	.0478	11.35	23.9	3720	3 Thru Holes			
1151	BG	11	3/16"	.0478	9.96	19.9	3407	3 Indentations	.0235	.021	.019
1152	BG	12	3/16"	.0478	9.96	20.1	3457	3 Indentations	.023	.022	.023
1153	BG	13	3/16"	.0478	9.96	20.3	3445	Proj. Not Recovered			

TABLE III

COMPLETE BEFORE AND AFTER FIRING DATA

Base Cover Plate Test of 3"/70 EX 24-9 Projectiles in Gun Type G Mod 14 No. 24934

Proj. No.	Variation	Firing Order 3/17/52	Hole Size	Base Plate Thickness (in.)	Powder Charge (lbs.) HKPC-1	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	Visible Deformation of Base Plate after firing	Deformation (in.) Depth of Indentations in Base Plate in position relative to holes in Proj.		
1122	C	1	1/8"	.031	9.96	20.2	3403	3 Indentations	.013	.0105	.012
1123	C	8	1/8"	.031	9.96	20.2	3391	3 Indentations	.011	.010	.0095
1124	C	9	1/8"	.031	9.96	19.9	3410	1 Thru hole 2 Indentations			
1125	C	2	1/8"	.031	11.35	24.5	3699	2 Thru holes 1 Indentation			
1126	C	3	1/8"	.031	11.35	24.8	3746	2 Thru holes 1 Indentation			
1127	CH	4	1/8"	.0478	11.35	25.2	3719	3 Indentations	.0015	.0015	.0015
1128	CH	5	1/8"	.0478	11.35	24.6	3726	3 Indentations	.001	.002	.002
1129	CH	10	1/8"	.0478	9.96	20.8	3378	1 Indentation	.0015	.0005	.001
1130	CH	11	1/8"	.0478	9.96	20.2	3368	No Indentation	.000	.000	.000
1131	CH	12	1/8"	.0478	9.96	20.2	3400	No Indentation	.0005	.0005	.000

TABLE IV

COMPLETE BEFORE AND AFTER FIRING DATA

Base Cover Plate Test of 3"/70 EX 24-9 Projectiles in Gun Type G Mod 14 No. 24934

Proj. No.	Variation	Firing Order 3/7/52	Hole Size	Base Plate Thickness (in.)	Powder Charge (lbs.) HKPC-1	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	Visible Deformation of Base Plate after firing	Deformation (in.) Depth of Indentation in Base Plate in position relative to holes in Proj.		
1084	D	1	3/32"	.031	9.96	20.4	-	Not Recovered			
1085	D	2	3/32"	.031	9.96	20.5	-	No Indentation	.001	.001	.000
1086	D	3	3/32"	.031	9.96	20.1	3451	3 Indentations	.0003	.001	.0037
1087	D	4	3/32"	.031	11.35	Miss	3753	3 Indentations	.0032	.003	.0032
1088	D	5	3/32"	.031	11.35	Miss	3720	3 Indentations	.0035	.0035	.010
1089	DJ	6	3/32"	.0478	9.96	20.1	3388	No Indentation	.000	.000	.000
1090	DJ	7	3/32"	.0478	9.96	19.6	3375	No Indentation	.000	.000	.000
1091	DJ	8	3/32"	.0478	9.96	20.2	3395	No Indentation	.000	.000	.000
1092	DJ	9	3/32"	.0478	11.35	Miss	3748	No Indentation	.000	.000	.000
1093	DJ	10	3/32"	.0478	11.35	Miss	3693	No Indentation	.000	.000	.000

TABLE V

COMPLETE BEFORE AND AFTER FIRING DATA

Base Cover Plate Test of 3"/70 EX 24-9 Projectiles in Gun Type G Mod 14 No. 24934

Proj. No.	Variation	Firing Order	Hole Size	Base Plate Thickness (in.)	Powder Charge (lbs.) HKPC-1	Average Pressure (t.s.i.)	Muzzle Velocity (ft./sec.)	Visible Deformation of Base Plate after firing	Deformation (in.) Depth of Indentation in Base Plate in position relative to holes in Proj.		
		3/17/52									
1132	E	6	1/16"	.031	11.35	24.6	3716	* None	+.0025	+.0005	+.0015
1133	E	7	1/16"	.031	11.35	23.8	3708	* None	+.0005	+.0005	+.0005
		4/1/52									
1162	E	1	1/16"	.031	9.96	18.2	3390	* None	+.0002	+.002	+.0015
1163	E	6	1/16"	.031	9.96	19.9	3413	* None	+.003	+.003	.000
1164	E	7	1/16"	.031	9.96	20.3	3419	None	.000	.000	.000
1165	EK	8	1/16"	.0478	9.96	20.8	3451	None	.000	.000	.000
1166	EK	9	1/16"	.0478	9.96	19.0	3401	* None	+.002	+.002	+.002
1167	EK	10	1/16"	.0478	9.96	19.8	3383	None	.000	.000	.000
1168	EK	2	1/16"	.0478	11.35	25.4	3751	* None	+.001	+.001	+.001
1169	EK	3	1/16"	.0478	11.35	24.9	3717	None	.000	.000	.000

* Raised metal on projectile bases around 1/16" dia. holes & punch holes marking position of slots caused base plates to bulge over holes after firing.

TABLE VI

SUMMARY OF COMPLETE BEFORE AND AFTER FIRING DATA

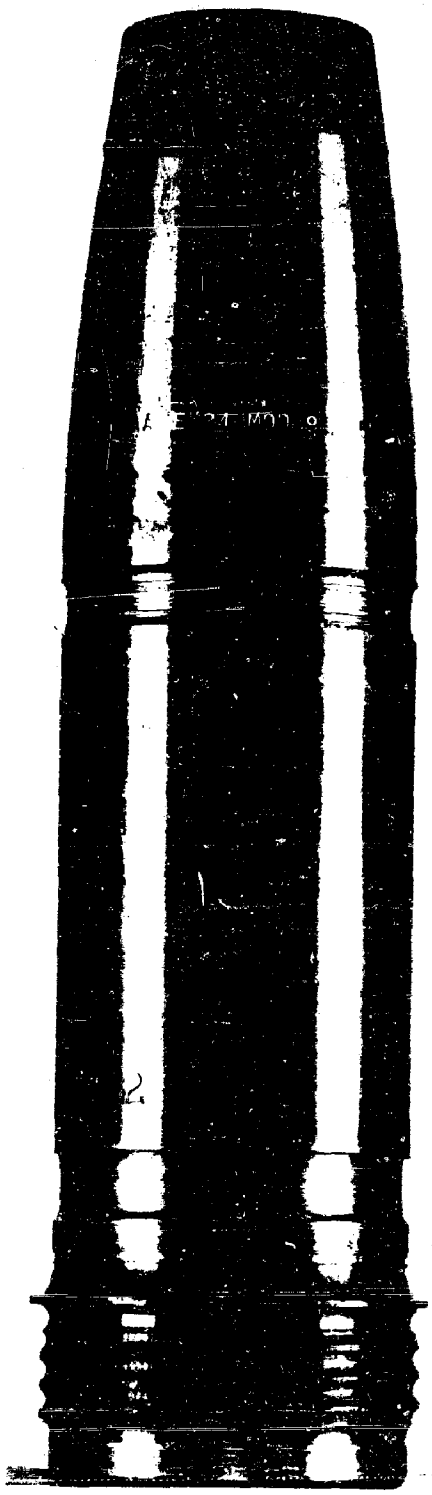
Base Cover Plate Test of 3"/70 EX 24-9 Projectiles in Gun Type G Mod 14 No. 24934

Variation	Rounds	Hole Size	Cover Plate Thickness	Pressure	Deformation of Base Plate	Remarks
A	3	1/4"	.031	Service	3 Thru holes	Failed
A	2	1/4"	.031	Proof	3 Thru holes	Failed
AF	3	1/4"	.0478	Service	3 Thru holes	Failed
AF	2	1/4"	.0478	Proof	3 Thru holes	Failed
BG	3	3/16"	.0478	Service	3 Indentations	Passed 1 rd. not recovered
BG	2	3/16"	.0478	Proof	3 Thru holes	Failed 1 rd. not recovered
C	3	1/8"	.031	Service	Holes or Indentations	Failed
C	2	1/8"	.031	Proof	Holes or Indentations	Failed
CH	3	1/8"	.0478	Service	Slight or none	Passed
CH	2	1/8"	.0478	Proof	Slight or none	Passed
D	3	3/32"	.031	Service	Slight or none	Passed
D	2	3/32"	.031	Proof	Indentations	Passed

TABLE VI (Continued)

Variation	Rounds	Hole Size	Cover Plate Thickness	Pressure	Deformation of Base Plate	Remarks
DJ	3	3/32"	.0478	Service	None	Passed
DJ	2	3/32"	.0478	Proof	None	Passed
E	3	1/16"	.031	Service	* None	Passed
E	2	1/16"	.031	Proof	* None	Passed
EK	3	1/16"	.0478	Service	* None	Passed
EK	2	1/16"	.0478	Proof	* None	Passed

* Raised metal on projectile bases around 1/16" dia. holes & punch holes marking ends of slots caused metal of plate to be raised after firing.



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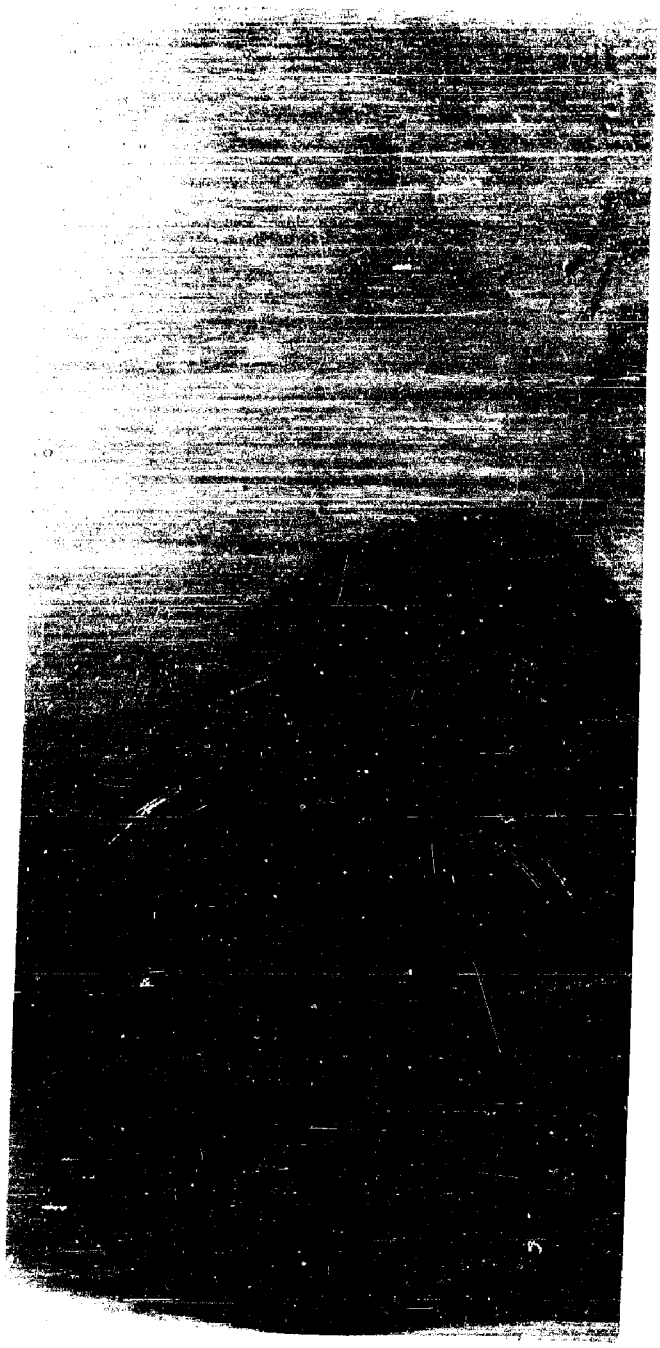
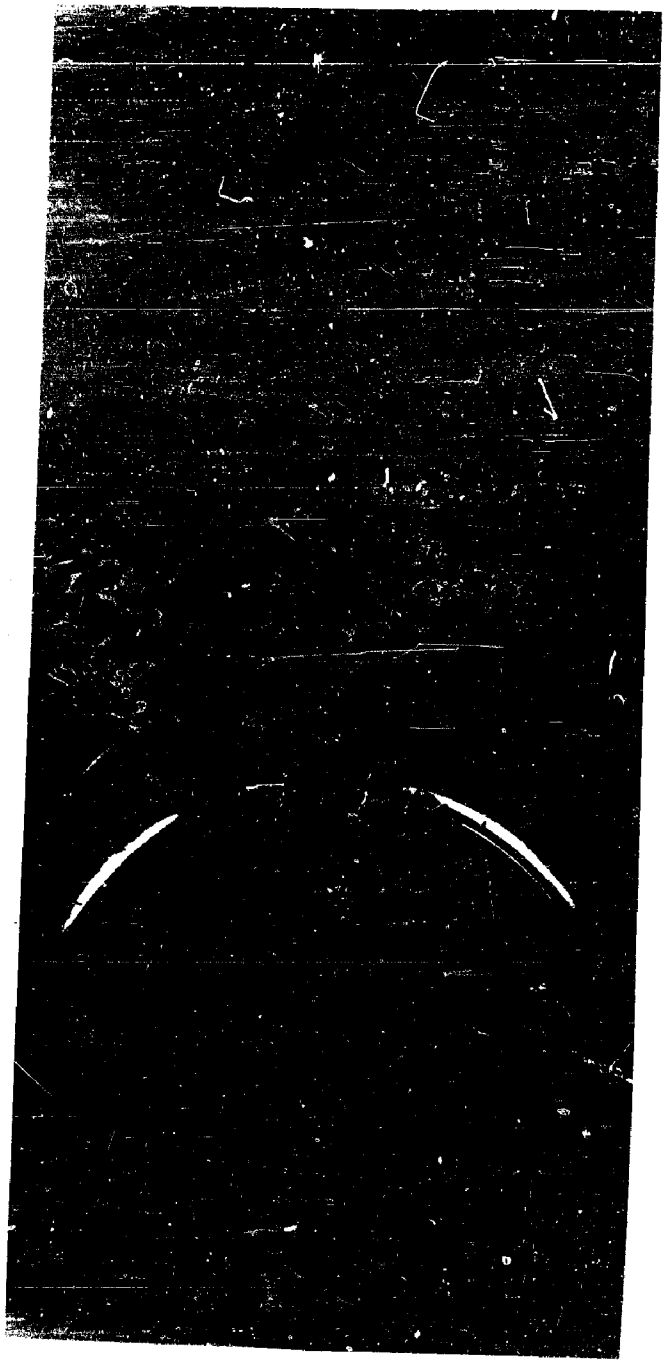
3"/70 AA Projectile Type EX 24 Mod 9 with forward band removed.

Figure 1





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25 January 1952

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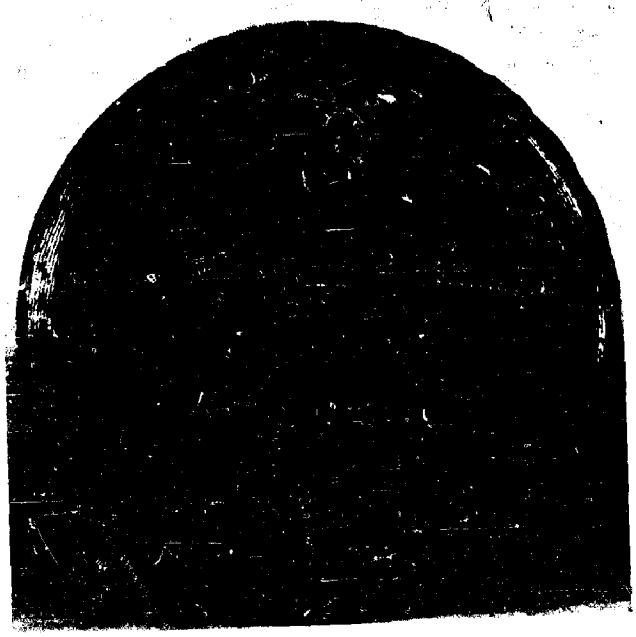
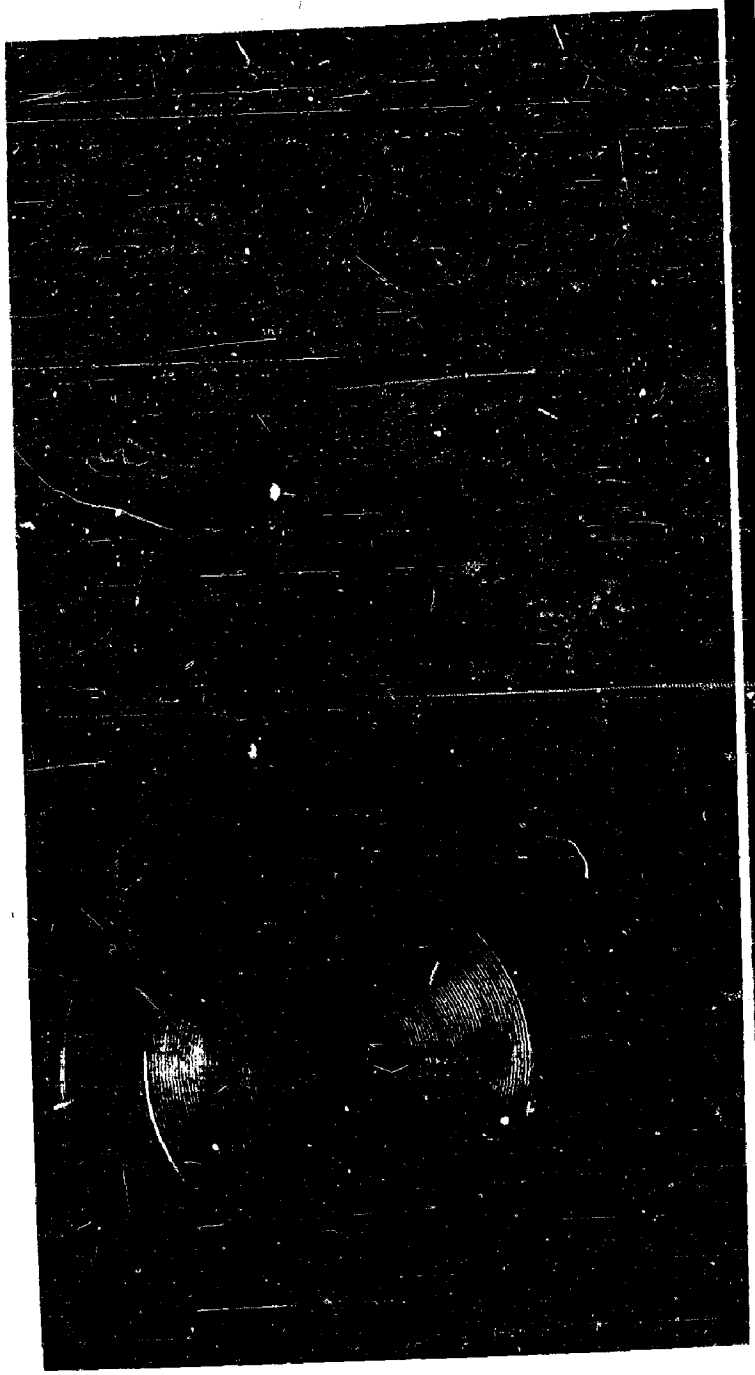
Typical Example of recovered variation "A" projectile fired at service pressure

Typical Example of recovered variation "AF" projectile fired at service pressure

Figure 2





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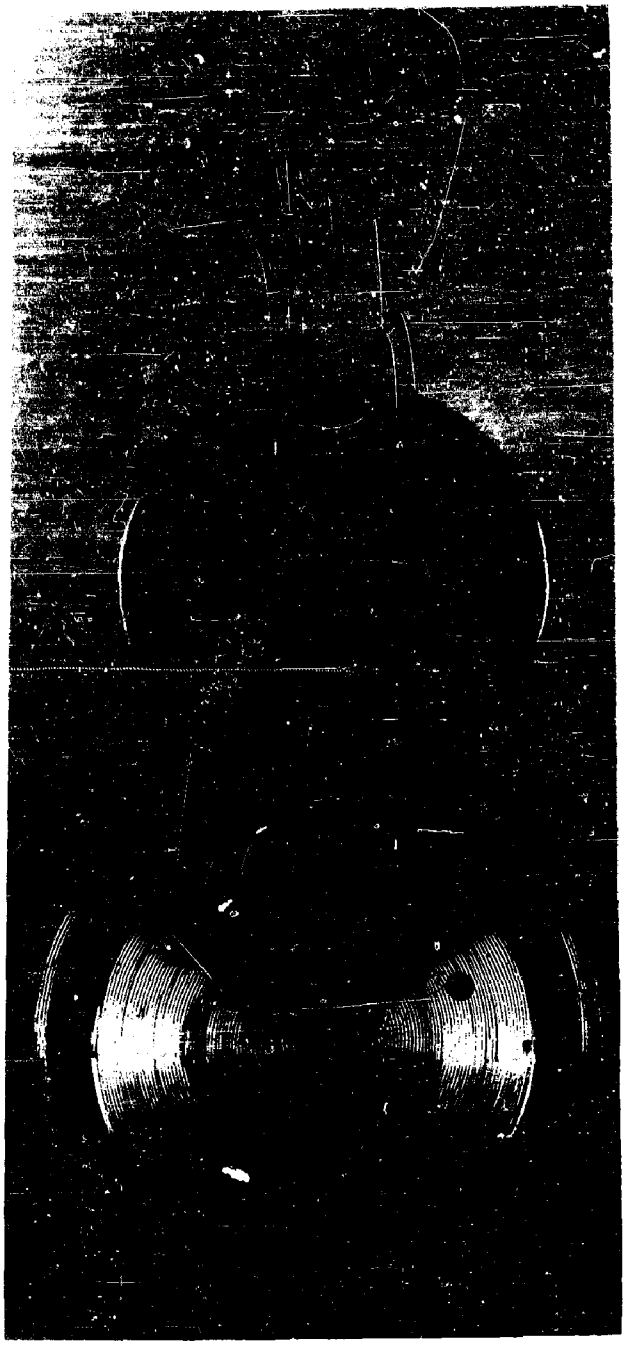
Typical Example of recovered variation "BG" projectile fired at proof pressure

Typical Example of recovered variation "BG" projectile fired at service pressure

Figure 3



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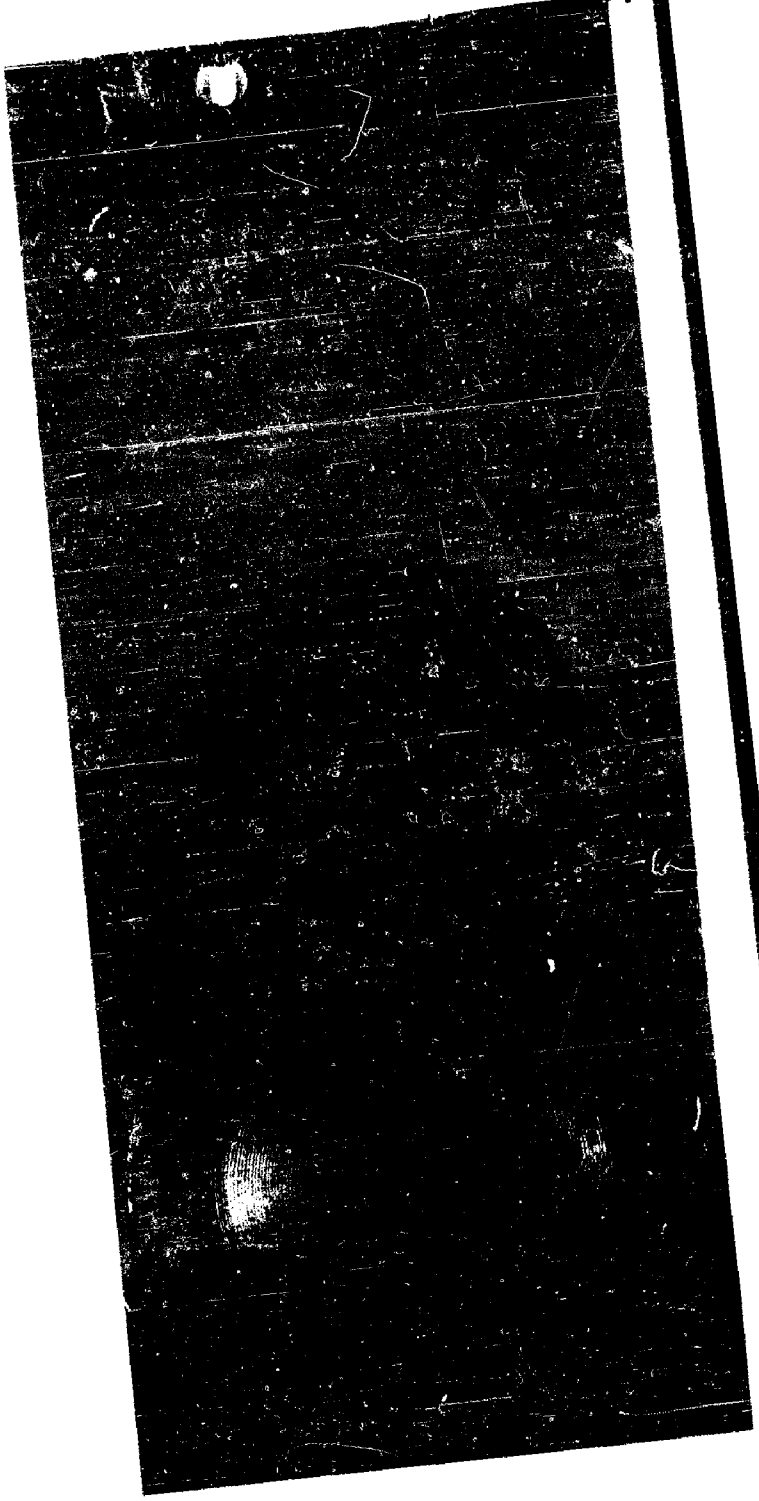
Typical Example of recovered variation "C" projectile fired at service pressure

Typical Example of recovered variation "C" projectile fired at proof pressure

Figure 4



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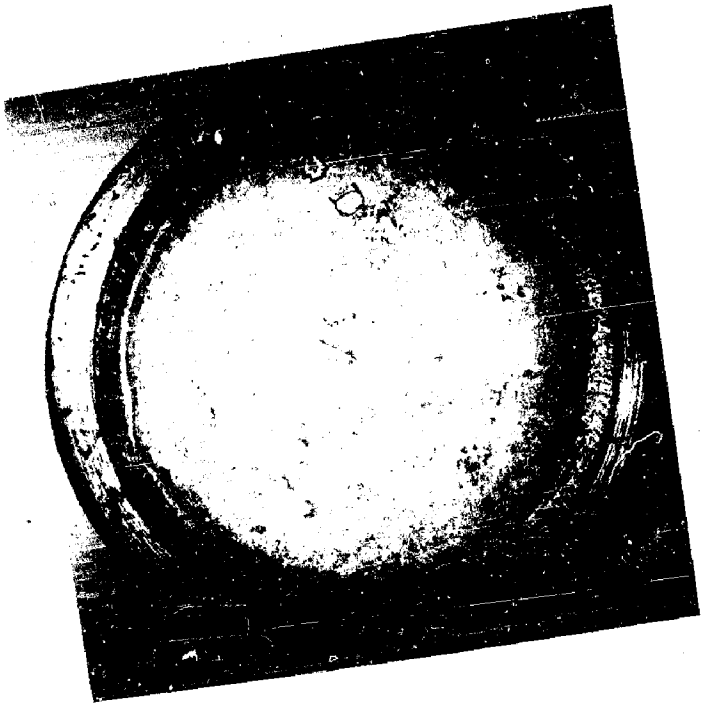
Typical Example of recovered variation "CH" projectile fired at service pressure

Typical Example of recovered variation "CH" projectile fired at proof pressure

Figure 5



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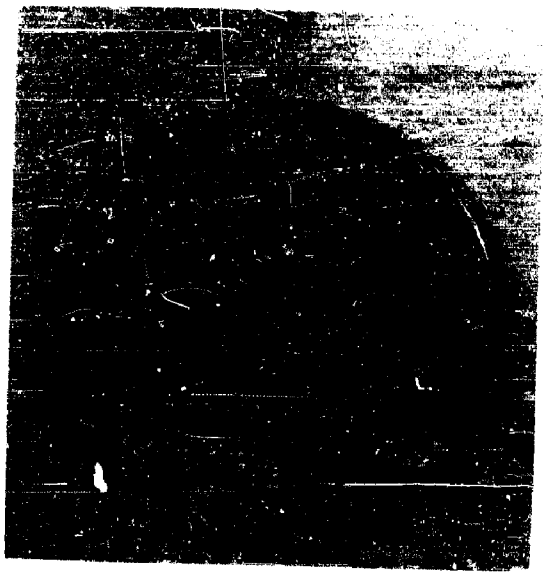
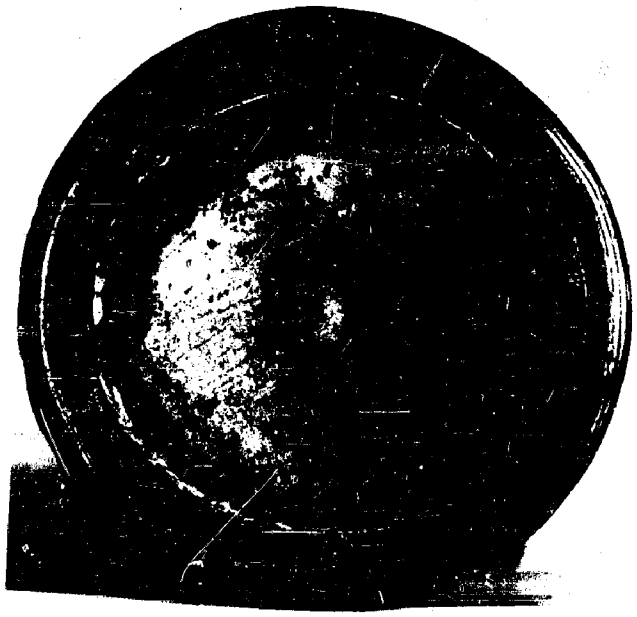
Typical Example of
recovered variation
"D" projectile fired
at service pressure

Figure 6

Typical Example of
recovered variation
"D" projectile fired
at proof pressure





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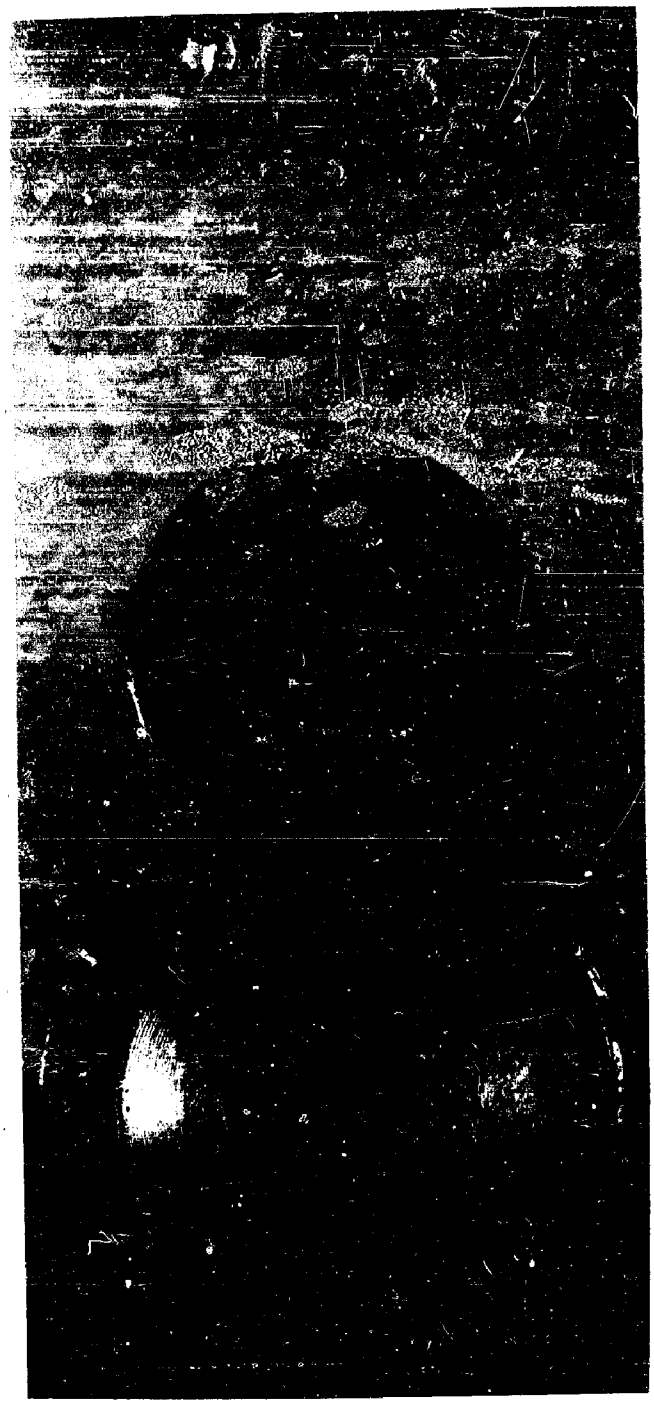
Typical Example of recovered variation "DJ" projectile fired at service pressure

Typical Example of recovered variation "DJ" projectile fired at proof pressure

Figure 7



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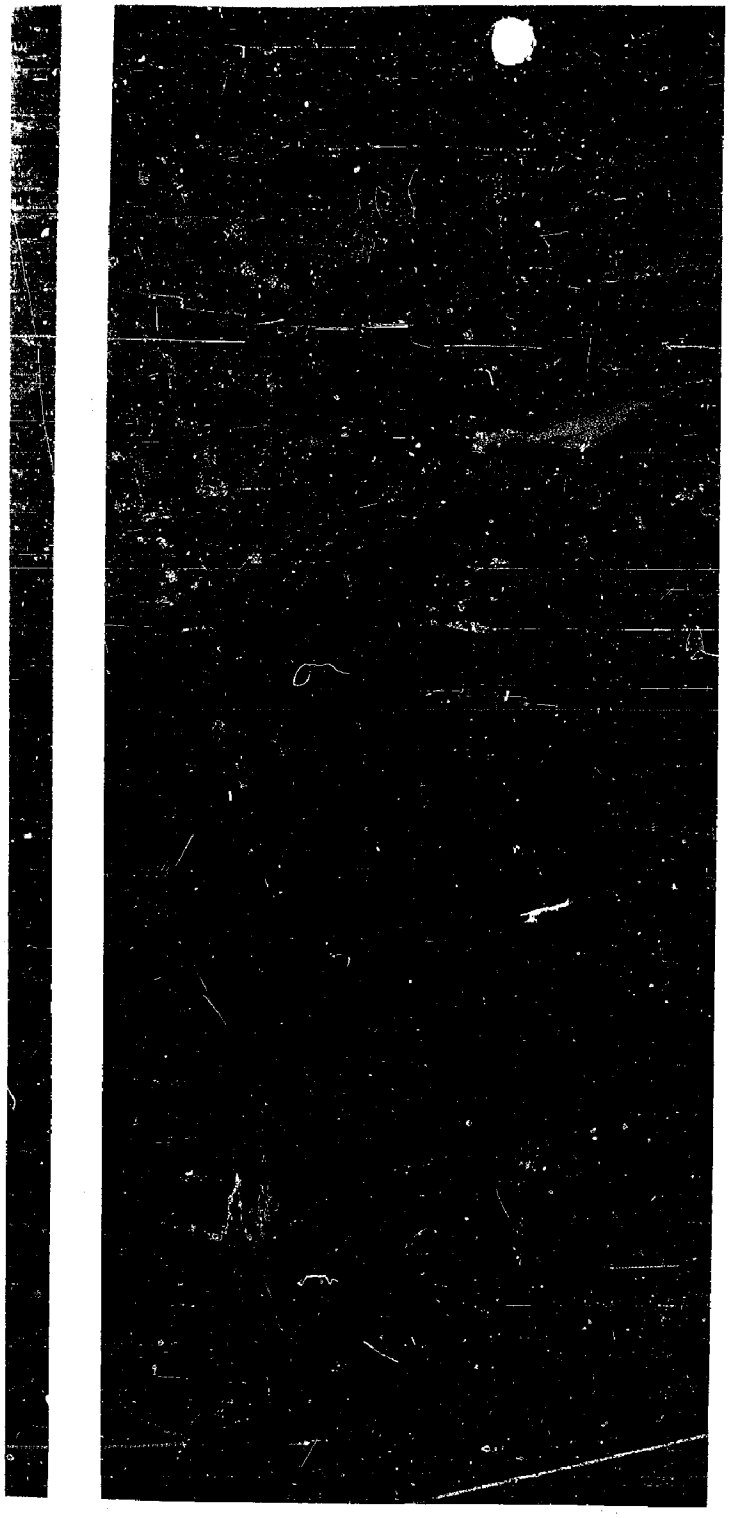
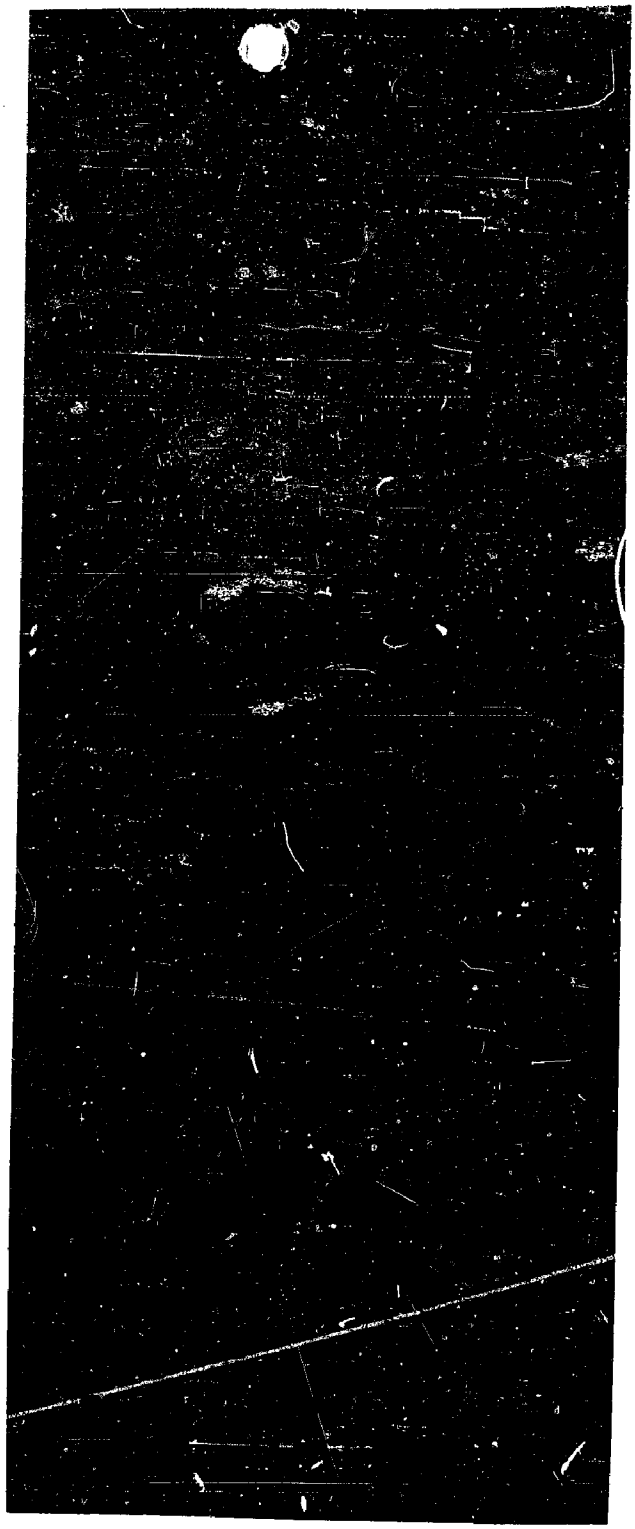
Typical Example of recovered variation "E" projectile fired at service pressure

Typical Example of recovered variation "E" projectile fired at proof pressure

Figure 8





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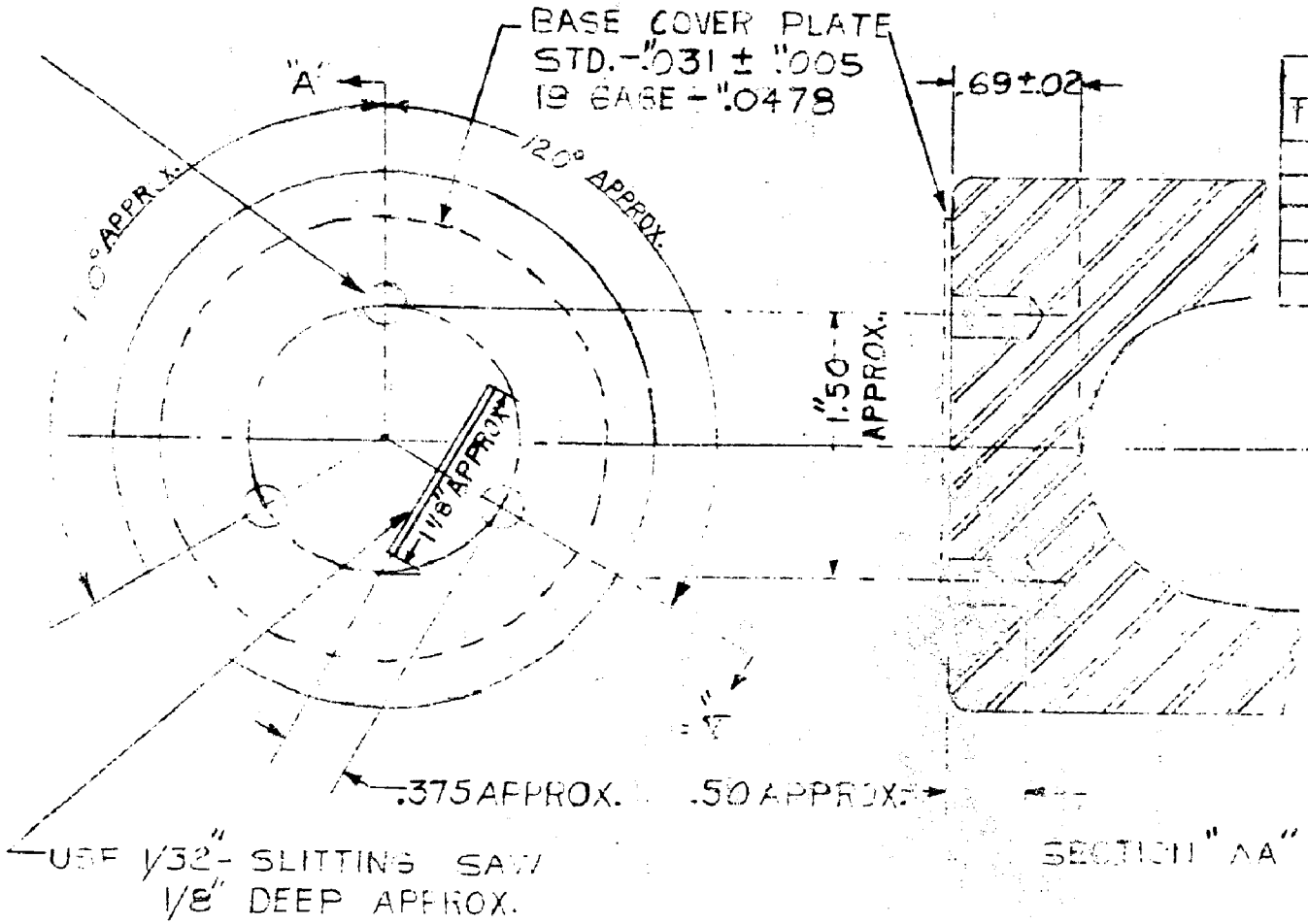
Typical Example of recovered variation "EK" projectile fired at service pressure

Typical Example of recovered variation "EK" projectile fired at proof pressure

Figure 9



TYPE	DRILL SIZE	WITH SLOT
A	#4	NO
B	3/16	NO
C	1/8	NO
D	3/32	NO
E	1/16	YES

FIGURE 10

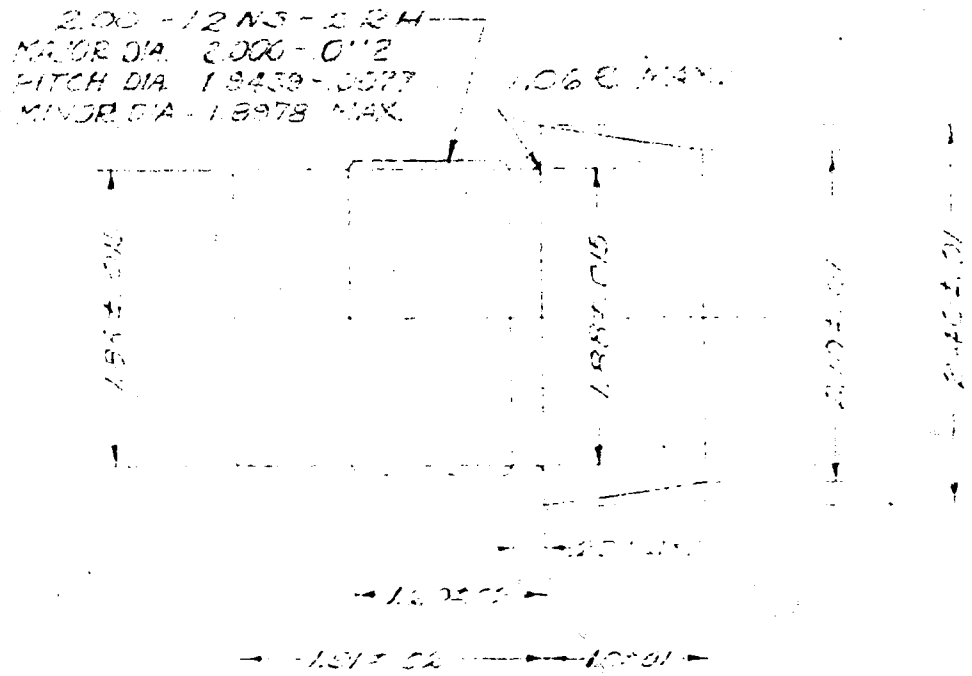
3"/70 PROJECTILE EX. 64 MOD. 9
FOR TESTING EFFECTIVENESS OF BASE COVER PLATE

SCALE: 1-1

REF: LANSDOWNE STEEL AND IRON CO.
MORTON, PA. DWG. NO. X-6229

2-28-52 Dim.

DRAWING NO.
APL-303



DUMMY NOSE PLUG
(FLAT NOSE)

CONFIDENTIAL
Security Information

CONFIDEN

UNCLASSIFIED

UNCLASSIFIED

P14/1

AD-A000 072

STI-ATI-202 264 * [redacted] 251575 SECURITY INFORMATION

Naval Proving Ground, Dahlgren, Va.

TEST AND DEVELOPMENT OF 3"/70 AA PROJECTILES - TEST OF 3"/70 AA PROJECTILES FOR EFFECTIVENESS OF BASE COVER PLATES, by Rex B. Butler. 47th Partial rept., (OVER) Final rept. 1 Dec 52, 6p, illus, tables. Rept. no. 1065

U

Ordnance (22)
Ammunition & Explosives (1)

Projectiles, Antiaircraft
Projectiles - Testing

~~(Copies obtainable from ASTIA-DSC)~~

* Antiaircraft Ammunition Firing Tests (Ordnance)

NTIS, Auth: MICROFILM USNSWC notice, 29 JAN 76

[redacted]

U Auth: USNSWC notice, 29 JAN 76