

AD- 052210

SECURITY REMARKING REQUIREMENTS

DOD, 5200.1-R, DEC 78

REVIEW ON 28 AUG 74

THIS REPORT HAS BEEN DELIMITED
AND CLEARED FOR PUBLIC RELEASE
UNDER DOD DIRECTIVE 5200.20 AND
NO RESTRICTIONS ARE IMPOSED UPON
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

UNCLASSIFIED

AD. 52210

CLASSIFICATION CHANGED
TO: UNCLASSIFIED
FROM CONFIDENTIAL
AUTHORITY:

APG, D/A etc,

19 NOV 80



UNCLASSIFIED

Armed Services Technical Information Agency

AD

52210

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

**Reproduced by
DOCUMENT SERVICE CENTER
KNOTT BUILDING, DAYTON 2, OHIO**

UNCLASSIFIED

AD No. 52210
ASST. FILE COPY

CTC

CONFIDENTIAL

RDHG-1327--24 Oct 51



Aberdeen Proving Ground

MARYLAND

AN INVESTIGATION OF THE FIRING, FLIGHT

AND RANGE PENETRATING CHARACTERISTICS

OF SHOT, AP, 76MM, T100 SERIES

THIS DOCUMENT CONSISTS OF 92 PAGES

COPY 11 OF 19 COPIES, SERIES 1

D. A. PROJECT NO. 501-05-012
DEVELOPMENT AND PROOF SERVICES

Fourth Report OCO Project No. TAl-1301

ARMY OF ABERDEEN PROVING GROUND MD 417

CONFIDENTIAL

AN INVESTIGATION OF THE FIRING, FLIGHT
AND ARMOR PENETRATING CHARACTERISTICS
OF SHOT, AP, 76MM, T166 SERIES
FOURTH REPORT ON PROJECT TAL-1702

54A A

68869

NOV 13 1954

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

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND
MARYLAND

ORDTA
PRIORITY: 1A

JBR:ia/lr
16 September 1954

AN INVESTIGATION OF THE FIRING, FLIGHT
AND ARMOR PENETRATING CHARACTERISTICS

OF SHOT, AP, 76MM, T166 SERIES

FINAL REPORT ON PROJECT TAI-338

DATES OF TEST: January 1951 - May 1954

OBJECT

To determine, by various ballistic tests, the optimum shot design for the T166 series of projectiles for the Gun, 76mm, M1 Series.

SUMMARY

A total of twelve shot designs, both experimental and standard models were fired against various armor arrangements to determine the characteristics of the experimental models and compare their performance with the standard types. On the basis of armor performance, one type of experimental shot was chosen from extended tests including accuracy, component security and time of flight. These tests were fired over the period January 1951 - May 1954. During the early months of 1954 the requirement for this type of shot was cancelled because the weapon for which it was designed was generally superseded by guns of greater potential. The basic information gained in this series of firing trials is important to the Ordnance Corps but its application is not of immediate importance.

CONCLUSIONS

1. The armor penetration characteristics of the T166 series shot are not outstandingly superior to other shot in the 75mm, 3", and 76mm calibers developed or under development.
2. The data gained from the firing trials may be useful in the application of the design features to other problems of armor versus projectile.
3. Of the T166 designs investigated, the E2 model indicates a slight superiority over the other designs.

RECOMMENDATION

It is recommended that the extensive trials of similar shot be limited to scale firing until promising designs are evolved. The full-scale tests, then, would be confined to designs which have been partially proven, and full-scale firing trials could be concerned with not more than 3 or 4 designs.

CONFIDENTIAL

DISTRIBUTION FOR FOREIGN REPORT ON PROJECT TAL-1202

<u>COPY NO.</u>	<u>DISTRIBUTION</u>	APG COPY #	OF 13 COPIES
2-3	Chief of Ordnance Washington 25, D. C.		
4	Attn: ORDTA ORDTX-AR	Addressee	2 copies 1 copy
5	Commanding Officer Picatinny Arsenal Dover, N.J.		1 copy
6	Commanding Officer Frankford Arsenal Philadelphia 37, Pa. Attn: Laboratory		1 copy
7	Commanding Officer Watertown Arsenal, Watertown, Mass. Attn: Laboratory		1 copy
8	Liaison Officer Aberdeen Proving Ground, Md. Attn: Col. H. duB. Lewis		1 copy
9-13	Armed Services Tech Inf. Agency Document Service Center Dayton, Ohio		5 copies
0-1	Technical Information Branch Aberdeen Proving Ground, Md.		Original & 1 copy

I. INTRODUCTION

A. Frankford Arsenal has been charged with the technical supervision of a project directed toward the development of an AP Shot for the Guns, 76mm, M1A1C, M1A2 and T94. In 1950, when the Arsenal received the directive from the Office, Chief of Ordnance, it was believed the development could be accomplished quite simply by applying data gained during development of the Shot, AP, 76mm, T128 for Gun, 76mm, T91. At about the same time, however, development trials of the Shot, AP, 75mm, T148 indicated the superiority of a truncated shot body over the conventional design, against certain armor arrangements. It was decided to attempt to combine the qualities of the conventional, T128 design and the unconventional, truncated, T148 design and thereby produce a shot which would be effective against a wide range of armor targets. The decision was supported by data gained from small-scale firing conducted by the Arsenal under Project TAL-5002. The design which resulted from the above decision was one which, generally, incorporated a truncated T128 shot body with a tip attached. It was reasoned that the truncated body would be particularly effective against armor targets of relatively low thickness and high obliquity, and the presence of a tip would not degrade this performance. Likewise, the presence of the tip would permit increased penetration of relatively thick armor targets at low obliquity, as compared with truncated, untippec shot, and the truncated body would not degrade this performance.

B. The authority directing development of the T166 shot is contained in letter file OO 471.13/23 from OCO to Frankford Arsenal. Authority for the Proving Ground tests is contained in the first indorsement to letter file OO 471.13/43, APG 471.1/175. A copy of the armor correspondence is contained in Appendix A of this report. This report is the first issued by the Proving Ground on the T166 shot.

II. DESCRIPTION OF MATERIAL

A. PROVESTERS

1. A total of twelve shot types were fired during the first phase of armor testing. These shot were assigned type letters as follows:

TYPE

A	Shot, AP, 75mm, T148
B	Shot, AP, 75mm, T148 (Mod.)
C	Shot, AP, 76mm, T128E6 (Mod.)
D	Shot, AP, 3", M79
E	Shot, AP, 76mm, T166E4
F	Shot, AP, 76mm, T166E5
G	Shot, AP, 76mm, T166E2
H	Shot, AP, 75mm, E72
I	Shot, AP, 76mm, T128E6
J	Shot, AP, 76mm, T166E3
K	Shot, AP, 76mm, T166E2 (Mod.)
L	Shot, AP, 76mm, T166E6

Reference is made to the correspondence included in Appendix A of this report for shot descriptions furnished by Frankford Arsenal, and to Firing Record P-5T162 of Appendix B.

2. A brief description of the various types follows:

a. Shot type A (75mm, T148). Shot made from the 75mm, M72 projectile. The M72 shot were modified to the T148 design (flat nose), and rehardened by quenching the shot nose only. The shot are made of WD 4150 steel. Windshields were attached to the shot bodies with plastic cement. Reference is made to Picatinny Arsenal Notes on Development of Cartridge, AP-T, T148 and T148E1, for 75mm Guns, M3, M6 and M17", Project No. TA1-1251, dated 7 March 1951. Photograph A63964, inclosed with this record shows the shot (less windshield) after a recovery firing trial.

b. Shot type B (75mm, T148 Mod.). These shot were T148 models with a slightly overmatching tip. The tips were made from 76mm, T128E6 shot bodies, of NE98V65 (Mod.) steel, hardened and attached to the T148 bodies with plastic cement. The shot were fired without windshields.

c. Shot type C (76mm, T128E6 Mod.). The shot, made of NE98V65 (Mod.) steel, were modified by cutting off the nose section to obtain a 2-1/2" diameter flat, hardened and base tempered. Matching tips from NE98V65 (Mod.) steel, hardened, were attached to the shot bodies with plastic cement. The shot were fired without windshield.

d. Shot type D (3", M79). The standard AP shot for the Gun, 3", M5, made in accordance with drawing No. 75-18-45. The shot is made from WD 4150 steel, of conventional design.

e. Shot type E (76mm, T166E4). Shot made from T128E6 bodies, softened and modified to a truncated 1/4 caliber radius ogive with a 2.59" diameter flat on the nose. The shot were rehardened by martempering and base tempering. Skirted tips with 4.485" radius ogive were machined from NE98V65 (Mod.) steel to fit the T166E4 nose shape, hardened, and attached to the shot bodies with plastic cement. Aluminum die-cast windshields attached to the tips with plastic cement.

f. Shot type F (76mm, T166E5). Shot made from T128E6 bodies, softened and modified to a truncated 5" radius ogive with a 2.5" diameter flat on the nose. The shot were rehardened by martempering and base tempering. Overmatching tips with 5" radius ogive were machined from NE98V65 (Mod.) steel, hardened, and attached to the shot bodies with plastic cement. Aluminum die-cast windshields attached to the shot bodies with plastic cement.

g. Shot type G (76mm, T166E2). Shot made from T128E6 bodies, softened and modified to a truncated 1/2 caliber radius ogive with a 2.5" diameter flat on the nose. The shot were rehardened by martempering and base tempering. Overmatching tips with 5" radius ogive were machined from NE98V65 (Mod.) steel, hardened, and attached to the shot bodies with plastic cement. Aluminum die-cast windshields attached to the shot bodies with plastic cement.

h. Shot type H (75mm, M72). The standard AP shot for the 75mm Gun, M3, made in accordance with drawing 75-2-305. The shot is made from WD 4150 steel, of conventional design.

i. Shot type I (76mm, T128E6). This shot is expected to become standard for the Gun, 76mm, T91. It is made from NE98V65 (Mod.) steel, of conventional design. The rotating band is of the "case over band" design. A modification of the rotating band, used on six rounds during this firing trial, was the replacement of gilding metal with plastic.

j. Shot model J (76mm, T166E3). Shot made from T128E6 bodies, softened and modified to a truncated 15° conical ogive with a 2.592" diameter flat on the nose. The shot were rehardened by martempering and base tempering. Skirted tips with a 4.485" radius ogive were machined from NE98V65 (Mod.) steel and attached to the shot bodies with plastic cement. Aluminum die-cast windshields were attached to the tips with plastic cement.

k. Shot type K (76mm, T166E2 Mod.). These shot were of the T166E2 design, without hardened tips or windshields.

l. Shot type L (76mm, T166E6). These shot were of T166E2 design except the tips were attached to the shot bodies by brazing instead of by plastic cement.

3. Shot, AP, 76mm, T166E2 (Lot FAE-962) were fired for the investigation of component security. Reference is made to Firing Record P-52192, Appendix B.

4. Shot, AP, 76mm, T166E2 with various body hardesses were fired to investigate the effects of hardness. Reference Firing Record P-56758, Appendix B.

III. DETAILS OF TEST

A. PROCEDURE

1. Armor plate firings were conducted using established techniques, the target plate being emplaced about 300 feet from the gun.

2. The investigation of the bonding material between windshield, tip and body was conducted by firing temperature conditioned rounds into a target at approximately 1000 yards range. Ultra-speed photographs were taken of the shot in flight to observe for component security.

B. RESULTS

The detailed, round-by-round data is included in Firing Records P-53162, P-52192 and P-56758 Appendix B of this report. A summary follows:

An overall evaluation of the results is difficult because of the nature of the tests. Small numbers of shot against a variety of armor targets and the fact that all shot types were not fired against the complete series of targets, revealed only that T166 series of shot was outclassed by various other shot against certain targets and outclassed these same shot against other targets. This result was anticipated because of the known fact that a punching action is particularly effective against relatively thin armor at high obliquities, and the T166 shot operates as a punching shot against this armor arrangement. The data also indicates conflicting results, particularly between the T166E2 and the T128E6 penetrations. The T166 shot indicated their best performance against the T3/4 tank hull, and in the defeat of a particular spaced armor

arrangement. A special armor firing of T166E2 shot (Firing Record P-56758) confirmed the above-mentioned premise, and also indicated a shot body hardness less than the normal was superior to both the normal and "super hard" bodies. A firing trial of T166E2 shot for component security (Firing Record P-52192) indicated satisfactory results when a thermo-setting plastic was used to attach the windshield and the tip.

IV. CONCLUSIONS

A. A shot which functions as a punching projectile under certain attack conditions, and as a piercing projectile under other attack conditions is a highly desirable item of ordnance. The T166 series indicates the potentialities of an arrangement wherein a detachable tip is used to obtain variations in the action. For this reason the results are of interest and importance. At least two other methods are known. Certain Russian shot have a groove machined in the body just below the bourrelet, and a German 75mm shot has been examined which was designed to have a two-piece body, the sections being held by a butt weld.

B. A particular armor target may be most easily defeated by a projectile of special design, but the targets expected to be engaged by our tanks offer a variety of armor arrangements and the "special design" projectiles are prone to comparison failures when tested against conventional shot over the entire range of possible targets. This condition is indicated by the comparison of results against the 2"/60° target, wherein 75mm, T148 shot gave excellent results as compared with the T128E6 shot, and the 3"/55° target wherein the T128E6 shot gave a limit of 3500 fps and the T148 shot was not fired because its potential is known to be below that required for defeat of 3"/55° armor. The results of the T166-series shot trial indicate the potential of the designs to result in a shot which overcomes the deficiencies of "special design" and maintains effectiveness over a range of targets. This effect is the basis for the conclusions stated earlier in this report.

C. The T166 shot design has not been proven wholly acceptable, and additional firing trials are required to prove any final design.

V. RECOMMENDATION

If an AP shot for the Gun, 76mm, M1 series is designed, a series of tests should be performed on the approved designs (in addition to the tests prior to approval) to investigate the action of the shot over a wide range of conditions. These tests should include observation of shot action at extreme temperatures, excessive pressures and from tubes in various conditions of wear; accuracy, component security and armor defeating characteristics should also be investigated.

APPROVED:

Frank J. Hoyle
T. F. COLLIERAN
Director, Development
and Proof Services

J. Mahan
for J. B. REZIN
Engineer, Ordnance

Benjamin S. Coolwin
BENJAMIN S. COOLWIN
Chief, Arms and Ammunition Div.

APPENDICES

- APPENDIX A - CORRESPONDENCE
- APPNEDIX B - FIRING RECORDS
- APPENDIX C - PHOTOGRAPHS

THIS DOCUMENT CONSISTS OF⁵⁷..... PAGES
COPY⁴..... OF¹³..... COPIES, SERIES.....

RETAIN OR DESTROY PER AR 380-5 AND
SR345-215-5 OR COMPARABLE AF OR NAVY
REGULATIONS. DO NOT RETURN

APP 2) 400.112/218

APPENDIX A
CORRESPONDENCE

O.O. 471.13/43
ATTN: ORDTA
FA 471.13/1850-4
APG 471.1/175

1st Ind

RECORD
LSMichael/bw/53401
MAY 29 1951

Dept Army, Ord O, Washington 25, D. C.

TO: CG, Aberdeen Proving Ground, Md.

1. Your proving ground is requested to conduct tests of Shot, AP, 76mm, T166 (type) in accordance with inclosed Frankford Arsenal Test Program Request No. 4.

2. Inasmuch as part of the preliminary work has already been completed (Ref. Par. 2 of basic letter) only one or two more lots of T166 (type) shot remain to be tested.

3. Cost of the foregoing program is chargeable to Project TAL-1301. Test results are "CONFIDENTIAL".

BY COMMAND OF MAJOR GENERAL FORD:

W. L. BELL, Jr.
Col, Ord Corps
Assistant

Incl
n/c (1 cy w/d)

DEPARTMENT OF THE ARMY
ORDNANCE DEPARTMENT

FRANKFORD ARSENAL
PHILADELPHIA 37,
PENNSYLVANIA

IN REPLY
REFER TO

FA 471.13/1850-4
ORDBA-LC
Project TAI-1301

MAY 23 1951
APG 471.1/175

SUBJECT: Development of Shot, AP, 76mm, T166, for M1A1C, M1A2
and T94 Guns.

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

ATTN: ORDTA

1. In accordance with letter file, O.O. 471.13/23, from your office, this arsenal has prepared Test Program Request No. 4 for the 76mm, AP, T166 shot. The attached copy of the program is submitted for your consideration and transmittal to Aberdeen Proving Ground.

2. It should be noted that the program includes preliminary work that has already been conducted with tipped projectiles (lots 1 to 4 inclusive). Consequently, only one or two lots of shot need to be fired before the final design of the 76mm, AP, T166 shot can be established.

W. E. BECKER
Col, Ord Corps
Commanding

Incl:
Test Program No. 4 (dupl)

cc: Picatinny Arsenal
Watertown Arsenal
Aberdeen Prov Gr

TEST PROGRAM REQUEST NO. 4

APG 471.1/175
Incl. 1

1. Material for Test:

Various lots of Shot, AP, 76mm, T166 series, manufactured to several designs.

2. Procurement Authority:

- a. Allotment Advice:
- b. Project No.: TAL-1301
- c. RAD No.: ORDTA 1-12821

3. Arsenal Expenditure Order No.: 5360-1

4. Object of Development or Experiment:

To develop a Shot, AP, 76mm, T166 for use in Guns, M1A1C, M1A2 and T94 suitable for defeat of armor at obliquities from 0° to 70°.

5. Local Tests:

A considerable number of 20mm scale model penetration tests have been conducted to provide the basis for the design of the T166 shot.

6. Object of Tests:

- a. To determine the penetration performance of Shot, AP, 76mm, T166 against homogeneous armor plate of about 300 BHN of 2 inch, 2-1/2 inch, 3 inch, 4 inch, and 5 inch thickness and at various obliquities ranging from 0 to 70 degrees.
- b. To determine the security of attachment of tip, windshield, and rotating band, and, the accuracy and time of flight of the T166 shot to 1000 yards and 2000 yards.

7. Description in Detail of Improvements made since last Proving Ground Tests:

The design of the T166 shot is similar in many respects to that of the Shot, AP, 75mm, T148, except that a separate hard steel overhanging tip will be attached to the shot body to enable it to penetrate thicker armor at all obliquities.

8. Precautions in Handling and Testing:

The usual procedure for handling and testing AP shot should be followed. Fragments of projectiles fired against armor should be recovered and retained for examination by Frankford Arsenal.

9. History Sketch:

Letter O.O. 471.13/23, from Office, Chief of Ordnance to Frankford Arsenal, dated 26 September 1950, directed development of Shot, AP, 76mm, T166, for use in Guns, M1A1C, M1A2, and T94. It was believed that the development could be accomplished with comparatively little firing against armor plate, because T128 tests results would be directly applicable. However, in firing against 2 inch armor at 60° obliquity, the superiority of the new truncated T148 shot over the conventional T128 shot, indicated the advantage of developing the unconventional truncated design for the T166 shot.

As has been shown in connection with the T148 shot development, it is possible to design efficient truncated projectile nose shapes. At high obliquity, monobloc projectiles of the new type remain essentially intact and undeformed in much the same way as conventional pointed projectiles that penetrate at low obliquity. However, just as conventional monobloc shot designed to remain intact during penetration at low obliquity tend to rupture early in the process at higher obliquity, the new truncated shot designed to remain intact at high obliquity tend to rupture early in the process at low obliquity. Unfortunately for the truncated shot, most low obliquity targets of practical interest consist of overmatching armor that is very difficult to perforate with ruptured shot. This difficulty must be overcome by some new "high-low" obliquity design made to combine the advantages of the truncated and conventional shapes and to eliminate the corresponding limitations. As reported in B.I.O.S. Final Report Number 1343, the Germans attempted to overcome this difficulty by using a truncated ogive provided with a cap and matching tip. It was hoped that this design would combine the advantages of the truncated ogive for angle attack and of the pointed ogive at normal attack, but the actual trial proved to be disappointing. Additional similar designs were contemplated but were never made.

At the present time, based upon 20mm scale model penetration tests conducted at Frankford Arsenal as a part of the "Long Range Armor Piercing Ammunition Development Program, Project TAL-5002", the most promising solution to this problem of developing an optimum "high-low" obliquity projectile design appears to be a projectile having a hard pointed overhanging tip attached to a hard truncated body. The T166 shot to be tested as outlined below would be made to incorporate these features. This new shot will be substantially different in design from all standard types of AP projectiles. Consequently, to provide an adequate evaluation of this unconventional design, fairly extensive tests will be required against homogeneous armor ranging from 2 inches to 5 inches in thickness, set at various obliquities from 0° to 70°. Results of these tests will be used as basis for the final design of the T166 shot, and also as a guide for adapting this new design to projectiles of other calibers.

10. Recommended Test Programs:

The following lots of projectiles are being prepared for tests:
(NE98V65 Steel - Heat Treatment: Martemper)

LOT NO.	SHOT TYPE	SHOT DESIGN	APPRX. SHOT WEIGHT (lb)	NO. OF SHOT	BALLISTIC TEST
1	Tipped T-128	Matching tip Cyclewelded on truncated T-128 ogive. W/WS	14.5	10	2 inch armor at 60° 3 inch armor at 55°
2	T166E2 (Modified T-128)	Overhanging tip Cyclewelded on truncated 1/2 caliber radius ogive. W/WS	14.4	20	2-1/2" armor at 60° 3 inch armor at 55° 3 inch armor at 60°
3	T166E3 (Modified T-128)	Skirted tip Cyclewelded on truncated 15° conical ogive. W/WS	15.6	10	3 inch armor at 55°
4	T166E4 (Modified T-128)	Skirted tip Cyclewelded on truncated 1/4 caliber radius ogive.	14.6	25	2-1/2" armor at 60° 2 inch armor at 60° 3 inch armor at 55° 3 inch armor at 60°
5**	T-166 Series (Modified) T-128	Skirted tip Cyclewelded on truncated ogive to be selected. W/WS	14.5	25	2-1/2" armor at 60° 2 inch armor at 60° 3 inch armor at 55° 3 inch armor at 60°
6	T166 Series (Modified) T-128	To be selected from above lots Tip will be brazed on shot body. W/WS	14.5	35	2-1/2" armor at 60° 2 inch armor at 60° 3 inch armor at 55° 3 inch armor at 60° 1/2 inch mild steel at 60° for tip detachment test

** This lot may possibly be omitted.

(cont'd) (NE98V65 Steel - Heat Treatment: Martemper)

<u>LOT NO.</u>	<u>SHOT TYPE</u>	<u>SHOT DESIGN</u>	<u>APPROX. SHOT WEIGHT (lb)</u>	<u>NO. OF SHOT</u>	<u>BALLISTIC TESTS</u>
7	T166 Series	To be selected from above lots	14.5	160*	2 inch armor at 70° 2 inch armor at 60° 2-1/2" armor at 60° 3 inch armor at 55° 3 inch armor at 60° 4 inch armor at 30° 5 inch armor at 0° 1/2 inch mild steel at 60° for tip detachment test. Charge discharge Determine security of tip, windshield, and band, as well as accuracy and time of flight to 1000 yards and 2000 yards.
8	T166 Series	Like Lot No. 7 with tip and windshield	14.5	300	200 shot to AFF Board No. 2 for Service Board Tests.

*35 of these shot will have no tips and windshields, and will weight less than 14.5 lb.

Lot No. 1

The ten shot for this lot will be made by modifying regular T128 shot bodies of NE98V65 (modified) steel. The nose section will be cut off at 2-5/8" diameter and a new matching tip will be made from NE98V65 (modified) steel bar. This tip will be hardened by martempering and cyclewelded to the hardened truncated T128 ogive shot body. These shot will be tested against homogeneous armor of approximately 300 BHN. The targets will be 2" plate at 60° obliquity and 3" plate at 55° obliquity.

Lot No. 2

These twenty shot will be made by modifying regular T128 shot bodies. The nose section will be cut off. The new nose shape of the shot body will be truncated and have a 1/2 caliber radius ogive. A new overhanging tip will be machined from NE98V65 (modified) steel hardened by martempering, and will be cyclewelded to the hardened shot body. These shot will be assembled with cyclewelded aluminum windshields and will be designated T166E2. They will be tested against homogeneous armor of approximately 300 BHN. The targets will be 2-1/2" plate and 3" plate at 60° obliquity and 3" plate at 55° obliquity.

Lot No. 3

The ten shot for this lot will be made by modifying regular T128 shot bodies by cutting off the nose section and reshaping the new nose to a truncated 15° conical ogive. New skirted tips will be machined from NE98V65 (modified) steel. Both these tips and the shot bodies will be hardened by a martempering heat treatment. The skirted tips will be cyclewelded to the shot bodies. These shot will be assembled with cyclewelded aluminum windshields and will be designated T166E3. They will be tested against 3" homogeneous armor of approximately 300 BHN, at 55° obliquity.

Lot No. 4

Twenty-five shot will be made for this lot by softening and modifying T128 shot bodies. The nose sections will be cut off the T128 bodies and new truncated noses having 1/4 caliber radius ogive will be reshaped on these bodies. New skirted tips will be machined from NE98V65 (modified) steel. The tips and the shot bodies will be hardened by martempering. The skirted tips will be cyclewelded to the shot bodies and aluminum windshields will be cyclewelded to the tips. These shot will be designated T166E4. They will be tested against homogeneous armor of approximately 300 BHN. The targets will be 2" plate, 2-1/2" plate and 3" plate at 60° obliquity and 3" plate at 55° obliquity.

Lot No. 5

This lot may be omitted provided the necessary results have been obtained with the previous lots. However, if further improvement is required, 25 shot will be made by softening and modifying regular T128 shot bodies. The nose sections will be cut off the T128 bodies and new truncated ogives, which will be selected at some later date, will be reshaped on these bodies. New skirted tips will be machined from NE98V65 (modified) steel bar. The tips and the shot bodies will be hardened by a martempering heat treatment. The skirted tips will be cyclewelded to the shot bodies and assembled with cyclewelded aluminum windshields. These shot will be tested against homogeneous armor of approximately 300 BHN. The targets will be 2" plate, 2-1/2" plate and 3" plate at 60° obliquity and 3" plate at 55° obliquity.

Lot No. 6

Thirty-five shot will be made for this lot by softening and modifying regular T128 shot bodies. The shape of the shot nose and tip will be selected from the above lots. The tips will be made from NE98V65 (modified) steel bar and will be brazed onto the shot bodies of this lot. After attachment, the tips and the

shot bodies will be heat treated as a unit by a waterquenching
in a treatment. After hardening, the shot will be assembled
with cyclowelded windshields. These shot will be used to
test the influence of the brazed joint upon penetration per-
formance and its ability to resist tip detachment by firing
against mild steel skirting plate. The targets will be 2"
plate, 2-1/2" plate and 3" plate at 60° obliquity, 3" plate
at 55° obliquity, and 1/2" mild steel skirting plate at 60°
obliquity.

Lot No. 7

Since the shot for this lot will be of the final design
with standard 76mm rotating bands, a larger group of 140 shot
will be required for more extensive testing. The shot bodies
for this lot will be made from NE98765 (modified) steel.
Thirty-five of these shot bodies without tips and windshields
will be fired against 2" plate and 2-1/2" plate to evaluate
the performance of the bodies. Tips will be either brazed or
cyclowelded to the remaining 125 of these bodies and suitable
windshields will be cyclowelded to the tips. They will be
tested against homogeneous armor of approximately 300 HV. The
targets will be as follows:

2 inch plate at 70° Obliquity
2-1/2" plate at 60° Obliquity
2 inch plate at 60° Obliquity
3 inch plate at 60° Obliquity
3 inch plate at 55° Obliquity
4 inch plate at 30° Obliquity
5 inch plate at 0° Obliquity
1/2 inch mild steel at 60°
obliquity for tip detachment
test.

In addition, the shot from this lot will be used for charge
determination, security of tip, windshield and band, and ac-
curacy and time of flight to 1000 yards and 2000 yards. Also
they will be fired at excess pressure to determine windshield,
tip and band security.

Lot No. 8

These 300 shot will be made from NE98765 (modified) steel
to the final design with the same designation as the shot of
Lot No. 7. These shot will be shipped by Frankford Arsenal to
Picatinny Arsenal where they will be loaded into complete
rounds. Two-hundred of these shot will be delivered to Army
Field Force, Board No. 2 for Service Board Tests.

11. General Considerations:

Rolled homogeneous armor plate of approximately 300 BHN will be used in these tests. Standard 3" Shot, AP, M79, will be fired at each target to compare with the experimental projectiles. Projectiles or fragments should be recovered for examination after penetration. All projectiles not used in the tests outlined above shall be held for possible modification or other firing. Advance information of scheduled firing tests is requested so that representatives of this Arsenal can arrange to be present.

The above test program may be modified at the discretion of the Proof Director at Aberdeen Proving Ground.

12. Reference:

Letter from Office, Chief of Ordnance to Frankford Arsenal,
26 September 1950, CO 471.13/23.

13. Coordination

Chief of Ordnance
Aberdeen Proving Ground
Watertown Arsenal
Picatinny Arsenal
Frankford Arsenal

W. B. BECKER
Col, Ord Corps
Commanding

APPENDIX B
FIRING RECORDS

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

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND
FIRING RECORD

OBJECT OF TEST: To Investigate the Armor
Penetrating Characteristics
of Shot, AP, 76 mm, T166
Series.

January 1951 -
DATE OF TEST December 1952
FIRING RECORD NO. P-53162
SHEET 1 OF 26
AUTHORITY: APG 471.1/175
OO 471.13/43
W.O.NO. 2023-145-0

DEVELOPMENT: ORDIA
PROJECT NO.: TAI-1942

dlr

M A T E R I E L

Gun, 75 mm, M3, No. B5244.
Tube, 75 mm, M3, No. 41891, Test rds. with suffix "A".
Carriage, Howitzer, 105 mm, M2A1, No. unknown.

Gun, 76 mm, M1A2, No. 9994.
Tube, 76 mm, M1A2E1, No. 18195, Test rds. 1-6, 9-36.
Carriage, 76 mm, T4E1, No. 2.

Gun, 76 mm, T91, No. 3.
Tube, 76 mm, T91, No. 24099, Test rds. 7-8.
Mount, 90 mm AA, M1A1, No. 639.

Gun, 76 mm, T91E3, No. 274.
Tube, 76 mm, T91E3, No. 24113, Test rds. 112-174, 185-209.
Mount, 90 mm AA, M2, No. 224.

Gun, 76 mm, T91, No. 3.
Tube, 76 mm, T91, No. 24116, Test rds. 37-96.
Mount, 90 mm AA, M1A1, No. 639.

Gun, 76 mm, T91, No. 2.
Tube, 76 mm, T91, No. 24111, Test rds. 97-111.
Mount, 90 mm AA, M1A1, No. 639.

Gun, 75 mm, T83E1, No. 7.
Tube, 75 mm, T83E1, No. 70299, Test rds. 175-184.
Mount, 90 mm AA, M1A1, No. 4302.

A M M U N I T I O N

Shot, AP, 75 mm, T148E1, Lot FAE-1028.
Shot, AP, 75 mm, T148. Supplied by FA, no lot.
Shot, AP, 75 mm, T148 (Mod). Supplied by FA, no lot.
Shot, AP, 75 mm, M72, Lot 216-23140-13.
Shot, AP, 3", M79.

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

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

FIRING RECORD NO. P-53162
SHEET 2 OF 26

Shot, AP, 76 mm, T166E2 and T166E2 (Mod).
Shot, AP, 76 mm, T166E3.
Shot, AP, 76 mm, T166E4.
Shot, AP, 76 mm, T166E5.
Shot, AP, 76 mm, T166E6.

Shot, AP, 76 mm, T128E6.
Shot, AP, 76 mm, T128E6 (Mod). Supplied by FA, no lot.

Propellant, MP, M6, Lot OKI-12490 w/web .0370".
Propellant, MP, M6, Lot OKI-12479 w/web .0377".
Propellant, MP, M17, Lot FXA-6758 w/web .043".
Propellant, MP, M6, Lot IAB-32495 w/web .0370".

Case, Cartridge, 75 mm, M18. Washed and resized stock lots.
Case, Cartridge, 76 mm, M26. Washed and resized stock lots.
Case, Cartridge, 76 mm, T19E1. Washed and resized stock lots.
Case, Cartridge, 75 mm, T6E3 (Mod. 76 mm, M26). Washed and resized stock lots.

Primer, Percussion, 150 grain, M31A2. Stock lots.
Primer, Percussion, 400 grain, T66. Stock lots.
Primer, Percussion, 270 grain, M40A1. Stock lots.

ARMOR PLATE

Thickness	2"	2"	2-1/2"	3"	3"
Plate No.	2-15	21399-2 21399-3	21399-1	19618-4	D-1
Hardness (BHN)	288	302-311	302-311	285-311	260-261
Charpy Value ft-lbs at -40°F	27	30	27-29	36-37	50-53
% C	No report	.28	.28	.27	.27
Mn		.42	.42	.41	1.47
Si		.22	.22	.20	.22
S		.034	.034	.028	.018
P		.024	.024	.020	.015
Mo		.25	.25	.28	.35
Cr		1.58	1.58	1.38	.68
Ni		3.00	3.00	3.10	.68
B					

FIRING RECORD NO. P-53162
SHEET 3 OF 26

Thickness	3"	2"	3"	1/4" (k)	2" (1)
	Plate No.	09778A1	0159875A 0159878A2	011795A2	None
Hardness (BHN)	293-297	291	302	No Report	270
Charpy Value ft-lbs at -40°F.	31	27.5	54-60	No Report	No Report
%C	.30	.28	No Report	No Report	No Report
Mn	1.48	1.48			
Si	.19	.25			
S	.002	.02			
P	.013	.01			
Mo	.42	.40			
Cr	.98	.94			
Ni	.87	.81			
B					

ARMOR PLATE

Russian Tank, T34, Medium. The hull of this tank was used as the target, and the upper front glacis plate fired on with various shot types. The armor is 1.8"/60°, hard homogeneous, with a BHN of approximately 500.

ROUND-BY-ROUND DATA

1. Firing tests against 2" rolled homogeneous armor at 60°.

- Shot types:
- A - Shot, AP, 75 mm, T148.
 - B - Shot, AP, 75 mm, T148 with tip to design T128E6 attached with plastic cement.
 - C - Modified Shot, AP, 76 mm, T128E6 (flat nosed) with tip to design T128E6 attached with plastic cement.
 - D - Shot, AP, 3", M79.
 - E - Shot, AP, 76 mm, T166E4
 - F - Shot, AP, 76 mm, T166E5
 - I - Shot, AP, 76 mm, T128E6
 - K - Shot, AP, 76 mm, T166E2 (Mod).
 - L - Shot, AP, 76 mm, T166E6

22

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

FIRING RECORD NO. P-53162
SHEET 4 OF 26

Armor Plates: A - Plate No. 2-15.
B - Plate No. 21399-3.
C - Plate No. 21399-2.
H - Plate No. 0159875A.
J - Plate No. 0159878A2.

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE
	TYPE	WT LBS	LOT	CHARGE OUNCES		
3	C	14.20	12490	40.0	1864	A
4	C	14.17	12490	36.0	1714	A
64	D	15.02	12479	55.0	2216	B
65	D	15.02	12479	52.0	2163	B
66	D	14.98	12479	50.0	2092	B
67	E	14.67	12479	50.0	2111	B
68	E	14.70	12479	50.0	2111	B
69	E	14.70	12479	52.0	2160	B
70	E	14.70	12479	58.0	2359	B
71	E	14.70	12479	55.0	2277	B
72	E	14.70	12479	51.0	2150	B
73	E	14.69	12479	48.0	2047	B
74	D	15.02	12479	51.0	2117	B
75	D	15.01	12479	52.0	2196	C
76	D	14.97	12479	52.0	2187	C
77	D	15.00	12479	52.0	2166	C
78	F	14.52	12479	52.0	2181	C
79	F	14.47	12479	48.0	2039	C
80	F	14.52	12479	46.0	1974	C
81	F	14.50	12479	43.0	1888	C
82	F	14.54	12479	44.0	1907	C
83	F	13.90	12479	47.0	2018	C
1A	A	13.33	6758	36.0	2182	A
2A	A	13.35	6758	38.6	2336	A
3A	B	14.14	9258	32.0	2153	A
4A	B	14.14	9258	28.0	1874	A
5A	B	14.12	9258	30.0	1941	A
6A	A	13.35	9258	28.0	1894	A
7A	A	13.37	9258	26.5	1815	A
128	I	14.52	32495	52.0	2130	H
129	I	14.55	32495	58.0	2280	H
130	I	14.54	32495	63.0	2462	H
131	I	14.50	32495	60.0	2444	H
132	I	14.52	32495	58.0	2354	H

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

FIRING RECORD NO. P-53162
SHEET 5 OF 26

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE
	TYPE	WT LBS	LOT	CHARGE OUNCES		
133	I	14.48	32495	64.0	2521	H
134	I	14.52	32495	61.0	2456	H
135	K	12.87	32495	45.0	2071	H
136	K	12.88	32495	37.0	1814	H
137	K	12.88	32495	40.0	1891	H
138	K	12.83	32495	43.0	1992	H
139	K	12.85	32495	41.5	1950	H
140	-L	14.19	32495	45.0	2006	H
141	L	14.18	32495	40.0	1877	H
142	L	14.20	32495	43.0	1943	H
143	L	14.18	32495	41.5	1899	H
144	L	14.12	32495	40.0	1858	H
145	L	14.16	32495	40.0	1854	H
146	L	14.19	32495	40.0	1869	H
147	K	12.86	32495	40	1648	J
148	K	12.84	32495	37	1770	J
149	K	12.86	32495	39	1840	J
150	K	12.87	32495	41	1887	J
151	L	14.20	32495	42	1874	J
152	L	14.18	32495	44	1921	J
153	L	14.22	32495	48	2046	J
154	I	14.44	32495	59	2366	J
155	I	14.46	32495	61	2424	J
156	L	14.17	32495	46	1990	J
157	L	14.19	32495	48	2035	J

TEST RD NO.	PENETRATION	REMARKS - All dimensions in inches
3	Complete	Front open 8 x 3-1/2, rear open 3 x 3. Shot rejected intact, w/o tip.
4	Complete	Front open 7 x 3-1/2, balance as test rd. 3.
64	Disregarded	Struck top edge of plate.
65	Complete	Front open 8 x 4, rear open 2 x 2-1/2. Shot rejected broken.
66	Partial	Front open 8-1/4 x 3-1/2. Medium bulge, rear. Shot rejected broken.
67	Disregarded	Struck top edge of plate.
68	Partial	Front open 9 x 3-1/4. Very large, cracked bulge in rear. Shot rejected intact, cracked.
69	Complete	Front open 8 x 3-1/4, rear open 3 x 3.

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

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

FIRING RECORD NO. P-53162
SHEET 6 OF 26

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
70	Disregarded	Struck previous impact.
71	Complete	Front open $8\text{-}\frac{3}{4}$ x $3\text{-}\frac{1}{4}$, rear open 6 x $4\text{-}\frac{5}{8}$. Shot passed through plate.
72	Complete	Front open, 8 x $3\text{-}\frac{1}{4}$, rear open 5 x $2\text{-}\frac{5}{8}$. Shot rejected broken.
73	Complete	Front open $7\text{-}\frac{3}{4}$ x $3\text{-}\frac{1}{2}$, rear open $3\text{-}\frac{1}{2}$ x 4 . Shot rejected intact.
74	Partial	Front open $6\text{-}\frac{1}{2}$ x $3\text{-}\frac{1}{4}$. Medium bulge w/cracking in rear. Shot rejected broken.
75	Complete	Front open 7 x 3 , rear open $2\text{-}\frac{1}{2}$ x $1\text{-}\frac{1}{2}$.
76	Partial	Front open 7 x 3 , very large bulge with punching started, rear.
77	Partial	Front open 7 x 3 , very large bulge w/ 5 " horizontal crack, rear.
78	Complete	Front open 9 x $3\text{-}\frac{1}{2}$, rear open 6 x 4 . Shot rejected broken.
79	Complete	Front open 6 x $3\text{-}\frac{1}{2}$, rear open 4 x $2\text{-}\frac{1}{2}$. Shot rejected broken.
80	Complete	Front open 7 x $3\text{-}\frac{1}{2}$, rear open 4 x 3 . Shot rejected broken.
81	Partial	Front open $9\text{-}\frac{1}{2}$ x 3 . Medium bulge, rear.
82	Partial	Front open $8\text{-}\frac{1}{2}$ x 3 . Very large bulge w/fine cracking, rear.
83	Complete	Front open 8 x $3\text{-}\frac{1}{2}$, rear open 4 x 2 .
1A	Complete	Front open 7 x $3\text{-}\frac{1}{2}$, rear open $2\text{-}\frac{1}{2}$ x 2 . Nose and body broken, base rejected intact.
2A	Complete	Front open $7\text{-}\frac{1}{2}$ x $3\text{-}\frac{3}{4}$, rear open $3\text{-}\frac{1}{2}$ x $4\text{-}\frac{1}{2}$. Shot passed through plate.
3A	Complete	Front open $6\text{-}\frac{1}{4}$ x $3\text{-}\frac{1}{2}$, rear open 3 x 4 .
4A	Partial	Front open $9\text{-}\frac{1}{2}$ x $3\text{-}\frac{1}{4}$. Very large bulge, cracked. Shot rejected intact.
5A	Complete	Front open $8\text{-}\frac{1}{2}$ x $3\text{-}\frac{1}{2}$, rear open 5 x 3 . Shot rejected intact w/o tip. Vertical crack in nose.
6A	Complete	Front open 8 x $3\text{-}\frac{1}{2}$, rear open 4 x 3 . Shot rejected intact.
7A	Partial	Front open 8 x 3 . Very large bulge, cracked. Army complete Penetration. Shot rejected intact.
128	Partial	Front open 8 x $3\text{-}\frac{1}{4}$. Medium bulge, rear. Smooth scoop, shot rejected intact.
129	Partial	Front open 8 x $3\text{-}\frac{1}{2}$. Large bulge, rear. Smooth scoop, shot rejected intact.
130	Complete	Front open 8 x $3\text{-}\frac{1}{2}$, rear open 5 x 3 . Shot broken.
131	Partial	Front open 8 x 3 . Medium bulge, rear. Smooth scoop.
132	Partial	Front open $8\text{-}\frac{1}{2}$ x 3 . As test rd. 131.

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

FIRING RECORD NO. P-53162
SHEET 7 OF 26

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
133	Complete	Front open 7x3, rear open 6x5 (with slight spall over 9").
134	Partial	Front open 8 x 3-1/4. As test rd. 131.
135	Complete	Front open 8 x 4, rear 5 x 3. Shot rejected broken.
136	Partial	Front open 8-1/2 x 3-1/2. Medium bulge rear. Shot rejected intact except for chips.
137	Partial	Front open 9-1/2 x 3-1/4. Medium bulge, rear. Smooth scoop on face. Shot rejected intact except for shearing chips off the nose.
138	Complete	Front open 9 x 4, rear open 6 x 4.
139	Complete	Front open 9 x 3-1/2, rear open 5-3/4 x 4-1/4.
140	Complete	Front open 10 x 3-1/2, rear open 7-1/2 x 4-1/2. Shot rejected broken in two pieces. A clean break at the band seat.
141	Partial	Front open 9 x 3-1/2. Medium bulge, rear. Smooth scoop on face.
142	Complete	Front open 10 x 3-1/2, rear open 5 x 3 w/o spall, 6-3/4 x 9 w/spall. Clean break at the band seat.
143	Complete	Front open 10 x 4, rear open 3 x 6 w/o spall, 6-1/2 x 8-3/4 w/spall. Clean break at the band seat.
144	Complete	Front open 9 x 3, rear open 3x6 w/o spall, 7x12 w/spall. Clean break at band seat.
145	Complete	Front open 9 x 3-1/2, rear open 3 x 5 w/o spall, 5-1/4 x 6 w/spall.
146	Complete	Front open 9 x 3-1/2, rear open 4 x 5 w/o spall, 6x6 w/spall.
147	Disregard	Armor spalled on the rear face. A complete penetration. Shot rejected broken.
148	Partial	Front open 8 x 3-1/2. Large bulge, rear, with fine cracking. Smooth scoop on face. Shot broken.
149	Partial	Front open 4 x 6. Punching 1/2" out of rear. Shot broken.
150	Partial	Front open 4 x 8. Punching 1" out of rear. Shot broken.
151	Partial	Front open 4 x 9. As 148.
152	Partial	Front open 3-1/2 x 9. As 148.
153	Disregard	As 147.
154	Partial	Front open 3 x 10. As 148.
155	Partial	Front open 3-1/4 x 10. As 148.
156	Partial	Front open 4 x 9. As 148.
157	Disregard	As 147.

2. Firing tests against 2-1/2" rolled homogeneous armor at 60°.

Shot types: D - Shot, AP, 3", M79.
E - Shot, AP, 76 mm, T166E4.
F - Shot, AP, 76 mm, T166E5.
G - Shot, AP, 76 mm, T166E2.

Armor Plates: D - Plate No. 21399-1.

96

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

FIRING RECORD NO. P-53162
SHEET 8 OF 26

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMC ^m PLATE	WIND FCC."
	TYPE	WT LB	LOT	CHARGE OUNCES			
26	D	15.02	12490	55.0	2342	D	
27	D	15.12	12490	57.0	2423	D	
28	D	15.00	12490	60.0	2536	D	
29	D	14.98	12490	59.0	2499	D	
30	D	14.99	12490	59.0	2498	D	
31	G	14.40	12490	55.0	2328	D	.010
32	G	14.40	12490	58.0	2351	D	.028
33	D	15.05	12490	60.0	2506	D	
34	G	14.42	12490	62.0	2492	D	.015
35	G	14.41	12490	65.0	2617	D	.012
36	G	14.40	12490	68.0	2927	D	.018
37	E	14.88	12479	70.0	Lost	D	.028
38	E	14.88	12479	76.0	2900	D	.015
39	E	14.89	12479	73.0	2807	D	.036
40	E	14.84	12479	73.0	2800	D	.028
41	E	14.87	12479	72.0	2769	D	.033
42	E	14.96	12479	74.0	2824	D	.014
43	E	14.91	12479	74.0	2823	D	.009
44	E	14.92	12479	72.0	2762	D	.006
45	E	14.88	12479	69.0	2677	D	.008
46	G	14.42	12479	70.0	2737	D	.029
47	G	14.40	12479	66.0	2618	D	.038
48	E	14.92	12479	66.0	2557	D	.049
49	E	14.89	12479	68.0	2616	D	.010
50	G	14.42	12479	68.0	2644	D	.048
51	D	14.98	12479	66.0	2528	D	
60	E	14.90	12479	66.0	Lost	D	.007
61	E	14.69	12479	66.0	2569	D	.018
62	E	14.74	12479	62.0	2472	D	.018
84	F	14.45	12479	62.0	2495	D	
85	F	14.52	12479	64.0	2574	D	
86	F	14.53	12479	64.0	2554	D	
87	F	14.49	12479	66.0	2610	D	
88	F	14.46	12479	68.0	2648	D	
89	F	13.90	12479	68.0	2637	D	

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

FIRING RECORD NO. P-53162
SHEET 9 OF 26

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
26	Partial	Front open 3-1/2 x 6. Punching started on a cracked bulge. Smooth scoop on face.
27	Partial	Front open 3-1/2 x 6. Punching started on a cracked bulge. Evidence of shot breakage.
28	Complete	Front open 4 x 6, rear open 3 x 4. Shot rejected broken.
29	Disregarded	Struck previous impact.
30	Partial	Front open 4 x 7. Punching out 1".
31	Partial	Front open 4 x 10. Medium bulge, rear. Smooth scoop on face.
32	Partial	Front open 4 x 10. Medium bulge w/very fine cracking, rear. Smooth scoop on face.
33	Complete	Front open 4 x 6, rear open 2-1/2 x 1. Shot rejected broken.
34	Partial	Front open 3-1/2 x 10-1/2. Very large bulge w/fine cracking, rear. Shot rejected intact.
35	Partial	Front open 4 x 11. Very large bulge w/circular crack 12" diameter. Shot intact.
36	Complete	Front open 4 x 9, rear open 4-1/2 x 2-1/2 w/o spall, 5 x 8 w/spall. Shot broken, base rejected.
37	Partial	Front open 3 x 10. Very large bulge with fine cracking, rear.
38	Complete	Front open 4-1/2 x 9-1/2, rear open 3 x 5.
39	Disregarded	Struck previous impact.
40	Complete	Front open 4 x 11, rear open 3 x 4-1/2.
41	Disregarded	Struck near previous impact.
42	Disregarded	Struck previous impact.
43	Complete	Front open 4 x 10, rear open 4 x 5.
44	Complete	Front open 4 x 8, rear open 3 x 4.
45	Complete	Front open 4 x 10-1/2, rear open 3 x 5.
46	Complete	Front open 4 x 10-1/2, rear open 3 x 4.
47	Partial	Front open 4 x 10-1/2, very large bulge, cracked.
48	Partial	Front open 4 x 10-1/2. As test rd. 47.
49	Complete	Front open 4 x 10, rear open 3 x 4-1/2.
50	Complete	Front open 4-1/2 x 10, rear open 3 x 2.
51	Complete	Front open 4 x 6, rear open 3 x 2.
60	Disregarded	Armor placed at wrong angle.
61	Complete	Front open 4 x 9, rear 4-1/2 x 8. Shot rejected intact.
62	Partial	Front open 4 x 10, very large, cracked bulge in rear. Shot rejected broken.
84	Partial	Front open 4-1/2 x 7. Very large, cracked bulge.
85	Partial	Front open 4 x 7-1/2, rear 1/2 x 4. Punching almost off. Shot rejected broken.
86	Partial	Front open 4 x 7. Punching started. Shot rejected broken.

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

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

FIRING RECORD NO. P-53162
SHEET 10 OF 26

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
87	Complete	Front open 4 x 7, rear 3 x 4. Shot rejected broken.
88	Complete	Front open 4 x 8, rear 3 - 1/2 x 4 - 1/2. Shot rejected broken.
89	Partial	Front open 4 - 1/2 x 6. Large bulge, rear. Rotating band functioned properly.

3. Firing tests against 3" rolled homogeneous armor at 30°.

Shot types: B - Shot, AP, 75 mm, T1148 with tip to design T128E6 attached with plastic cement.

H - Shot, AP, 75 mm, M72

I - Shot, AP, 76 mm, T128E6

Armor Plate: E - Plate No. 19618-4

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE
	TYPE	WT LB	LOT	CHARGE OUNCES		
5	I	14.21	12190	38.0	1760	E
6	I	14.16	12190	46.0	1974	E
8A	B	14.08	6758	37.0	2229	E
9A	B	14.10	6758	33.0	2009	E
10A	B	14.11	6758	30.0	1859	E
11A	B	14.10	6758	27.0	1722	E
12A	B	14.08	6758	28.5	1795	E
13A	H	13.88	6758	33.0	2026	E
14A	H	13.90	6758	36.0	2157	E
15A	H	13.96	6758	34.0	2106	E
16A	B	14.08	6758	28.5	1787	E
17A	H	13.94	6758	31.0	1950	E
18A	B	14.08	6758	30.0	1842	E
19A	H	13.88	6758	33.0	2065	E
20A	H	13.90	6758	32.0	2005	E

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

FIRING RECORD NO. P-53162
SHEET 11 OF 26

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
5	Partial	Front open 5 x 4. Very slight bulge. Shot broken and rejected.
6	Partial	Front open 5 x 5. Slight bulge. Shot broken and rejected.
8A	Complete	Front open 4-1/2 x 4, rear 3-1/2 x 3-1/2. Evidence of shot through plate, intact.
9A	Complete	Front open 5 x 7, rear 2-1/2 x 3. Shot broken and rejected.
10A	Complete	Front open 6-1/2 x 4, rear 3 x 2. As rd. 9A.
11A	Partial	Front open 7 x 4-1/2, large bulge, rear. Shot rejected with chip out of nose.
12A	Partial	Front open 7 x 4. Large bulge with fine cracking, rear. Shot rejected with nose chipped.
13A	Partial	Front open 4-1/2 x 4-1/2. Medium bulge, rear. Shot rejected broken
14A	Complete	Front open 4-1/2 x 4-1/2, rear 3 x 3-1/2. Shot broken, passed through plate.
15A	Complete	Front open 4-1/2 x 4-1/2, rear 3 x 3.
16A	Partial	Front open 7 x 4-1/2. Large bulge, rear.
17A	Partial	Front open 4 x 4-1/2. Medium bulge, rear.
18A	Partial	Front open 7 x 3-1/2. Large bulge with fine cracking. Shot rejected intact.
19A	Partial	Front open 4 x 5. Medium bulge, rear. Shot rejected broken.
20A	Partial	Front open 4-1/2 x 4-1/2. As test rd. 19A.

4. Firing tests against 3" rolled homogeneous armor at 55°.

- Shot types:
- D - Shot, AP, 3", M79.
 - C - Shot, AP, 76 mm, T128E6 (Modified, flat nose) with tip to design T128E6 attached with plastic cement.
 - E - Shot, AP, 76 mm, T166E1
 - F - Shot, AP, 76 mm, T166E5
 - G - Shot, AP, 76 mm, T166E2
 - J - Shot, AP, 76 mm, T166E3
 - I - Shot, AP, 76 mm, T128E6
 - K - Shot, AP, 76 mm, T166E2 (Mod)
 - L - Shot, AP, 76 mm, T166E6

- Armor Plate:
- E - Plate No. 19618-4.
 - F - Plate No. "Demo. No. 1".
 - I - Plate No. 011795A2.

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

27

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

FIRING RECORD NO. P-53162
SHEET 12 OF 26

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE	WIND ECC. °
	TYPE	WT LB	LOT	CHARGE OUNCES			
1	C	14.14	12490	60.0	2479	E	
2	C	14.18	12490	68.0	2640	E	
7	C	14.20	12490	76.0	2868	E	
8	C	14.20	12490	73.0	2822	E	
9	G	14.40	12490	62.0	2500	F	.028
10	G	14.41	12490	68.0	2688	F	.010
11	G	14.41	12490	65.0	2594	F	.035
12	G	14.40	12490	63.5	2545	F	.015
13	G	14.45	12490	64.5	2577	F	.005
14	D	15.03	12490	65.0	2716	F	
15	D	15.04	12490	68.0	2894	F	
16	J	15.63	12490	55.0	2300	F	.015
17	J	15.61	12490	60.0	2484	F	.024
18	J	15.64	12490	60.0	2503	F	.043
19	J	15.62	12490	62.0	2522	F	.032
20	J	15.66	12490	63.0	2586	F	.047
21	J	15.66	12490	63.0	2575	F	.040
22	J	15.64	12490	61.5	2529	F	.030
54	G	14.42	12479	79.0	2973	F	.040
55	G	14.40	12479	74.0	2819	F	.010
56	E	14.90	12479	66.0	2556	F	.012
57	D	14.89	12479	78.0	2858	F	
58	E	14.89	12479	70.0	2680	F	.013
59	E	14.92	12479	68.0	2617	F	.011
63	E	14.73	12479	71.0	2788	E	.031
90	F	14.51	12479	70.0	2721	E	
91	F	14.50	12479	70.0	2713	E	
92	F	14.50	12479	66.0	2601	E	
93	F	14.53	12479	62.0	2497	E	
94	F	14.47	12479	64.0	2563	E	
95	F	14.44	12479	63.0	2535	E	
96	F	13.91	12479	65.0	2590	E	
112	I	14.48	32495	65.0	2402	I	
113	I	14.52	32495	70.0	2567	I	
114	K	12.89	32495	70.0	2645	I	
115	K	12.90	32495	75.0	2756	I	
116	I	14.50	32495	70.0	2572	I	
117	K	12.88	32495	80.0	2909	I	
118	I	14.48	32495	68.0	2527	I	
119	K	12.90	32495	80.0	2902	I	
120	I	14.54	32495	66.0	2472	I	
121	K	12.88	32495	81.0	2928	I	

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

FIRING RECORD NO. P-53162
SHEET 13 OF 26

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE
	TYPE	WT LB	LOT	CHARGE OUNCES		
122	K	12.90	32495	77.5	2825	I
123	L	14.19	32495	70.0	2587	I
124	L	14.18	32495	65.0	2462	I
125	L	14.19	32495	70.0	2569	I
126	L	14.12	32495	67.0	2499	I
127	L	14.14	32495	69.0	2566	I
168	K	12.83	32495	62	2530	I
169	K	12.82	32495	58	2412	I
170	K	12.81	32495	54	2297	I

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
1	Partial	Front open 6-1/2 x 4-1/2. Medium bulge in rear. Shot broken and rejected.
2	Partial	Front open 6 x 5-1/2. Medium bulge in rear. Bulge not as abrupt as on test rd. 1.
7	Complete	Front open 5-1/2 x 7-1/2, rear 3 x 4. Shot broken and rejected.
8	Partial	Front open 5-1/2 x 8. Very large bulge with 300° cracking and punching started.
9	Partial	Front open 4 x 9. Very large bulge with punching started, rear. Shot rejected intact with crack in the nose.
10	Complete	Front open 4 x 9, rear 3 x 4. Smooth hole.
11	Complete	Front open 4 x 8, rear 2 x 2.
12	Partial	Front open 4 x 9. Very large bulge with five cracking. Shot rejected intact.
13	Partial	Front open 4-1/2 x 9. As test rd. 12.
14	Partial	Front open 5 x 7. Medium bulge, rear.
15	Partial	Front open 4-1/2 x 7-1/2. Large bulge, rear.
16	Disregarded	Struck bottom edge of plate.
17	Disregarded	As rd. 16.
18	Partial	Front open 4 x 7. Punching 1" out of rear face of plate. Nose tip broken in plate.
19	Disregarded	Double hit on plate, evidence of tip separation.
20	Disregarded	As rd. 19.

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

22

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

FIRING RECORD NO. P-53162
SHEET 14 OF 26

<u>TEST RD NO.</u>	<u>PENETRATION</u>	<u>REMARKS - ALL DIMENSIONS IN INCHES</u>
21	Complete	Front open 4 x 7, rear 2-1/2 x 4. Evidence of shot breaking.
22	Partial	Front open 4 x 9. Large bulge with fine cracking.
54	Complete	Front open 4 x 7, rear 4 x 6.
55	Complete	Front open 5 x 8, rear 4 x 4.
56	Partial	Front open 3-1/2 x 8, very large bulge with fine cracking. Shot rejected intact.
57	Partial	Front open 4 x 7-1/2, Very large, cracked bulge.
58	Complete	Front open 4 x 9, rear 4 x 4.
59	Partial	Front open 3-1/2 x 9. As rd. 56.
63	Complete	Front open 4 x 8, rear 4 x 4-1/2. Shot broken.
90	Disregarded	Wrong armor plate used.
91	Complete	Front open 4-1/2 x 7-1/2, rear 2 x 3.
92	Complete	As rd. 91. Shot rejected broken.
93	Partial	Front open 5 x 8-1/2. Large bulge with very fine cracking, rear. Shot broken.
94	Complete	Front open 4-1/2 x 7, rear 2-1/2 x 3. Shot broken.
95	Partial	Front open 4-1/2 x 9. Large bulge with very fine cracking. Shot rejected broken.
96	Partial	Front open 4-1/2 x 7. Punching started on large bulge.
112	Partial	Front open 6 x 4. Medium bulge in rear. Shot rejected broken.
113	Complete	Front open 6 x 4-1/2, rear 2-1/2 x 2-3/4. Shot broken.
114	Partial	Front open 5 x 4-1/4. Slight bulge, rear. Shot broken.
115	Partial	Front open 5 x 4. Medium bulge, rear. Shot broken.
116	Complete	Front open 6 x 4-1/2, rear 2-1/2 x 2-1/2. Shot broken.
117	Partial	Front open 6-1/2 x 4-1/2. Hinged spall, 300°, out 1".
118	Complete	Front open 5-1/2 x 4, rear 4 x 5.
119	Complete	Front open 4-1/2 x 6-1/4, rear 4 x 4.
120	Partial	Front open 4-1/2 x 6. Medium bulge, rear.
121	Partial	Front open 4-1/2 x 6. Large bulge with 1" circular crack.
122	Partial	Front open 4-1/2 x 6. Punching 1" out.
123	Complete	Front open 5 x 8, rear 5 x 7 w/spall.
124	Partial	Front open 4-1/2 x 6-1/2. Medium bulge, rear.
125	Complete	Front open 4-1/2 x 7, rear 2-1/2 x 5-1/4.
126	Partial	Front open 5 x 6-3/4. Large bulge with fine cracking.
127	Partial	Front open 5 x 6-1/2. As rd. 117.
168	Partial	Front open 4 x 5, small bulge. Shot broken.
169	Partial	Front open 4 x 6, small bulge. Shot broken.
170	Partial	Front open 4 x 6, small bulge. Shot broken.

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

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

FIRING RECORD NO. P-53162
SHEET 15 OF 26

5. Firing tests against 3 rolled homogeneous armor at 60°.

Shot types: D - Shot, AP, 3", M79
E - Shot, AP, 76 mm, T166E4
F - Shot, AP, 76 mm, T166E5
G - Shot, AP, 76 mm, T166E2

Armor Plate: F - Plate No. "Demo. No. 1".
G - Plate No. 09778A1.

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE	WIND SEC."
	TYPE	WT LBS	LOT	CHARGE OUNCES			
23	G	14.41	12490	68.0	2852	F	.023
24	G	14.39	12490	64.0	2556	F	.015
25	G	14.41	12490	66.0	2722	F	.022
52	G	14.39	12479	79.0	2977	F	.025
53	E	14.88	12479	78.0	2916	F	.024
97	F	14.55	12479	76.0	2861	G	
98	F	14.49	12479	79.0	2926	G	
99	F	14.52	12479	77.5	2611	G	
100	F	14.46	12479	79.0	2928	G	
101	F	14.50	12479	77.5	2898	G	
102	D	15.00	12479	75.0	2839	G	
103	D	15.00	12479	76.0	2836	G	
104	D	15.00	12479	73.0	2750	G	
105	D	15.00	12479	75.0	2780	G	
106	F	14.45	12479	60.0	2392	G	
107	F	14.45	12479	54.0	2203	G	
108	F	14.47	12479	50.0	2078	G	

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

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

FIRING RECORD NO. P-53162
SHEET 16 OF 26

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
23	Partial	Front open 4-1/2 x 9. Large bulge with fine cracking. Shot rejected broken.
24	Partial	Front open 4-1/2 x 11. As rd. 23 except shot intact.
25	Partial	Front open 4 x 10. As rd. 24.
52	Partial	Front open 5 x 9-1/2. Very large bulge.
53	Partial	Front open 4-1/2 x 8. Very large bulge.
97	Partial	Front open 5 x 8. Large bulge. Shot broken.
98	Complete	Front open 4-1/2 x 7, rear 3 x 3. Shot broken.
99	Partial	Front open 5 x 8. Slight bulge. Shot broken.
100	Complete	Front open 5 x 8, rear 4 x 5. Shot broken.
101	Complete	Front open 4-1/2 x 7, rear 3 x 3. Shot broken.
102	Partial	Front open 5 x 7. Punching out 1-1/2".
103	Complete	Front open 5 x 6-1/2, rear 3 x 3. Shot broken.
104	Partial	Front open 3-1/2 x 5-1/2. Medium bulge. Shot broken.
105	Partial	Front open 4 x 6-1/4. Large bulge. Shot broken.
106	Partial	Front open 4-1/2 x 7. Slight bulge. Shot broken.
107	Partial	Front open 4 x 6-1/2. Slight bulge. Shot broken.
108	Partial	Front open 3-1/2 x 9. Very slight bulge. Shot broken.

6. Firing tests against 3" rolled homogeneous armor at 0°.

Shot types: I - Shot, AP, 76 mm, T128E6,

Armor Plate: G - Plate No. G9778A1.

TEST RD NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE
	TYPE	WT LB	LOT	OUNCE		
109	I	13.61	12479	80.0	2946	G
110	I	13.60	12479	75.0	2811	G
111	I	13.60	12479	68.0	2637	G

TEST RD NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
109	Disregarded	Shot tumbled in flight. This shot had a plastic band.
110	Disregarded	As rd. 109.
111	Disregarded	As rd. 109.

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

FIRING RECORD NO. P-53162
SHEET 17 OF 26

7. Firing Tests against 2" rolled homogeneous armor at 70°.

Shot types: K - Shot, AP, 76 mm, T166E2 (Modified).

Armor Plate: J - Plate No. 0159878A2

TEST NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	ARMOR PLATE
	TYPE	WT LB	LOT	CHARGE OUNCES		
163	K	12.85	32195	60	2433	J
164	K	12.83	32195	65	2617	J
165	K	12.83	32195	62.5	2555	J
166	K	12.82	32195	75	2903	J
167	K	12.86	32195	55	2315	J

TEST NO.	PENETRATION	REMARKS - ALL DIMENSIONS IN INCHES
163	Partial	Front opening 3-1/4 x 10. Slight bulge on rear face of plate. Shot broken.
164	Partial	Front opening 3 x 6. As 163.
165	Partial	Front opening 3-1/2 x 11. As 163.
166	Partial	Front opening 3 x 7-1/2. Medium bulge on rear face of plate. Shot broken.
167	Partial	Front opening 3 x 8. As 163.

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

FIRING RECORD NO. P-53162
SHEET 18 OF 28

8. Firing tests against Russian, T34 hull. Impacts on upper front glacis plate (1.8°/60°).

TEST NO.	SHOT		PROPELLANT		STRIKING VELOCITY fps	PENETRATION
	TYPE	WT LB	LOT	CHARGE GRAMS		
158	T166R2	14.14	32495	46	1989	Complete
159	T128R6	14.46	32495	60	2393	Complete
160	T128R6	14.44	32495	56	2273	Partial
161	T128R6	14.48	32495	56	2277	Complete
162	T166R2	14.14	32495	44	1940	Complete
171	T128R6	14.52	32495	46	1976	Partial
172	T128R6	14.90	32495	51	2141	Complete
173	T128R6	14.53	32495	44	1913	Partial
174	T128R6	14.50	32495	45.5	1953	Partial
175	T166R2	14.19	32495	40	1802	Complete
176	T166R2	14.16	32495	34	1654	Partial
177	T166R2	14.14	32495	36	1722	Complete
178	T148R1	12.92	32495	33	1730	Disregard
179	T148R1	12.95	32495	33	1734	Complete
180	T148R1	12.99	32495	30	1618	Partial
181	T148R1	12.97	32495	32	1694	Partial
182	T148R1	12.91	32495	34	1771	Disregard
183	T148R1	12.95	32495	34	1787	Partial
184	T148R1	12.98	32495	34	1776	Partial

TEST NO.

REMARKS - ALL DIMENSIONS IN INCHES

158	Front open 4 x 8. Rear open 8 x 8 w/spall.
159	Front open 4 x 10. Rear open 8 x 12 w/spall.
160	Front open 3 x 5. Shot struck the splash bar below the hatch cover.
161	Front open 3-1/2 x 9. Rear open 8 x 8 w/spall.
162	Front open 3-1/2 x 5. Rear open 2 x 2, no spall.
171	Front open 3 x 7. Shot struck bottom edge of plate, at junction of glacis.
172	Front open 4 x 6. Rear open 3 x 4, no spall. Shot struck bottom edge (as rd 1) and tore out plate.
173	Front open 3 x 6. As rd. 160.
174	Front open 3 x 8. Shot broken on plate.
175	Front open 3 x 7. Rear open 8 x 10 w/spall
176	Front open 3 x 7. Small bulge, cracked, rear.
177	Front open 3 x 9. Rear open 6 x 9 w/spall
178	Shot struck turret ring, over the glacis.
179	Front open 4 x 8. Rear open 6 x 8 w/spall.
180	Front open 3 x 8, a smooth scoop. No bulge in rear.
181	Front open 3 x 8.
182	Shot struck top edge of bottom glacis.
183	Front open 3 x 9, smooth scoop. Impact over right sprocket.

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

FIRING RECORD NO. P-53162
SHEET 19 OF 26

After firing the various shot at the hull, the following general results were noted:

- a. The machine gun bulge was knocked off due to loosening of the weld. A crack had developed on the glacis plate extending from the complete penetrations of test rds. 177 and 179, to the machine gun opening.
- b. Weldments around the recovery hooks cracked.
- c. Weldments around the hatch cover cracked.
- d. The weldment attaching the top glacis plate to the rest of the hull had been cracked along the left side and about half way across the bottom.

9. Firing tests against spaced armor.

Armor arrangements:

1. Plate, $1/4$ " thick, mounted at 60° (K).
2. Plate, $1/4$ " thick, mounted parallel to and 8" in front of 2" plate at 60° , plates K and L.
3. Plate, 2" thick, mounted at 60° (L).

Shot types: G - Shot, AP, 76 mm, T166E2.
I - Shot, AP, 76 mm, T126E6.
L - Shot, AP, 76 mm, T166E6.

Armor Plates: K - $1/4$ " Plate, unnumbered.
L - 2" Plate, unnumbered.

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

CONFIDENTIAL

FIRING RECORD NO. P-53162
SHEET 20 OF 26

TEST RD NO.	SHOT		PROP CHG OZS	STRIKING VELOCITY fps	ARMOR		REMARKS
	TYPE	WT LB			PLATE	ARRANGE	
185	G	14.50	70	2609	K	1	
186	L	14.54	70	2615	K	1	
187	G	14.52	70	2625	K	1	
188	L	14.43	70	2642	K	1	w/o windshield
189	G	14.20	70	2637	K	1	w/o windshield
190	L	14.55	60	2396	K	1	
191	G	14.50	60	2349	K	1	
192	I	14.54	60	2368	K	1	
193	I	14.54	70	2640	K	1	
194	G	14.51	45	1776	L	3	No pin in tip
195	G	14.56	50	2034	L	3	No pin in tip
196	G	14.51	53	2122	L	3	
197	I	14.56	68	2630	L	3	
198	G	14.51	60	2357	K/L	2	
199	G	14.54	53	2144	K/L	2	
200	G	14.51	56	2238	K/L	2	
201	G	14.52	58	2303	K/L	2	
202	G	14.52	62	2395	K/L	2	
203	I	14.54	70	2696	K/L	2	
204	I	14.48	65	2572	K/L	2	
205	I	14.56	67	2626	K/L	2	
206	L	14.52	58	2270	K/L	2	
207	L	14.56	61	2386	K/L	2	
208	I	14.54	64	2464	L	3	
209	G	14.52	51	2084	L	3	

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

FIRING RECORD NO. P-53162
SHEET 21 OF 26

TEST
RD
NO.

PENETRATION

REMARKS - ALL DIMENSIONS IN INCHES

185	-	Witness Plate:	Three holes, one a double hit, keyholed, 3 diameter and 5 long. Shot struck top edge of plate support and results disregarded.
186	-	Witness Plate:	Three holes. One a keyholed impact with 3 diameter and 5 length. Second circular 2-1/2 diameter. Third a semicircle.
		Camera:	Three pieces of shot. Tip off and body broken at leading edge of rotating band. Shot pieces not tipped.
187	-	Witness Plate:	Two holes. One a keyholed impact with 3 diameter and 4-3/4 length. Second hole about 18 below first circular with 2-1/2 diameter.
		Camera:	As round 186.
188	-	Witness Plate:	One hole, a keyholed impact with 3 diameter and 4 length.
		Camera:	Two pieces. Body broken at leading edge of rotating band. Shot pieces not tipped.
189	-	Witness Plate:	Two holes, both circular, 9-1/2 apart, diameters 3 and 2-1/2.
		Camera:	As round 186. Smear camera did not function properly. Observations made from inspection of the ultra-speed film, which is not as definitive.
190	-	Witness Plate:	Single hole, irregular shape, 9 long, 3 wide.
		Camera:	Three pieces. Tip off, body broken at leading edge of rotating band. Body fragments tipped in horizontal plane.
191	-	Witness Plate:	Two holes, one a keyholed impact with 3 diameter and 5 length. The second hole was circular 2-1/2 diameter.
		Camera:	As round 186.
192	-	Witness Plate:	Single hole 4 long. Indications of either yaw or a double, keyholed impact. If yaw, estimate is 45°.

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

FIRING RECORD NO. P-53162
SHEET 22 OF 26

<u>TEST RD NO.</u>	<u>PENETRATION</u>	<u>REMARKS - ALL DIMENSIONS IN INCHES</u>
193	-	Witness Plate: As round 192. Camera: As round 192.
194	Partial	Front open 3-1/2 x 9. Medium bulge on rear of plate. Tip off and shot body broken at leading edge of the rotating band.
195	Partial	Front open 3 x 9. Hinged spall (300°) out 1". Shot broken as in round 194.
196	Complete	Front open 3 x 9, rear open 3 x 6. Shot body rejected intact with crack in nose.
197	Complete	Front open 3 x 9-1/2, rear open 3 x 4. Shot broken, base in plate.
198	Complete	Main armor: front open 3-3/4 x 7-1/2, rear open 3 x 3-1/2. Shot broken as in round 194.
199	Partial	Main armor: front open 3-1/4 x 11. Hinged spall (300°) out 1/2". Shot rejected intact.
200	Partial	Main armor: front open 3-1/2 x 10-1/2, smooth scoop. Very large bulge with fine cracking on rear face of plate. Shot body broken as in round 194.
201	Partial	Main armor: front open 3-1/2 x 6. Star cracking on the rear face, Y with 2" arms.
202	Complete	Main armor: front open 4 x 7, rear open 4 x 7. Slight back spall (1-1/2" over 150°). Shot broken as round 194.
203	Complete	Main armor: front open 4 x 8, rear open 3 x 4-1/2.
204	Partial	Main armor: front open 3-1/2 x 8, large bulge with fine cracking on rear face of plate.
205	Complete	Main armor: front open 3-1/2 x 7, rear open 4 x 4.
206	Partial	Main armor: front open 3-1/2 x 6. Very large bulge with fine cracking on rear face of plate.
207	Complete	Main armor: front open 4 x 7-1/2, rear open 4 x 6.
208	Partial	Front open 3 x 11. Large bulge with fine cracking.
209	Partial	Front open 3-1/2 x 9. Punching started, 1" out.

CONFIDENTIAL

FIRING RECORD NO. P-53162
SHEET 23 OF 26

SUMMARY

1. Firing against 2" armor at 60° Obliquity.

Caliber	75 mm	75 mm	76 mm
Shot Type	T1148 (A)	T1148 (B)	T12886 (G)
Rounds Fired	4	3	2
High Partial Pen., fps	1815	1874	-
Low Complete Pen., fps	1894	1941	1714
Protection Ballistic Limit, fps	1855	1908	-
Limit Estimation, fps	-	-	-1714
Caliber	3"	76 mm	76 mm
Shot Type	M79 (D)	T16684 (E)	T16685 (F)
Rds. Fired	7	7	6
High Partial Pen., fps	2187	2111	1907
Low Complete Pen., fps	2163	2047	1974
Protection Ballistic Limit, fps	-	-	1940
Limit Estimation, fps	2165	-2130	-
Caliber	76 mm	76 mm	76 mm
Shot Type	T12886 (I)	T16682 (Mod) (K)	T16686 (L)
Rds. Fired	9	9	12
High Partial Pen., fps	2186	1891	1990
Low Complete Pen., fps	2162	1950	1854
Protection Ballistic Limit, fps	2139	1920	-
Limit Estimation, fps	-	-	2000

2. Firing against 2-1/2" armor at 60° obliquity

Caliber	3"	76 mm
Shot Type	M79 (A)	T16682 (G)
Rds. Fired	7	8
High Partial Pen., fps	2198	2618
Low Complete Pen., fps	2506	2644
Protection Ballistic Limit, fps	2502	2631
Limit Estimation, fps	-	-
Caliber	76 mm	76 mm
Shot Type	T16684 (E)	T16685 (F)
Rds. fired	14	6
High Partial Pen., fps	2557	2574
Low Complete Pen., fps	2569	2610
Protection Ballistic Limit, fps	2563	2592
Limit Estimation, fps	-	-

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

FIRING RECORD NO. F-53162
SHEET 24 OF 26

3. Firing against 3" armor at 30° Obliquity.

Caliber	75 mm	75 mm	76 mm
Shot Type	M72 (H)	T1148 Mod (B)	T12086 (I)
Rds. Fired	6	7	2
High Partial Pen., fps	2065	1842	1974
Low Complete Pen., fps	2106	1859	-
Protection Ballistic Limit, fps	2087	1851	-
Limit Estimation, fps	-	-	+1974

4. Firing against 3" armor at 55° Obliquity.

Caliber	76 mm	76 mm	76 mm
Shot Type	T12086 Mod (C)	T16684 (S)	T16685 (T)
Rds. Fired	4	4	7
High Partial Pen., fps	2822	2617	2535
Low Complete Pen., fps	2868	2680	2563
Protection Ballistic Limit, fps	2845	2690	2590

Caliber	76 mm	76 mm	76 mm
Shot Type	T16682 (O)	T12086 (I)	T16683 (J)
Rds. Fired	7	5	7
High Partial Pen., fps	2577	2172	2529
Low Complete Pen., fps	2594	2527	2575
Protection Ballistic Limit, fps	2585	2500	2552

Caliber	76 mm	76 mm	3"
Shot Type	T16682 Mod (K)	T16686 (L)	M79 (D)
Rds. Fired	9	5	3
High Partial Pen., fps	2928	2566	2094
Low Complete Pen., fps	2902	2569	-
Protection Ballistic Limit, fps	-	2568	-
Limit Estimation, fps	+2928	-	+2094

5. Firing against 3" armor at 60° Obliquity.

Caliber	3"	76 mm
Shot Type	M79 (D)	T16684 (R)
Rds. Fired	4	1
High Partial Pen., fps	2839	2916
Low Complete Pen., fps	2836	-
Protection Ballistic Limit, fps	-	-
Limit Estimation, fps	+2839	+2916

Caliber	76 mm	76 mm
Shot Type	T16685 (P)	T16682 (G)
Rds. Fired	8	4
High Partial Pen., fps	2861	2977
Low Complete Pen., fps	2898	-
Protection Ballistic Limit, fps	2800	-
Limit Estimation, fps	-	+2977

CONFIDENTIAL

FIRING RECORD NO. P-53162
SHEET 25 OF 26

6. Firing against 3" armor at 0° Obliquity.

The three shot fired in this phase were assembled with plastic rotating bands, the shot tumbled in flight and the penetration results were disregarded.

7. Firing against 2" armor at 70°.

Five Shot, AP, 76 mm, T166E2 Mod. (K) were fired with Striking Velocities ranging from 2315 fps to 2993 fps; no complete penetrations were obtained.

8. Firing against Russian, T34 Tank Hull on the upper glacis plate.

Caliber	76 mm	76 mm	75 mm
Shot Type	T166E2	T128E6	T166E1
Rds. Fired	5	7	7
Limit Estimation, fps	1700	2100	1800

9. Firing against spaced armor targets:

1/4" / 60° / 8" Spaced / 2" / 60°.

Caliber	76 mm	76 mm	76 mm
Shot Type	T166E2 (G)	T128E6 (I)	T166E6 (L)
Rds. Fired	5	3	2
High Partial Pen., fps	2703	2572	2270
Low Complete Pen., fps	2357	2626	2386
Protection Ballistic Limit, fps	-	-	-
Limit Estimation, fps	2330	2600	2428

Check firing against the same main-armor target, 2" / 60°.

	<u>Rounds Fired</u>	<u>Limit Estimation, fps</u>
76 mm, T166E2 (G)	4	2100
76 mm, T128E6 (I)	2	2600

CONFIDENTIAL

FIRING RECORD NO. P-53162
SHEET 26 OF 26

This firing record is to be appended to the "Fifth Report on Project No. TA1-5002".

APPROVED:

Benjamin S. Goodwin
BENJAMIN S. GOODWIN
Chief, Arms and
Ammunition Division

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

f. Mahan
for JOHN B. REZIN
Engineer Ordnance

DEVELOPMENT AND PROOF SERVICES
 ABERDEEN PROVING GROUND, MARYLAND
 FIRING RECORD

23, 24, 25, 26 June 1953

OBJECT OF TEST: Development of Shot, AP, T166E2
 for 76mm Gun. Investigation of
 Armor Defeating Ability and
 Flight Characteristics.

DATES OF TEST: 10 July 1953
 FIRING RECORD NO.: F-56758
 SHEET 1 OF 4
 AUTHORITY: OO 471.13/43
 APG FILE: 471.1/175
 W.O. NO.: 9cl-07-00-3

DEVELOPMENT: ORDTA
 Project TAL-1308

1r

MATERIEL

Gun, 76mm, T9LE3, No. 426
 Tube, 76mm, T9LE3, No. 24236
 Plate, See Round-by-Round Data

Gun, 75mm T83E1, No. 166
 Tube, 75mm T83E1, No. 70281
 Mount, T-69, No. 129
 Recoil Mech., T47E2, No. 88

AMMUNITION

Projectile, Shot, AP, 76mm, T166E2, Shot, AP,
 75mm M72 & T149.
 Propellant, MP, M6, Lot RAD-35044, Web .0373"
 MP, M6, Lot PAE-6131, Web .0290"
 Case, Cartridge, 76mm, T19E1, Resized and
 Washed, Mixed Lots, 75mm T6E3E1
 Primer, Percussion, 400 Grain, M58, Lot PA-73-29

TEST PROCEDURE

The experimental rounds of Shot, AP, T166E2 for the 76mm Gun were fired against 4" plate at 30° obliquity and 2" plate at 60° obliquity. The experimental rounds were divided into three hardness patterns with the following nomenclature:

S - Soft body
 H - Regular hard body
 HC-HCR - Super hard body

The 76mm, T166E2 with conventional tip, the 75mm, M72 and the 75mm, T149 rounds were used as reference rounds to determine the penetration performance of the experimental rounds.

FIRING RECORD NO.: P-56758
SHEET 2 OF 4ROUND-BY-ROUND DATA

Plate No. 070957-A, 4" at 30° Obliquity, Plate Characteristics Not Available

<u>TUBE</u> <u>RD NO.</u>	<u>SHOT</u> <u>TYPE</u>	<u>SHOT WT</u> <u>lbs</u>	<u>PROP WT.</u> <u>oz</u>	<u>STRIKING</u> <u>VEL., fps</u>	<u>PENETRATION</u>
76mm T166E2, Experimental Lot Fired in T91E3 Tube					
178	H	14.14	58	2356	Partial
179	H	14.15	68	Lost	Complete
180	H	14.14	66	2679	Complete
181	H	14.16	62	2548	Partial
182	H	14.17	64	2602	Partial
183	H	14.15	65	2533	Partial crack bulge.
184	H	14.19	67	2696	Complete
185	H	14.15	66	2667	Partial
186	H	14.16	68	2628	Partial, crack bulge.
187	H	14.14	69.5	2750	Complete
188	HC-HCR	14.09	65	2641	Partial
189	HC-HCR	14.02	69	2753	Partial
190	HC-HCR	14.06	73	2873	Partial, crack bulge.
191	HC-HCR	14.07	77	2964	Complete
192	HC-HCR	13.87	74	2896	Bad hit
193	HC-HCR	14.08	74	2885	Complete
194	HC-HCR	14.01	71	2799	Partial
195	HC-HCR	14.05	75	2906	Partial
196	HC-HCR	14.05	76.5	2946	Complete
197	S	14.19	72	2820	Bad hit
198	S	14.16	72	2815	Complete
199	S	14.16	68	2717	Complete
200	S	14.14	64	2596	Partial
201	S	14.19	66	2648	Partial
202	S	14.16	69	2735	Bad hit
203	S	14.15	69	2730	Partial crack bulge.
204	S	14.15	71	2792	Partial crack bulge.
205	S	14.17	73	2838	Complete
206	S	14.16	70	2753	Partial crack bulge.

75mm Reference Rounds Fired in T83E1 Tube

337	M72	13.89	54*	2809	Complete
338	M72	13.90	48*	2616	Complete
339	M72	13.91	44*	2471	Partial
340	M72	13.95	46*	2534	Partial
341	M72	13.91	47.5*	2588	Complete
342	M72	13.93	47*	2574	Partial
343	M72	13.95	48*	2602	Partial

FIRING RECORD NO.: P-56758
SHEET 3 OF 4

Plate No. Q156731-A; 2" @ 60° Obliquity, BHN: 289, Charpy: 40 @ -40°F.

<u>TUBE</u> <u>RD NC.</u>	<u>SHOT</u> <u>TYPE</u>	<u>SHOT WT</u> <u>lbs</u>	<u>PROP WT.</u> <u>oz</u>	<u>STRIKING</u> <u>VEL., fps</u>	<u>PENETRATION</u>
76mm T166E2 Experimental Lot Fired in T91E3 Tube					
207	H	14.17	50*	2166	Complete
208	H	14.16	46*	2040	Complete
209	H	14.16	44*	1974	Partial - bulge
210	H	14.16	47*	2042	Complete
211	H	14.17	45*	2009	Complete
212	H	14.17	42.5*	1945	Partial 120° crack.
213	HC-HCR	14.08	46*	2057	Partial 160° crack.
214	HC-HCR	14.05	50*	2173	Complete
215	HC-HCR	14.11	48*	2094	Complete
216	HC-HCR	14.09	45*	1999	Partial
217	HC-HCR	14.13	49*	2132	Partial
218	S	14.16	48*	2100	Complete
219	S	14.15	43*	1946	Partial, bulge
220	S	14.16	45.5	2022	Partial, bulge
221	S	14.16	47*	2073	Complete

76mm Reference Round W/Conventional Tip Fired in T91E3 Tube.

222	T166E2	14.16	44*	1978	Partial, bulge
-----	--------	-------	-----	------	----------------

75mm Reference Round Fired in T83E1 Tube.

64	M72	13.93	44*	2182	Partial
65	M72	13.88	49*	2404	Partial
66	M72	13.98	54*	2574	Complete
67	M72	13.92	52*	2495	Complete
68	M72	13.91	50*	2440	Complete
69	M72	13.95	48*	2356	Complete
70	M72	13.87	46*	2280	Complete
71	M72	13.95	44*	2200	Partial
72	M72	13.99	45*	2249	Partial
73	M72	13.99	47.5*	2327	Partial
74	M72	13.90	49*	2430	Partial
75	T149	14.57	55*	Lost	Complete
76	T149	14.55	55*	2610	Partial
77	T149	14.55	57*	2665	Complete

* Propellant Lot No. PAE-6131-R

SUMMARY OF RESULTS

Plate Ballistic Limit

	4" ARMOR PLATE @ 30° OBLIQUITY		2" ARMOR PLATE @ 60° OBLIQUITY	
76mm, AP, T166E2 Experimental Rds.	S	2687 (6)		1992 (4)
	H	2895 (6)		2114 (4)
	HC-HCR	2774 (6)		2035 (4)
75mm, AP, M72 Reference Rds.		2552 (4)		2373 (6)

NOTE: The numbers in parenthesis indicate the number of complete and partial penetrations used to obtain the plate ballistic limit within an approximate velocity range of 150 fps.

REMARKS

The comparison between body hardness in the experimental rounds indicates that the soft body is superior to the harder shot patterns at both 30 and 60 degree plate obliquities.

Results show that the experimental rounds are superior to the M72 reference rounds when fired against armor plate at an obliquity of 60 degrees. At the low obliquity of 30 degrees the M72 reference round resulted in a lower plate ballistic limit than the experimental rounds.

The following representatives observed the subject test:

- Mr. P. Eucker - Frankford Arsenal
- Mr. D.F. Arriente - Frankford Arsenal

APPROVED:

Benjamin S. Goodwin
BENJAMIN S. GOODWIN
Chief, Arms and
Ammunition Division

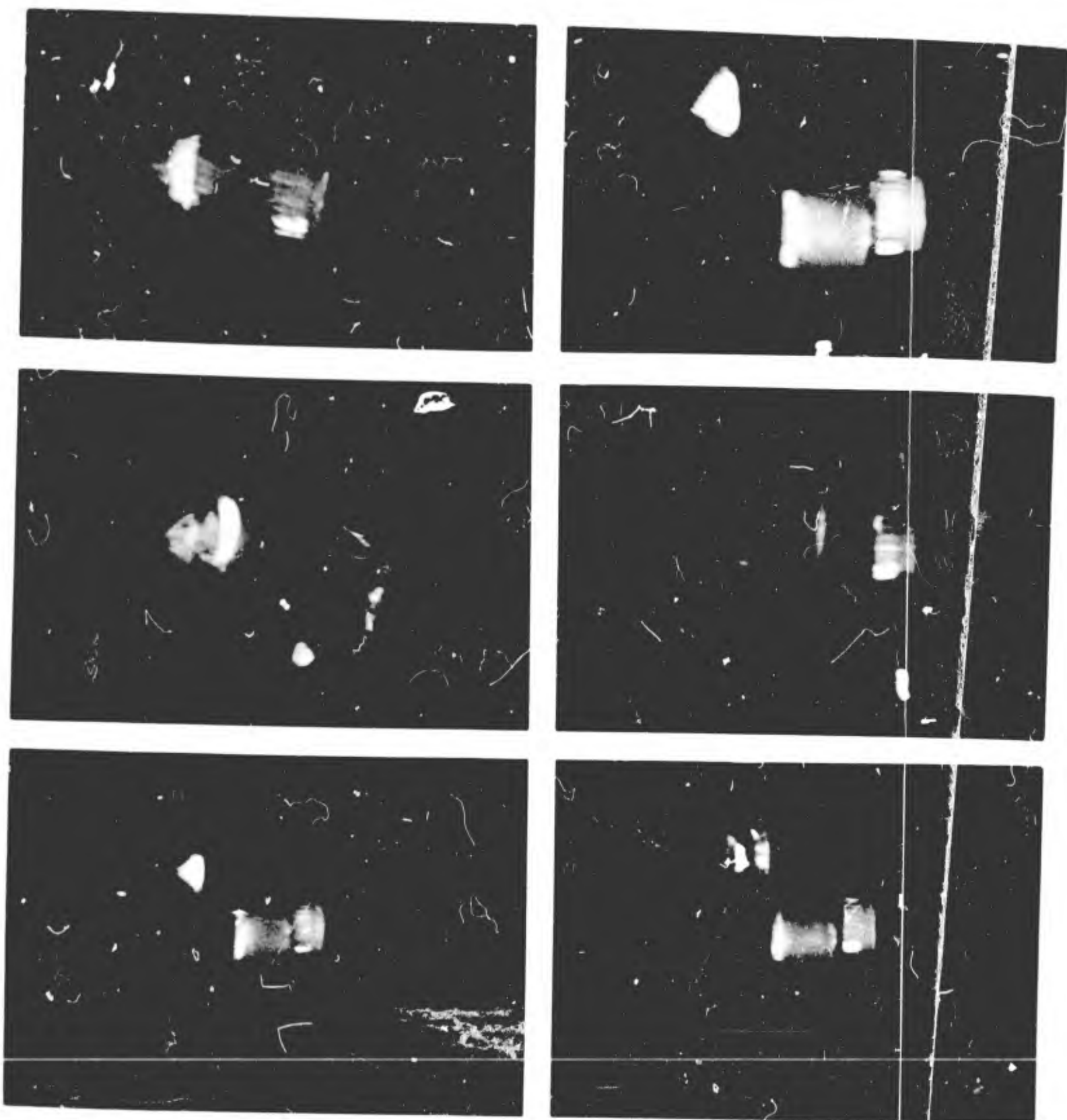
H. A. Bechtol
H. A. BECHTOL
Chief, Ammunition Br.

J. Malan
for JOHN S. DIGIOVANNI
Proof Director

- INCLOSURES: 1. Distribution
2. Letter file OO 471.13/43

APPENDIX C

PHOTOGRAPH



A85104 RESTRICTED

8 ABERDEEN PROVING GROUND 8

12 December 1956

Project No. TA1-1301. Long Range Development of Ammunition.
Shot, AP, 76mm, T166 Series. Projectiles fired through $\frac{1}{4}$ " plate at
60° obliquity. Projectile shown in lower right photograph was of
conventional design, others were of "tipped" design. Ref. APG Firing
Record F-53162, Test Rounds 186 to 192.

UNCLASSIFIED

UNCLASSIFIED