AD NUMBER
AD006850
CLASSIFICATION CHANGES
TO: **unclassified**
FROM: **confidential**
LIMITATION CHANGES
TO: **Approved for public release; distribution is unlimited.**
FROM: **Distribution authorized to DoD only; Administrative/Operational Use; FEB 1953. Other requests shall be referred to Naval Proving Ground, Dahlgren, VA. Pre-dates formal DoD distribution statements. Treat as DoD only.**
AUTHORITY
28 Feb 1965 per DoDD 5200.10; NWC ltr dtd 4 Mar 1976

AD _____

[redacted]

CONFIDENTIAL
SECURITY INFORMATION

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1092

TASK ASSIGNMENT NPG-Re3f-650-1-52

FINAL Report

GUN FIRING TEST OF WARHEAD, SEMI ARMOR PIERCING 3000 LB. TI FOR MATADOR

FINAL Report

Task Assignment NPG-Re3f-650-1-52

Copy No. 12

Classification CONFIDENTIAL SECURITY INFORMATION

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

PART A

SYNOPSIS

1. Five (5) Warheads, SAP, 3000 lb. T1, for Matador were submitted to Naval Proving Ground for ballistic test and evaluation of homogeneous steel armor penetration properties.

2. It is concluded that:

a. The inert loaded Warhead, SAP, 3000 lb. T1 for Matador, fired at 1100 f/s striking velocity and 20° obliquity will penetrate nominal 2-1/4" homogeneous steel armor and remain in effective condition.

b. At the same velocity and 0° or 20° obliquity, the warhead will fail against nominal 3-1/4" homogeneous steel armor.

c. Failure of the warhead to penetrate the targets is attributed to the welds. In all cases, failure occurred at or originated at a weld.

d. From the test results, the employment of a weldment as a SAP warhead appears to be impractical.

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

TABLE OF CONTENTS

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

PART B

INTRODUCTION

1. AUTHORITY:

This test was conducted in accordance with references (a) and (b) as authorized by reference (c) and continued under reference (e).

2. REFERENCES:

a. CHORD, Dept. of Army Conf ltr 00.471.94/163[illegible](C)ORDTM - Record J. W. Moseman/trr/4587 of 21 Dec 1949
b. BUORD Conf ltr S75-1(42) (Re3f-MX-771)EJHL:fml Ser 5158 of 17 Jan 1950
c. BUORD Conf ltr NP9 Re3f-EJHL:fml of 14 Mar 1950
d. BUORD Conf ltr Re3f-EJHL:fml S75-1(42) Ser 12999 of 17 Oct 1950
e. BUORD Conf ltr NP9 Re3f-EJHL:am Ser 24428 of 15 Aug 1951

3. OBJECT OF TEST:

The tests were conducted to determine the maximum homogeneous armor plate thickness that the Warhead, SAP, 3000 lb. T1 for Matador would penetrate at 20° obliquity and 1100 f/s striking velocity and remain in an effective condition.

4. PERIOD OF TEST:

a.	Date of Project Letter	14 March 1950
b.	Date Tests Commenced	21 July 1950
c.	Date Tests Resumed	13 February 1952
d.	Date Test Completed	21 February 1952

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

PART C

DETAILS OF TEST

5. DESCRIPTION OF ITEM UNDER TEST:

Warhead, SAP, 3000 lb. T1 for Matador was manufactured for the Army by the A. O. Smith Corp. and submitted for test with details of modification for gun firing as shown by Department of the Army Dwgs. TAM 3009 and TAM 3011. This modification did not stand up for gun firing and after the first test, the four (4) remaining warheads were sent to the Naval Gun Factory under reference (d) for remodification as shown by Department of the Army Dwgs. TAM 3090 and TAM 3091.

6. DESCRIPTION OF TEST EQUIPMENT:

a.	Gun:	24" Smooth Bore, Type A Mod 0, No. 235
b.	Propellant:	5"/38 Smokeless Powder SPDN 9830 plus Black Cannon Powder
c.	Targets:	Various thicknesses of homogeneous armor plate

7. PROCEDURE:

Five (5) Warheads, SAP, 3000 lb. T1 for Matador were inert loaded with vermiculite-cement of specific gravity 1.62. These warheads were fired from a 24" smooth-bore gun against homogeneous steel armor plates of thicknesses from 2.19 to 4.06. The target plates were set at 0° and 20° obliquity. The armor targets were backed by a large sandpile which was used as a recovery medium. Each warhead was recovered and examined prior to firing the next round. Representatives of Bureau of Ordnance and the Department of the Army were consulted before firing each round to determine target thicknesses and test conditions.

8. RESULTS AND DISCUSSION:

The ballistic data are given in detail on Tables II through VI, Appendix (B), and are summarized in Table I, Appendix (A). The bronze bourrelet rings on the warhead as originally submitted for test broke down in the gun. The gun was damaged by scraping and gauging and the warhead struck the target plate at a large yaw angle. The test was considered invalid and the remaining warheads were sent to the Naval Gun Factory for a further modification of the bourrelet

rings to make them suitable for gun firing. Upon the return of the warheads from the Naval Gun Factory, testing was resumed. Round 2 was fired against 4"06 armor at 872 f/s striking velocity and 20° obliquity. The warhead was rendered ineffective by this test, the forward nose section being broken off at the weld and the ogival after nose section cracked longitudinally back to and partially around the second circumferential weld. Round 3 was fired against 3"25 armor at 1164 f/s striking velocity and 20° obliquity. This warhead was ineffective and in practically the same condition as Round 2. Round 4 was fired against 2"19 armor at 1107 f/s striking velocity and 20° obliquity. This warhead was effective with no deformation. At the request of the Army representatives, Round 5 was fired against 3"25 armor at 0° obliquity and 1104 f/s striking velocity. This warhead was ineffective being cracked open at the weld ground, the forward nose section and cracked longitudinally back to and partially around the circumferential weld.

PART D

CONCLUSIONS

9. It is concluded that:

a. The inert loaded warhead, SAP, 3000 lb. T1 for Matador, fired at 1100 f/s striking velocity and 20° obliquity, will penetrate nominal 2-1/4" homogeneous steel armor and remain in effective condition.

b. At the same velocity and 0° or 20° obliquity the warhead will fail against nominal 3-1/4" homogeneous steel armor.

c. Failure of the warhead to penetrate the targets in an effective condition is attributed to the welds. In all cases failure occurred at or originated at a weld.

d. From the test results, the employment of a weldment as a SAP warhead appears to be impractical.

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

The tests upon which this report is based were conducted by:
W. W. MEYERS, Plate Battery Officer
Terminal Ballistics Department

This report was prepared by:
W. W. MEYERS, Plate Battery Officer
Terminal Ballistics Department

This report was reviewed by:
R. H. LYDDANE, Director of Research
Terminal Ballistics Department
E. L. LEVSTIK, Lieutenant Commander, USNR
Terminal Ballistics Batteries Officer
Terminal Ballistics Department
W. B. ROBERTSON, Lieutenant Commander, USN
Terminal Ballistics Officer
Terminal Ballistics Department
C. C. BRAMBLE, Director of Research, Ordnance Group

APPROVED: J. F. BYRNE
Captain, USN
Commander, Naval Proving Ground

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

CONFIDENTIAL

NPG REPORT NO. 1092

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Final Report

on

Task Assignment NPG-Re3f-650-1-52

- -

Final Report

on

Gun Firing Test of Warhead

Semi Armor Piercing 3000 lb. T1 for Matador

Project No.: NPG-Re3f-650-1-52
Copy No.: 12
No. of Pages: 6

Date: FEB 28 1953

CONFIDENTIAL
SECURITY INFORMATION

TABLE I

SUMMARY OF TEST CONDITIONS AND RESULTS

Test Date	Impact No.	Target thickness inches	Target obliquity degrees	Striking Velocity feet per second Des.	Act	Pressure tons per square inch	Penet.	Through Opening
7/21/50	34972	4".06	20	1000	773	2.8	-	---
Warhead broke up in gun-Gun damaged-Plate pushed from butts by yawed warhead.								
2/13/52	39640	4".06	20	1100	872		C	21" x 46"
Warhead not effective-Nose section broken off at weld-Body cracked open to and broken open at weld aft of the ogive section.								
2/15/52	39654	3".25	20	1100	1164	3.6	C	22" x 33"
Warhead not effective-Nose section broken off at weld-Bomb body cracked open to and broken open at weld aft of ogive section.								
2/19/52	39656	2".19	20	1100	1107	3.8	C	23" x 24-1/2"
Warhead effective and intact-No deformation.								
2/21/52	39682	3".25	0	1100	1104	-	C	22" x 23"
Warhead not effective-Cracked around weld at nose section-Cracked longitudinally back to forward support band.								

File No.

Butt Firing

U. S. Naval Proving Ground

Dahlgren, Va. 194

IMPACT NO. 34972

IMPACT DATE 7-21-50

BUTT NO. F

OBJECT Ballistic Test of Guided Missile Warhead S.A.P.-T1 vs. 4" Class B Armor Plate #843 at 20°

REFERENCE N.P.G. ~~LETTER~~ Report No. 1092 DATED

PLATE

Gauge 3.75

Class B

Maker Midvale

No. 8443 Group M121

Contract NORD 151

Date received 26 June 1942

Dimensions 105 3/4" X 127 1/8" X 179 1/8"

No. of impact on plate 3

Thickness at impact 4.06"

OBLIQUITY 20°

Impact dimensions

PENETRATION plate pp

Flaking front

Flaking back

Dist. from top, bottom

Dist. from right, left

Dist. from nearest impact

Dish

Spur

Cracks - Bulge

Button (Thrown)(Started)

Through Opening

PROJECTILE

Caliber 24"

Maker A. O. Smith

Type Guided Missile Warhead

Lot No. AOS/9 Year of Specification —

Mark — Mod. T1 No. —

Date received 6-8-50

~~Capped~~ or uncapped

~~Weight (capped)~~ #

Weight (uncapped) 3261.

Length (uncapped) 79.00

Fuze NONE

Filler Vermiculite

Flight by screen

Condition after firing:-

~~EFFECTIVE~~ or INEFFECTIVE

Bourrelet ring broke down in gun. Gun damaged. Warhead struck target plate at large yaw angle. Warhead broken up.

BALLISTIC DATA

NOTE: All limits are for this plate and this obliquity only.	-1- Desired	-2- Oscillograph MEAN	-3- Chronograph	-4- Limit, estimated for this thickness of impact.	-5- Actual, adjusted to nominal gauge.	-6- Limit, for nominal gauge, based on this impact only. (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts.
Striking velocity (f.s.)	1000	773					

REMARKS PRESSURE: 2.8

Powder TEMP: 76°

CONFIDENTIAL

Security Information

Limit shots only

e/d

F(e/d, ~~θ~~)

N.P.G. Photo. No.

TABLE II

APPENDIX B

~~Acceptance or Rejection recommended~~

W. W. Hughes

Ord. ~~U. S. Navy~~

GUN 24" #235 TYPE A MOD. 0

File No.

Butt Firing

U.S. Naval Proving Ground

Dahlgren, Va. 2-13-52 194

IMPACT No. 39640
IMPACT DATE 2-13-52
BUTT No. F

OBJECT Ballistic Test of Warhead, SAP, 3000 Lb. T1 for Matador vs. 4" Class B Armor at 20° Obliquity.

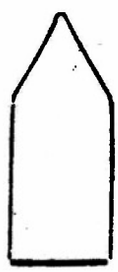
REFERENCE N.P.G. ~~LETTER~~ Report No. 1092 DATED

PLATE

Gauge 4"16
Class B
Maker Midvale
No. 11715 Group M-283
Contract Nord-5341
Date received 22 May 1945
Dimensions 119" x 330"
No. of impact on plate 9
Thickness at impact 4"06
OBLIQUITY 20°
Impact dimensions 23" x 48"
PENETRATION Complete
Flaking front 0
Flaking back 0
Dist. from top, ~~bottom~~ 57"
Dist. from right, ~~left~~ 109"
Dist. from nearest impact 35"
Dish 6"
Spur 10"
Cracks - Bulge 0
Button (Thrown) ~~(Started)~~
Through Opening 21" x 46"

PROJECTILE

Caliber 23.919
Maker A. O. Smith
Type Warhead
Lot No. AOS-3 Year of Specification
Mark -- Mod. -- No. 6
Date received
~~Capped~~ or uncapped
~~Weight (capped)~~
Weight (uncapped) 3141.0#
Length (uncapped) 79.15
Fuze None
Filler Vermiculite
Flight by screen
Condition after firing:-
~~EFFECTIVE~~ or INEFFECTIVE
Nose section broken off at weld
Bomb body cracked aparts and
broken pin at weld aft of
the ogive section -



BALLISTIC DATA

NOTE: All limits are for this plate and this obliquity only.	-1- Desired	-2- Oscillograph Mean	-3- Chronograph	-4- Limit, estimated for this thickness of impact.	-5- Actual, adjusted to nominal gauge.	-6- Limit, for nominal gauge, based on this impact only. (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts.
Striking velocity (f.s.)		872					

REMARKS

CONFIDENTIAL
Security Information

Limit shots only
e/d
F(e/d, ~~θ~~)
N.P.G. Photo. No.

TABLE II
APPENDIX B

Acceptance or Rejection recommended

W. W. MEYERS, lh
Ord. Eng. GS-12 ~~Lt. U.S. Navy~~

GUN: 24" Smoothbore Type A Mod 0 #235

File No.

Butt Firing

U. S. Naval Proving Ground
Dahlgren, Va. 2-15-52 194

IMPACT No. 39654
IMPACT DATE 2-15-52
BUTT No. F

OBJECT Ballistic Test of Warhead, SAP, 3000 lb, T1 for Matador

REFERENCE N.P.G. ~~LETTER~~ Report No. 1092 DATED

PLATE

Gauge 3"0
Class B
Maker Carnegie
No. TT542 Group C751-322
Contract -
Date received 16 June 1945
Dimensions 121" x 335"
No. of impact on plate 29
Thickness at impact 3"25
OBLIQUITY 20°
Impact dimensions 24" x 38"
PENETRATION Complete
Flaking front 0
Flaking back 0
Dist. from top, ~~bottom~~ 80"
Dist. from ~~right~~, left 146"
Dist. from nearest impact 38"
Dish 6"
Spur 11"
Cracks - Bulge 0
Button (Thrown)(~~Started~~)
Through Opening 22" x 33"

PROJECTILE

Caliber 23"9057
Maker A. O. Smith
Type Warhead
Lot No. AOS-5 Year of Specification
Mark -- Mod. - No. 5
Date received -
~~Capped~~ or uncapped
~~Weight (capped)~~
Weight (uncapped) 3014.0#
Length (uncapped) 79"15
Fuze None
Filler Vermiculite
Flight by screen
Condition after firing:-
~~EFFECTIVE or~~ INEFFECTIVE
Nose section broken off at weld - Bomb body cracked open to and broken open at weld aft of ogive section

BALLISTIC DATA

NOTE: All limits are for this plate and this obliquity only.	-1- Desired	-2- Oscillograph Mean	-3- Chronograph	-4- Limit, estimated for this thickness of impact.	-5- Actual adjusted to nominal gauge.	-6- Limit, for nominal gauge, based on this impact only. (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts.
Striking velocity (f.s.)		1164					

REMARKS Wt. of Chg: 160# SPDN 9830 14" Std. Silk Bag
Used 3- 5# B. P. Boosters
Av. Pressure 3.6 T.S.I

CONFIDENTIAL
Security Information

Limit shots only
e/d
F(e/d, Θ)
N.P.G. Photo. No.

TABLE IV
APPENDIX B

Acceptance or Rejection recommended

W. W. MEYERS, lh
Ord. Eng. GS-13 ~~MXSXNAVY~~

GUN: 24" Smoothbore Type A Mod 0 #235

File No.

Butt Firing

U. S. Naval Proving Ground
Dahlgren, Va. 2-19-52 194

IMPACT NO. 39656
IMPACT DATE 2-19-52
BUTT NO. F

OBJECT Ballistic Test of Matador Warhead 3000 lb. CAP T1

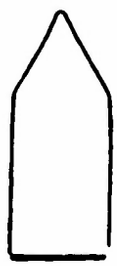
REFERENCE N.P.G. ~~LETTER~~ Serial No. 1692 DATED

PLATE

Gauge 2".174
Class STS
Maker Carnegie
No. X-18167 Group ~~Retest~~ A-9
Contract 448-S-1-A 57-778
Date received June 22, 1943
Dimensions 92-1/8" x 201-1/8"
No. of impact on plate 3
Thickness at impact 2".19
OBLIQUITY 20°
Impact dimensions 25" x 26"
PENETRATION Complete
Flaking front 0
Flaking back 0
Dist. from top, ~~bottom~~ 52"
Dist. from ~~right~~, left 78"
Dist. from nearest impact 43"
Dish 5"
Spur 9"
Cracks - Bulge 0
Button (Thrown)(~~Stuck~~)
Through Opening 24" x 24-1/2"

PROJECTILE

Caliber 23".940
Maker A. O. Smith
Type Warhead
Lot No. AOS-15 Year of Specification
Mark - Mod. - No. 3
Date received
~~Capped~~ or uncapped
~~Weight capped~~
Weight (uncapped) 3128.00#
Length (uncapped) 79".15
Fuze None
Filler Vermiculite
Flight by screen
Condition after firing:-
EFFECTIVE ~~or INEFFECTIVE~~
Intact - No deformation.



BALLISTIC DATA

NOTE: All limits are for this plate and this obliquity only.	-1- Desired	-2- Oscillograph Mean	-3- Chronograph	-4- Limit, estimated for this thickness of impact	-5- Actual, adjusted to nominal gauge	-6- Limit, for nominal gauge, based on this impact only (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts.
Striking velocity (f.s.)		1107					

REMARKS Powder Charge - 150# SPDN-9830 with 3 - 5# B. P. Boosters

CONFIDENTIAL
Security Information

Limit shots only
e/d
F(e/d, ~~+~~)
N.P.G. Photo. No.

~~Acceptance or Rejection recommended~~

TABLE V
APPENDIX B

W. W. Mayes
Ord. Eng. ~~U.S. Navy~~

GUN: 24" Smoothbore Type A Mod 0 #235

File No.

Butt Firing

U. S. Naval Proving Ground
Dahlgren, Va. 2-21-52 194

IMPACT No. 39682
IMPACT DATE 2-21-52
BUTT No. F

OBJECT. Ballistic Test of Warhead SAP, 3000# T1 Matador Bomb

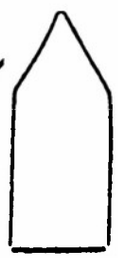
REFERENCE N.P.G. ~~LETTER~~ Report Mar 1952 DATED

PLATE

Gauge 3"4
Class B
Maker Carnegie
No. TT542 Group C751-322
Contract -
Date received 16 June 1945
Dimensions 131" x 335"
No. of impact on plate 30
Thickness at impact 3"25
OBLIQUITY 0°
Impact dimensions 24" x 24"
PENETRATION Complete
Flaking front 0
Flaking back 0
Dist. from top, ~~bottom~~ 76"
Dist. from ~~right~~, left 64"
Dist. from nearest impact 27"
Dish 7"
Spur 6"
Cracks - Bulge 0
Button (Thrown)(~~Started~~)
Through Opening 22" x 23"

PROJECTILE

Caliber 23"934
Maker A. O. Smith
Type Warhead
Lot No. AOS-6 Year of Specification
Mark - Mod. - No. 15
Date received -
~~Capped~~ or uncapped
~~Weight capped~~
Weight (uncapped) 3211.00#
Length (uncapped) 79"15
Fuze None
Filler Vermiculite
Flight by screen
Condition after firing:-
~~EFFECTIVE or~~ INEFFECTIVE
Cracked from circumferentially ground weld at nose section. Cracked longitudinally from 1st circumferential weld. Cracked also partially around and circumferential weld.



BALLISTIC DATA

Note: All limits are for this plate and this obliquity only.	-1- Desired	-2- Oscillograph Mean	-3- Chronograph	-4- Limit estimated for this plate and obliquity	-5- Actual adjusted [illegible]	-6- Limit, for nominal gauge, based on this impact only (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts
Striking velocity (f.s.)		1104					

REMARKS
Chg. 150# SPDN-9830, with 3-5# B.P. Boosters
Avg. Pressure - 3.6

CONFIDENTIAL
Security Information

Limit shots only
e/d
F(e/d, ~~t~~)
N.P.G. Photo. No.

~~Acceptance or Rejection recommended~~

TABLE VI
APPENDIX B

W. W. Rogers
Asst. Eng ~~U.S. Navy~~

GUN: 24" Smoothbore, Type A Mod 0 #235

NP9-51723 13 February 1952 CONFIDENTIAL SECURITY INFORMATION

Impact 39640, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 4906 Class B plate at 20° obliquity and 872 ft./sec. striking velocity.
Front View

Figure 1

NP9-51724 15 February 1952 CONFIDENTIAL
SECURITY INFORMATION

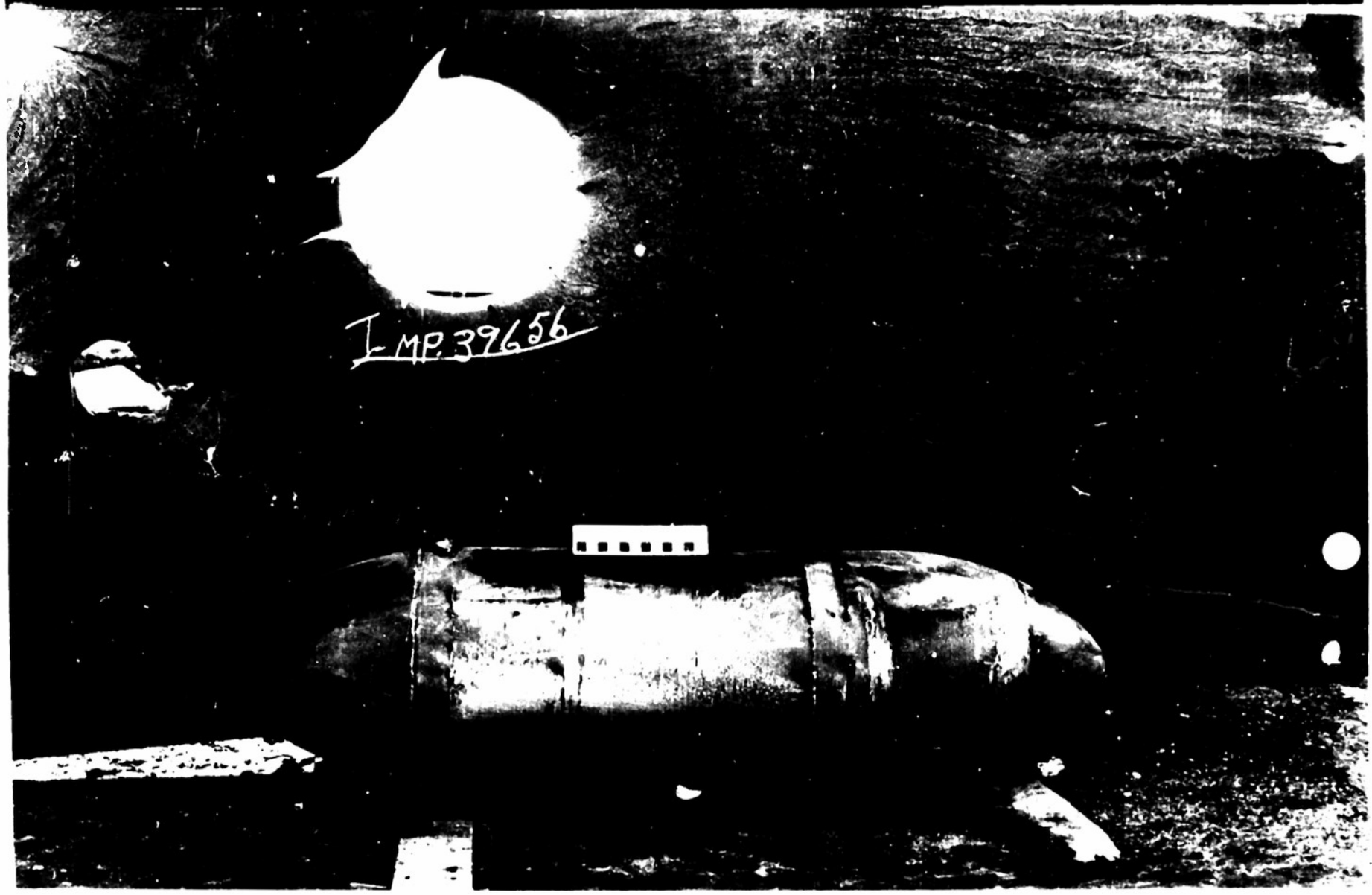
Impact 39654, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 3725 Class B plate at 20° obliquity and 1164 ft./sec. striking velocity.
Front View Figure 2

NP9-51725 19 February 1952

CONFIDENTIAL
SECURITY INFORMATION

Impact 39656, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 2"19 STS plate at 20° obliquity and 1107 ft./sec. striking velocity.
Front View

Figure 3

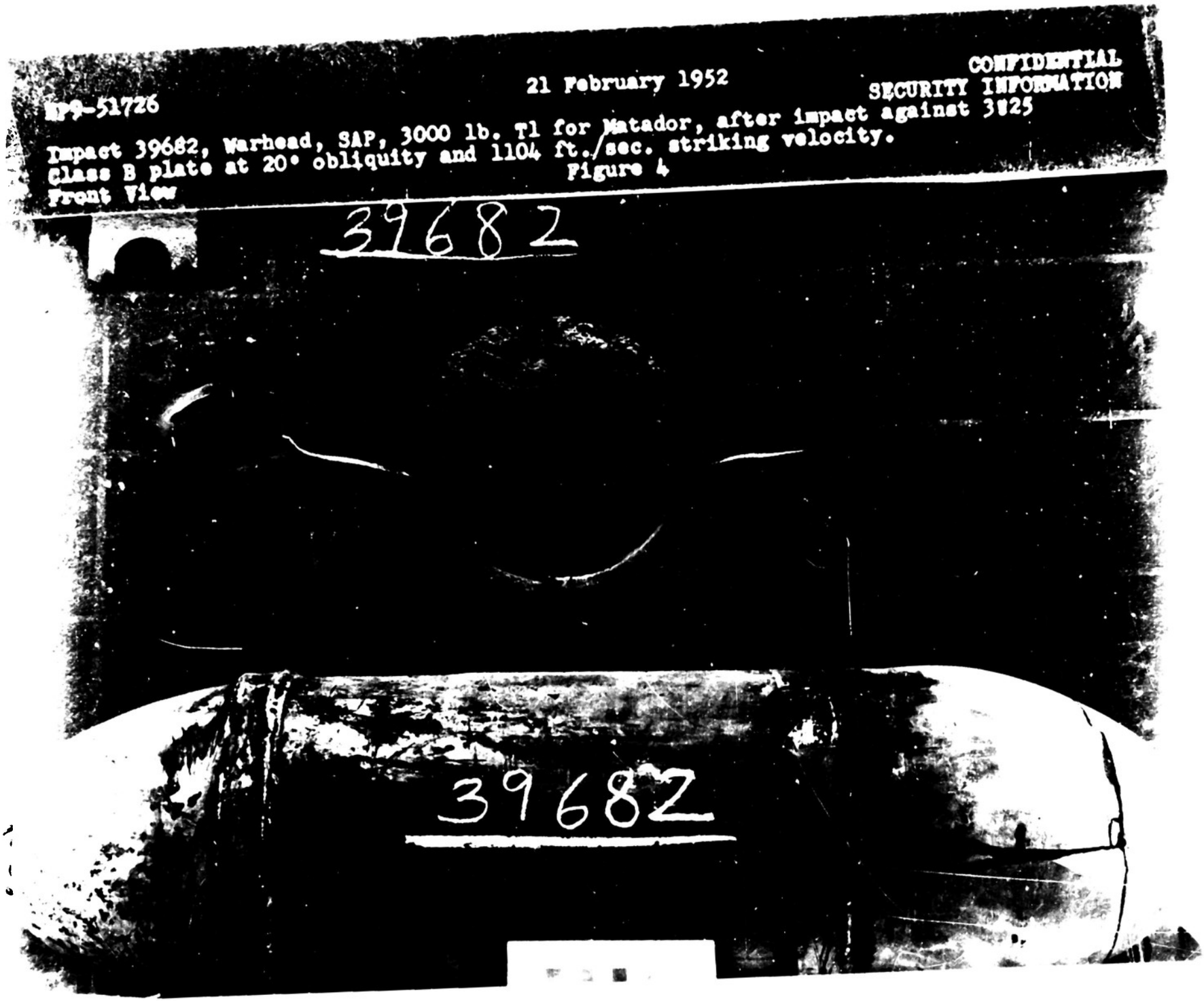


21 February 1952

MP-51726

Impact 39682, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 3125 Class B plate at 20° obliquity and 1104 ft./sec. striking velocity.
Front View

Figure 4



Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. TI for Matador

DISTRIBUTION

Bureau of Ordnance:

Ad3	1
Re3c	6
Chief of Ordnance Department of the Army Attn: ORDTX-AR	1
Commanding General, Aberdeen Proving Ground Aberdeen, Maryland Attn: Technical Information Section Development and Proof Services	1
Commander, Operational Development Force U. S. Atlantic Fleet, U. S. Naval Base Norfolk 11, Virginia	1
Navy Research Section, Library of Congress Washington 25, D. C. (Via BUORD Re3c)	2
Naval Gun Factory Attn: Aircraft Armament Section	1
Commanding General Air Materiel Armament Test Center Eglin Air Force Base, Florida	1
Commanding Officer Picatinny Arsenal Dover, New Jersey Attn: Technical Division	2
Bureau of Aeronautics Attn: Armament Section	2
NATC, Patuxent River, Maryland	3
NAOTS, Chincoteague, Virginia	1

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

- -

DISTRIBUTION (Continued)

Air Material Command Liaison Officer Wing 3 Headquarters, Aberdeen Proving Ground Aberdeen, Maryland	2
Naval Liaison Officer USAFPGC, Eglin Field, Fla.	1
NOTS, Inyokern, California	1
NOTS, Inyokern, California Attn: Aviation Ordnance and Test Department	1
Naval Air Development Center Johnsville, Pa.	1
U. S. Air Force AMC Engineering Field Office Room 1833, Main Navy Building Navy Department, Washington, D. C.	2
Local: OTP	1
OT	1
File	1