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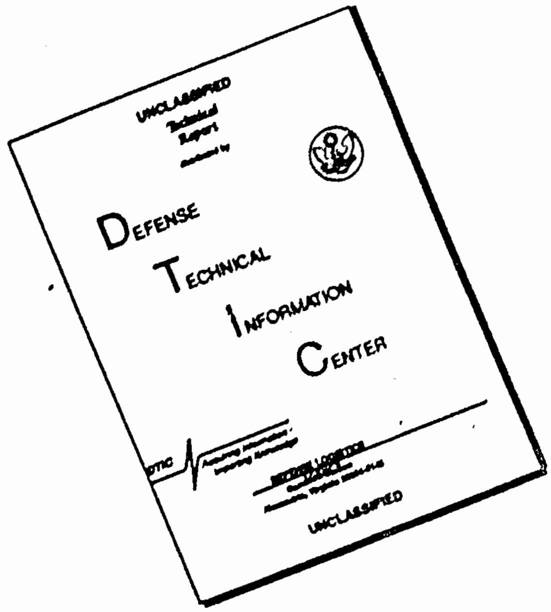

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AD390746

T.I.S.

Aberdeen Proving Ground

MARYLAND

FIRST REPORT ON TEST OF SHOT, AP, 105 MM, T182

SECURITY INFORMATION

DEVELOPMENT AND PROOF SERVICES

FIRST Report OCO Project No. TA1-1503

ARMY-- OS---ABERDEEN PROVING GROUND, MD-- 415

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AND

FIRST REPORT ON PROJECT TA1-1503

(11) 30 Oct 51

(12) 36p.

(16) OCO-TA1-1503

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C O N F I D E N T I A L

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND
MARYLAND

30 October 1951

Authority: ORDTA
Priority: 1A

FIRST REPORT ON TEST OF SHOT, AP, 105 MM, T182

AND

FIRST REPORT ON PROJECT TA1-1503

DATES OF TEST: JANUARY - SEPTEMBER 1951

The objective of the report is

OBJECT

To develop a granulation and propelling charge for the Gun, 105 mm, T140 using the Gun, 105 mm, T5 and to investigate the firing, flight and armor penetrating characteristics of Shot, AP, 105 mm, T182.

SUMMARY

A propelling charge, using T12 propellant, was established for the T182 shot in the T5E1 gun which resulted in a muzzle velocity of 3500 feet per second at a pressure of 46600 psi. The accuracy and form factor for the T182 shot were determined and a preliminary investigation made of the armor penetrating capability of the shot.

CONCLUSIONS

It is concluded that the shot as submitted by Frankford Arsenal are generally satisfactory. If further development of the shot is desired, additional firing tests must be made to extend and confirm the data gained in these trials. It is also concluded that, using a T12 propellant with web about .085", a muzzle velocity of 3500 feet per second may be obtained at a pressure level of about 47000 psi, in the T5 gun.

RECOMMENDATIONS

It is recommended that future tests of the T182 shot be concerned with component security under extreme conditions of pressure and temperature, with armor penetration over a range of conditions, and with additional accuracy firings.

A T12 propellant with web .085" is recommended as the powder for use with the T182 shot, and this type and granulation of powder should be available for future tests of the shot.

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C O N F I D E N T I A L

I INTRODUCTION

A. DISCUSSION

Interest has been revived in the Gun, 105 mm, T5E2, for use as a tank-mounted weapon, and also in the development of a new weapon - Gun, 105 mm, T140. To increase the effectiveness of the T5 gun and to develop a satisfactory projectile for the T140 gun, the Ordnance Office requested a series of firing trials. These trials were to be concerned with the investigation of an armor piercing shot for flight and penetration characteristics, and to develop a propelling charge for the shot in the T5 gun which would serve as a preliminary step in charge development for the T140 gun. The projectile used for the tests was designated Shot, AP, 105 mm, T182. The T182 shot were to be made from existing Shot, APC, 105 mm, T32E1 by removing the cap and replacing the windshield.

B. REFERENCES

The tests reported herein were authorized in letters O.O. 471.14/58(c), 400.112/1785(c) and 471.14/80. This is the first report on Shot, AP, 105 mm, T182. Copies of the correspondence are contained in Appendix A.

II DESCRIPTION OF MATERIAL (REFERENCE, APPENDIX E)

A. Shot, AP, 105 mm, T182. Three types of this shot were fired, arbitrarily designated T182(A), T182(B) and T182(C). All the shot were originally T32E2, APC projectiles. T182(A) were shot modified at Aberdeen Proving Ground. For these shot, the cap and windshield were removed from the T32E2 shot. On some of the shot the windshield was replaced by brazing to the shot body, and on the remainder the windshield was not replaced. It was believed that the heating required to braze the windshield might affect the hardness of the shot ogive and thereby bias penetration results. For short range firing against armor for ballistic limit determinations, the unwindshielded shot were used. For the firing against plate at 1000 yards range the shot with windshield were used, primarily as spotting rounds. T182(B) were T32E2 shot modified at Frankford Arsenal. The cap and windshield of the T32E2 shot were removed. On a portion of the shot the steel windshield was replaced using an adapter to fit the ogive to the windshield. These shot weighed about 36 pounds. On the remainder of the shot, an aluminum windshield was fitted to the shot without an adapter and attached by means of plastic cement. These shot weighed about 35 pounds. T182(C) were T32E2 shot modified at Frankford Arsenal. The cap and windshield were removed and also one-half of the nose of the shot. The nose was removed by a cut parallel to the shot base to give a flat nose, with the flat having a diameter of 2.8". The shot length was about 9" with a weight of 32 pounds. No windshields were attached to the shot and they were used for short range firing against armor plate.

B. Shot, HVAP, 105 mm, T29E3 and T29E4. These shot are of the composite-rigid type Sabot and are assembled with a 10 pound tungsten carbide core.

C. Shell, HE, 105 mm, T30E3 (Inert loaded). Empty shell were loaded to 34.6 pounds with an inert mixture. The design of the shell at the base and rotating band is the same as that for the T32E3 shot.

III DETAILS OF TEST (REFERENCE, FIRING RECORD P-48560, APPENDIX C)

A. PROCEDURE

The firing trials were divided into two general phases; the first was concerned with powder charge establishment and the second with armor plate penetration. During the powder charge phase, data was gained on the flight and accuracy of the T182 shot as well as the charge establishment using the T30E3 shell.

1. Powder Charge Phase

Various lots of T12 propellant were investigated to find the optimum for the shot. Pressure-velocity data showed no single lot to give satisfactory performance and a 50/50 blend of two lots was made. This blend gave the most satisfactory results, and a seven round uniformity series was fired. The data was corrected for shot weight and the presence of gages, and a charge determined which would satisfy the requirements of the directives. In addition, while investigating the powder charges, rounds were fired at about 1000 yards range to determine the accuracy and time of flight.

2. Armor Penetration Phase

All firing was conducted against 5" homogeneous plate at 55° obliquity.

a. Short range (100 yard) firing: A ballistic limit, Protection, was obtained for the plate using T182(A) shot without windshields. HVAP shot were then fired and the plate limit established for these shot. The flat-nosed, T182(C) shot were then fired and an unconfirmed limit obtained. Only 5 of these shot were available. All firing was done against a single armor plate.

b. Long range (1000 yard) firing: Two spotting rounds of T182(A) shot with windshields were fired first, followed by three rounds of T182(B) with steel windshields. The final round was another T182(A) for comparison.

B. RESULTS (DETAILED RESULTS ARE CONTAINED IN APPENDIX C)

1. Powder Charge Establishment

A charge of 17.38 pounds of 50/50 blended powders Lot EXA-6805 (.0795" web) and Lot EXA-6806 (.0893" web) was established to give the 35.5 pound Shot, AP, 105 mm, T182 muzzle velocity of 3500 feet per second with a chamber pressure of 46600 psi. The round is assembled with Primer, Perc., 400 gr, T48 and with a 5 oz Grade A1 Black Powder Igniter on top of the charge. Reference: Graph in Appendix D.

2. Armor Plate Firing

Plate 5"/55°

Projectile	Wt, Lb	Approx B.L.- fps	Effective Range - Yards
AP, T182(A)	33.3	3130	-1250 (1)
AP, T182(B)	35.5	Not fired	+1000 (2)
AP, T182(C) Flat nose	31.9	3183	1750 (3)
HVAP, T29E4	24.7	3722	1200 (4)

(1) Calculated, based on MV 3500 fps and form factor of 1.196 on G6.1. One round fired at 1000 yards did not defeat the plate.

(2) One round against the plate at 1000 yards range did defeat the plate.

(3) Calculated, based on MV 3700 fps and i = 1.196 G6.1.
(4) Calculated, based on MV 4200 fps and i = 1.12 G8.

3. Accuracy Data

a. First firing, 7 round group, 1000 yards.
P.E. (H) - 0.04 mils, P.E. (V) - 0.16 mils.

b. Second firing, 6 round group, 1000 yards.
P.E. (H) - 0.04 mils, P.E. (V) - 0.145 mils.

4. Time of Flight Data

Based on the data gained by firing the T182(B) shot for flight time over approximately 1000 yards, the form factor is 1.196 on G6.1 drag function. Reference, Graph of Appendix D.

C. OBSERVATION

The weight of the T182 shot varied depending on the method of windshield attachment and the material used in the windshield. The shot without a windshield weighed 33.3 pounds, with a steel windshield and adapter 36 pounds, and with an aluminum windshield cemented directly to the ogive 35 pounds. The aluminum windshield was satisfactory during these firing trials.

IV CONCLUSIONS

A. It is possible to fire the 35.5 pound T182 shot with a muzzle velocity of 3500 feet per second.

B. The accuracy and drag characteristics of the T182 shot are satisfactory. Use of an aluminum windshield will permit a weight decrease.

C. The armor penetration appears satisfactory but further test work is required to extend and confirm the data.

V RECOMMENDATION

The T182 shot be considered for further development for use in the 105 mm Guns T5 and T140. Additional tests of the shot should include investigations of component security under extreme conditions of pressure and temperature, of armor penetration considering a number of plate arrangements, and additional accuracy firings.

APPROVED:

T. F. COLLERAN
Director, Dev. &
Proof Services

JOHN D. ARMITAGE
Col., Ord. Corps
Chief, Arms & Am Div.

JOHN B. REZIN
Engineer, Ordnance

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APPENDICES

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APPENDIX A

Correspondence

Letter File O.O. 471.112/1785(c), APG(c) 471/469 dated 20 December 1950 (2 sheets).

Letter File O.O. 471.14/58(c), APG(c) 471/123 dated April 4 1951 (1 sheet).

Letter File O.O. 471.14/80, APG 471.1/168 dated 25 May 1951 (1 sheet).

C O N F I D E N T I A L

0.0.400.112/1785(c) RECORD

ORDTA LSMichael/bw/53401

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ORDNANCE
WASHINGTON, D.C.

20 DEC 1950

APG(c) 471/469

SUBJECT: Shot, AP, 105-mm, T182, (TA1-1503)

TO: Commanding General
Aberdeen Proving Ground
Maryland

1. In view of recently revived interest in Gun, 105-mm, T5E2, this office requests that the following tests be conducted as expeditiously as practicable. The necessary ammunition components and guns are available at your facility.

2. Caps should be removed from approximately fifteen Shot, APC, 105-mm, T32E1, by a method which will not reduce the body-nose hardness to any significant degree. The decapped bodies should be weighed to determine whether or not they conform with the weight of 33.55 lbs. obtained by totaling component weights shown on Drawing 75-4-179. The bodies should also be inspected for cracks or other defects, and unsound shot should be replaced. These monobloc projectiles will be identified as Shot, AP, 105-mm, T182.

3. Modify approximately ten Shot, Test, 105-mm, T52 by machining off the forward end in order to reduce the weight to 34.5 lbs. (estimated shot weight with windshield). The modified projectiles will be identified as Shot, Test, 105-mm, T5E1.

4. Fire the T182 shot in Gun, 105-mm, T5E2 (or equal) against 5-inch homogeneous armor plate at 55° obliquity, to obtain a "protection" ballistic limit.

5. Within the Rated Maximum Pressure of 48,000 psi use the T5E1 Test Shot and T12 Propellant to establish the maximum attainable velocity in Gun, 105-mm, T5E2. Rough computations in this office indicate that a velocity of about 3600 f/s can be achieved.

6. Costs incurred in conducting the above tests are chargeable to RAD Order ORDTA 1-12235. Results should be reported under Project TA1-1503, D/A 504-03-025, with cross reference to TA1-5002, D/A 504-01-001. Test results are "Confidential". The work should be performed under temporary D/A priority of 1A.

C O N F I D E N T I A L

ORDTA
SUBJECT: Shot, AP, 105-mm, T182, (TA1-1503)

7. This office and Frankford Arsenal should be informed of the date scheduled for the AP test phase in order that representatives may make arrangements to be present.

BY COMMAND OF MAJOR GENERAL FORD:

/s/ W. L. Bell, Jr.
/t/ W. L. BELL, Jr.
Col, Ord Corps
Assistant

CC
Picatinny Arsenal
Frankford Arsenal

//

C O N F I D E N T I A L

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ORDNANCE
WASHINGTON, D.C.

RECORD

LSMichael/bw/53401

O.O. 471.14/58(c)

APR 4 1951

ORDTA

APG(c) 471/123

SUBJECT: Shot, AP, 105mm, T182 Type

TO: Commanding General
Aberdeen Proving Ground
Maryland

1. Frankford Arsenal will furnish your proving ground with approximately 20 Shot, AP, 105mm, T182 (type) produced by removing the caps from existing Shot, APC, 105mm, T32 (type) and re-attaching the windshields to the shot bodies. The weight of the new item is expected to be approximately 35 pounds. The consignment will be marked, "For component security test and plate test to be directed by OCO".

2. Your proving ground is requested to modify a quantity of either Shot, Test, 105mm, T52 or Shell, HE, 105mm, T30E3 to conform in weight with the new T182 (type) AP Shot, and to establish a propelling charge to give the maximum attainable velocity in Gun, 105mm, T5E2, within 48,000 psi.

3. Ten of the T182 (type) AP shot should then be fired at the established velocity in an accuracy test against a vertical target at 1000 yards range. Concurrent observation should be made for displacement or loss of windshield and adequacy of rotating band. If practicable, a few of the shot should be recovered for examination of the rotating band.

4. Ballistic limits obtained in earlier tests of the T182 (type) AP shot indicate that the 5"/55° homogeneous armor target can be defeated at over 1000 yards range. Your proving ground is requested to determine whether or not that performance is possible by firing a few of the T182 shot against the specified target at 1000 yards actual range.

5. Test results should be reported under Project TA1-1503. The project is "Restricted" except that information regarding defeat of armor is "Confidential". The D/A priority is 1A.

BY COMMAND OF MAJOR GENERAL FORD:

/s/ W. L. Bell, Jr.
/t/ W. L. BELL, Jr.
Col, Ord Corps
Assistant

CC
Frankford Arsenal
Picatinny Arsenal

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C O N F I D E N T I A L

COPY R E S T R I C T E D COPY

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ORDNANCE
WASHINGTON

OO 471.14/20
APG 471.1/168

RECORD
D: Jackman/met/74961

25 May 1951

ORDTA

SUBJECT: Preliminary Tests in 105mm Gun, T5, to Develop a Granulation and Propellant Charge for the 105mm Gun, T140 (AP Round). Project TA1-1503

TO: Commanding General

Aberdeen Proving Ground, Maryland

1. For the purpose stated in the subject, it is requested that firings be conducted in the 105mm Gun, T5E2, with a 35.0-lb proof slug to simulate the Shot, AP, T182. Proof slugs may be fashioned from the Shot, Test, T52 (Dwg. P80204), by cutting the weight down to 35.0-lbs. For propellant, use a blend of equal weights of T12 lots EXA-6805 and EXA-6806 to obtain an average web of approximately .085".

2. It is suggested, on account of the preliminary nature of the work and the small amount of propellant available for it, that only a minimum number of rounds be fired to determine the charge, and that a uniformity series then be fired. The aim should be to obtain a velocity of 3500 f/s at a pressure level of approximately 47000 psi and certainly not exceeding 48000 psi. Because the maximum rated pressure of the gun will be exceeded, appropriate precautions should be taken. Note amounts of flash and smoke; also any evidence of hang-fires, flarebacks, etc.

3. It is requested that the Burnside Laboratory of the duPont Company be advised in advance of these firings and invited to send representatives to witness them.

4. The D/A priority for this work is 1B. The security classification is "RESTRICTED". Costs may be charged to RAD No. ORDTA-1-12215-2.

BY COMMAND OF MAJOR GENERAL FORD:

/s/ W. L. Bell, Jr.
/t/ W. L. BELL, Jr.
Col, Ord Corps
Assistant

Priority 1B
Project - TA1-1503
W.O. 1013-543-0

6192

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R E S T R I C T E D

APPENDIX B

First Memorandum Report on Test of Shot, AP, 105 mm, T182 in Gun, 105 mm, T5E2, Project TA1-1503 (2 sheets) with Inclosure No. 1, "Powder Charge Establishment Data" (1 sheet) and Inclosure No. 2, "Armor Penetration Data" (1 sheet).

Second Memorandum Report on Test of Shot, AP, 105 mm, T182 in Gun, 105 mm, T5E2 - Project TA1-1503 (1 sheet) with Inclosure No. 1 "Powder Charge Establishment Data" (1 sheet) and Inclosure No. 2, "Armor Plate Penetration Data" (1 sheet).

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RECORD

JBSerim/asp/12218

ORDBG-DPD

SUBJECT: First Memorandum Report on Test of Shot, AP, 105mm, T182 in Gun, 105mm, T5E2. Project TA1-1503

TO: Chief of Ordnance
Washington 25, D. C.

Attn: ORDTA

References: O.O. 4?0.112/1785(c), APG (c) 471/469

1. Introduction:

In view of renewed interest in the Gun, 105mm, T5E2, the development of an AP Shot for the weapon is being investigated. The particular shot under consideration is a modified T32E2, APC design. The shot, designated T182, is the T32E2 without cap, and weighs 34.6 pounds with tracer.

2. Results:

a. The results of tests concerned with the powder charge establishment are inclosure one of this report.

b. The results of tests concerned with armor plate penetration are inclosure two of this report.

3. Conclusions:

a. Powder, Propellent, MP, T12 Lot EXA 6564 (web .073") and Powder, Propellent, MP, T12 Lot PAE-5006 (web .080") are too fast to meet the requirements for a satisfactory propelling charge for the T182 shot from the T5E2 gun.

b. The following limits may be expected from five inch homogeneous armor at 55 degrees obliquity:

Shot	Protection Limit Velocity
T182 (AP)	3130 fps
T29E4 (HVAP)	3620 fps
T182 (Modified)*	3180 fps

* Truncated conical ogive with 2.84 inches diameter flat.

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Subj: First Memorandum Report on Test of Shot, AP, 105mm, T182 in Gun, 105mm, T5E2
To: Chief of Ordnance

4. Recommendations:

a. Because the etailed data indicates the EXA-6564 powder is actually slower than the M&F-5006 powder despite the difference in web size, it is recommended that an EXA powder of .080 inch web be submitted for examination.

b. It is also recommended that armor penetration of the T182 type shot be investigated further and include design variations. These design variations may be based on the scale work now in progress at Frankford and Watertown Arsenals.

2 Incls
Incl 1 Powder Charge Data
Incl 2 Armor Penetration Data

JOHN D. ARMITAGE
Colonel, Ord Corps
Chief, Arms & Amm. Div.

cc
OCO, Attn: Mr. L. Anderson
OCO, Attn: Mr. L. Michael
Frankford Arsenal, Attn: Mr. [illegible]uker

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Inclosure 1

Powder Charge Establishment data.

1. Powder, Propellent, MP, T12 Lot EKA 6564
Case capacity (dump charge) - 18 lbs. 3 oz.

Test Rd.	Tube Rd.	Proj. Wt. Lbs.	Pdr. Charge Lbs.	Pdr. Charge Ozs.	M.V. fps	Avg. Chamber Pressure, psi
1	38*	34.63	12	0	2727	284
2	39	34.63	13	8	3122	369
4	41	34.63	15	8	3421	475
25	10**	34.62	14	0	3249	383
26	11	34.62	14	0	3244	374

* Rds. 38-41, Tube, 105mm, T5E2 No. 80
** Rds. 10-11, Tube, 105mm, T5E2 No. 27

2. Powder, Propellent, MP, T12 Lot PAK-5006
Case capacity (dump charge) - 17 lbs. 11 oz.

Test Rd.	Tube Rd.	Proj. Wt. Lbs.	Pdr. Charge Lbs.	Pdr. Charge Ozs.	M.V. fps	Avg. Chamber Pressure, psi
21	6*	34.61	15	0	3514	495
22	7	34.62	15	0	3491	491
23	8	34.62	14	8	3407	462
24	9	34.62	14	8	3403	452

* Rds. 6-9, Tube, 105mm, T5E2 No. 27

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Inclosure 2

Armor Penetration Data

Plate: 5" Homo. at 55° Obliquity

Test Rd. 3, Plate WA 5-15, BHN 285
Test Rds. 5-20, Plate No. 19552-1. BHN 269-285. Charpy (-40°F.) 30 foot pounds.

Test Rd.	Shot Type	Strike Vel. fps	Penetration	Remarks:
3	T182	3260	COmplete	Plate spalled on rear face, 10" x 11 1/2"
5	"	3087	----------	Struck top edge of plate.
6	"	3118	Partial	Punching started.
7	"	3173	Complete	Plate punched out.
8	"	3141	Complete	Plate punched out.
9	"	3051	Partial	Punching started.
10	T2983	2979	Partial	No bulge.
11	"	3551	Partial	Medium bulge.
12	T2974	4021	Complete	
13	"	3753	Complete	
14	"	3616	Partial	Large bulge.
15	"	3691	Partial	Very large bulge.
16	T182(Mod)	[illegible]	Partial	Medium bulge.
17	"	3032	Partial	Large bulge.
18	"	3139	Partial	Very large bulge w/punching started.
19	"	3159	Partial	Very large bulge w/punching started.
20	"	3206	Complete	Shot broken and [illegible]ected. Plate punched out.

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[illegible]
JBRosin/asp/12E18

ORDDG-BPD

TO: Chief of Ordnance, Washington, D.C., Attn: [illegible]

Title: Second Memorandum Report on Test of Shot, AP, 105mm, T128 in Gun, 105mm, T5E2 - Project TA1-[illegible]

References: OO 471.14/58(c), APG (c) 471/123

1. Introduction

The first memorandum report included the data obtained in the first armor plate--powder charge establishment firing. This first firing indicated an EXA-T12 Propellant with web about 0.08" would be satisfactory for establishing a charge. The firing also indicated the shot would defeat 5" homogeneous armor at 55° obliquity at 1000 yards range. The Proving Ground was furnished two lots of T12 Powder, EXA-6805 (web 0.080") and EXA-6806 (web 0.090") for powder charge work and a total of 20 T128 Shot were received from Frankford Arsenal.

2. Results

a. The results of tests concerned with the powder charge establishment are inclosure one of this report.

b. The results of tests concerned with armor plate penetration are inclosure two of this report.

3. Conclusions

a. Powder, Propellant, MP, T12, Lot EXA-6805 (web .08") is considered slightly fast and Lot EXA-6806 (web .09") considered slightly slow for an optimum charge.

b. The shot received from Frankford Arsenal are capable of defeating 5" homogeneous armor at 55° at 1000 yards range.

4. Recommendations

A T12 Propellant with properties similar to the EXA lots but with web .085" - .087" be procured for preliminary development tests of the shot. About [illegible]000 pounds will be needed.

2 Incls
1. Powder Charge Data
2. Armor Penetration Data

JOHN B. ARMITAGE
Colonel, Ord Corps
Chief, Arms & Ammunition Division

cc: Mr. B. [illegible], OCO
Mr. L. Michael, OCO

CONFIDENTIAL

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Ammunition Branch
Arms & Ammunition Division
Development & Proof Services

POWDER CHARGE ESTABLISHMENT DATA

1. Powder, Propellant, MP, T12, Lot EXA-6805.
Case capacity (dump charge) - 18.2 pounds.

Test Round	Tube* Number	Proj. Wt.** lbs.	Pdr. Charge lbs.	MV fps	Average Chamber Pressure, psi/100
27	12	34.62	14.5	3221	379
28	13	34.62	15.5	3366	440
31	16	34.62	16.0	3455	472

2. Powder, Propellant, MP, T12, Lot EXA-6806
Case capacity (dump charge) - 18.7 pounds.

Test Round	Tube Number	Proj. Wt. lbs.	Pdr. Charge lbs.	MV fps	Average Chamber Pressure, psi/100
29	14	34.62	16.0	3065	325
30	15	34.62	17.0	3215	357
32	17	34.62	18.0	3394	419

* - Tube, 105mm, T5E2 No. 27
** - Shell, HE, 105mm, T30E3, Inert Loaded

Incl 1

Ammunition Branch
Arms & Ammunition Division
Development & Proof Services

ARMOR PLATE PENETRATION DATA

Plate: 5" Homo. at 55° obliquity at 978 yards range.
Hardness - BHN 260-285.
Charpy Impact Valve (-40°F) - 37 ft. lbs.

Test Round	Tube Round (1)	Pdr. Charge lbs. (2)	Shot Type (3)	Shot Weight, lbs.	Pressure psi/100	Remarks
33	18	16.2	T182, APG	34.85	479	Miss
34	19	16.2	"	34.65	484	Miss
35	20	16.2	T182, FA	35.55	481	Miss
36	21	16.2	T182, FA	35.37	479	Miss
37	22	16.2	T182, FA-	35.50	482	Complete Pen.
38	23	16.2	T182, APG	34.60	505	Partial Pen.

(1) - Tube, 105mm, T5E2, No. 27.
(2) - Pdr., Propellent, MP, T12. Lot EXA-6805.
(3) - T182, APG - Shot modified at APG
T182, FA - Shot modified at Frankford Arsenal

Incl 2

APPENDIX C

FIRING RECORD NO. P-48560

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND
FIRING RECORD

OBJECT OF TEST: To Establish a Propelling Charge and to Investigate the Armor Penetrating Characteristics of Shot, AP, 105 mm, T182.

DEVELOPMENT: ORDTA
Project: TA1-1503
Priority: 1A

DATES OF TEST: 7 January - 26 July 1951
FIRING RECORD NO. P-48560
SHEET 1 OF 9
O.O. FILE NO. 471.14/58(c)
A.P.G. FILE NO. 471/123
O.O. FILE NO. 471.14/30
A.P.G. FILE NO. 471.1/168
W.O. NO. 1023-141-0 etg

MATERIEL

Gun, 105 mm, T5E2, No. 80
Tube, 105 mm, T5E2, No. 80. Previous rounds 37; Test rounds 1-4
Recoil system: T123E1, No. 1
Mounted in Tank, 105 mm Gun, T29, USA No. 30162836

Gun, 105 mm, T5E1, No. 8
Tube, 105 mm, T5E1, No. 24. Previous rounds 163; Test rounds 5-20
Recoil system: T123E1, No. unknown
Mounted in Tank, 105 mm Gun, T28, USA No. 40226809

Gun, 105 mm, T5E2, No. 11
Tube, 105 mm, T5E2, No. 27. Previous rounds 5; Test rounds 21-53.
Recoil system: T123E1, No. 1
Mounted in Tank, 105 mm Gun, T29; Test rounds 21-38
Mounted on APG Pedestal Mount; Test rounds 38-53

Pedestal: Carriage, How., 8", M1, No. 1130
Mech., Recoil, M4 for 8" How., No. 1313

AMMUNITION

Shot: AP, 105 mm, T182, Modified Shot, APC, 105 mm, T32E2, Lot PAE-1367 w/MP Lot BS 7-D-46.

Shot: HVAP, 105 mm, T29E3, No lot number for carrier, Core lot C-45.

Shot: HVAP, 105 mm, T29E4, No lot number for carrier, Core Lot C-45.

Shell: HE, 105 mm, T30E3, (Inert loaded), MP lot NTE-2-1945 w/Fuze, Dummy, M73, Lot EOP-7-8.

Powder: Propellant, MP, T12, Lot EXA-6564, web .073".
Propellant, MP, T12, Lot PAE-5006, web .080".
Propellant, MP, T12, Lot EXA-6805, web .079".
Propellant, MP, T12, Lot EXA-6806, web .089".
Propellant, MP, T12, Lot PAE-5071, web .075".

Case: Ctg., 105 mm, T4E1, Lot PAE- 114.

Primer: Perc., 400 grain, T48, Lot PAE-868.

Plug: Closing, Palmatex, 105 mm, No lot.

Tracer: M4, Lot PAE-2048.

Igniter: Supplementary, 5 oz, Grade A1 Black Powder on top of charge.

ARMOR PLATE

On test round 3: Homogeneous, 5", No. WA 5-15.
On test rounds 5-20: Homogeneous, 5", No. 19552-1.
On test rounds 33-38: Homogeneous, 5", No. 20975-1

Plate	19552-1	20975-1	5-15
Hardness, BHN	277	277	285*
Charpy (-40°F)	31 ft-lb	37 ft-lb	
% C	0.30	0.30	
% Mn	0.42	0.54	
% Cr	1.40	1.33	
% Ni	3.22	3.34	

* = No further information available.

FACILITIES

Counter and camera chronograph, accuracy and time of flight screen.

ROUND-BY-ROUND DATA

A. Powder Charge Establishment.

TEST RD	POWDER LOT	POWDER CHG LB	POWDER CHG OZ	PROJ TYPE	PROJ WT - LB	UNCORRECTED MV fps	UNCORRECTED PRESSURE psi/100
1	6564	12	0	T30E3	34.63	2727	284
2	6564	13	8	T30E3	34.63	3122	369
4	6564	15	8	T30E3	34.63	3[illegible]21	475
21	5006	15	0	T30E3	34.61	3514	495
22	5006	15	0	T30E3	34.62	3491	491
23	5006	14	[illegible]	T30E3	34.62	3407	462
24	5006	14	8	T30E3	34.62	3403	452
25	5006	14	0	T30E3	34.62	3249	383
26	5006	14	0	T30E3	34.62	3244	374
27	6805	14	6	T30E3	34.62	3221	379
28	6805	15	[illegible]	T30E3	34.62	3366	[illegible]40
29	6806	16	0	T30E3	3[illegible].62	3065	325
30	6806	17	0	T30E3	34.62	321[illegible]	35[illegible]
31	6805	16	0	T30E3	34.62	3455	472
32	6806	1[illegible]	0	T30E3	34.62	3394	41[illegible]
39	*	17	0	T182	35.47	3404	464
40	*	17	4	T182	36.[illegible]1	3470	473
41	*	17	6	T182	36.27	3522	486
42	*	17	8	T182	36.24	3512	471
43	*	17	[illegible]	T182	3[illegible].[illegible]0	3526	475
44	*	17	8	T182	36.48	Lost	484
45	*	17	3	T182	36.24	3517	486
46	*	17	8	T182	36.10	3516	474
47	*	17	9	T182	36.17	3504	472
48	5071	15	12	T182	34.9[illegible]	35[illegible]3(1)	554
49	5071	15	0	T182	35.0[illegible]	34[illegible]2	502
50	5071	14	3	T182	34.[illegible]	3[illegible]13	4[illegible]1
51	5071	14	8	T182	34.[illegible]7	3427	478
52	5071	14	8	T182	35.10	3402	480
53	5071	14	8	T182	34.[illegible]	[illegible]400	4[illegible]0

* = Blend, 50/50 of Powder Lots 6805 and 6806.
(1) = Test rounds 48-53. Velocity is instrumental at 14[illegible].1'.

B. Armor Plate Firing

TEST RD	POWDER LOT	POWDER CHG LB	POWDER CHG OZ	PROJ TYPE	PROJ WT -LB	UNCORRECTED STRIKE VEL fps	UNCORRECTED PRESSURE psi/100
3	6564	15	0	T182(A)	33.25	3280	433
5	6564	14	0	T182(A)	33.36	3087	340
6	6564	14	0	T182(A)	33.28	3118	353
7	6564	14	8	T182(A)	33.35	3173	369
8	6564	14	3	T182(A)	33.27	3141	363
9	6564	13	12	T182(A)	33.27	3051	330
10	6564	12	0	T29E3	24.47	2979	218
11	6564	15	0	T29E3	24.45	3551	333
12	6564	17	0	T29E4	24.64	4021	487
13	6564	16	0	T29E4	24.74	3753	394
14	6564	15	6	T29E4	24.64	3616	354
15	6564	15	11	T29E4	24.72	3691	367
16	6564	13	8	T182(C)	31.92	2894	306
17	6564	14	0	T182(C)	31.87	3032	325
18	6564	14	8	T182(C)	31.85	3139	366
19	6564	14	12	T182(C)	31.94	3159	372
20	6564	15	0	T182(C)	31.91	3206	390
33	6805	16	2	T182(A)	34.85	3505	479
34	6805	16	2	T182(A)	34.65	3469	484
35	6805	16	2	T182(B)	35.53	3488	481
36	6805	16	2	T182(B)	35.37	3487	479
37	6805	16	2	T182(B)	35.50	3484	482
38	6805	16	2	T182(A)	35.60	3506	505

(A) = T32E2 shot modified at Aberdeen Proving Ground.
(B) = T32E2 shot modified at Frankford Arsenal.
(C) = Shot as (B) except ogive cut to give flat nose.

C. Data on Armor Plate Impacts

1. Plate: 5"/55°, WA 5-15. Shot: T182(A).

TEST RD	STRIKE VEL- fps	PENETRATION	REMARKS
3	3280	Complete	Large spall off rear of plate

2. Plate: 5"/55°, 19552-1. Shot: T182(A)

TEST RD	STRIKE VEL - fps	PENETRATION	REMARKS
5	3087	————	Disregard - struck edge of plate.
6	3118	Partial	Punching 2" off rear face.
7	3173	Complete	Rear opening 6" x 3-1/2".
8	3141	Complete	Rear opening 4" x 4".
9	3051	Partial	Large bulge, punching started.

3. Plate: 5"/55°, 19552-1. Shot: T29E3 (test rounds 10-11) and T29E4 (test rounds 12-15).

TEST RD	STRIKE VEL - fps	PENETRATION	REMARKS
10	2979	Partial	No bulge on rear face.
11	3551	Partial	Medium bulge on rear face.
12	4021	Complete	Rear opening 4-1/2" x 5".
13	3753	Complete	Rear opening 5" x 7".
14	3616	Partial	Large bulge on rear face.
15	3691	Partial	Very large bulge on rear face.

4. Plate: 5"/55°, 19552-1. Shot: T182(C). This shot has a flat nose 2.8" in diameter.

TEST RD	STRIKE VEL - fps	PENETRATION	REMARKS
16	2894	Partial	Medium bulge, shot broken, [illegible]
17	3032	Partial	Large bulge on rear face.
18	3139	Partial	Very large bulge on rear face.
19	3159	Partial	Very large bulge on rear face.
20	3206	Complete	Rear opening 5" x 3". Shot broken and rejected.

5. Plate: 5"/55°, 20975-1. Shot: T182(A) - test rounds 33, 34, 38. T182(B) - test rounds 35-37. Firing conducted at 1000 yards range with muzzle velocity approximately 3500 fps and striking velocity 3200 fps.

TEST RD	SUPER EL MILS	REMARKS
33	3.2	Struck butt.
34	3.0	Short 20 yards. Windshield off.
35	3.2	Over 200 yards.
36	1.8	Struck butt.
37	1.6	Hit, complete penetration. Rear opening 5" x 8".
38	1.5	Hit, partial penetration. Punching started.

D. Data on accuracy and time of flight taken in conjunction with powder charge firing.

TEST RD	TIME OF FLIGHT OVER 2980.77 FT-SEC	TARGET MEASURE - FROM BULL LEFT	UP	DOWN
39	0.88565	Warming round.		
40	0.86847	Warming round.		
41	0.85554	28.5"	----	----
42	0.85821	32.0"	1.0"	----
43	0.85453	29.0"	7.0"	----
44	Lost	28.5"	----	4.5"
45	0.85702	31.0"	18.5"	----
46	0.85680	30.5"	15.0"	----
47	0.85976	25.5"	5.0"	----
	OVER 2981.12 FT-SEC			
48	0.82974	23.5"	50.5"	----
49	0.85710	22.0"	23.0"	----
50	0.87422	24.0"	30.5"	----
51	0.87134	27.0"	21.5"	----
52	Lost	24.0"	22.5"	----
53	0.87767	24.5"	12.5"	----

Note: In firing the weapon for accuracy, the tube was boresighted on the bull, then elevated 3 mils. The groups, rounds 39-47 and rounds 48-53 were fired on different days. On both days the weather was warm with variable, light breezes 0-7 mph and no precipitation.

E. Data on case capacity with various powder lots. Case, Ctg., 105 mm, T4E1 with Primer, Perc., 400 gr, T48 allowing sufficient room for closing plug and 5 oz igniter on top of charge.

	CHARGE DUMP	CHARGE DUMP AND TAP
Powder Lot EXA-6564	18 lb, 3.6 oz	19 lb, 14.3 oz
PAE-5006	17 lb, 11.0 oz	18 lb, 14.0 oz
EXA-6805	18.17 lb	19.27 lb
EXA-6806	18.73 lb	19.19 lb
50/50 Blend, 6805-6806	18.44 lb	19.28 lb

F. Data on corrections used for reducing raw data.

1. Decrease in velocity for increase in projectile weight - 2.6 feet per second per 0.1 lb.

2. Increase in chamber pressure for the presence of two Gage, Medium Caliber, M3 - 330 psi.

3. Increase in velocity for the presence of two Gage, Medium Caliber, M3 - 4.7 fps.

4. Increase in chamber pressure for increase in projectile weight - 88 psi per 0.1 lb.

G. Data on Flash and Smoke.

Test rounds 27-32 and 39-47.

TEST RD	POWDER LOT	FLASH SIZE	FLASH COLOR	SMOKE AMOUNT	SMOKE COLOR
27	6805	Small, 8'	Yellow	Small	Lt. Grey
28	6805	Small, 8'	Yellow	Small	Lt. Grey
29	6806	Medium, 10'	Yellow	Medium	Lt. Grey
30	6806	Medium, 10'	Yellow	Medium	Lt. Grey
31	6805	Medium, 10'	Yellow	Medium	Lt. Grey
32	6806	Medium, 10'	Yellow	Medium	Lt. Grey
39	50/50 Blend of Lots 6805 - 6806	Medium, 10'	Yellow	Medium	Lt. Grey
40	"	Medium, 10'	Yellow	Medium	Lt. Grey
41	"	Medium, 10'	Yellow	Medium	Lt. Grey
42	"	Medium, 10'	Yellow	Medium	Lt. Grey
43	"	Medium, 10'	Yellow	Medium	Lt. Grey
44	"	Medium, 10'	Yellow	Medium	Lt. Grey
45	"	Medium, 10'	Yellow	Medium	Lt. Grey
46	"	Medium, 10'	Yellow	Medium	Lt. Grey
47	"	Medium, 10'	Yellow	Medium	Lt. Grey

Note: No round gave evidence of hangfire, flareback or unconsumed powder in the tube.

SUMMARY

A. Powder Charge.

A charge of 17.38 lb of T12 propellant, 50/50 blend of Lots EXA-6805 (.0795" web) and EXA-6806 (.0893" web) will give the 35.5 pound, T182 shot a muzzle velocity of 3500 fps with chamber pressure 46600 psi using the 400 grain, T48 primer and a 5 oz black powder igniter on top of the charge.

B. Armor Plate Firing.

Plate: 5"/55°.

PROJECTILE	WT - LB	APPROX B.L. - fps	EFFECTIVE RANGE, YARDS
AP, T182(A) Mod. at APG	33.3	3130	1250 (1)
AP, T182(B) Mod. at FA	35.5	Not fired	+1000 (2)
AP, T182(C) Mod. at FA flat nose	31.9	3183	1750 (3)
HVAP, T29E4 w/10 lb WC core	24.7	3722	1200 (4)

(1) Calculated, based on MV 3500 fps and form factor of 1.196 on $G_{6.1}$. One round fired at 1000 yards range did not defeat the plate.

(2) One round against the plate at 1000 yards range did defeat the plate.

(3) Calculated, based on MV 3700 fps and i = 1.196 $G_{6.1}$.

(4) Calculated, based on MV 4200 fps and i = 1.12 G_8.

C. Accuracy.

1. Test rounds 41-47. Maximum spread vertical 23", horizontal 6" target at 1000 yards. P.E. (V) - 0.16 mils, P.E. (H) - 0.04 mils.

2. Test rounds 48-53, maximum spread vertical 18", horizontal 5" target at 1000 yards. P.E. (V) - 0.145 mils, P.E. (H) - 0.04 mils.

D. Time of Flight.

Ballistic Research Laboratories in a memorandum dated 3 July 1951 stated the form factor of the 35.5 pound Shot, AP, 105 mm, T182 to be 1.196 on the G6.1 drag function with a probable error of 0.010.

OBSERVATIONS

A. After firing test round 3 the lever for the firing pin plunger was broken.

B. After firing test round 3, armor plate no. WA 5-15 was spalled on the rear face to an extent such that firing was discontinued on the plate. Watertown Arsenal reports on the physical properties of the plate, other than hardness, have not yet been received.

C. After firing test round 4 the recoil bolts on the gun failed, allowing the gun to over-recoil. The Gun, 105 mm, T5E2 No. 80 could no longer be used.

D. The windshield came off test round 34 while the shot was in flight.

E. The weights of the shot submitted by Frankford Arsenal varied. The variance was due to the type of metal used in the windshield and to dimensional variations in the adapter which fitted the ogive of the shot to the windshield. Test rounds 35-37 and 39-47 were assembled with shot having steel windshields and their weights varied from 35.37 to 36.61 pounds. Test rounds 48-53 were assembled with shot having aluminum windshields and no adapters (the windshields were attached with a plastic cement) and their weight varied from 34.87 to 35.10 pounds.

F. After firing test rounds 39-47, examination of the cartridge cases showed fluting on every case. The cases had been resized prior to firing.

OBSERVERS

The following personnel witnessed portions of the firing tests:

Mr. N. Armiento, Frankford Arsenal.
Mr. H. Fatzinger, Frankford Arsenal.
Mr. C. Ianotti, Frankford Arsenal.

APPROVED:

John D. Armitage
JOHN D. ARMITAGE
Col., Ord. Corps
Chief, Arms & Am Div.

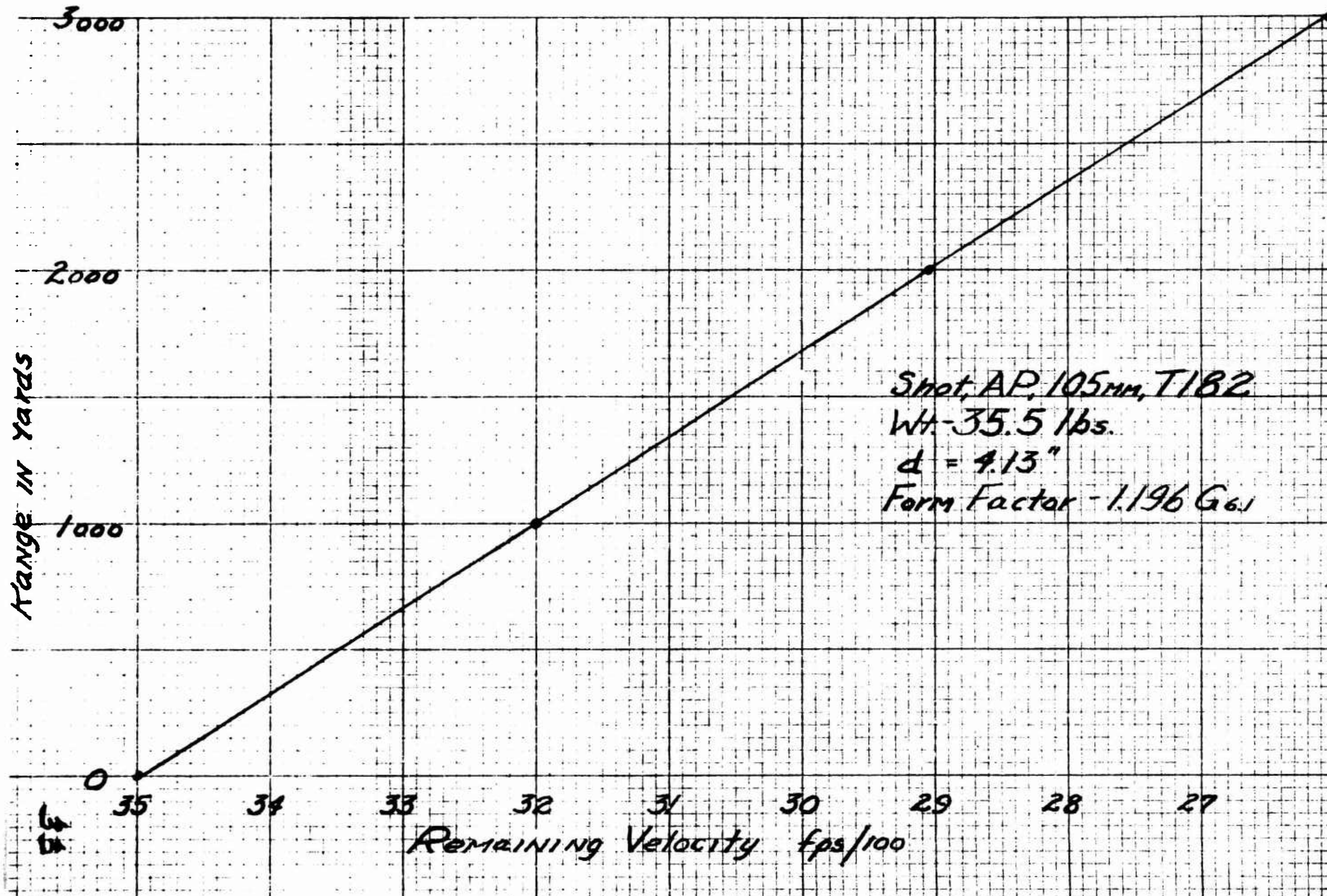
H. A. Bechtol
H. A. BECHTOL
Chief, Ammunition Branch

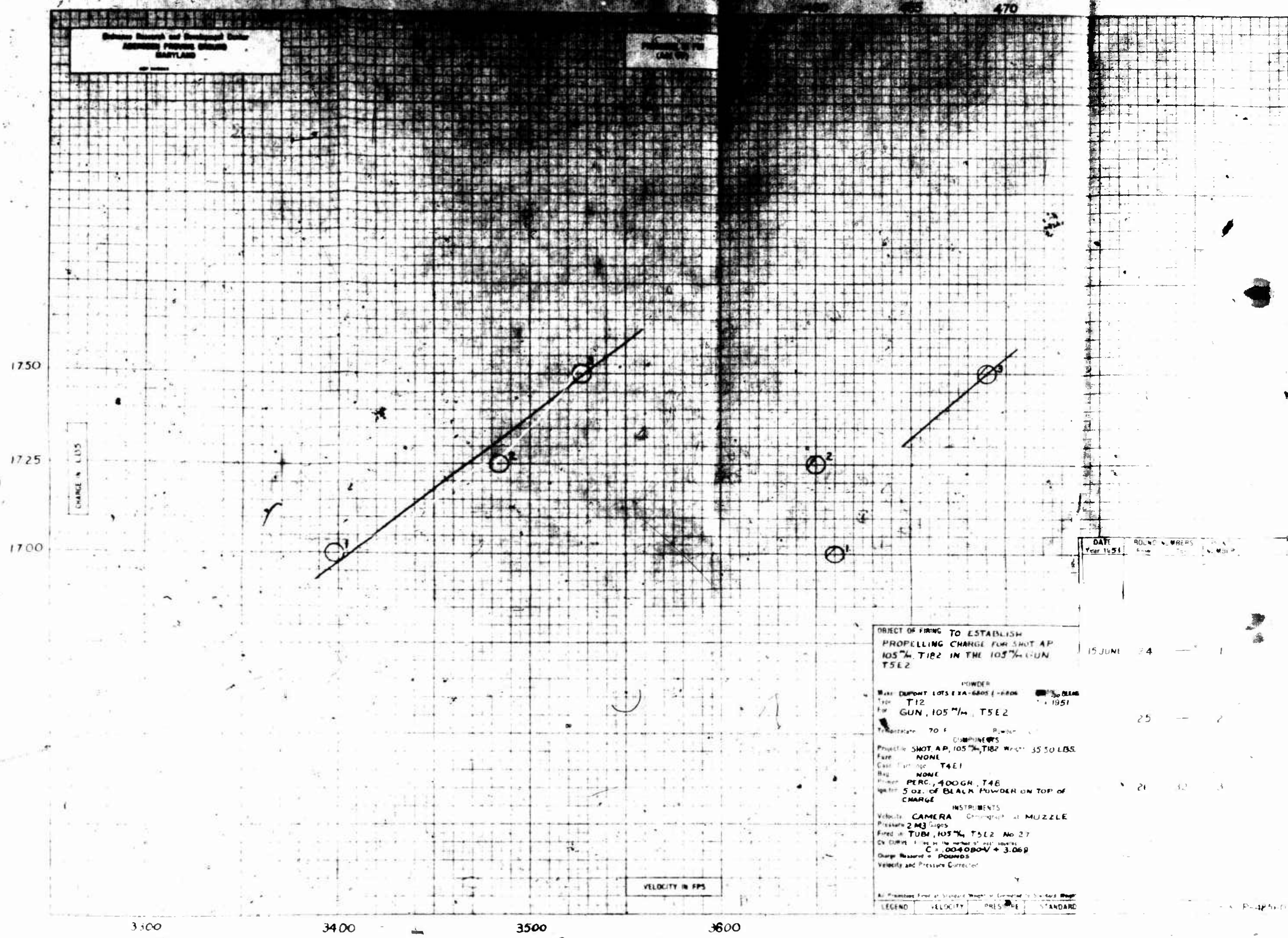
John B. Rezin
JOHN B. REZIN
Engineer, Ordnance

APPENDIX D

Graphs (2)

359-5G KEUFFEL & ESSER CO.
10 X 10 to the inch.
MADE IN U. S. A.



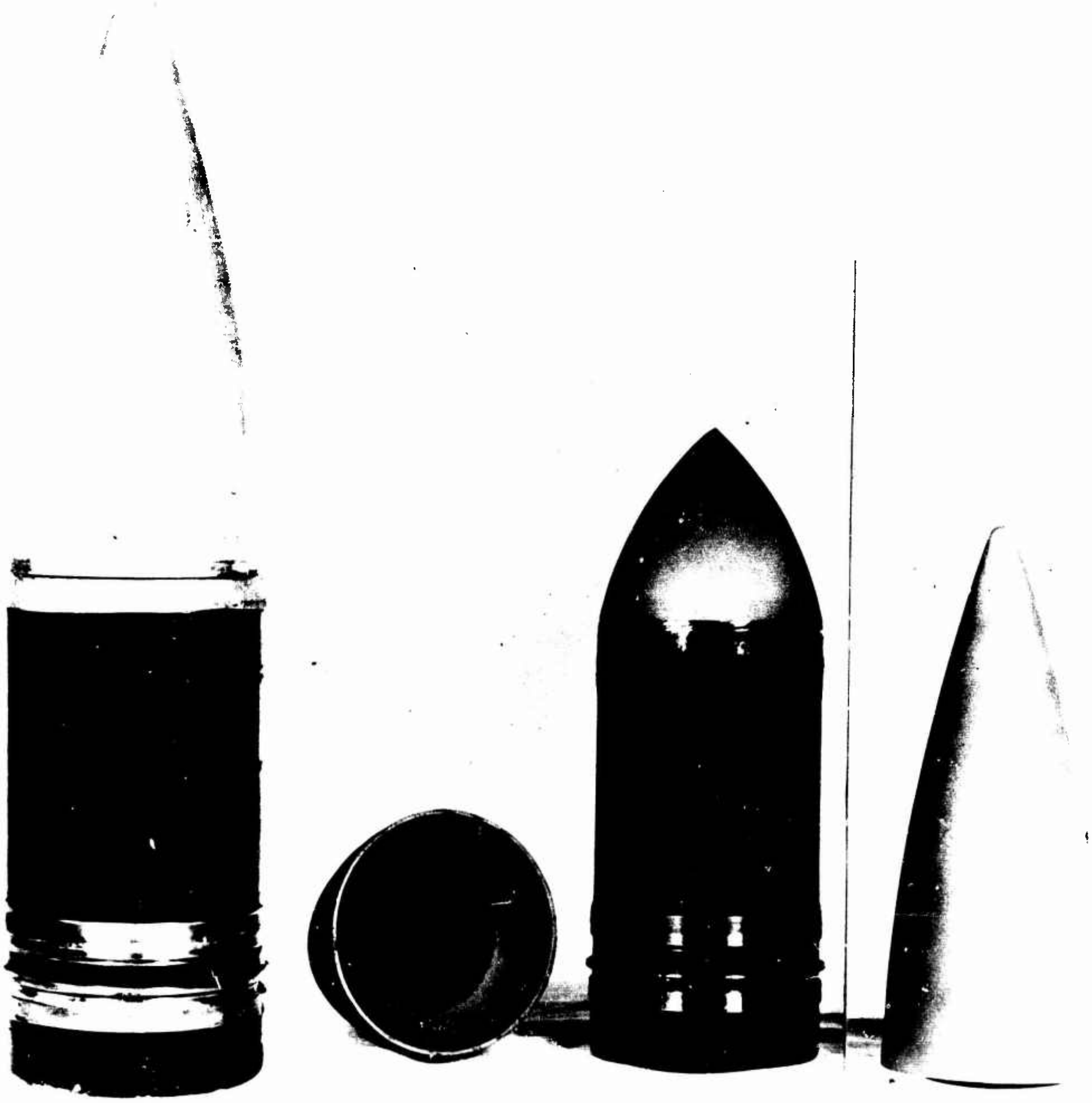

470
CHARGE IN LBS
1750
1725
1700
VELOCITY IN FPS
3300
3400
3500
3600
OBJECT OF FIRING TO ESTABLISH PROPELLING CHARGE FOR SHOT AP 105 M/M T182 IN THE 105 M/M GUN T5E2
POWDER
DUPONT LOTS EXA-6805 (-6806
T12
GUN, 105 M/M, T5E2
1951
70 F
COMPONENTS
Projectile SHOT AP, 105 M/M, T182 Weight 35.50 LBS.
Fuze NONE
T4E1
NONE
Primer PERC., 400GR, T48
Igniter 5 oz. of BLACK POWDER ON TOP of CHARGE
INSTRUMENTS
Velocity CAMERA at MUZZLE
Pressure 2 M3 Gages
Fired in TUBE, 105 M/M, T5E2 No. 27
C = .004080V + 3.069
POUNDS
Velocity and Pressure Corrected
LEGEND
VELOCITY
PRESSURE
STANDARD
DATE Year 1951
ROUND NUMBERS
15 JUNE
24
25
21
32
1
2
3

APPENDIX E

Photograph

No. A71999

5
34



A71999 RESTRICTED ABERDEEN PROVING GROUND 28 September 1951

Project No. TA1-1503. Developm^nt of Ammunition for 105mm Gun.
Shot, AP, 105mm, T182. LEFT A**embled shot. RIGHT: View showing
ogive contour and adapter in.) windshield.