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REPORT NO. DPS/APG MISC/192

ARTILLERY DIVISION

REPORT ON

TEST OF

SHOT, 120-MM, AP-T, T116E5,

ASSEMBLED WITH CYCLEWELDED, ALUMINUM ALLOY, DIE-CAST.

WINDSHIELDS REINFORCED WITH THREE CARBON-STEEL ROLL PINS (U)

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ABERDEEN PROVING GROUND MISCELLANEOUS REPORT NO. 192

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R. N. DEMPSEY

JANUARY 1959

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Aberdeen Proving Ground
Maryland

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DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND
MARYLAND

AUTHORITY: FA-MIC-2B-3

RDempsey/ncj
29 December 1958

TEST OF SHOT, 120-MM, AP-T, T116E5, ASSEMBLED WITH
CYCLEWELDED, ALUMINUM ALLOY, DIE-CAST WINDSHIELDS
REINFORCED WITH THREE CARBON-STEEL ROLL PINS (U)

APG Miscellaneous Report No. 192

Dates of Test: 28, 30 January and 6 February 1958

ABSTRACT

Shot, 120-mm, AP-T, assembled with windshields attached to the shot with cycleweld C-14 adhesive, reinforced with three carbon-steel roll pins, were tested to determine their metal-parts security and armor-plate penetration.

Ninety shot were assembled into complete rounds and fired under various conditions of temperature and excess pressure to determine effects on windshield security. Seven of the same shot were fired against 5-inch armor plate at 55-degree obliquity to check any change in penetrating capabilities. There were no windshield losses at the 2000-, 2250-, and 2500-yard targets; obturator failure caused two of these shot to miss all three targets. A ballistic limit of 3001 fps was obtained from the test shot and a ballistic limit of 2908 fps was obtained from the standard 120-mm, T116E5, AP shot.

The modification employing three carbon-steel roll pins to mechanically secure the windshields to the shot body has proven to be feasible for renovating the AP shot currently in storage. The penetrating capabilities may have been altered slightly by the application of the roll pins.

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1. INTRODUCTION

For the past several years a number of investigations have taken place to determine the causes for some of the metal-parts failures noted during the testings of 90-mm and 120-mm shot. In the past two years efforts were devoted to obtaining a better bonding material and/or closer control of the bonding process in order to insure windshield security at longer ranges. These efforts failed, making it necessary to pursue methods of mechanically attaching windshields to the AP and TP shot. Attempts were made to secure the windshield components by the use of setscrews. These proved successful at ranges up to 2500 yards but presented production problems. The most significant of these problems was stripped threads on the setscrew resulting from variations in torque forces used in assembly, which apparently were difficult to control. In addition, the process was found to be very costly. An alternate method of mechanically attaching the windshield to the shot body was developed using cycleweld C-14 adhesive reinforced with three carbon-steel roll pins inserted through the windshield into shot bodies. These were tested at Aberdeen Proving Ground and are explained in this report.

2. DESCRIPTION OF MATERIEL

All Shot, AP-T, 120-mm, T116E5, identified as Lot FA-E-201, were assembled with die-cast windshields reinforced by three 1/4- by 5/8-inch, carbon-steel roll pins.

3. DETAILS OF TEST

3.1 Procedures

The renovated shot were tested for metal-parts security and for armor-plate penetration as specified in the Test Program Request (Appendix A) and described below.

For metal-parts security, ninety rounds were fired from a 120-mm tube, in its third quarter of life, at three cloth targets set up consecutively at 2000-, 2250-, and 2500-yard range. Photographs were obtained from an 8-mm framing camera located at the gun muzzle and a 35-mm smear camera located approximately 100 feet in front of the gun. The ninety shot were fired in three groups, 25 at extreme low temperature (-65°), 25 at extreme high temperature (+160°), and 40 with an excess pressure charge established to yield 112% rated maximum pressure in a new tube. Complete round-by-round data are contained in Firing Record P-63495, Appendix B.

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3.2 Results

3.2.1 Armor Plate Penetration

For armor-plate penetration, the rounds considered in the establishment of the plate ballistic limit are tabulated below:

<u>Test Round Number</u>	<u>Propellant Weight,</u> <u>lb oz</u>	<u>Striking Velocity,</u> <u>fps</u>	<u>Penetration</u>
Test Shot, TL16E5 (Basic Shot Lot RJWL-22) ^a :			
259	23 10	2954	Partial
261	24 0	3005	Complete
262	23 14	2989	Partial
263	24 2	3017	Complete
264	23 12	3000	Partial
265	24 4	3039	Complete

^aPlate ballistic limit of 3001 fps established.

Standard Shot, TL16E5 (Lot RJWL-34)^b:

251	23 0	2870	Complete
254	23 2	2884	Partial
255	22 15	2882	Partial
256	23 6	2918	Partial
257	23 12	2954	Complete
258	23 10	2941	Complete

^bPlate ballistic limit of 2908 fps established.

It is believed that comparable penetration results might be obtained if the same basic lot number of shot, both test and standard, be used.

3.2.2 Extreme Low Temperature (-65°). Twenty-four of the 25 shot fired at low temperature retained their windshields at the 2000- and 2250-yard targets. Four rounds impacted lower than the other shot on the 2000- and 2250-yard targets, so consequently were short of the 2500-yard target. One round missed all three targets and was believed to be the result of an obturator failure in the tube. (Photograph Numbers B28690 and B28691, Appendix C.)

3.2.3 Extreme High Temperature (+165°). The results of the firings at high temperature are identical to those obtained under the above extreme cold firings. (Photograph Numbers B28692 and B28693, Appendix C.)

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3.2.4 Excess Pressure. All 40 shot retained their windshields at the 2000- and 2250-yard targets. Three rounds impacted lower than the others, so consequently 37 rounds on the 2000- and 2250-yard targets impacted short of the 2500-yard target. (Photograph Number B28694, Appendix C.)

3.3 Observations

The feasibility of substituting the present rubber obturators with synthetic rubber obturators was studied. This was a preliminary investigation, the results of which had no bearing on the primary objective of this test; therefore, synthetic obturators were substituted for the standard rubber obturators on the conditioning rounds fired. Muzzle photographs of all the conditioning rounds revealed satisfactory obturation of the limited few fired in this test.

4. CONCLUSIONS

It is concluded that:

- a. The application of three carbon-steel roll pins is a satisfactory method for assisting in holding the windshield to the shot body.
- b. The penetrating capabilities of the shot appear to have been reduced slightly by the application of the roll pins; however, the results may not be significant.

5. RECOMMENDATIONS

It is recommended that:

- a. Additional firings be conducted using standard and test shot of the same basic lot number to verify armor penetration results.
- b. If the above tests are conducted and the results prove satisfactory, the carbon-steel roll pins be adopted as a method for renovation and for the manufacture of new shot.

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SUBMITTED:

R. N. Dempsey
R. N. DEMPSEY
Test Director

REVIEWED:

H. B. Anderson
H. B. ANDERSON
Chief, Artillery
Ammunition Branch

H. A. Bechtol
H. A. BECHTOL
Chief,
Artillery Division

APPROVED:

H. A. Noble
H. A. NOBLE
Assistant to the Deputy Director
for Engineering Testing
Development and Proof Services

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OBSERVER

Present during the test was:

Mr. John Psyk, Frankford Arsenal

APPENDICES

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APPENDIX A
Correspondence
ORDNANCE CORPS
FRANKFORD ARSENAL
PHILADELPHIA 37.
PENNSYLVANIA

JTPsyk/mp/3177

13 January 1958

IN REPLY

REFER TO ORDBA-MIR

FA 471. *1/13 Jan 58*

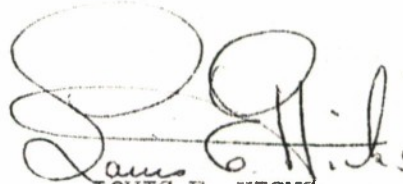
SUBJECT: Shot, AP, 120mm, TL16

TO: Commanding General
Aberdeen Proving Ground
Maryland
ATTN: D&PS, Mr. G. Youmans

1. Forwarded herewith for your information and retention is Frankford Arsenal's Test Program Request #FA-MIC-2B-3 which outlines a program to determine metal parts security and plate penetration capabilities of the proposed design for the 120mm TL16 AP-T Shot.

2. It is requested that this Arsenal be notified in advance of the firing of these tests in order that a representative may be present to assist with the assembly of rounds and to witness the firing of the test program.

FOR THE COMMANDER:



LOUIS E. HICKS
Major, Ord Corps
Assistant

1 Incl
TPR #FA-MIC-2B-3 (in dupe)

1 of w/d in Mr. Rapp

cc: OAC, ORDLY-ARAT w/incl

JFPsyk/mp/3177
10 January 1958

1. Material for Test:

One-hundred (100) each 120mm T116E5 Mod., identified as Lot #FA-E-201. Three (3) carbon steel roll pins have been applied to each shot in accordance with Frankford Arsenal drawing FD 20579, Revision 1.

2. Project Authority:

- a. OAC Project No. 56-140.
- b. PESD 60304111-19-46122-00-0-321.

3. Arsenal Expenditure Order No.: 64929-01

4. Object of Development or Experiment:

To overcome current deficiencies of metal parts security on all shot by the substitution of alternate methods of windshield attachment or by an improvement of those methods currently utilized.

5. History Sketch:

For the past several years, a number of investigations have taken place to determine the causes for some of the metal parts failures noted during ballistic acceptance testings of 90mm and 120mm shot. Prior to, and during this same period, periodic reports both from the Army Field Forces and the proving grounds have indicated that a number of the deficiencies namely rotating band losses, body engraving and windshield separations were apparently comprising the performance of both the 90mm and 120mm shot.

In the past, and up to the present, most efforts were devoted to obtaining a better bonding material and/or more closely controlling the bonding process. A point has now been reached whereby it is considered impractical to control the process more effectively. It is therefore necessary to pursue methods of mechanically attaching windshields to AP and TP shot. The optimum with this type of attachment will be a mechanical attachment which will be common to both AP and TP shot.

Because of the way in which the windshield and ogive fit together, there is what is commonly referred to as a "ball and socket" effect. Should the bond fail down range for any reason, the slightest amount of eccentricity or yaw would cause the entire force acting against the windshield to be applied eccentrically. A separation of the windshield then occurs with nothing in the design to oppose its separation. Recovered pieces of windshields with a spiral cut into the mating surface by the point of the ogive as the windshield was spun loose have led to this belief.

5. History Sketch (Cont'd)

Recently J. W. Rex Company received permission from OAC to fire a comparison test of 120mm shot in which die cast vs. forged windshield component would be further evaluated. Seventy (70) shot were shipped to JPG by J. W. Rex Company. Half were assembled using die cast windshields. The remainder were assembled using forged windshields. Three (3) windshield losses were experienced at 2000 yards: two (2) were die castings and one (1) was a forging under another program.

APG modified fifty (50) each 120mm TL16E6 shot for Frankford Arsenal by applying three (3) 1/4-28 full dog set screws to each shot. Forty (40) of these shot were fired for metal parts security from a gun in its last quarter of life. One (1) windshield was lost at the 2500 yard range.

6. Description in Detail of Improvements Made Since Last Proving Ground Test:

In previous testing, attempts were made to maintain the windshield components by the use of set screws in addition to various types of adhesives. Drilling and tapping of holes in both AP and TP shot presents problems which complicate production. Shot for this test have windshields attached by the use of cycleweld C-14 adhesive and three (3) 1/4x5/8 carbon steel roll pins. This roll pin design eliminates the problem of stripping threads by applying too much torque and represents a cost saving over the set screw design.

7. Local Tests

Roll pins have been inserted into a test fixture and spun up to 29,000 rps. None of the pins were ejected due to rotational forces. The interference between the pins and the hole varied from .0005 to .007.

8. Object of Test:

To determine the effectiveness of roll pins in maintaining metal parts security of windshields up to 2500 yards.

9. Precautions in Handling and Testing:

Normal safety precautions should be exercised while handling and testing AP shot.

10. Recommended Test Program:

Phase I - Metal Parts Security at -65° F Temperature

- a. Twenty-five (25) rounds of Lot #FA-E-201 will be temperature conditioned to -65°F.
- b. All shot will be fired using service charge from a 120mm TL23E1 gun having a tube with approximately 50% remaining life at cloth targets set up concurrently at 2000, 2250 and 2500 yards.

Phase II - Metal Parts Security at +160° F Temperature

- a. Twenty-five (25) rounds of Lot #FA-E-201 will be temperature conditioned to +160°F.
- b. All shot will be fired using service charge and the same tube used in Phase I. However, if the tube shows by star-gaging, to have at least 30% remaining life, another tube with approximately 35% remaining life will be substituted concurrently at 2000, 2250 and 2500 yards.

Phase III - Metal Parts Security at Ambient Temperature

- a. Forty (40) rounds of Lot #FA-E-201 will be fired at ambient temperature using a charge which will be 112% of maximum rated pressure of a new tube.
- b. All shot will be fired from a 120mm TL23E1 gun having a tube with no greater than 40% remaining life and no less than 30% at cloth targets set up concurrently at 2000, 2250 and 2500 yards.

Phase IV - Plate Firing

- a. Establish a PBL for test shot as compared to the 120mm TL16E5 reference shot against 5" of armor plate set at 55° obliquity.
- b. Ten (10) shot of Lot FA-E-201 will be used for this test.
- c. Record Pressures and velocities (muzzle and striking).
- d. Record any other data considered pertinent by the Proof Director.

10. Recommended Test Program (Cont'd)

For Phases I, II and III

a. Take photographs as follows:

- (1) At right angles to the muzzle of the gun using a Fastex Framing camera.
- (2) Perpendicular to the line of fire using a smear camera placed seventy-five (75) feet from the muzzle of the gun.
- (3) The film is not to be developed unless there is doubt concerning the results of any particular round.

Note: The results of each phase are to be reviewed by Frankford Arsenal representative before each subsequent phase is undertaken.

11. Coordination:

Aberdeen Proving Ground
Ordnance Ammunition Command
Frankford Arsenal

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Firing Record
DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND
FIRING RECORD

OBJECT OF TEST: To Determine if 120-mm AP and TP Shot Assembled with Cyclewelded, Aluminum-Alloy, Die-Cast Windshield Components Reinforced with Three Carbon-Steel Roll Pins, will Provide Satisfactory Metal-Parts Security and Plate Penetration (U)

DATES OF TEST: 28, 30 January and 6 February 1958

FIRING RECORD NO.: P-63495

SHEET 1 OF 6

AUTHORITY: FA File 471.1 dated 13 January 1958, APG File 471/8

Production Engineering

WORK ORDER NO.: 322-704-66 ncj

MATERIEL

Gun, 120-mm, T123E1, No. 10 (all phases).
Tube, 120-mm, T123E1, No. 4373 (all-phases).
Recoil Mechanism, 155-mm, M3, No. 1676 (Security Phase).
Mount, 8-inch Howitzer, T20, No. 1 (Security Phase).
Recoil Mechanism, 155-mm, M3, No. 60 (Plate Phase).
Carriage, 155-mm, M1, No. 452 (Plate Phase).

AMMUNITION COMPONENTS

Shot, AP-T, 120-mm, T116E5 (Test), Lot FA-E-201 (Basic Shot Lot No. RJW1-22).
Shot, AP, 120-mm, T116E5 (Standard), Lot RJW1-34.
Shot, AP-T, 120-mm, T116E5 (Conditioning), Lot RJW1-30.
Propellant, MP, M17, Lot SUN 33874 (Security Phase).
Propellant, MP, M6, Lot RAD 34856 (Plate Phase).
Obturator Assembly for 120-mm Shot, Lot FA-E-3801-1.
Primer, Percussion, T79, Lot LS-24-4.
Case, Cartridge, T25, Lot CHA 10-42.
Tracer, M5A2B1, Lot KOP 6-62.
Plug, Closing, Plastic (Drawing No. FC 7969), Lot PSC 1-1.

FACILITIES

Security Phase - fired from Barricade 1, Azimuth 25°20' West of South.

<u>Date of Firing</u>	<u>Chronograph Coil Distance, feet</u>	
	<u>Muzzle to 1st</u>	<u>1st to 2nd</u>
28 Jan	97.10	50.20
30 Jan	97.13	50.12

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FIRING RECORD NO. P-63495
SHEET 2 OF 6

Penetration Phase - fired from E Range at Light Armor; Azimuth, 36°
West of South.

Chronograph Coil Distance: Gun to 1st Coil - 99.70 feet
1st to 2nd Coil - 49.15 feet
2nd Coil to plate - 238.00 feet

INSTRUMENTATION

Pressure Gages: Gage, Pressure, Medium Caliber, M3, two per round;
Copper Lot 7C-55.

Cameras: One 8-mm Fastax, located at gun muzzle; one 35-mm smear
located approximately 100 feet in front of gun.

Targets: Three, 15- by 15-foot cloth, located at 2000-, 2250-, and
2500-yard range.

ARMOR PLATE DATA

Class B, Rolled Homogeneous, 5" x 120" x 144", Number 048572, Average
Bhn 275; Charpy (-40°F) 44 ft-lb.

Chemical composition: C - 0.028, Mn - 0.030, Si - 0.20, S - 0.022,
P - 0.011, Cr - 1.59, Ni - 3.29, Mo - 0.40.

ROUND-BY-ROUND DATA

Metal-Parts Security Phases

Tube	Time	Proj	Muzzle	Avg Chamber	Temp of	Windshield Security,			
Rd	Shot	of	Vel,	Pressure,	Firing,	ft - yards			
No.	No.	Firing	lb	fps	psi/100	°F	100	2000	2250 2500
Fired 23 January 1958									
150	C	Conditioning							
151	1	0858	50.36	3413	406	160	S	S	S S
152	2	1006	50.26	3395	376	160	S	S	S S
153	3	1100	50.28	3413	390	160	S	S	S S
154	4	1128	50.32	3453	408	160	S	S	S S
Fired 28 January 1958									
155	C	1016	50.20	3229	---	-65	S	S	S S
156	C	1024	50.04	3252	---	-65	S	S	S S
157	1	1045	50.36	3172	339	-65	S	S	S Short
158	2	1054	50.61	3186	344	-65	S	S	S S
159	3	1056	50.25	3160	334	-65	S	S	S S
160	4	1058	50.33	3158	322	-65	S	S	S S
161	5	1100	50.28	3168	334	-65	S	S	Over S top

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FIRING RECORD NO. P-63495
SHEET 3 OF 6

Tube Rd No.	Shot No.	Time of Firing	Proj Wt, lb	Muzzle Vel, fps	Avg Chamber Pressure, psi/100	Temp of Firing, °F	Windshield Security, ft - yards			
							100	2000	2250	2500
162	6	1104	50.29	3158	336	-65	S	S	S	S
163	7	1116	50.31	3160	336	-65	S	S	S	S
164	8	1119	50.25	3168	336	-65	S	S	S	S
165	9	1121	50.38	3174	338	-65	S	S	S	Short
166	10	1124	50.33	3176	341	-65	S	S	S	S
167	11	1126	50.30	3170	335	-65	S	S	Over top	S
168	12	1128	50.35	3143	336	-65	Missed all targets			
169	13	1137	50.36	3178	340	-65	S	S	S	S
170	14	1141	50.27	3121	330	-65	S	S	S	Short
171	15	1143	50.25	3143	328	-65	S	S	S	Short
172	16	1310	50.38	3133	328	-65	S	S	S	S
173	17	1314	50.33	3149	328	-65	S	S	Hit pipe hold- ing target at 2000 yards.	
174	18	1400	50.32	3150	327	-65	S	S	S	S
175	19	1402	50.38	3158	334	-65	S	S	S	S
176	20	1406	50.37	3145	328	-65	S	S	S	S
177	21	1410	50.22	3147	327	-65	S	S	S	S
178	22	1412	50.31	3108	328	-65	S	S	S	S
179	23	1415	50.33	3149	329	-65	S	S	S	S
180	24	1417	50.27	3156	334	-65	S	S	S	S
181	25	1420	50.27	3147	329	-65	S	S	S	S
182	5	1435	50.29	3396	386	160	S	S	S	S
183	6	1442	50.24	3389	377	160	S	S	S	S
184	7	1445	50.28	3373	372	160	S	S	S	S
185	8	1447	50.30	3376	359	160	S	S	S	Short
186	9	1452	50.23	3389	385	160	S	S	S	S
187	10	1454	50.40	3394	389	160	S	S	S	S
188	11	1457	50.41	3373	373	160	S	S	S	S
189	12	1500	50.35	3391	386	160	S	S	S	S
190	13	1502	50.38	3371	371	160	S	S	S	S
191	14	1510	50.37	3353	368	160	S	Missed all 3 targets		
192	15	1513	50.27	3367	373	160	S	S	S	S
193	16	1517	50.26	3362	366	160	S	S	S	S
194	17	1521	50.32	3358	366	160	S	S	S	Short
195	18	1524	50.30	3355	369	160	S	S	S	S
196	19	1526	50.06	3360	366	160	S	S	S	S
197	20	1529	50.25	3369	372	160	S	S	S	Short
198	21	1534	50.31	3364	370	160	S	S	S	S
199	22	1537	50.30	3378	367	160	S	S	S	S
200	23	1540	50.35	3373	378	160	S	S	S	Short
201	24	1542	50.32	3369	373	160	S	S	S	S
202	25	1545	50.32	3396	375	160	S	S	S	S

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FIRING RECORD NO. P-63495
SHEET 4 OF 6

Tube Rd No.	Shot No.	Time of Firing	Proj Wt, lb	Muzzle Vel, fps	Avg Chamber Pressure, psi/100	Temp of Firing, °F	Windshield Security,			
							ft - 100	yards 2000	yards 2250	yards 2500
Fired 30 January 1958										
204	C	1006	50.69	3337	---	Ambient	S	Missed all 3 targets		
205	C	1017	50.65	3350	---	Ambient	S	Missed all 3 targets		
206	C	1022	50.76	3328	---	Ambient	S	S	S	S
207	C	1027	50.81	3326	---	Ambient	S	S	S	S
208	1	1032	50.29	3270	376	Ambient	S	S	S	Short
209	2	1035	50.24	3285	383	Ambient	S	S	S	S
210	3	1038	50.27	3302	382	Ambient	S	S	S	S
211	4	1042	50.32	3311	388	Ambient	S	S	S	S
212	5	1044	50.34	3289	384	Ambient	S	S	S	S
213	6	1047	50.23	3272	374	Ambient	S	S	S	Short
214	7	1051	50.33	3285	376	Ambient	S	S	S	Short
215	8	1053	50.28	3300	384	Ambient	S	S	S	S
216	9	1057	50.33	3257	370	Ambient	S	S	S	S
217	10	1102	50.32	3280	375	Ambient	S	S	S	S
218	11	1104	50.24	Lost	385	Ambient	S	S	S	S
219	12	1107	50.25	3280	378	Ambient	S	S	S	S
220	13	1112	50.32	3283	378	Ambient	S	S	S	S
221	14	1114	50.30	3289	378	Ambient	S	S	S	S
222	15	1117	50.25	3283	378	Ambient	S	S	S	S
223	16	1121	50.32	3276	376	Ambient	S	S	S	S
224	17	1123	50.29	3289	389	Ambient	S	S	S	S
225	18	1125	50.36	3272	370	Ambient	S	S	S	S
226	19	1130	50.35	3280	376	Ambient	S	S	S	S
227	20	1137	50.22	3268	373	Ambient	S	S	S	S
228	C	1315	50.53	3300	---	Ambient	S	S	S	S
229	C	1318	50.39	3317	---	Ambient	S	S	S	S
230	21	1325	50.33	3280	374	Ambient	S	S	S	S
231	22	1328	50.27	3289	374	Ambient	S	S	S	S
232	23	1332	50.29	3280	376	Ambient	S	S	S	S
233	24	1334	50.36	3274	375	Ambient	S	S	S	S
234	25	1337	50.36	3270	374	Ambient	S	S	S	S
235	26	1340	50.30	3251	364	Ambient	S	S	S	S
236	27	1346	50.31	3283	373	Ambient	S	S	S	S
237	28	1349	50.26	3263	378	Ambient	S	S	S	S
238	29	1352	50.36	3268	376	Ambient	S	S	S	S
239	30	1355	50.32	3287	380	Ambient	S	S	S	S
240	31	1359	50.27	3289	377	Ambient	S	S	S	S
241	32	1403	50.28	3274	375	Ambient	S	S	S	S
242	33	1406	50.30	3274	372	Ambient	S	S	S	S
243	34	1410	50.28	3270	373	Ambient	S	S	S	S
244	35	1412	50.36	3272	377	Ambient	S	S	S	S
245	36	1415	50.26	3261	372	Ambient	S	S	S	S
246	37	1418	50.32	3255	364	Ambient	S	S	S	S

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FIRING RECORD NO. P-63495
SHEET 5 OF 6

Tube Rd No.	Shot No.	Time of Firing	Proj Wt, lb	Muzzle Vel, fps	Avg Chamber Pressure, psi/100	Temp of Firing, °F	Windshield Security, ft - yards			
							100	2000	2250	2500
247	38	1420	50.37	3272	367	Ambient	S	S	S	S
248	39	1424	50.33	3257	362	Ambient	S	S	S	S
249	40	1427	50.32	3261	367	Ambient	S	S	S	S

S = Satisfactory

Ambient Temperature - Approximately 40°

- Notes: 1. Conditioning rounds - rubber obturators were removed and replaced with synthetic obturators previous to firing.
2. Tube round number and color of synthetic obturators (for identification only):

Tube Rd No.	Color	Temp of Firing, °F	Obturation
155	Yellow	-65	Satisfactory
156	Silver	-65	Satisfactory
204-205	Silver	Ambient	Satisfactory
206-207	Yellow	Ambient	Satisfactory
228-229	Blue	Ambient	Satisfactory

3. All temperature rounds (-65° and +160°) were fired with a propelling charge which produces service pressure and velocity in a new tube.
4. All rounds fired at ambient temperature were fired with a propelling charge which produces 112% rated maximum pressure in a new tube.

Armor Penetration Phase

Fired 6 February 1958

Standard Rounds, T116E5,
Lot RJWL-34

Tube Rd No.	Prop Weight,		Proj Wt, lb	Striking Velocity, fps	Avg Chamber Pressure, psi/100	Penetration	Results
	lb	oz					
250	22	8	49.85	2802	270	Partial	1 1/4" bulge.
251	23	0	49.72 *	2870	289	Complete	Rear opening 4 1/2 x 7 1/2".
252	22	12	49.87	2843	278	Partial	1 1/2" bulge.
253	22	14	49.77	2866	294	Partial	2 1/4" bulge.
254	23	2	49.97 *	2884	300	Partial	2 1/4" bulge.
255	22	15	49.70 *	2882	296	Partial	3" bulge with a 4" crack.
256	23	6	49.65 *	2918	306	Partial	3" bulge with a 240° hinge crack.

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B-5

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FIRING RECORD NO. P-63495
SHEET 6 OF 6

Tube Rd No.	Prop Weight, lb oz	Proj Wt, lb	Striking Velocity, fps	Avg Chamber Pressure, psi/100	Penetration	Results
257	23 12	49.70 *	2954	320	Complete	Rear opening 4-1/2" x 5-3/4".
258	23 10	49.95 *	2941	324	Complete	Rear opening 2 1/2"x5 1/2".

Plate ballistic limit - 2908

Test Rounds T116E5, Lot FA-E-201 (Basic Lot RJW-1-22)

259	23 10	49.43 *	2954	309	Partial	2" bulge with a 5 1/2" crack.
260	24 0	49.45	3002	323	Bad hit	
261	24 0	49.52 *	3005	328	Complete	Rear opening 3 1/2"x5".
262	23 14	49.44 *	2989	316	Partial	1-3/4" bulge
263	24 2	49.53 *	3017	328	Complete	Rear opening 4"x5 1/2".
264	23 12	49.53 *	3000	316	Partial	1 1/2" bulge with three 1" cracks.
265	24 4	49.50 *	3039	334	Complete	Rear opening 3 1/2"x5".

Plate ballistic limit - 3001

*Rounds considered in obtaining plate ballistic limit.

SUBMITTED:

R. N. Dempsey

R. N. DEMPSEY
Mech Eng Tech

REVIEWED:

H. B. Anderson

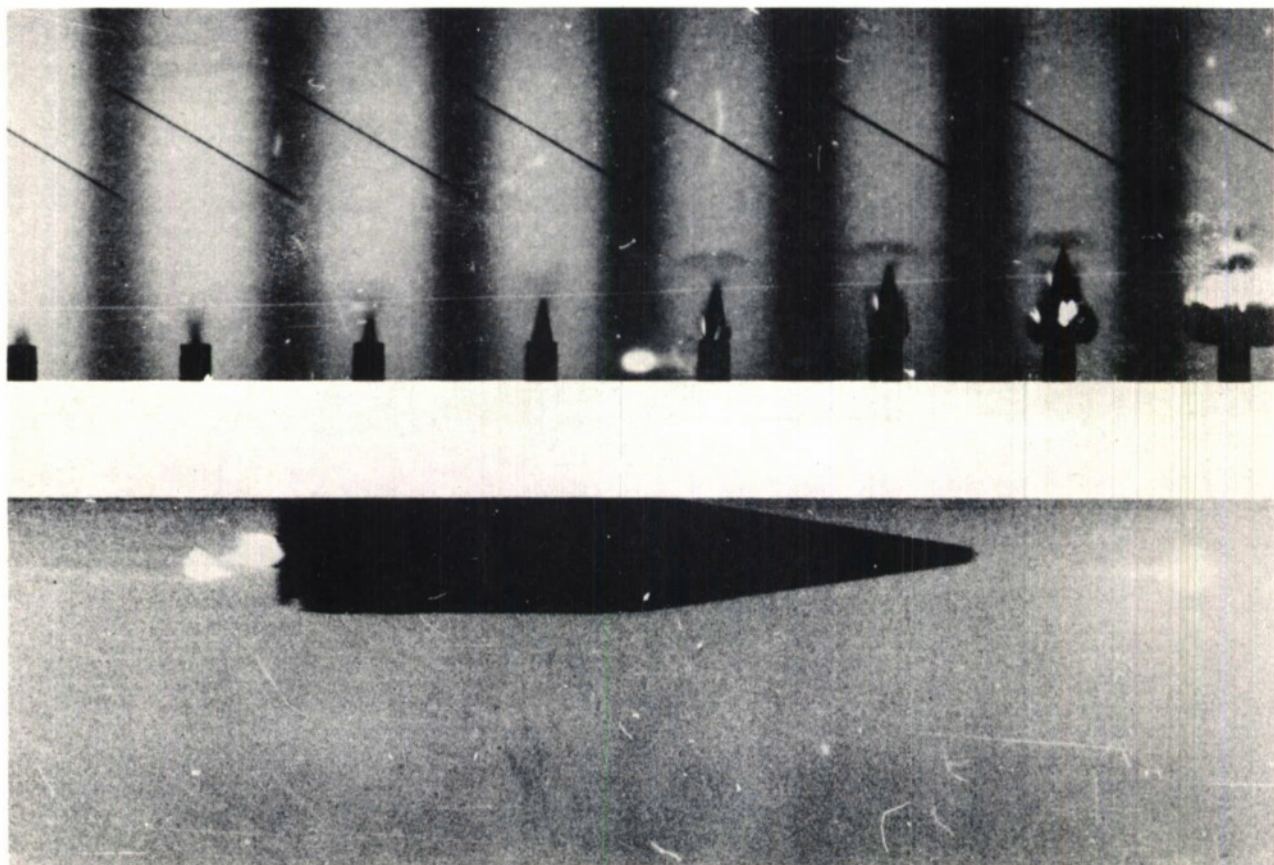
H. B. ANDERSON
Chief, Artillery
Ammunition Branch

APPROVED:

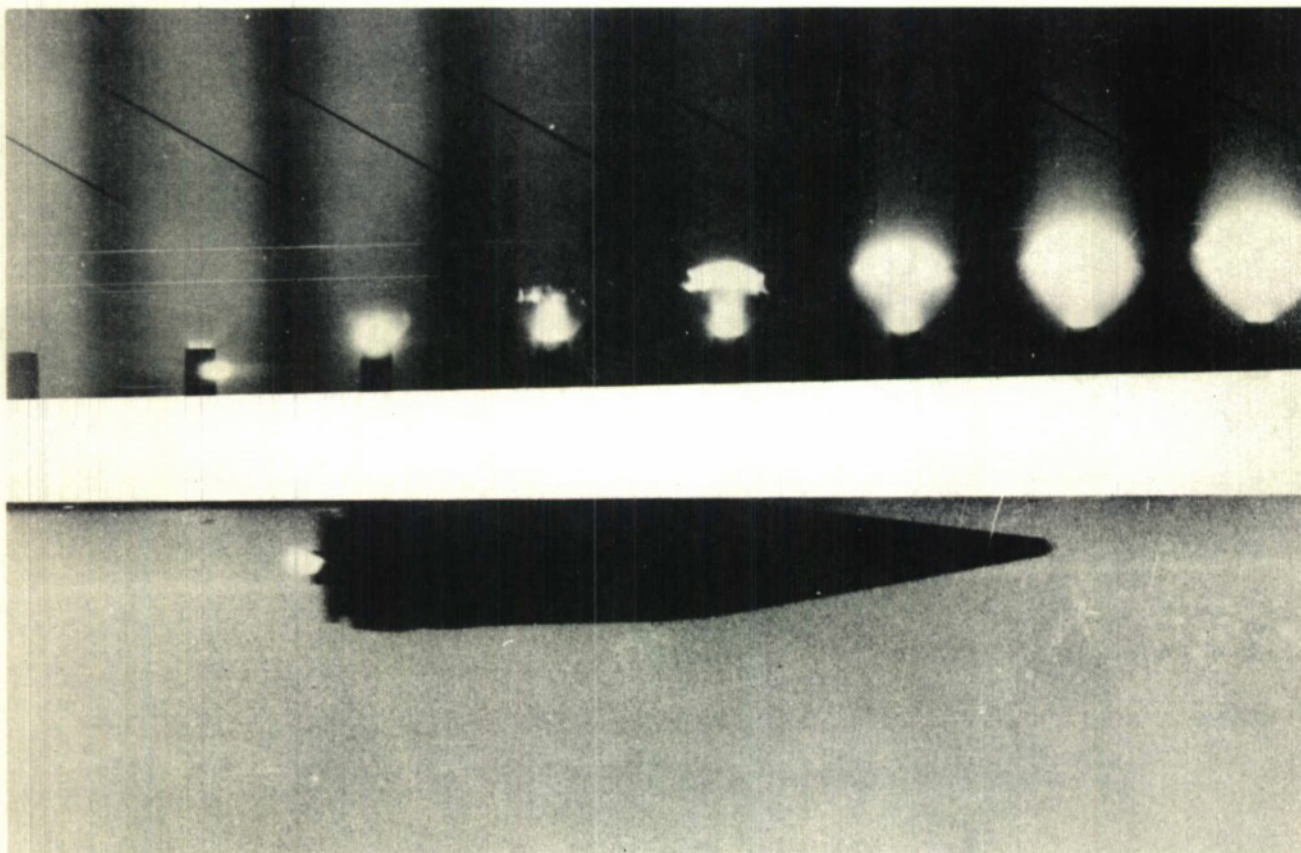
H. A. Bechtel

H. A. BECHTEL
Chief
Artillery Division

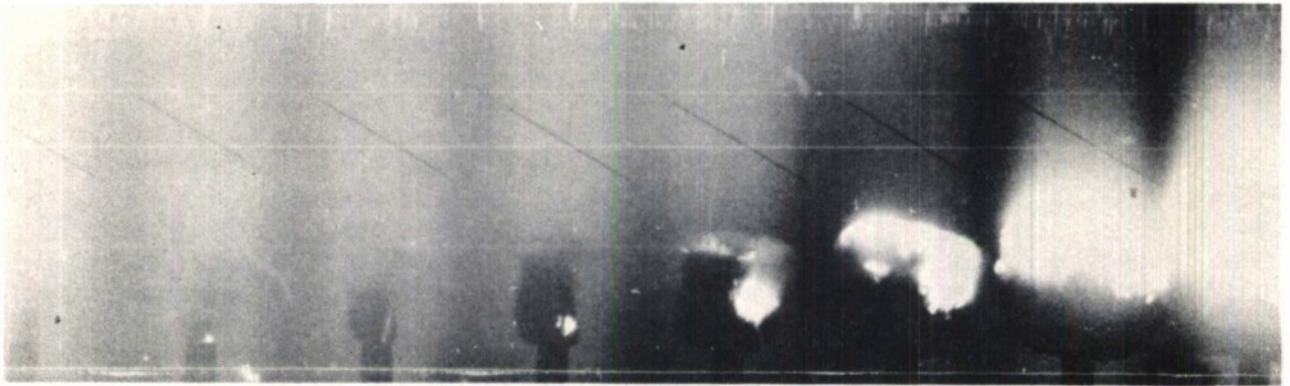
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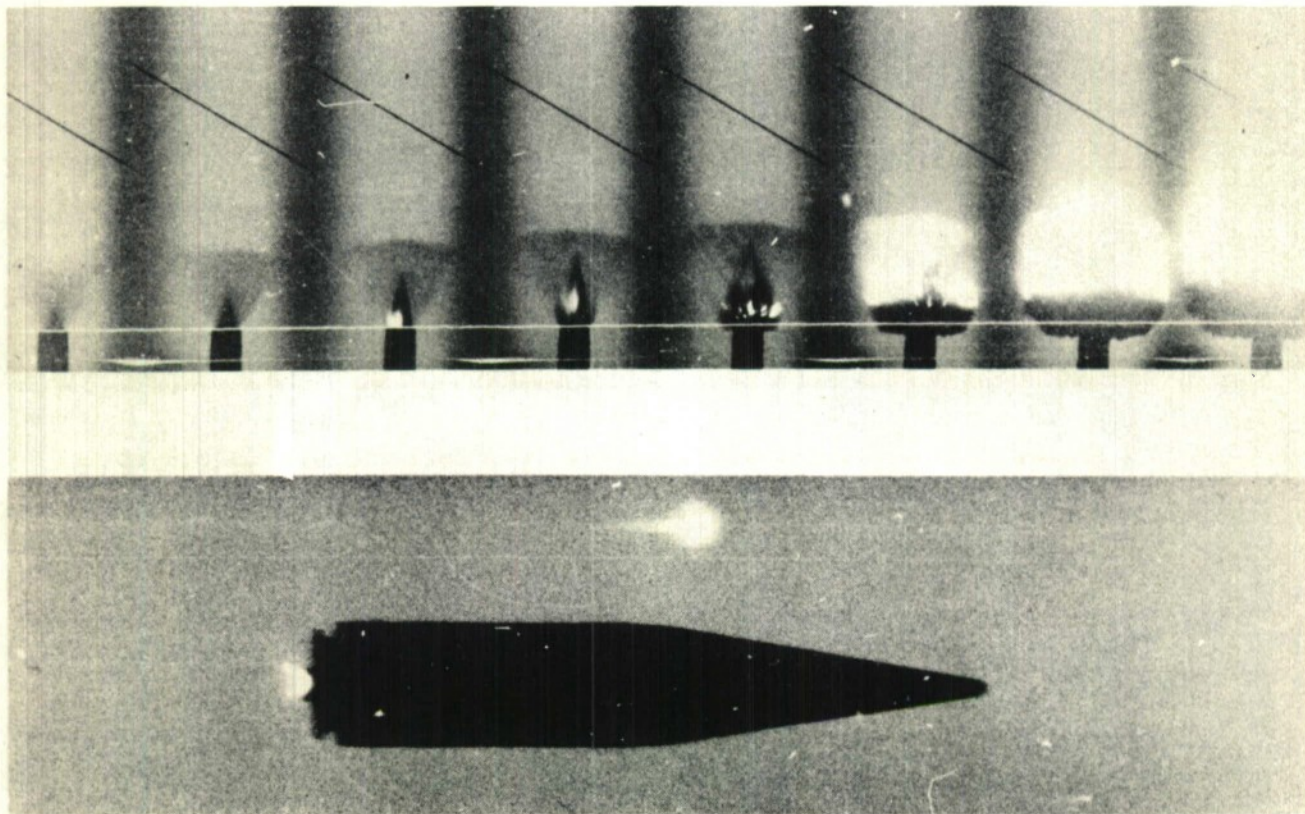
B28690: Shot, AP-T, 120-mm, T116E5 assembled with 5° obturator and with windshields attached by adhesives reinforced with 3 carbon-steel pins. Typical example of shot obturation and flight when conditioned at -65°F. Muzzle velocity 3149 fps, chamber pressure 32,800 psi, tube round number 173. TOP: Obturation (muzzle). BOTTOM: Shot condition (100 ft from muzzle).



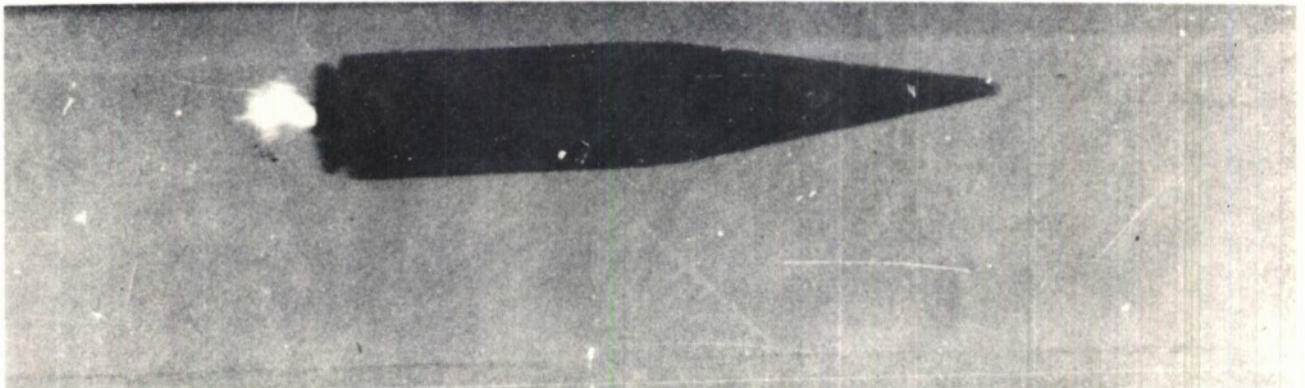
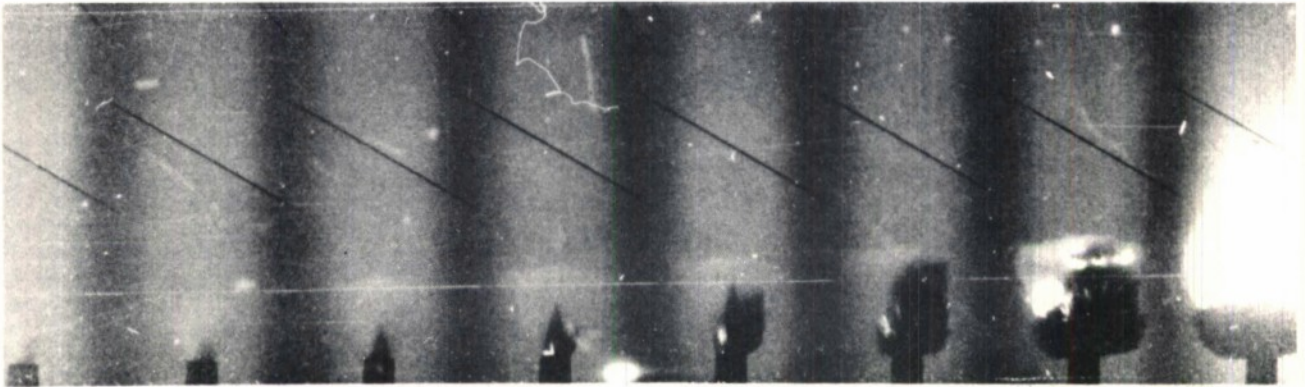
B28691: Shot, AP-T, 120-mm, T116E5 assembled with 5° obturator and with windshields attached by adhesives reinforced with 3 carbon-steel pins. Obturation and flight of only round failing to impact on target when conditioned at -65°F. Muzzle velocity 3143 fps, chamber pressure 33,600 psi, tube round number 168. TOP: Obturation (muzzle). BOTTOM: Shot condition (100 ft from muzzle).



B28692: Shot, AP-T, 120-mm, T116E5 assembled with 5° obturator and with windshields attached by adhesives reinforced with 3 carbon-steel pins. Obturation and flight of only round failing to impact on target when conditioned at +160°F. Muzzle velocity 3353 fps, chamber pressure 36,800 psi, tube round number 191. TOP: Obturation (muzzle). BOTTOM: Shot condition (100 ft from muzzle).



B28693: Shot, AP-T, 120-mm, T116E5 assembled with 5° obturator and with windshields attached by adhesives reinforced with 3 carbon steel pins. Typical example of shot obturation and flight when conditioned at +160°F. Muzzle velocity 3358 fps, chamber pressure 36,600 psi, tube round number 194. TOP: Obturation (muzzle). BOTTOM: Shot condition (100 ft from muzzle).



B28694: Shot, AP-T, 120-mm, T116E5 assembled with 5° obturator and with windshields attached by adhesives reinforced with 3 carbon-steel pins. Typical example of shot obturation and flight when fired at ambient temperature at 112% excess pressure of a new tube. Muzzle vel 3289 fps, chamber pressure 37,400 psi, tube rd no. 231. TOP: Obturation (muzzle). BOTTOM: Shot condition (100 ft from muzzle).

APPENDIX D

Distribution

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