ARTILLERY DIVISION

REPORT ON

EVALUATION OF PREPRODUCTION SHOT, APDS, 105-MM, M392A1 FOR M68 GUN (U)

Second Report on Project OAC-1/60

R. H. ALLEN

Unclassified

Regraded

By authority of DTIC AD 317 307

Date

29 July 81

JUNE 1960

Aberdeen Proving Ground
Maryland
Reproduction of this document, in whole or in part, is prohibited except with permission of the issuing office; however, ASTIA is authorized to reproduce the document for U. S. Governmental purposes.

All request for additional copies of this report will be made to ASTIA, Arlington Hall Station, Arlington 12, Virginia.
AD- 317307
SECURITY REMARKING REQUIREMENTS
DOD 5200.1-R, DEC 78
REVIEW ON 28 JUN 80
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.
EVALUATION OF PREPRODUCTION SHOT, APDS, 105-MM, M392A1 FOR M68 GUN  (U)

DESCRIPTIVE NOTE: Rept. no. 2, JUN 60 16P ALLEN, R.H.;
PROJ: OAC-I-60

UNCLASSIFIED REPORT C-11, 698

DESCRIPTORS: *ARMOR PIERCING AMMUNITION, *HYPERVELOCITY PROJECTILES, *PROJECTILES, *SABOT PROJECTILES, MAGNESIUM ALLOYS, MECHANICAL PROPERTIES, PENETRATION, TESTS  (U)
IDENTIFIERS: M-392 CARTRIDGES(105-MM), M-68 GUNS(105-MM)   (U)
EVALUATION OF PREPRODUCTION SHOT, APDS, 105-MM, M392A1 FOR M68 GUN (U)

Second Report on Project QAC-I/60
Date of Test: February 1960

ABSTRACT (S)

Fifty Shot, APDS, 105-mm, M392A1 were supplied for an evaluation of armor-penetration and 1000-yard-accuracy characteristics. The shot were divided into two groups of 25 each and assembled with sabots from two different suppliers.

The defeat-of-armor phase was fired first using the stipulated shot and a 5-inch rolled homogeneous armor plate set at 60° obliquity. A protection ballistic limit of \( \frac{1}{4} \)600 fps was obtained for the US shot, but due to the urgency of the program a protection ballistic limit was not obtained for the UK shot.

In the accuracy and metal-parts phase the shot to be fired at 70°F were assembled with experimental tracers designated XM+. Ten of the rounds were temperature-conditioned at -40°F and the other 20 were fired at 70°F in groups of ten. Acceptable accuracy was obtained with the sabots from both suppliers.

In view of the promising accuracy results obtained in this program, it is recommended that a more extensive test be fired with similarly constructed projectiles to confirm the adequacy of design and construction. Additional plate-performance tests should be conducted with both the UK and US shot to establish a valid comparison of the two rounds.

"This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act of 1917, 35 U.S.C. Section 192, and Title 18, U.S.C., Section 1010. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law."
CONTENTS (U)

INTRODUCTION .............................................. 3
DESCRIPTION OF MATERIEL ................................. 3
DETAILS OF TEST ........................................... 3
   Procedure ............................................. 3
   Results ............................................... 4
CONCLUSIONS ............................................... 4
RECOMMENDATIONS .......................................... 5
APPENDIX A: CORRESPONDENCE .............................. A-1
APPENDIX B: FIRING RECORD ............................... B-1
APPENDIX C: AMMUNITION DATA ............................ C-1
APPENDIX D: DISTRIBUTION ................................. D-1
1. (S) INTRODUCTION

Previous firing of the 105-mm, APDS shot, as manufactured by the US gave positive evidence of sabot failure and/or total breakup of the sub-projectile within the tube. Investigation as to the cause of breakup revealed that tighter control was necessary over material physical properties than was implied by UK drawings and specifications.

Metal parts submitted for the current test have been manufactured in accordance with the latest technical data and advice from UK representatives. The purpose of this test is to confirm and evaluate the performance of shot produced by US production methods for the translated design.

2. (S) DESCRIPTION OF MATERIEL

The following materiel was under test:

a. Shot, APDS, 105-mm, M392A1, numbered 301 through 325, Lot FA-E-554. Sabots consist of AZ61 magnesium alloy from supplier "A".

b. Shot, APDS, 105-mm, M392A1, numbered 326 through 350, Lot FA-E-554-1. Sabots consist of AZ61 magnesium alloy from supplier "B".

Further information may be found in Appendix C (data sheet with shot characteristics).

3. DETAILS OF TEST

3.1 (U) Procedure

In this test the plate-penetration phase was fired first. A piece of armor plate was placed in the butts at the required obliquity, and following each round the plate was checked for movement and to assure the correct obliquity. As the first plate fired upon was small in area, the number of hits was limited. A larger plate with a comparable BHN and Charpy value was then used to insure a fair hit.

In the accuracy phase, ten rounds were temperaturized at the request of the arsenal representative and tracers were not assembled with these rounds. All other rounds fired for accuracy at 1000 yards were assembled with the experimental tracers. Velocities of the shot during the accuracy firings were not recorded, at the request of the arsenal representative. A smear type camera was emplaced 35 feet from
the muzzle but was not used because of inclement weather during the firing of the test. All rounds fired were assembled with the service charge as received from the UK.

3.2 (S) Results

Considering the plate-firing results of the last 10 US shot fired in L7 Tube No. L/25, a PEL of 4609 fps was obtained. Only three UK shot were fired before the plate firing was suspended at the request of the FA representative in favor of the target accuracy firing. Insufficient data were obtained with the UK shot to make a valid comparison of plate performance with the US version.

In the accuracy phase of the test, the ten rounds temperature-conditioned at -40°F were fired first followed by the remaining 20 rounds at 70°F. The results of the firing follow:

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Temperature, °F</th>
<th>Probable Error, mils Vertical</th>
<th>Lateral</th>
<th>Range, yards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-40</td>
<td>0.12</td>
<td>0.08</td>
<td>1000</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>0.11</td>
<td>0.09</td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>0.19</td>
<td>0.13</td>
<td>1000</td>
</tr>
<tr>
<td>Grand Average</td>
<td></td>
<td>0.14</td>
<td>0.10</td>
<td></td>
</tr>
</tbody>
</table>

Test Round 38 in group three was an outlier and exhibited what appeared to be a tracer separation. However, no positive evidence of projectile failure could be found and it is concluded that no serious malfunction occurred.

4. (S) CONCLUSIONS

It is concluded that:

a. The current production Shot, APDS, 105-mm, M392A1 will yield satisfactory accuracy and metal-parts security if manufactured from AZ61 magnesium alloy from either supplier "A" or "B".

b. The data generated from the plate firing is not conclusive and further firing with both control and test rounds will be necessary to yield a more conclusive PEL.
5. (S) RECOMMENDATIONS

It is recommended that:

a. In view of the promising accuracy results obtained in this program it is recommended that a more extensive test be fired with similarly constructed projectiles to confirm the adequacy of design and construction.

b. Additional plate performance tests should be conducted with both UK and US shot to establish a valid comparison of the two rounds.

SUBMITTED:

Ralph H. Allen
Test Director

REVIEWED:

H. B. Anderson
Chief, Artillery
Ammunition Branch

H. A. Bechtol
Chief, Artillery
Division

APPROVED:

H. A. Noble
Assistant Deputy Director
for Engineering Testing
Development and Proof Services
APPENDICES

| A, CORRESPONDENCE   | A-1  |
| B, FIRING RECORD    | B-1  |
| C, AMMUNITION DATA  | C-1  |
| D, DISTRIBUTION     | D-1  |
SUBJECT: Cartridge, APDS-T, 105mm, M392

TO: Commanding General
    Aberdeen Proving Ground
    Maryland
    ATTN: ORDBG-D&PS, Mr. H. Anderson

Inclosed is Test Program Request FA-IEP-59-6114-1-3 covering testing of subject cartridge. It is requested that this Arsenal be notified in advance of the test in order that a representative may be present. This Arsenal has been advised that funds to fire this program will be forwarded to Aberdeen Proving Ground by Picatinny Arsenal.

FOR THE COMMANDER:

G. W. BROWN
Assistant
cc: OCO, ATTN: ORDIM w/incl
    OAC, ATTN: ORDLY-AI w/incl
    Pic Ars, ATTN: ORDBB-DC w/incl
    APG, ATTN: ORDBG-D&PS w/incl
1. Material for Test:

   (a) Twenty-five (25) each Projectile, 105mm, APDS-T, M392, numbered 301 through 325. Sabots of AZ61 magnesium alloy from supplier "A", sub-numbers 1 and 3 following the basic number identify the bar from which sabots were machined.

   (b) Twenty-five (25) each projectile, 105mm, APDS-T, M392, numbered 326 through 350. Sabots of AZ61 magnesium alloy from supplier "B", sub-numbers and letters following the basic number identify the bar from which the sabots were machined and the relative position in that bar.

   (c) U. K. NQM propellant and L1A3 primers with approved igniters for fifty (50) rounds.

   (d) Fifty (50) case cartridge, 105mm, M115

   (e) U. K. tank gun, 105mm L7A1, one-quarter to one-half worn.

2. Project Authority:

   DCS Log Project No. 517-FY-58 (ORD) A6-86-58-1

3. Arsenal Expenditure Order No:

   X0 84525-02
   X0 94639-01

4. Object of Development or Experiment:

   To evaluate performance of rounds produced during U. S. Production engineering of the translated U. K. design.

5. History Sketch:

   Failures encountered in previous engineering testing (ref: TPR's FA-IEP-59-6114-1-1, FA-IEP-59-6114-1-2 and FA-D-86) have indicated that a higher degree of control is required over material physical properties than implied by U. K. drawings and specifications. Review of test data and discussions with U. K. design personnel have resulted in a revision of drawings and specifications for this purpose. Metal parts to be tested under this TPR have been manufactured in accordance with this latest technical data package and are considered representative of the U. S. production of the M392 APDS-T projectile.
6. Improvement or Changes since Last Proving Ground Test:

(a) Test rounds for this TPR have been assembled with an improved nose component. Laboratory tests show this component to have mechanical properties listed as follows:

1. Ultimate tensile 119,900 psi
2. Hardness 32-33 R
3. Compression Test ($\frac{3}{8}$"x $\frac{1}{8}$" cylinder)
   - Original length .501"
   - Length after Comp. .252" - No visible evidence of cracking after compression testing.

7. Object of this Test:

Confirmation of final technical data package.

8. Local Tests:

Mechanical Testing

Supplier "A"

(a) Bar #1

<table>
<thead>
<tr>
<th>Tensile</th>
<th>Yield</th>
<th>% Elong.</th>
</tr>
</thead>
<tbody>
<tr>
<td>44,000</td>
<td>27,200</td>
<td>16.3</td>
</tr>
<tr>
<td>43,500</td>
<td>26,200</td>
<td>16.2</td>
</tr>
</tbody>
</table>

(b) Bar #3

<table>
<thead>
<tr>
<th>Tensile</th>
<th>Yield</th>
<th>% Elong.</th>
</tr>
</thead>
<tbody>
<tr>
<td>42,400</td>
<td>26,100</td>
<td>14.5</td>
</tr>
<tr>
<td>42,200</td>
<td>24,700</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Supplier "B"

<table>
<thead>
<tr>
<th>Tensile</th>
<th>Yield</th>
<th>% Elong.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
<td>Rear</td>
<td>Front</td>
</tr>
<tr>
<td>Bar #1</td>
<td>44,800</td>
<td>44,400</td>
</tr>
<tr>
<td>Bar #9</td>
<td>42,100</td>
<td>44,400</td>
</tr>
</tbody>
</table>

9. Precautions in Handling and Testing:

Normal safety precautions should be employed in handling and testing of this ammunition.
10. **Recommended Test Program:**

This program will be fired in two (2) phases.

**Phase I - Metal Parts Security and Accuracy**

**Phase II - Plate penetrations capability of this design**

**Phase I - Metal Parts Security**

(a) Fire forty (40) test projectiles, identified as 301 through 320 and 326 through 345 at a 1000 yard target at service pressure and ambient temperature.

(b) Record muzzle velocity and chamber pressure for each round.

(c) Provide a photographic record of the performance of each round by smear photographs at 10° and 30° from the muzzle.

(d) Record P. E. separately (in 20 round groups) for projectile nos. 301 through 320 and 326 through 345.

**Note:** Supplemental information may be recorded as determined significant by the Proof Director.

**Phase II - Plate Penetration**

(a) Using the ten (10) remaining projectiles (nos. 321 through 325 and 346 through 350), establish a PBL against the required thickness of homo-rolled armor plate inclined at an angle of 60° from a plane normal to the trajectory.

(b) Record muzzle velocity and chamber pressure for each round.

(c) Provide clear and sufficiently detailed photographs to show the nature of shot impact with the plate.

**Note:** Another plate thickness and/or obliquity may be selected by the Proof Director, if in his opinion, an advantage may be gained with respect to better formulation of a reference PBL. Reference rounds may be used if available.

11. **Examination of Projectiles prior to Testing:**

(a) Record projectile weights and diameters of centering bands and rotating bands.

(b) Examine each projectile for gap forward of, or at the rear of the rotating band, and between the base and the rear of the sabot.
12. **References:**

   (a) Project Order 80304230-1-19-51751-01-0, dated 20 June 1958.

   (b) AIFO #87170100-99-4,5250-21

13. **Coordination:**

   Chief of Ordnance - ORDIM
   Picatinny Arsenal - ORDBB-DC
   Ordnance Ammunition Command - ORDLY-
   Aberdeen Proving Ground - D&PS
   Frankford Arsenal - 6151
APPENDIX B

Firing Record

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

FIRING RECORD

Evaluation of Preproduction Shot, APDS, 105-mm, M392Al for M68 Gun (U)
Project No.: OAC-I/60
Production Evaluation
Firing Record No.: P-56181 Dates of Test: 16, 17, 18 Feb 1960 Authority: Ltr dtd 9 Feb 1960
ORDBA-615I, w/TPR FA-
IEP-59-6114-1-3

PROJECT NO.: OAC-I/60

ITEMS UNDER TEST (U)

Shot, APDS, 105-mm, M392Al, Numbered 301 through 325, Lot FA-E-554.
Shot, APDS, 105-mm, M392Al, Numbered 326 through 350, Lot FA-E-554-1.

SUPPORTING FACILITIES AND MATERIALS

Ammunition (S):
All components from UK.
Primer, Electric, 467 grains, L1A3, Black Powder, Lot 3.
Case, Cartridge, 105-mm, RW-244, Lot 11P.
Propellant, N/QM, 0.044-inch web, Lot BS-23826.

Weapon (U):
Tube, 105-mm, L/7Al, No. L/17 (Test Rounds 1 to 6).
Tube, 105-mm, L/7Al, No. L/25 (Test Rounds 7 to 44).
Gun, 105-mm, M68, No. 4.
Recoil Mechanism, 155-mm, M3, No. 1135.
Mount, 155-mm, Ml, No. 332 (for plate phase only).
Mount, Pedestal, 155-mm, No. 91 (set in concrete) for accuracy phase.

Plate Data (U):
The plate data sheet may be found in Appendix C.

Velocity Coil Measurements (U):

16 February 1960
Muzzle to first coil - 80.04 feet
Between coils - 49.59 feet
Second coil to center of plate - 109.50 feet
Velocity measured at - 103.025 feet
17 February 1960

Muzzle to first coil - 80.15 feet
Between coils - 49.645 feet
Second coil to center of plate - 108.40 feet
Velocity measure at - 104.87 feet

M3 Pressure Gage Data (U):

All rounds in plate firing assembled with two M3 gages.

Type of Gage: Medium Caliber (M3), Copper Cup.

Position of Gage: In base of case.

Crusher Cylinder: Metal of 1956, Annealed 1956, Lot 9C-56.

Initial Compression: 0

ROUND-BY-ROUND DATA (U)

Round-by-round data may be found in Inclosure 1.

REMARKS (U)

This firing record forms a part of the Second Report on Project OAC-I/60.

SUBMITTED:

RALPH H. ALLEN
Test Director

REVIEWED:

H. B. ANDERSON
Chief,
Artillery Ammunition Branch

APPROVED:

H. A. BECHTOL
Chief,
Artillery Division

1 Incl
1. Round-by-Round Data
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>L/17</td>
<td>135</td>
<td>1 11 8</td>
<td>UK</td>
<td>4381</td>
<td>4369</td>
<td>398</td>
<td>Partial</td>
<td>2 1/2 x 11 x 4</td>
</tr>
<tr>
<td></td>
<td>136</td>
<td>2 12 0</td>
<td>UK</td>
<td>Lost</td>
<td>Lost</td>
<td>410</td>
<td>Partial</td>
<td>3 x 11 1/2 x 4 1/2</td>
</tr>
<tr>
<td></td>
<td>137</td>
<td>3 12 1</td>
<td>UK</td>
<td>Lost</td>
<td>Lost</td>
<td>416</td>
<td>Partial</td>
<td>3 x 11 x 4 1/2</td>
</tr>
<tr>
<td></td>
<td>138</td>
<td>4 12 1</td>
<td>US</td>
<td>4723</td>
<td>4711</td>
<td>458</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>139</td>
<td>5 12 1</td>
<td>US</td>
<td>4741</td>
<td>4729</td>
<td>463</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>6 12 1</td>
<td>US</td>
<td>4750</td>
<td>4738</td>
<td>472</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>L/25</td>
<td>5</td>
<td>7 11 8</td>
<td>US</td>
<td>4534</td>
<td>4522</td>
<td>431</td>
<td>Partial</td>
<td>3 x 11 x 3 1/2</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>8 11 10</td>
<td>US</td>
<td>4657</td>
<td>4645</td>
<td>456</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>9 11 8</td>
<td>US</td>
<td>4644</td>
<td>4632</td>
<td>453</td>
<td>Complete</td>
<td>3 x 11 x 5</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>10 11 9</td>
<td>US</td>
<td>4627</td>
<td>4615</td>
<td>458</td>
<td>Partial</td>
<td>3 x 12 x 4 1/2</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>11 11 10</td>
<td>US</td>
<td>4631</td>
<td>4619</td>
<td>442</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>12 11 7</td>
<td>US</td>
<td>Lost</td>
<td>Lost</td>
<td>427</td>
<td>Partial</td>
<td>2 1/2 x 10 1/2 x 4 1/2</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>13 11 8</td>
<td>US</td>
<td>4601</td>
<td>4594</td>
<td>429</td>
<td>Partial</td>
<td>3 x 10 1/2 x 4 1/2</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>14 11 8</td>
<td>US</td>
<td>4567</td>
<td>4550</td>
<td>426</td>
<td>Complete</td>
<td></td>
</tr>
</tbody>
</table>
### Round-by-Round Data, Accuracy Firing at 1000 Yards (S)

<table>
<thead>
<tr>
<th>Round No.</th>
<th>Shot No.</th>
<th>Temperature Fired, °F</th>
<th>Vertical</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>15</td>
<td>331-1-L</td>
<td>-40</td>
<td>441</td>
</tr>
<tr>
<td>14</td>
<td>16</td>
<td>333-1-N</td>
<td>-40</td>
<td>36</td>
</tr>
<tr>
<td>15</td>
<td>17</td>
<td>334-1-P</td>
<td>-40</td>
<td>35</td>
</tr>
<tr>
<td>16</td>
<td>18</td>
<td>330-1-K</td>
<td>-40</td>
<td>33</td>
</tr>
<tr>
<td>17</td>
<td>19</td>
<td>332-1-M</td>
<td>-40</td>
<td>32.5</td>
</tr>
<tr>
<td>18</td>
<td>20</td>
<td>328-1-I</td>
<td>-40</td>
<td>29.5</td>
</tr>
<tr>
<td>19</td>
<td>21</td>
<td>329-1-J</td>
<td>-40</td>
<td>26.5</td>
</tr>
<tr>
<td>20</td>
<td>22</td>
<td>347-1-T</td>
<td>-40</td>
<td>25</td>
</tr>
<tr>
<td>21</td>
<td>23</td>
<td>326-1-F</td>
<td>-40</td>
<td>21</td>
</tr>
<tr>
<td>22</td>
<td>24</td>
<td>327-1-G</td>
<td>-40</td>
<td>22</td>
</tr>
</tbody>
</table>

**Probable Error, mils**

- Vertical: .12
- Horizontal: .08

<table>
<thead>
<tr>
<th>Round No.</th>
<th>Shot No.</th>
<th>Temperature Fired, °F</th>
<th>Vertical</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>25</td>
<td>309-1</td>
<td>70</td>
<td>18</td>
</tr>
<tr>
<td>24</td>
<td>26</td>
<td>317-3</td>
<td>70</td>
<td>14.5</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>303-1</td>
<td>70</td>
<td>18</td>
</tr>
<tr>
<td>26</td>
<td>28</td>
<td>318-3</td>
<td>70</td>
<td>18</td>
</tr>
<tr>
<td>27</td>
<td>29</td>
<td>302-1</td>
<td>70</td>
<td>16</td>
</tr>
<tr>
<td>28</td>
<td>30</td>
<td>335-1-Q</td>
<td>70</td>
<td>22</td>
</tr>
<tr>
<td>29</td>
<td>31</td>
<td>312-3</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td>30</td>
<td>32</td>
<td>346-1-R</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td>31</td>
<td>33</td>
<td>313-3</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>32</td>
<td>34</td>
<td>339-9-Q</td>
<td>70</td>
<td>7</td>
</tr>
</tbody>
</table>

**Probable Error, mils**

- Vertical: .11
- Horizontal: .09

<table>
<thead>
<tr>
<th>Round No.</th>
<th>Shot No.</th>
<th>Temperature Fired, °F</th>
<th>Vertical</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>35</td>
<td>343-9-L</td>
<td>70</td>
<td>-5.5</td>
</tr>
<tr>
<td>34</td>
<td>36</td>
<td>340-9-P</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>35</td>
<td>37</td>
<td>301-1</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td>36</td>
<td>38</td>
<td>341-9-N</td>
<td>70</td>
<td>-29</td>
</tr>
<tr>
<td>37</td>
<td>39</td>
<td>306-1</td>
<td>70</td>
<td>-16</td>
</tr>
<tr>
<td>38</td>
<td>40</td>
<td>338-9-R</td>
<td>70</td>
<td>-6</td>
</tr>
<tr>
<td>39</td>
<td>41</td>
<td>304-1</td>
<td>70</td>
<td>-27</td>
</tr>
<tr>
<td>40</td>
<td>42</td>
<td>337-9-T</td>
<td>70</td>
<td>-28</td>
</tr>
<tr>
<td>41</td>
<td>43</td>
<td>305-1</td>
<td>70</td>
<td>-27</td>
</tr>
<tr>
<td>42</td>
<td>44</td>
<td>342-9-M</td>
<td>70</td>
<td>-23</td>
</tr>
</tbody>
</table>

**Probable Error, mils**

- Vertical: .19
- Horizontal: .13

Distance muzzle to center of target 2,963.84 feet
Boresight elevation 3.1 mils
Superelevation 3.9 mils
## APPENDIX C
### Ammunition Data

#### SECURITY CLASSIFICATION

<table>
<thead>
<tr>
<th>FILE NO.</th>
<th>SUBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>105 M/M M592A1</td>
<td></td>
</tr>
</tbody>
</table>

#### SHOT CHARACTERISTICS

<table>
<thead>
<tr>
<th>#</th>
<th>Weight</th>
<th>Dia. of R. Band</th>
<th>Cono. of R. Band</th>
<th>Dia. of Centering Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>301-1</td>
<td>12.71</td>
<td>4.265</td>
<td>.004</td>
<td>OK</td>
</tr>
<tr>
<td>302-1</td>
<td>12.7</td>
<td>4.267</td>
<td>.007</td>
<td>OK</td>
</tr>
<tr>
<td>303-1</td>
<td>12.72</td>
<td>4.27 to 4.273</td>
<td>.003</td>
<td>OK</td>
</tr>
<tr>
<td>304-1</td>
<td>12.72</td>
<td>4.269 to 4.273</td>
<td>.006</td>
<td>4.119</td>
</tr>
<tr>
<td>305-1</td>
<td>12.72</td>
<td>4.265</td>
<td>.005</td>
<td>OK</td>
</tr>
<tr>
<td>306-1</td>
<td>12.72</td>
<td>4.265</td>
<td>.005</td>
<td>OK</td>
</tr>
<tr>
<td>309-1</td>
<td>12.7</td>
<td>4.269 to 4.270</td>
<td>.001</td>
<td>OK</td>
</tr>
<tr>
<td>312-3</td>
<td>12.74</td>
<td>4.270 to 4.271</td>
<td>.001</td>
<td>OK</td>
</tr>
<tr>
<td>313-3</td>
<td>12.72</td>
<td>4.270</td>
<td>.007</td>
<td>OK</td>
</tr>
<tr>
<td>317-5</td>
<td>12.71</td>
<td>4.270 to 4.2715</td>
<td>.006</td>
<td>OK</td>
</tr>
<tr>
<td>318-5</td>
<td>12.73</td>
<td>4.267</td>
<td>.006</td>
<td>OK</td>
</tr>
<tr>
<td>319-5</td>
<td>12.72</td>
<td>4.265</td>
<td>.004</td>
<td>OK</td>
</tr>
<tr>
<td>320-5</td>
<td>12.75</td>
<td>4.267</td>
<td>.004</td>
<td>OK</td>
</tr>
<tr>
<td>321-1</td>
<td>12.72</td>
<td>4.265</td>
<td>.005</td>
<td>OK</td>
</tr>
<tr>
<td>322-1</td>
<td>12.71</td>
<td>4.265</td>
<td>.004</td>
<td>OK</td>
</tr>
<tr>
<td>325-1</td>
<td>12.72</td>
<td>4.268</td>
<td>.005</td>
<td>OK</td>
</tr>
</tbody>
</table>

**REPLACES NME FORM 96, 1 OCT 48. WHICH MAY BE USED**
ORDNANCE CORPS
AMMUNITION DATA CARD AND
LOT DESCRIPTION SHEET

ARSENAL, PLANT, OR DISTRICT
Frankford Arsenal

ITEM
Projectile 105-mm M382A1 - APDS-T

CONTRACTOR
Frankford Arsenal

DRAWING AND REVISION
F-8595461 REV A

SPEC. AND REVISION
MIL-G-2550

DATE COMPLETED
February 1960

CONTRACT ORDER NO.
FA-E-554

DATE SENT
February 1960

SENT TO
Aberdeen Proving Ground, Md.

COMPONENT
Component Parts Manufactured by F. A. to Dwg.
Sheath Forward
Sheath Rear
Cup
Base
Sabot
Rotating Band
Centering Band
Plug & Disc Assembly
Core
Nose

D-8595474
D-8595477
C-8595466
D-8595475
D-8595476
C-8595469
C-8595470
C-8595462
C-8595471

Manufactured by Kennametal Inc.

DISPOSITION
Finally Accepted

INSPECTOR'S SIGNATURE AND TYPED NAME
/s/ R. W. Anderson
/t/ R. W. ANDERSON

Remarks:
* Packing of Lot ---Projectiles will be packed on Pallets not to exceed 50 each. Pallet may contain lesser amts. Pending on Total Quantity shipped.
**ARDNANCE CORPS**
**AMMUNITION DATA CARD AND LOT DESCRIPTION SHEET**

**ARSENAL, PLANT, OR DISTRICT**
Frankford Arsenal

**NET QUANTITY**
26

**LOT NUMBER**
FA-E-554-1

**ITEM**
Projectile 105-mm M382A1 - APDS-T

**CONTRACTOR**
Frankford Arsenal

**DRAWING AND REVISION**
F-8595461 REV A

**SPEC. AND REVISION**
MIL-G-2550

**DATE STARTED:**
February 1960

**DATED COMPLETED:**
February 1960

**DATE INSPECTED:**
February 1960

**SENT TO**
Aberdeen Proving Ground, Md.

**DATE SENT**
February 1960

**COMPONENT**

<table>
<thead>
<tr>
<th>Component Parts Manufactured by F.A. to Dwg.</th>
<th>DRAWING NO.</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheath Forward</td>
<td>D-8595474</td>
<td>A</td>
</tr>
<tr>
<td>Sheath Rear</td>
<td>D-8595477</td>
<td>A</td>
</tr>
<tr>
<td>Cup</td>
<td>C-8595466</td>
<td>A</td>
</tr>
<tr>
<td>Base</td>
<td>D-8595475</td>
<td>A</td>
</tr>
<tr>
<td>Sabot</td>
<td>D-8595476</td>
<td>A</td>
</tr>
<tr>
<td>Rotating Band</td>
<td>C-8595469</td>
<td>A</td>
</tr>
<tr>
<td>Centering Band</td>
<td>C-8595470</td>
<td>A</td>
</tr>
<tr>
<td>Plug &amp; Disc Assembly</td>
<td>C-8595462</td>
<td>A</td>
</tr>
<tr>
<td>Core</td>
<td>C-8595471)</td>
<td>A</td>
</tr>
<tr>
<td>Nose</td>
<td>C-8595472)</td>
<td>Manufactured by Kennametal Inc.</td>
</tr>
</tbody>
</table>

*FY 59, WD 97110100-99-60200
FAXO-94622-01-50 12 February 1960

**DISPOSITION**
Finally Accepted

<table>
<thead>
<tr>
<th>INSPECTOR'S SIGNATURE AND TYPED NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>/s/ R. W. Anderson</td>
</tr>
<tr>
<td>/t/ R. W. ANDERSON</td>
</tr>
<tr>
<td>C-8595473</td>
</tr>
</tbody>
</table>

**Remarks:**
*Projectiles made of Alcoa Magnesium - packed with Lot FA-E-554 on pallets.
**ARMOR DATA CHECK SHEET**  
**SIP-12**

**MFG. RECORD NO.** 929002  
**MFG.** The Midvale Company  
**ADDRESS** Philadelphia, Pa.  
**MFG. DATE**  
**SHIPPEO TO** Aberdeen, Md.  
**SHIPPEO VIA:** X FRT EXP TRK  
**SAMPLE:** X PRIMARY RETEST CASTING  
**PRESENTS:** LBS.  
**CASTING NO.** B-5689

**PRIMARY CONTRACTOR**  
The Midvale Company

**CONTRACT**  
DA-18-001-ORD-2625

**ORDNANCE DISTRICT (OR ARSENAL)**  
Phila. Regional Office for Aberdeen Proving Ground

---

### CHEMICAL COMPOSITION

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>S</th>
<th>P</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Location</th>
<th>1ST INGOT</th>
<th>MID INGOT</th>
<th>LAST INGOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.31</td>
<td>0.44</td>
<td>0.28</td>
<td>0.010</td>
<td>0.015</td>
<td>1.53</td>
<td>3.60</td>
<td>36</td>
<td>TOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MIDDLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BOTTOM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### STEEL MILL FRACTURE DATA

<table>
<thead>
<tr>
<th></th>
<th>CARBURIZE</th>
<th>HOMOGENIZE</th>
<th>NORMALIZE</th>
<th>HARDEN</th>
<th>DRAW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TEMP</td>
<td>TIME</td>
<td>TEMP TIME AT TEMP</td>
<td>TEMP</td>
<td>TIME</td>
</tr>
<tr>
<td>1</td>
<td>600</td>
<td>5 hours</td>
<td>1400</td>
<td>12 hours</td>
<td>1540</td>
</tr>
<tr>
<td>2</td>
<td>1300</td>
<td>12 hours</td>
<td>1170</td>
<td>15 hours</td>
<td></td>
</tr>
</tbody>
</table>

**HEAT TREATMENT**

<table>
<thead>
<tr>
<th></th>
<th>HEAT NO.</th>
<th>INGOT</th>
<th>SLAB</th>
<th>PLATF NO.</th>
<th>THICK</th>
<th>SIZE</th>
<th>REQ BHN</th>
<th>ACTUAL BHN</th>
<th>HEAT TREATED FRACTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B-5689</td>
<td>14140-1</td>
<td>5&quot;</td>
<td>72x72</td>
<td>240</td>
<td>255-241</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>241-241</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PHYSICAL PROPERTIES

**Room Temperature**

<table>
<thead>
<tr>
<th>AM</th>
<th>36.0</th>
<th>CM</th>
<th>52.5</th>
<th>117500</th>
<th>101000</th>
<th>24.2</th>
<th>64.7</th>
<th>AM</th>
<th>55.0</th>
<th>CM</th>
<th>60.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>37.0</td>
<td>CM</td>
<td>52.0</td>
<td>119000</td>
<td>99000</td>
<td>24.0</td>
<td>66.4</td>
<td>AM</td>
<td>53.0</td>
<td>CM</td>
<td>59.0</td>
</tr>
<tr>
<td>AO</td>
<td>52.5</td>
<td>CO</td>
<td>67.5</td>
<td>116000</td>
<td>100500</td>
<td>27.0</td>
<td>70.9</td>
<td>AO</td>
<td>60.5</td>
<td>CO</td>
<td>69.0</td>
</tr>
<tr>
<td>AO</td>
<td>53.5</td>
<td>CO</td>
<td>68.0</td>
<td>120500</td>
<td>103000</td>
<td>26.0</td>
<td>69.1</td>
<td>AO</td>
<td>63.5</td>
<td>CO</td>
<td>65.0</td>
</tr>
</tbody>
</table>

**REMARKS**

Sonntag Universal Impact Machine  
Inspector-in-Charge The Midvale Company

---

### BALLISTIC TEST RECORD

<table>
<thead>
<tr>
<th>TEST</th>
<th>PROJECTILE</th>
<th>OBL.</th>
<th>THKS.</th>
<th>RECO. YEL.</th>
<th>ACT. YEL.</th>
<th>RESULT</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**PROOF FACILITY SIGNATURES**

To be filled in on typewriter (carbon backed) or by hand using India Ink (for reproduction).
<table>
<thead>
<tr>
<th>COPY NO.</th>
<th>NAME AND ADDRESS</th>
<th>NO. OF COPIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Chief of Ordnance Department of the Army Washington 25, D.C. Attn: ORDIM</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Commanding General Frankford Arsenal Philadelphia 37, Pa. Attn: ORDBA-6151</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Commanding General Ordnance Ammunition Command Joliet, Illinois Attn: ORDLY-AI</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Commanding Officer Picatinny Arsenal Dover, New Jersey Attn: ORDBB-DC</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Commanding Officer Diamond Ordnance Fuze Lab Washington 25, D.C. Attn: ORDTL 012</td>
<td>1</td>
</tr>
<tr>
<td>8,9</td>
<td>British Joint Services Mission Defence Research Staff 1800 K Street, N. W. Washington 6, D.C. THRU: OCO-ORDGU-SE</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>Commanding Officer USA Ordnance Test Activity Yuma Test Station Yuma, Arizona</td>
<td>1</td>
</tr>
<tr>
<td>13 thru 22</td>
<td>Commander Armed Services Tech Info Agency Arlington Hall Station Arlington 12, Virginia</td>
<td>10</td>
</tr>
<tr>
<td>COPY NO.</td>
<td>NAME AND ADDRESS</td>
<td>NO. OF COPIES</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>23,24,25</td>
<td>CONARC Liaison Office</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Aberdeen Proving Ground, Md.</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Navy Liaison Office</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Aberdeen Proving Ground, Md.</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>ARDC Liaison Office</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Aberdeen Proving Ground, Md.</td>
<td></td>
</tr>
<tr>
<td>0,1,2</td>
<td>Technical Library</td>
<td>Original</td>
</tr>
<tr>
<td></td>
<td>Aberdeen Proving Ground, Md.</td>
<td>1-Reference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-Record</td>
</tr>
</tbody>
</table>