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Aberdeen Proving Ground

MARYLAND

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CODE SHEET INCLUDED

CARTRIDGE, HEAT, 57MM, M307A1 (MOD)

WITH MODIFIED COPPER LINERS (U)

THIS DOCUMENT CONSISTS OF 27 PAGES

COPY 9 OF 19

D.A. Project No. 504-07-001

DEVELOPMENT AND PROOF SERVICES

First Report

OCC Project No. TA3-5204

Regarding data cannot be predetermined

ARMY-OS-ABERDEEN PROVING GROUND, MD-415

FC

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DEVELOPMENT AND PROOF SERVICES  
ARMEDEN PROOFING GROUND  
MARYLAND

AUTHORITY: ORDBB-TJ1, 471.5/6-91  
AFG (C) 471/307

CWlichinger/rmj  
26 September 1957

CARTRIDGE, HEAT, 57mm, M307A1 (MCO)

WITH MODIFIED COPPER LINERS (U)

FIRST REPORT ON ORDNANCE CORPS PROJECT NO. TA3-5206

DATES OF TEST: 26 FEBRUARY 1957 TO 12 JUNE 1957

ABSTRACT

OBJECTIVE

This test was designed to obtain information concerning 57mm, spin-compensated HEAT ammunition.

SUMMARY

Shells with fluted conical liners were tested for dynamic penetration of armor plate.

The multi-piece modified shells were tested at excess pressure for metal parts security.

Shells were fired with inert boosters to check fuze functioning.

CONCLUSIONS

Substantial improvement in penetration was obtained with fluted liners as compared to known performance of smooth liners.

Observations from this test indicate that the modified M307A1 projectiles can withstand excess pressure conditions.

Results indicate that the M90A1 fuze was functioning properly and was not bypassing the booster in initiating the Composition B bursting charge.

RECOMMENDATIONS

Development and testing of fluted liners to counteract undesirable rotational effects associated with spin-stabilized rounds should be continued.

NOV 20 1957

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**I. INTRODUCTION**

A. The primary objective of this test was to obtain information from dynamic tests of modified 57mm, HEAT ammunition, and, by comparing it with existing data for the standard 57mm HEAT round, to determine the effectiveness of the fluted liner in compensating for the rotational effect on penetration.

B. In Phase One of this program the M307A1 (Mod.) projectiles, containing fluted liners made by the rubber-covered-punch process, were fired against homogeneous armor plate to determine the penetration characteristics of the round.

C. In Phase Two the modified M307A1 projectiles were subjected to excess pressure conditions to determine if the new design was of adequate strength. The standard M307A1 projectile had a one-piece body. The body of the modified projectile was made from two pieces joined together by a screw thread.

D. The third and final phase of this program was to determine if the M90A1 Fuse would initiate the main charge of Composition B if an inert booster was used.

**II. DESCRIPTION OF MATERIAL**

A. Cartridge, HEAT, 57mm, M307A1 (Mod) with PBX booster pellet and five auxiliary detonator, 180 each, Lot PA-E-24034. (Reference Appendix D, Dwg. 75-1-215; Appendix C, Data Card No. 83539.)

B. Cartridge, HEAT, 57mm, M307A1 (Mod) with PBX booster pellet and a dummy auxiliary detonator, 100 each, Lot PA-E-24037. (Reference Appendix D, Dwg. 75-1-215; Appendix C, Data Card No. 83542.)

C. Cartridge, HEAT, 57mm, M307A1 with inert booster pellet, 25 each, Lot PA-E-24035.

D. Cartridges from Lots PA-E-24034 and 24035 were received as complete rounds and X-Rayed by this proving ground to determine quality of loading. Ammunition data cards for these lots are inclosed in Appendix C.

E. Cartridges from Lot PA-E-24037 were received as complete rounds less propellant and were loaded at this proving ground with enough propellant to reach 7280 psi (112% of rated maximum pressure), at a temperature of: +125°F.



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III DETAILS OF TEST

A. PROCEDURE FOR PHASE I

Phase I of this test consisted of firing 180 rounds, Lot PA-B-24034, as follows:

1. -Forty-five cartridges were conditioned to  $70^{\circ} \pm 5^{\circ}$  F. for a minimum of 16 hours. These rounds were fired against 4-inch homogeneous armor plate with a one-inch witness plate six inches behind the target.

2. -Forty-five cartridges were conditioned to  $70^{\circ} \pm 5^{\circ}$  F. for a minimum of 16 hours. These rounds were fired against five-inch homogeneous armor plate with a one-inch witness plate five inches behind the target.

3. -Forty-five cartridges were conditioned to  $-65^{\circ} \pm 5^{\circ}$  F. for a minimum of 16 hours. However, due to poor ignition of the propellant at a temperature of  $-65^{\circ}$  F, the conditioning temperature was changed to  $-40^{\circ}$  F after 21 rounds had been fired. These rounds were fired against four-inch homogeneous armor plate with a one-inch witness plate six inches behind the target.

4. -Forty-five cartridges were conditioned to  $-40^{\circ} \pm 5^{\circ}$  F. for a minimum of 16 hours. These rounds were fired against five-inch homogeneous armor plate with a one-inch witness plate five inches behind the target. The rounds were observed for premature functioning and the depth of penetration was recorded. Any round which impacted three-hole diameters from the edge of the plate or another impact was considered as an unfair hit.

B. RESULTS FOR PHASE I

1. Table I is a summary of firing of Phase I of this test.

- 2. Detailed round-by-round results may be found in firing record No. P-62641, Appendix A of this report.

3. Aberdeen Proving Ground photographs, Nos. B-23808 to B-23819, which show the entrance and exit views of penetrations of the target and witness plate, are inclosed in Appendix B.

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**TABLE I**

**SUMMARY OF FIRING**

| FIRING REF JRD<br>NO. P-62641                | RANGE<br>GUN TO TARGET: | B T D<br>150 ft. | DATES OF TEST: 26, 27, 28 Feb<br>and 7 March 1957 |                                       |                                                 |                                       |
|----------------------------------------------|-------------------------|------------------|---------------------------------------------------|---------------------------------------|-------------------------------------------------|---------------------------------------|
|                                              |                         |                  | 4" PLATE<br>AMMUNITION<br>AT<br>70°F.             | 5" PLATE<br>AMMUNITION<br>AT<br>70°F. | 4" PLATE<br>AMMUNITION<br>AT -65°F<br>AND -40°F | 5" PLATE<br>AMMUNITION<br>AT<br>-40°F |
| Total No. of Rounds                          |                         |                  | 45                                                | 45                                    | 45                                              | 45                                    |
| Failure to Function                          |                         |                  | 4                                                 | 4                                     | 2                                               | 2                                     |
| Improper Ignition of Prop.                   |                         |                  | —                                                 | —                                     | 3                                               | —                                     |
| Rounds Omitted (Unfair Hits)                 |                         |                  | 1                                                 | 4                                     | —                                               | 1                                     |
| Total No. of Valid Rounds                    |                         |                  | 40                                                | 37                                    | 40                                              | 42                                    |
| Total Rounds Penetrating:                    |                         |                  |                                                   |                                       |                                                 |                                       |
| 4" Plate                                     |                         |                  | 28                                                | —                                     | 28                                              | —                                     |
| 5" Plate                                     |                         |                  | —                                                 | 12                                    | —                                               | 23                                    |
| 1" Witness Plate                             |                         |                  | 11                                                | 2                                     | 3                                               | 8                                     |
| Total No. of Penetrations<br>greater than 3" |                         |                  | 36                                                | 28                                    | 35                                              | 39                                    |

Note: Rounds 1 - 21 conditioned at: -65°F.  
Rounds 22 - 45 conditioned at: -40°F.

Due to improper ignition of the propellant at  
-65°F, specifically rounds 277, 278, and 283,  
the conditioning temperature was changed to  
-40°F.

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C. PROCEDURE FOR PHASE II

In Phase II of this test 100 rounds of Lot PA-E-24037 were fired under the following conditions:

1. Cartridge cases contained enough propellant to develop 7280 psi, 112% of maximum rated pressure, after the rounds had been conditioned to +125°F for a minimum of 40 hours.

2. These rounds were fired for land impact at a range of approximately 4000 yards and observed for evidence of functioning. (Failure of the metal parts would be expected to result in instability or premature functioning in the bore or at the muzzle.)

D. RESULTS FOR PHASE II

There was no evidence of instability or of premature functioning or functioning on ground impact.

E. PROCEDURE FOR PHASE III

1. In Phase III of this program 25 rounds, Lot PA-E-25035 were conditioned to +70°F and fired against five-inch homogeneous armor plate.

2. The rounds were fired to determine if the M90A1 Fuze would initiate the Composition B in an inert boosted shell.

F. RESULTS FOR PHASE III

1. No plate penetrations were obtained. Examination of the target area disclosed large quantities of Composition B, indicating that the projectiles were either breaking up or deflagrating on impact to varying degrees.

2. Many base plugs were recovered from the shells. The base plugs had holes in them caused by the auxiliary detonator. This verified that the jet formed by the nose element of the fuze was properly directed to the booster rather than penetrating side of the spit-back tube or the cone proper. (Eccentricities in the auxiliary detonator were believed capable of yielding fuze failures.)

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**IV CONCLUSIONS**

A. It is concluded that:

1. Results from this test show that the M307A1 projectile with the fluted liners made by the rubber-covered-junk process is capable of defeating 4 to 5 inches of homogeneous armor plate and is therefore superior to the standard hemispherical liner which cannot be relied upon to consistently penetrate 3 inches of armor plate. (Inclosed in the reference is a list of reports which give the characteristics of the standard M307A1 projectile with hemispherical liner.)

2. The modified M307A1 projectile can withstand excess pressure conditions for the 57mm, M18, Rifle.

3. The nose element of the M90A1 fuse supplied with these projectiles was functioning properly.

**V RECOMMENDATION**

It is recommended that:

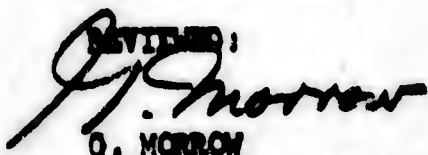
Development and testing of spin-compensating methods be continued to obtain a HEAT round which has optimum penetration characteristics.

**SUBMITTED:**



O. J. RICHMOND  
SP3 CPD  
Project Engineer

**REVIEWED:**

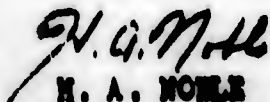


O. MORROW  
Chief, Mortar and  
Recalless Rifle Branch



H. A. ECKERT  
Chief  
Artillery Division

**APPROVED:**



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

REFERENCES

CLIFT, G. D., Performance of 57mm Shell  
Containing Fluted Liners Coined by the  
Rubber-Covered-Punch Process (C), Picatinny  
Arsenal Technical Report 2293, July 1956.

FIRING RECORD NO. P-47934

To determine the effect of clearance between  
shell bourrelet and rifle barrel on plate  
performance of Shell, HEAT, M307A1 with Fuze  
PD, M90A1, 57mm Rifle.

FIRING RECORD NO. P-49028

To develop Fuze, PI, TL89E1 for use in  
Shell, HEAT, 57mm, M307 or M307A1.

OBSERVERS

|              |   |   |   |   |                         |
|--------------|---|---|---|---|-------------------------|
| Mr. Jacobsen | . | . | . | . | Picatinny Arsenal       |
| Mr. McGarry  | . | . | . | . | Picatinny Arsenal       |
| Mr. Simon    | . | . | . | . | Ballistic Research Labs |

Code A

Code B

APPENDICES

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**DEVELOPMENT AND TEST SERVICES  
ARMED FORCES BOARD, WASHINGTON  
FIRING RECORD**

**ATTACHED A**

**SUBJECT OF TEST:** To obtain information  
concerning 57mm, spin-  
compensated HEAT  
Ammunition

**DATE OF TEST:** 26 February to  
12 June 1957

**FIRING RECORD NO.:** P-62641

**SHEET 1 OF 13**

**AUTHORITY:** ORDN-T-11, 471.5/6-9)  
AFM(C) 471/307

**DEVELOPMENT**

**PROJECT NO.:** TA3-5204

**WORK ORDER NO.:** 32-254-50 **NSJ**

**MATERIAL**

Rifle, 57mm, M18, No. 3871, with tripod mount.

**TEST AMMUNITION**

180 Cartridges, HEAT, 57mm, M307A1 (Mod), which contain PBX  
booster pellet and spit-back tube liner No. P-83981A  
Lot PA-E-24034, Data Card No. 83539.

100 Cartridges, HEAT, 57mm, M307A1 (Mod), except that shell  
contains a PBX booster pellet and a dummy auxiliary-  
detonator in the fuze also, spit-back liner No. 85762A  
Lot PA-E-24037, Data Card No. 83542.

25 Cartridges, HEAT, 57mm, M307A1, except that shell con-  
tains an inert booster pellet. The standard hemispheri-  
cal liner is used in this shell. Lot PA-E-24035, Data  
Card 83540.

**PLATE DATA**

|                      |                 |                 |         |         |
|----------------------|-----------------|-----------------|---------|---------|
| 4" Plate No.         | 0129398A2       | 015441A         |         |         |
| BHN "                | 241-241/255-255 | 302-302/302-293 |         |         |
| Charpy Impact        |                 |                 |         |         |
| Value at: -40°F.     | 55              | 49              |         |         |
| 5" Plate No.         | 0137600A1       | 0169625A        |         |         |
| BHN                  | 255-255/255-262 | 269-262/277-269 |         |         |
| Charpy Impact        |                 |                 |         |         |
| Value at: -40°F.     | No value        | No value        |         |         |
| 1" Witness Plate No. | A-139           | A-145           | A-124   | A-138   |
| BHN                  | 352-363         | 352-363         | 352-358 | 341-341 |
| Charpy Impact        |                 |                 |         |         |
| Value at: -40°F.     | 18.75           | 14.1            | 17.5    | 17.1    |

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**ROUND-BY-ROUND DATA**

FIELD RECORD NO. P-62661  
SHEET 2 OF 13

**PHASE I OF TEST**

DATE: 25 Feb. 1957

TIME: 1000 to 1600 Hours

RANGE: IVD Area

TEMPERATURE OF CARTRIDGE: 70° F.

CARTRIDGE LOT NO.: RA-E-24034

TARGET: Vertical armor plate 150 ft. from muzzle, consisting of 4 inch plate (No. 0129390A-2), 6 inch air space, followed by 1 inch witness plate (No. A-139).

| RIFLE<br>RD<br>NO. | PROJ.<br>NO. | COPPER<br>CHAMBER<br>PRESS, psi | PENETRA-<br>TION<br>inches | REMARKS                             |
|--------------------|--------------|---------------------------------|----------------------------|-------------------------------------|
| 148                | Lost         | 4300                            | 4                          | Marked witness plate                |
| 149                | Lost         | ---                             | 0                          |                                     |
| 150                | Lost         | ---                             | 4                          |                                     |
| 151                | Lost         | ---                             | 4                          | Marked witness plate                |
| 152                | 171          | ---                             | 0                          |                                     |
| 153                | 168          | Lost                            | 4                          | Marked witness plate                |
| 154                | 84           | ---                             | ---                        | Unfair hit                          |
| 155                | 62           | ---                             | 3 1/2                      | Bulged back of target               |
| 156                | 56           | ---                             | 3 1/2                      | Bulged back of target               |
| 157                | 150          | ---                             | 4                          |                                     |
| 158                | 143R         | 4400                            | 5                          | Completely penetrated witness plate |
| 159                | 133          | ---                             | 5                          | Completely penetrated witness plate |
| 160                | 54           | ---                             | 2 3/4                      |                                     |
| 161                | 82           | ---                             | 4                          |                                     |
| 162                | 131R         | ---                             | 5                          | Completely penetrated witness plate |
| 163                | 101          | 4400                            | 4                          | Marked witness plate                |
| 164                | 57           | ---                             | 3 1/8                      | Bulged back of target               |
| 165                | 9            | ---                             | 3 3/8                      | Bulged back of target               |
| 166                | 103R         | ---                             | 2 3/4                      |                                     |
| 167                | 100          | ---                             | 4                          |                                     |
| 168                | 231          | 4400                            | 5                          | Completely penetrated witness plate |
| 169                | 26           | ---                             | 4                          |                                     |
| 170                | 128          | ---                             | 3 3/4                      | Bulged back of target               |
| 171                | Lost         | ---                             | 3 7/8                      | Bulged back of target               |
| 172                | 86           | ---                             | 3 7/16                     |                                     |
| 173                | 193          | 4300                            | 4                          | Marked witness plate                |
| 174                | 107          | ---                             | 4                          |                                     |
| 175                | 79           | ---                             | 2 7/16                     |                                     |
| 176                | 110          | ---                             | 4                          | Marked witness plate                |
| 177                | 70           | 4400                            | 5                          | Completely penetrated witness plate |
| 178                | 172          | ---                             | 0                          |                                     |
| 179                | 109          | ---                             | 4                          | Marked witness plate                |
| 180                | 48           | ---                             | 4                          | Marked witness plate                |
| 181                | 24           | ---                             | 4                          | Marked witness plate                |
| 182                | 39           | Lost                            | 5                          | Completely penetrated witness plate |
| 183                | 45           | ---                             | 4                          |                                     |
| 184                | 108          | ---                             | 5                          | Completely penetrated witness plate |

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FIRING RECORD NO. P-43641  
SHEET 3 OF 13

| RIFLE<br>RD<br>NO. | PROJ.<br>NO. | COPPER<br>CHAMBER<br>PRESS, psi | PENETRA-<br>TION<br>inches | REMARKS                               |
|--------------------|--------------|---------------------------------|----------------------------|---------------------------------------|
| 185                | 43           | ----                            | 3 5/8                      |                                       |
| 186                | 237          | ----                            | 5                          | Completely penetrated witness plate   |
| 187                | 28           | 4000                            | 5                          | Completely penetrated witness plate   |
| 188                | 122          | ----                            | 5                          | Completely penetrated witness plate   |
| 189                | 21           | ----                            | ----                       | Unable to measure due to slug in hole |
| 190                | 53           | ----                            | 5                          | Completely penetrated witness plate   |
| 191                | 34R          | ----                            | 4                          |                                       |
| 192                | 71           | 4200                            | 0                          |                                       |

NOTE: Where "Marked witness plate" is listed in remarks, no appreciable penetration occurred.

PRESENT AT TEST: Mr. Jacobsen - Picatinny Arsenal  
Mr. Simon - Ballistic Research Lab

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FILING RECORD NO. 7-4242  
SHEET 4 OF 13

DATE: 27 and 28 Feb. 1957      TIME: 1225 to 1530 Hours  
RANGE: STD Area      TEMPERATURE OF CARTRIDGES: 70°F.  
CARTRIDGE LOT NO.: RA-S-24034

COIL DISTANCES:      Gun to First      -      44.2 - 44.2 ft.  
                            Between 1st and 2nd      -      30.05- 30.00 ft.  
                            Second to Plate      -      72.9 ft.

TARGET: Vertical armor plate 150 ft. from muzzle, consisting of 5 inch plate (No. 0137600-A1), 5 inch air space, followed by 1 inch witness plate (No. A-145).

| RIFLE | PROJ | COPPER     | MUZZLE           | STRIKING | PENETRA- |                                      |
|-------|------|------------|------------------|----------|----------|--------------------------------------|
| RD.   | NO.  | CHAMBER    | VEL.             | VEL.     | TION     |                                      |
| NO.   |      | PRESS, psi | fps              | fps      | inches   | REMARKS                              |
| 218   | 170  | 4300       | (Velocities were |          | 0        |                                      |
| 219   | 106  | —          | recorded on      |          | 3 1/2    |                                      |
| 220   | 128  | —          | rounds 252 to    |          | 2        |                                      |
| 221   | 31R  | —          | 261)             |          | 0        |                                      |
| 222   | 91R  | 4400       |                  |          | 3 1/16   |                                      |
| 223   | 165  | —          |                  |          | 3 5/8    |                                      |
| 224   | 89   | —          |                  |          | —        | Unfair hit                           |
| 225   | 102  | —          |                  |          | —        | Unfair hit                           |
| 226   | 239  | —          |                  |          | 2 7/8    |                                      |
| 227   | 49   | —          |                  |          | 6        | Completely penetrated witness plate. |
| 228   | 132  | 4800       |                  |          | 3 1/4    |                                      |
| 229   | 69   | —          |                  |          | 5        | Marked witness plate                 |
| 230   | 16   | —          |                  |          | 5        |                                      |
| 231   | 7R   | —          |                  |          | 2 7/16   |                                      |
| 232   | 60   | —          |                  |          | 4 1/8    |                                      |
| 233   | 76   | 4500       |                  |          | 5        |                                      |
| 234   | 184  | —          |                  |          | 3        |                                      |
| 235   | 22   | —          |                  |          | 0        |                                      |
| 236   | 87   | —          |                  |          | 4 3/4    | Bulged rear of target                |
| 237   | 147  | 4600       |                  |          | 3 3/4    |                                      |
| 238   | 46   | —          |                  |          | 3 3/4    |                                      |
| 39    | 64   | —          |                  |          | 3 1/8    |                                      |
| 40    | 65   | —          |                  |          | 3 1/2    |                                      |
| 241   | 42   | —          |                  |          | 5        | Marked witness plate                 |
| 242   | 105  | 4400       |                  |          | 2 7/8    |                                      |
| 243   | 85   | —          |                  |          | 5        | Marked witness plate                 |
| 244   | Lost | —          |                  |          | 4 1/2    | Bulged rear of target                |
| 245   | 11   | —          |                  |          | 2 5/8    |                                      |
| 246   | 30R  | —          |                  |          | —        | Unfair hit                           |
| 247   | 160  | 4300       |                  |          | —        | Unfair hit                           |
| 248   | 181  | —          |                  |          | 5        | Marked witness plate                 |
| 249   | 13   | —          |                  |          | 3 3/4    |                                      |
| 250   | 55   | —          |                  |          | 2 1/2    |                                      |
| 251   | 140  | —          |                  |          | 5        | Marked witness plate                 |

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FIELD NO. 10. 2-10-44  
PAGE 3 OF 13

| RIFLE PROJ<br>RD. NO. | COFFE<br>CHAMBER | MOBILE STRIKING<br>VEL. FPS | STRIKING<br>VEL. FPS | PENETRA-<br>TION<br>INCHES | REMARKS                             |
|-----------------------|------------------|-----------------------------|----------------------|----------------------------|-------------------------------------|
| 252 66                | 4900             | 1169                        | 1135                 | 0                          |                                     |
| 253 44                | ---              | 1160                        | 1127                 | 2 15/16                    |                                     |
| 254 198               | ---              | Lost                        | Lost                 | 6                          | Completely penetrated witness plate |
| 255 47                | ---              | 1151                        | 1119                 | 2 3/4                      |                                     |
| 256 A 71              | ---              | 1156                        | 1123                 | 3 1/4                      |                                     |
| 257 124               | 4800             | 1161                        | 1128                 | 5                          |                                     |
| 258 6                 | ---              | Lost                        | Lost                 | 2 3/4                      |                                     |
| 259 38                | ---              | Lost                        | Lost                 | 4                          |                                     |
| 260 192               | ---              | 1156                        | 1123                 | 4 15/16                    | Bulged back of target               |
| 261 142               | ---              | 1153                        | 1121                 | 5                          |                                     |
| 262 195               | 4800             |                             |                      | 5                          |                                     |

NOTE: Where "Marked witness plate" is listed in remarks, no appreciable penetration occurred.

PRESENT AT FIRING: Mr. Jacobsen - Picatinny Arsenal  
Mr. Simon - Ballistic Research Lab  
Code A  
Code B

CONFIDENTIAL

FIELD REPORT W-7-4244  
PAGE 4 OF 13

DATE: 5 and 7 March 1947 TIME: 0900 to 1200 Hours  
PLACE: JTC Area TEMPERATURE OF CARTRIDGES: -40°F and -40°F  
CARTRIDGE LOT NO.: 78-4-24034  
GILL DISTANCES: Gun to First: 44.25 - 44.5 ft.  
Between 1st and 2nd: 30. - 30.05 ft.  
Second to Plate: 72.85 ft.

TARGET: Vertical armor plate 150 ft. from muzzle, consisting of 4 inch plate (No. 015441A), 6 inch air space, followed by 1 inch witness plate (No. A124).

| RIFLE PROJ<br>RL NO.<br>NO.                          | COPPER<br>CHAMBER<br>PRESS, psi | MUZZLE<br>VEL.<br>fps | STRIKING<br>VEL.<br>fps | PENETRA-<br>TION<br>inches | REMARKS                                                                                             |
|------------------------------------------------------|---------------------------------|-----------------------|-------------------------|----------------------------|-----------------------------------------------------------------------------------------------------|
| 263 177                                              | 3100                            | (Velocities were      |                         | 4                          | Marked witness plate                                                                                |
| 264 162                                              | ---                             | recorded on           |                         | 4                          | Marked witness plate                                                                                |
| 265 127                                              | ---                             | Round 200 to 307)     |                         | 4                          |                                                                                                     |
| 266 178                                              | ---                             |                       |                         | 3 1/2                      |                                                                                                     |
| 267 96                                               | ---                             |                       |                         | 3 1/2                      |                                                                                                     |
| 268 94                                               | 3100                            |                       |                         | 4                          | Marked witness plate                                                                                |
| 269 242                                              | ---                             |                       |                         | 2 3/8                      |                                                                                                     |
| 270 179                                              | ---                             |                       |                         | 3 3/4                      | Bulged back of target                                                                               |
| 271 196                                              | ---                             |                       |                         | 4                          | Marked witness plate                                                                                |
| 272 164                                              | ---                             |                       |                         | 4                          |                                                                                                     |
| 273 185                                              | 2500(Est)                       |                       |                         | 4                          |                                                                                                     |
| 274 125                                              | ---                             |                       |                         | 0                          |                                                                                                     |
| 275 17                                               | ---                             |                       |                         | 4                          | Marked witness plate                                                                                |
| 276 69                                               | ---                             |                       |                         | 2 3/4                      |                                                                                                     |
| 277 236                                              | ---                             |                       |                         | 0                          | Poor ignition - found<br>projectile 10 ft. in front<br>of target - No evidence<br>of hitting plate. |
| 278 67                                               | 0                               |                       |                         | 0                          | Poor ignition - found<br>projectile 40 ft. in front<br>of gun.                                      |
| 279 121R                                             | 3400                            |                       |                         | 4                          |                                                                                                     |
| 280 82                                               | ---                             |                       |                         | 4                          | Marked witness plate                                                                                |
| 281 138R                                             | ---                             |                       |                         | 3 7/8                      | Bulged back of target                                                                               |
| 282 129R                                             | ---                             |                       |                         | 4                          |                                                                                                     |
| 283 149                                              | 0                               |                       |                         | 0                          | Poor ignition - found<br>proj. 20 ft. in front of<br>gun                                            |
| Above 21 rounds were fired on March 5th at -65°F     |                                 |                       |                         |                            |                                                                                                     |
| Following 24 rounds were fired on March 7th at -40°F |                                 |                       |                         |                            |                                                                                                     |
| 284 148                                              | 3100                            |                       |                         | 5                          | Completely penetrated<br>witness plate                                                              |
| 285 141R                                             | ---                             |                       |                         | 4                          |                                                                                                     |
| 286 158                                              | ---                             |                       |                         | 2 7/16                     |                                                                                                     |
| 287 190                                              | ---                             |                       |                         | 4                          |                                                                                                     |
| 288 12R                                              | 3200                            |                       |                         | 4                          | Marked witness plate                                                                                |
| 289 97                                               | ---                             |                       |                         | 4                          |                                                                                                     |



CONFIDENTIAL

FIRING RECORD NO. 9-4242  
SHEET 7 OF 12

| RIFLE<br>NO. | PROJ<br>NO. | COPPER<br>CHAMBER<br>PRESS, psi | MISILE<br>VEL<br>fps | STRIKE NO<br>VEL<br>fps | PENETRA-<br>TION<br>inches | REMARKS                                |
|--------------|-------------|---------------------------------|----------------------|-------------------------|----------------------------|----------------------------------------|
| 290          | 142         | ----                            | 1053                 | 1031                    | 4                          | Marked witness plate                   |
| 291          | 174         | ----                            | 1046                 | 1024                    | 4                          |                                        |
| 292          | 136         | ----                            | 1022                 | 1002                    | 2 7/16                     |                                        |
| 293          | 119         | 3600                            | 1027                 | 1019                    | 0                          |                                        |
| 294          | 59          | ----                            | 1035                 | 1015                    | 3                          |                                        |
| 295          | 185         | ----                            | 1056                 | 1034                    | 4                          |                                        |
| 296          | 8           | ----                            | 1054                 | 1032                    | 4                          |                                        |
| 297          | 58          | ----                            | 1056                 | 1034                    | 4                          | Marked witness plate                   |
| 298          | 27          | 3500                            | 1063                 | 1040                    | 4                          |                                        |
| 299          | 232         | ----                            | 1058                 | 1036                    | 4                          | Marked witness plate                   |
| 300          | 137         | ----                            | 1045                 | 1023                    | 4                          |                                        |
| 301          | 10          | ----                            | 1075                 | 1049                    | 5                          | Completely penetrated<br>witness plate |
| 302          | 234         | ----                            | 1043                 | 1022                    | 2 1/4                      |                                        |
| 303          | 189         | 3300                            | 1056                 | 1034                    | 4                          | Marked witness plate                   |
| 304          | 148         | ----                            | 1051                 | 1029                    | 3 1/2                      | Bulged back of target                  |
| 305          | 74          | ----                            | 1065                 | 1042                    | 3 5/8                      | Bulged back of target                  |
| 306          | 78          | ----                            | Lost                 | Lost                    | 4                          | Marked witness plate                   |
| 307          | 187         | ----                            | Lost                 | Lost                    | 4                          | Marked witness plate                   |

NOTE: Where "Marked witness plate" is listed in remarks,  
no appreciable penetration occurred.

PRESENT AT FIRING: Mr. McGarry - Picatinny Arsenal  
Mr. Simon - Ballistic Research Lab

A-7

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FIRING RECORD NO. 7-4241  
SHEET 8 OF 13

DATE: 7 March 1957 TIME: 1300 TO 1400 Hours  
RANGE: BTE Area TEMPERATURE OF CARTRIDGE: -40°F.  
CARTRIDGE LOT NO.: PB-S-24034

COIL DISTANCES: Gun to First - 44.3 - 44.2 ft.  
Between 1st and 2nd - 30.2 - 30.3 ft.  
Second to Target - 72.65 ft.

TARGET: Vertical armor plate 150 ft. from muzzle, consisting of  
5 inch plate (No. 1169629A), 5 inch air space, followed  
by 1 inch witness plate (No. A138).

| RIFLE<br>RD<br>NO. | PROJ<br>NO. | COPPER<br>CHAMBER<br>PRESS, psi | MUZZLE<br>VEL.<br>fps | STRIKING<br>VEL.<br>fps | PENETRA-<br>TION<br>inches | REMARKS                                |
|--------------------|-------------|---------------------------------|-----------------------|-------------------------|----------------------------|----------------------------------------|
| 308                | 183         | 3800                            | 1075                  | 1051                    | 6                          | Completely penetrated<br>witness plate |
| 309                | 81          | ---                             | 1049                  | 1027                    | 5                          | Marked witness plate                   |
| 310                | 98          | ---                             | 1030                  | 1010                    | 6                          | Completely penetrated<br>witness plate |
| 311                | 41          | ---                             | 1063                  | 1040                    | 6                          | Completely penetrated<br>witness plate |
| 312                | 75          | ---                             | 1055                  | 1033                    | 5                          | Marked witness plate                   |
| 313                | 72          | 3500                            | 1042                  | 1020                    | 5                          |                                        |
| 314                | 93          | ---                             | 1062                  | 1039                    | 6                          | Completely penetrated<br>witness plate |
| 315                | 50          | ---                             | 1063                  | 1040                    | 5                          | Marked witness plate                   |
| 316                | 154         | 3300                            | 1054                  | 1032                    | 2 7/16                     |                                        |
| 317                | 161         | ---                             | 1044                  | 1022                    | 6                          | Completely penetrated<br>witness plate |
| 318                | 19          | 3600                            | 1061                  | 1039                    | 4 1/4                      | Bulged back of target                  |
| 319                | 197R        | ---                             | 1068                  | 1045                    | 4 7/16                     | Bulged back of target                  |
| 320                | 167         | ---                             | 1057                  | 1035                    | 3 5/16                     |                                        |
| 321                | 18          | ---                             | 1046                  | 1024                    | 6                          | Completely penetrated<br>witness plate |
| 322                | 72          | ---                             | 1054                  | 1032                    | 5                          | Marked witness plate                   |
| 323                | 15          | 3600                            | 1062                  | 1039                    | 5                          |                                        |
| 324                | 157         | ---                             | 1056                  | 1034                    | 3 3/8                      |                                        |
| 325                | 130         | ---                             | 1046                  | 1024                    | 5                          |                                        |
| 326                | Lost        | ---                             | 1071                  | 1047                    | 5                          | Marked witness plate                   |
| 327                | 95          | ---                             | 1036                  | 1015                    | 4 1/8                      | Bulged back of target                  |
| 328                | 163         | ---                             | 1042                  | 1020                    | 4 3/16                     | Bulged back of target                  |
| 329                | 29          | 3500                            | 1045                  | 1023                    | 3 7/16                     |                                        |
| 330                | 73          | ---                             | 1062                  | 1039                    | 5                          | Marked witness plate                   |
| 331                | 182         | ---                             | 1059                  | 1036                    | 0                          |                                        |
| 332                | 4           | ---                             | 1064                  | 1041                    | 5                          | Marked witness plate                   |
| 333                | 88          | ---                             | 1063                  | 1040                    | 5                          |                                        |
| 334                | 166         | ---                             | 1046                  | 1024                    | 3 9/16                     |                                        |
| 335                | 33          | 3500                            | 1051                  | 1029                    | 5                          | Completely penetrated<br>witness plate |
| 336                | 1           | ---                             | 1064                  | 1041                    | 3                          |                                        |

CONFIDENTIAL

FIRING RECORD NO. F-4241  
SHEET 9 OF 13

| RIFLE<br>RD<br>NO. | PROJ<br>NO. | COPPER<br>CHAMBER<br>PRESS, psi | MUZZLE<br>VEL<br>fps | STRIKING<br>VEL<br>fps | PENETRA-<br>TION<br>inches | REMARKS                                |
|--------------------|-------------|---------------------------------|----------------------|------------------------|----------------------------|----------------------------------------|
| 337                | 83          | ---                             | 1042                 | 1020                   | 5                          |                                        |
| 338                | 61          | 3100                            | 1033                 | 1013                   | 4                          | Bulged back of target                  |
| 339                | 3           | ---                             | 1056                 | 1034                   | 0                          |                                        |
| 340                | 52          | ---                             | 1051                 | 1029                   | 4 1/8                      | Bulged back of target                  |
| 341                | 111R        | 3600                            | 1058                 | 1036                   | 3 1/2                      |                                        |
| 342                | 134         | ---                             | 1064                 | 1041                   | 2 7/8                      |                                        |
| 343                | 25          | 3900                            | 1062                 | 1035                   | ---                        | Unfair hit                             |
| 344                | 180R        | ---                             | 1046                 | 1024                   | 4                          | Bulged back of target                  |
| 345                | 120R        | ---                             | 1065                 | 1042                   | 3 3/16                     |                                        |
| 346                | 135         | ---                             | 1059                 | 1036                   | 5                          |                                        |
| 347                | 68          | ---                             | 1057                 | 1035                   | 5                          | Marked witness plate                   |
| 348                | 5           | 3600                            | 1059                 | 1036                   | 5                          | Marked witness plate                   |
| 349                | 176         | ---                             | 1048                 | 1026                   | 3 3/4                      |                                        |
| 350                | 99          | ---                             | 1056                 | 1034                   | 5                          | Marked witness plate                   |
| 351                | 117         | ---                             | 1059                 | 1036                   | 3 15/16                    |                                        |
| 352                | 175         | ---                             | 1079                 | 1047                   | 6                          | Completely penetrated<br>witness plate |

NOTE: Where "Marked witness plate" is listed in remarks,  
no appreciable penetrations occurred.

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ROUND-BY-ROUND DATA

FLAMING RECORD NO. F-42441  
SHEET 10 OF 13

PHASE II OF TEST

DATE OF FIRING: 28 March and 12 June 1957      TEMPERATURE: + 125°F.  
RANGE: BYD      AMMUNITION LOT NO. HA-B-2403?  
TARGET: 9600 Yard Recovery Field

| RIFLE<br>RD<br>NO. | PROJECTILE<br>NO. | CHAMBER<br>PRESSURE<br>psi | REMARKS     |
|--------------------|-------------------|----------------------------|-------------|
|                    |                   |                            | (See below) |
| 353                |                   |                            |             |
| 354                | 21 R              |                            |             |
| 355                | 89                |                            |             |
| 356                | 94 R              |                            |             |
| 357                | —                 | 7600                       |             |
| 358                | 18                |                            |             |
| 359                | 1 R               | 8000                       |             |
| 360                | 51 R              |                            |             |
| 361                | 2                 |                            |             |
| 362                | 50 R              | 7200                       |             |
| 363                | 49 R              |                            |             |
| 364                | C                 |                            |             |
| 365                | 6 R               | 8500                       |             |
| 366                | 46 R              |                            |             |
| 367                | 68                | 8000                       |             |
| 368                | 19 R              |                            |             |
| 369                | 31 C              |                            |             |
| 370                | 71                |                            |             |
| 371                | 13 R              |                            |             |
| 372                | 83 R              | 7300                       |             |
| 373                | 65                |                            |             |
| 374                | 29 R              |                            |             |
| 375                | 72                |                            |             |
| 376                | 55 R              |                            |             |
| 377                | 70                | 8300                       |             |
| 378                | 79                |                            |             |
| 379                | 40 R              |                            |             |
| 380                | 37                |                            |             |
| 381                | 77 R              |                            |             |
| 382                | 100 R             | 8400                       |             |
| 383                | 23                |                            |             |
| 384                | 78 R              |                            |             |
| 385                | —                 |                            |             |
| 386                | 91 R              |                            |             |
| 387                | 56                |                            |             |
| 388                | 38                | 8100                       |             |
| 389                | 35 R              |                            |             |
| 390                | 33                |                            |             |
| 391                | 82                |                            |             |
| 392                | 39                | 8500                       |             |

Rounds 353 to 392 inclusive:  
No evidence of premature function-  
ing or function upon ground  
impact.

## CONFIDENTIAL

ROUND-BY-ROUND DATA

FIRING RECORD NO. P-12641  
SHEET 11 OF 23PHASE II OF TEST

DATE OF FIRING: 28 March and 12 June 1957 (Continued)

| RIFLE<br>RD<br>NO. | PROJECTILE<br>NO. | CHAMBER<br>PRESSURE<br>psi | REMARKS     |
|--------------------|-------------------|----------------------------|-------------|
|                    |                   |                            | (See below) |
| 393                | 81                |                            |             |
| 394                | 43                |                            |             |
| 395                | 7                 |                            |             |
| 396                | 9 R               |                            |             |
| 397                | 12 R              | 8200                       |             |
| 398                |                   |                            |             |
| 399                | 278               |                            |             |
| 400                | 54                |                            |             |
| 401                | 30                |                            |             |
| 402                | 28                |                            |             |
| 403                | 32                |                            |             |
| 404                | 59                |                            |             |
| 405                | 84                |                            |             |
| 406                | 90                |                            |             |
| 407                | 85                |                            |             |
| 408                | 66                |                            |             |
| 409                | 20                | 7900                       |             |
| 410                | 10                |                            |             |
| 411                | 57                |                            |             |
| 412                | 22                |                            |             |
| 413                | 45                |                            |             |
| 414                | 8                 |                            |             |
| 415                | 93                |                            |             |
| 416                | 64                |                            |             |
| 417                | 27                |                            |             |
| 418                | 41                |                            |             |
| 419                | 7                 |                            |             |
| 420                | 48                |                            |             |
| 421                | 92                |                            |             |
| 422                | 99                |                            |             |
| 423                | 34                |                            |             |
| 424                | 16                |                            |             |
| 425                | 95                |                            |             |
| 426                | 11                |                            |             |
| 427                | 1                 | 7200                       |             |
| 428                | 69                |                            |             |
| 429                | 62                |                            |             |
| 430                | 44                | 7700                       |             |
| 431                | 97                |                            |             |

Rounds 393 to 430 inclusive:  
No evidence of premature func-  
tioning or function upon  
ground impact.

A-11

CONFIDENTIAL

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ROUND-BY-ROUND DATA

FIRING SEQUENCE NO. 7-2242  
SHEET 12 OF 13

PHASE II OF TEST

DATE OF FIRING: 28 March and 12 June 1957 (Continued)

| RIFLE<br>RD<br>NO. | PROJECTILE<br>NO. | CHAMBER<br>PRESSURE<br>psi | REMARKS |
|--------------------|-------------------|----------------------------|---------|
|--------------------|-------------------|----------------------------|---------|

(See below)

|     |     |      |
|-----|-----|------|
| 432 | 5   | 7900 |
| 433 | 29  |      |
| 434 | 24  | 7400 |
| 435 | 86  |      |
| 436 | --- |      |
| 437 | 88  |      |
| 438 | 53  |      |
| 439 | 96  |      |
| 440 | 61  |      |
| 441 | --- |      |
| 442 | 87  |      |
| 443 | 98  |      |
| 444 | 76  |      |
| 445 | 31  | 7400 |
| 446 | --- |      |
| 447 | --- |      |
| 448 | 47  |      |
| 449 | --- |      |
| 450 | --- |      |
| 451 | 42  |      |
| 452 | 3   |      |

No evidence of premature  
functioning or function  
upon ground impact.

At intervals throughout test chamber pressure was recorded with TIA.1  
copper pressure gages, inserted in the front of the chamber open  
and towards breech.



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ROUND-OF-ROUNDER DATA

FIELD RECORD NO. 7-2541  
SHEET 13 OF 13

PHASE III OF TEST

DATE OF FIRING: 27 February 1957

TEMPERATURE: + 70°F.

RANGE: BYD

AMMUNITION LOT NO. PA-B-24035 (Inert booster)

TARGET: Homogeneous Armor Plate

PRESENT FOR TEST: Mr. Jacobson - Picatinny Arsenal  
Mr. Simon - Ballistic Research Labs  
Code A  
Code B

TIME OF FIRING: 0930

| RIFLE<br>RD<br>NO.   | PROJECTILE<br>NO. | CHAMBER<br>PRESSURE<br>psi | REMARKS                           |
|----------------------|-------------------|----------------------------|-----------------------------------|
| 193                  | 4                 |                            | No penetration - Comp B on ground |
| 194                  | 7 R               |                            | " " " " " "                       |
| 195                  | 1 R               | 4300                       | - No impact on plate heard        |
| 196                  | 16 R              |                            | - Impact heard.                   |
| 197                  | 26 R              |                            | " " " "                           |
| 198                  | 24 R              |                            | " " " "                           |
| 199                  | 27 R              |                            | " " " "                           |
| 200                  | 20 R              |                            | " " " "                           |
| 201                  | 14                |                            | " " " "                           |
| 202                  | 18 R              |                            | " " " "                           |
| 203                  |                   |                            | " " " "                           |
| 204                  | 9 R               | 4700                       | " " " "                           |
| 205                  | 21                |                            | No Pene. - Impact heard           |
| 206                  | 5 R               |                            | " " " "                           |
| 207                  | B 12              |                            | " " " "                           |
| 208                  | 22 R              |                            | " " " "                           |
| 209                  | 29 R              |                            | " " " "                           |
| 210                  | B-2               |                            | " " " "                           |
| 211                  | 3 R               |                            | " " " "                           |
| 212                  | 17 R              | 4100                       | " " " "                           |
| TIME OF FIRING: 1015 |                   |                            |                                   |
| 213                  | 10 R              |                            | " " " "                           |
| 214                  | 30 R              |                            | " " " "                           |
| 215                  | 8 R               |                            | " " " "                           |
| 216                  | 15 R              |                            | " " " "                           |
| 217                  | 2 R               |                            | " " " "                           |

TIME: 1030

APPROVED:

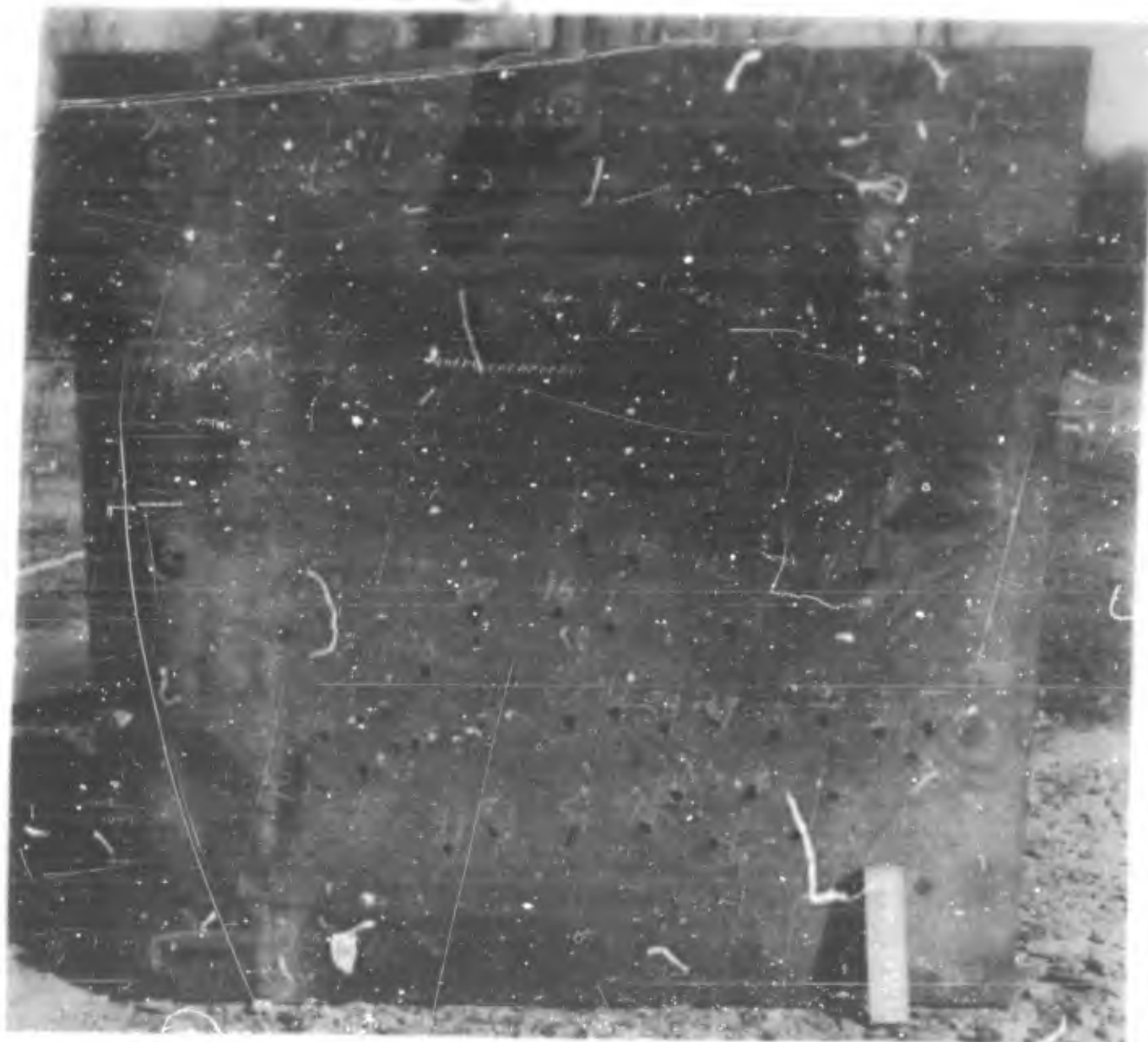
*H. A. Bechtol*  
H. A. BECHTOL  
Chief  
Artillery Division

*G. Morrow*  
G. MORROW  
Chief, Mortar and  
Recoilless Rifle Br.

*C. J. Eichinger*  
C. J. EICHINGER  
SP3 Ord Corps  
Project Engineer

CONFIDENTIAL

ARTICLE 3

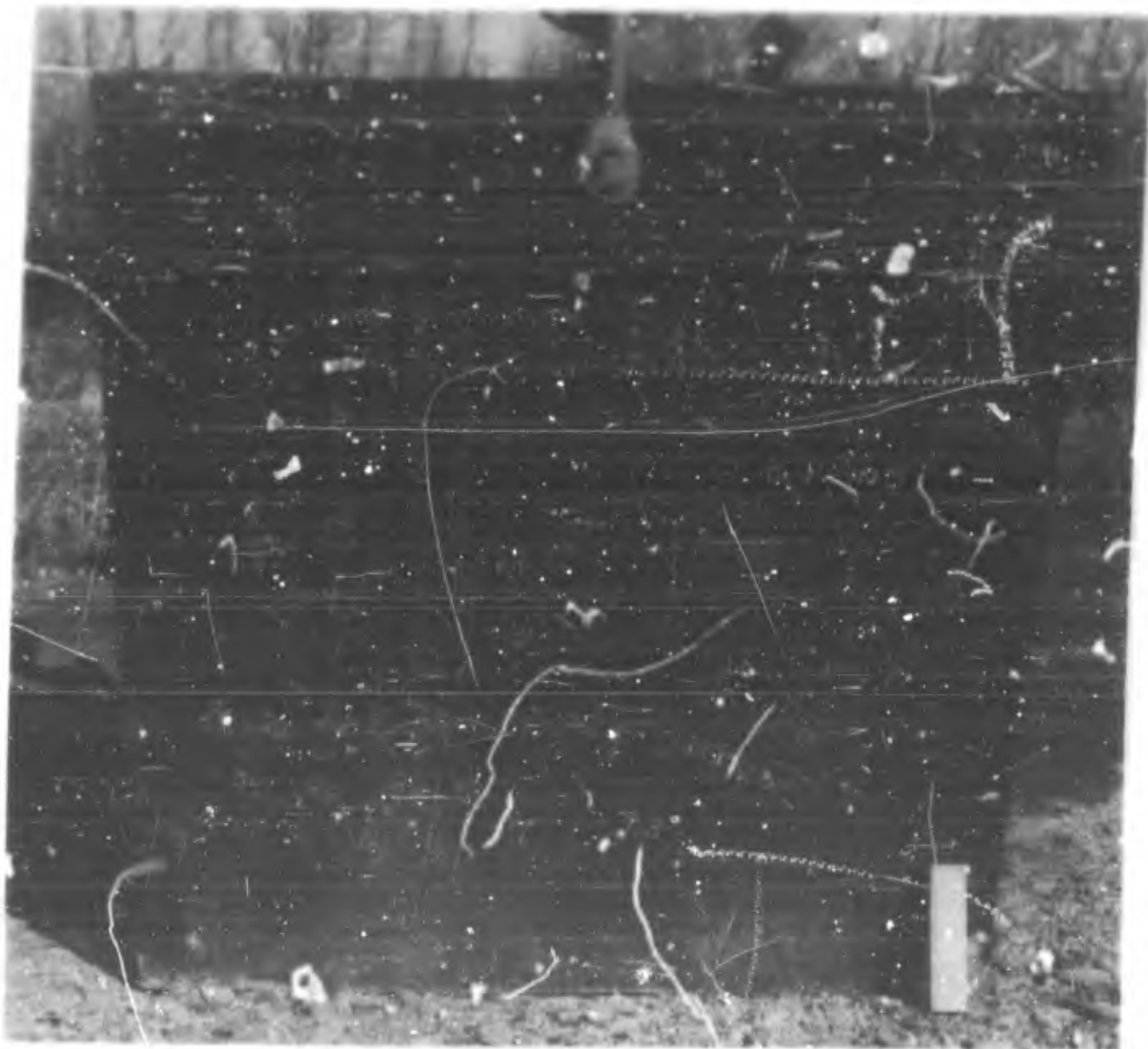


B23808 - Penetrations in 4 inch thick target plate with ammunition conditioned at 70°F. Plate normal to the line of fire.

B-1

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B23809 - Penetrations in 4 inch thick target plate with ammunition conditioned at 70°F. Plate normal to the line of fire.

E-2

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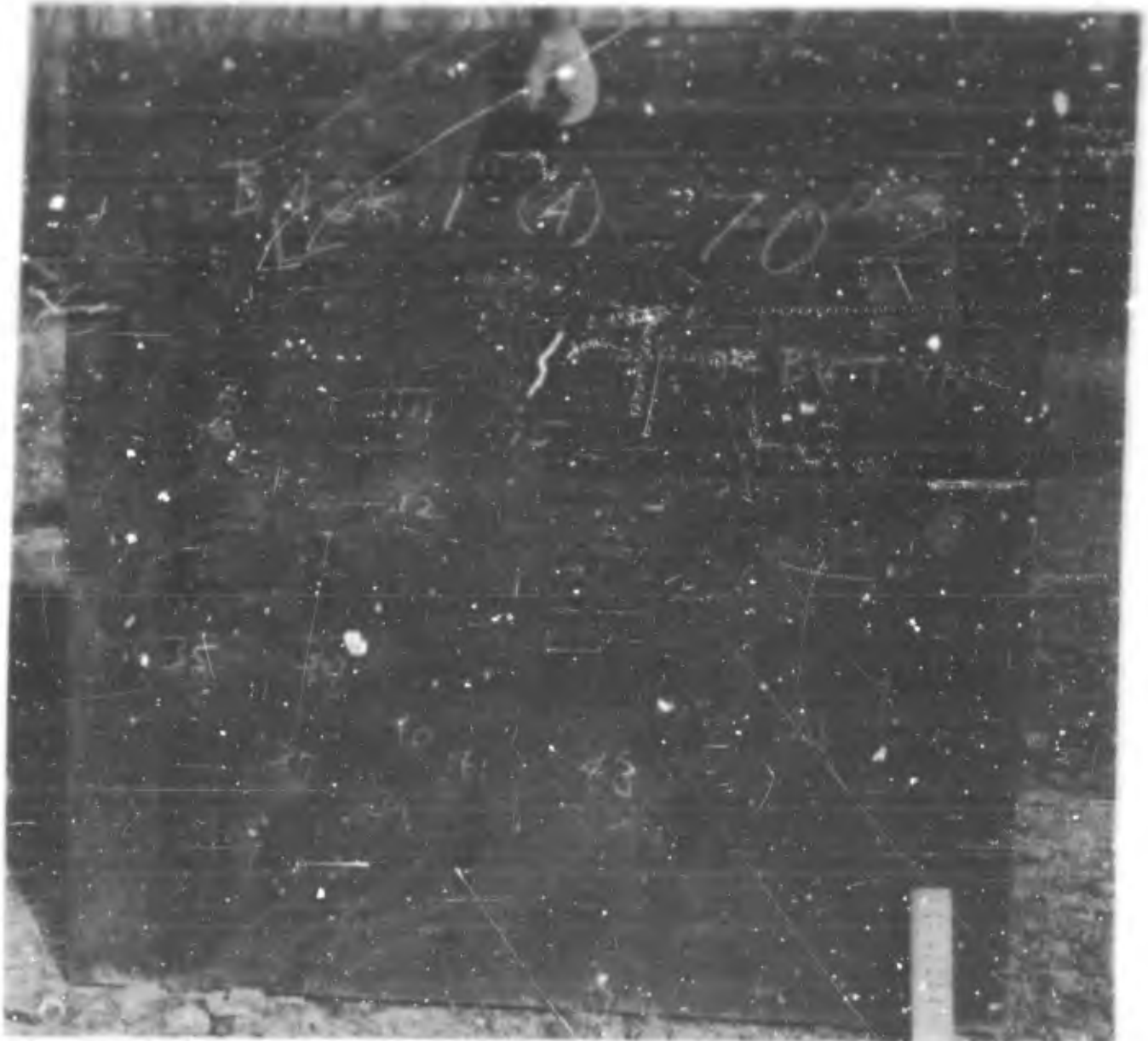
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B23810 - Penetrations in 1 inch thick witness plate positioned 6 inches behind 4 inch thick target plate.

B-3  
CONFIDENTIAL

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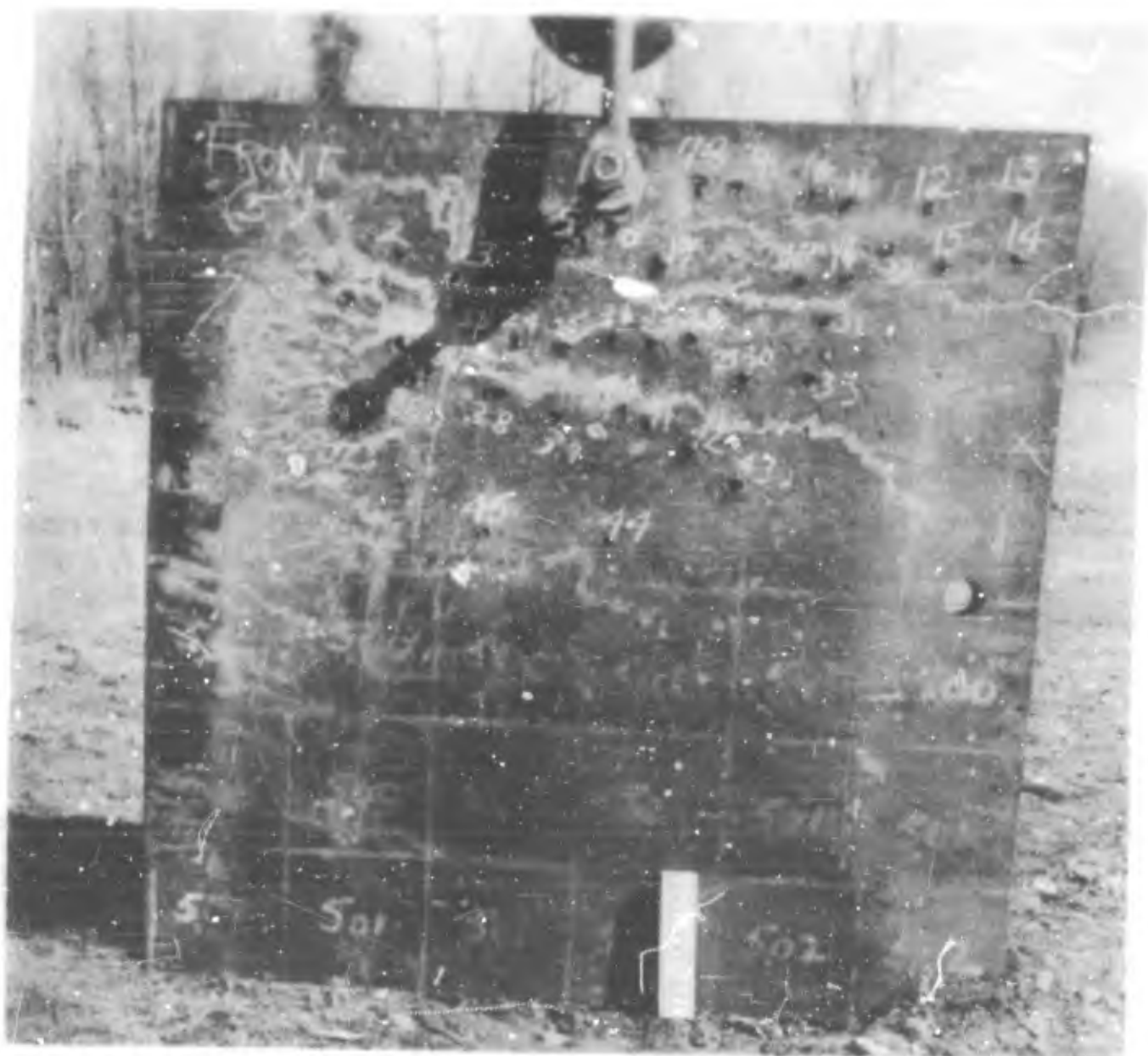


B23811 - Penetrations in 1 inch thick witness plate positioned  
6 inches behind 4 inch thick target plate.

B-4

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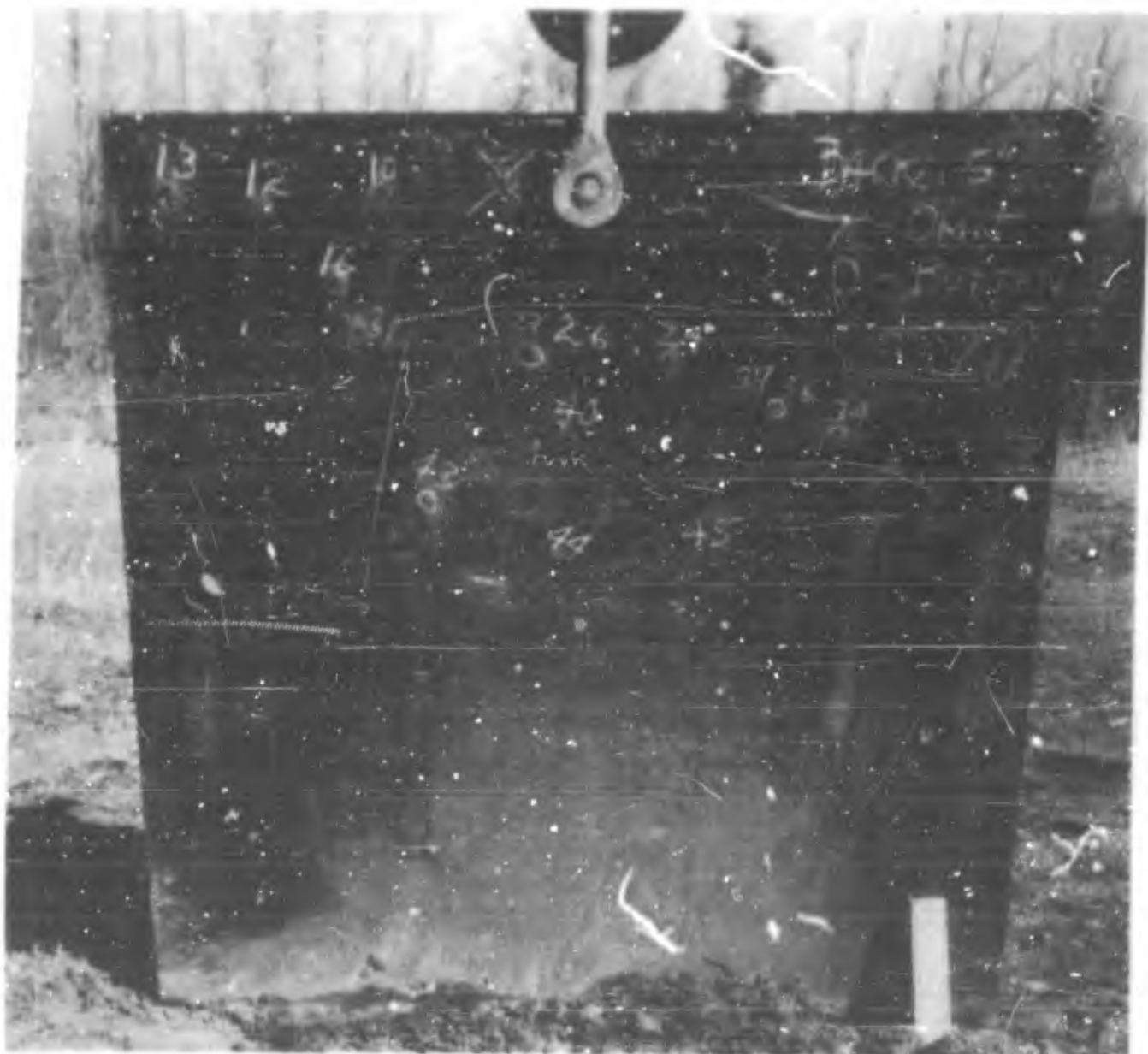
E23812 - Penetrations in 5 inch target plate with ammunition conditioned at 70°F. Plate normal to line of fire.

E-5

CONFIDENTIAL

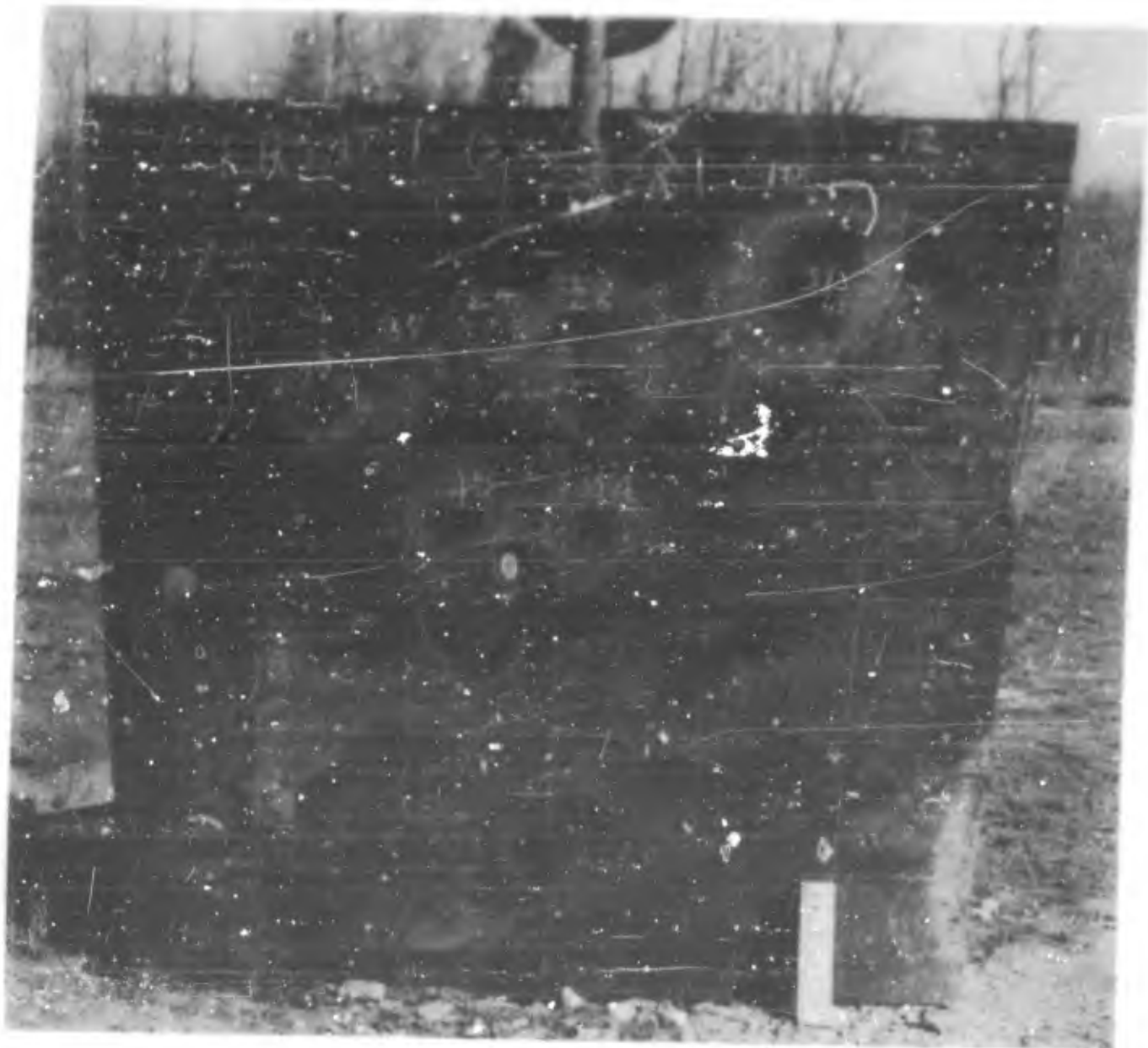


CONFIDENTIAL



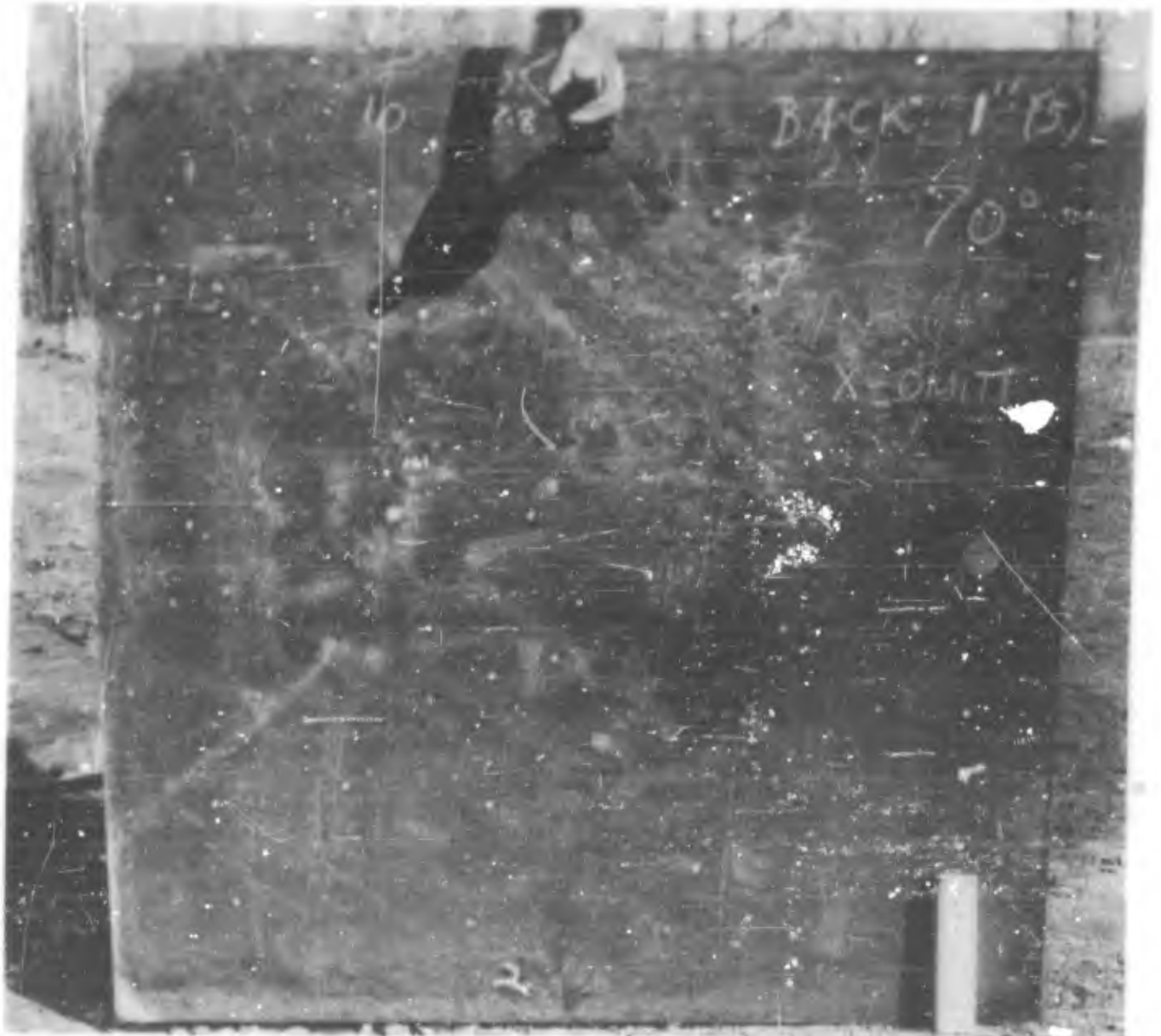
B23803 - Penetrations in 5 inch target plate with ammunition conditioned at 70°F. Plate normal to line of fire.

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B23814 - Penetrations in 1 inch thick witness plate positioned 5 inches behind 5 inch thick target plate.

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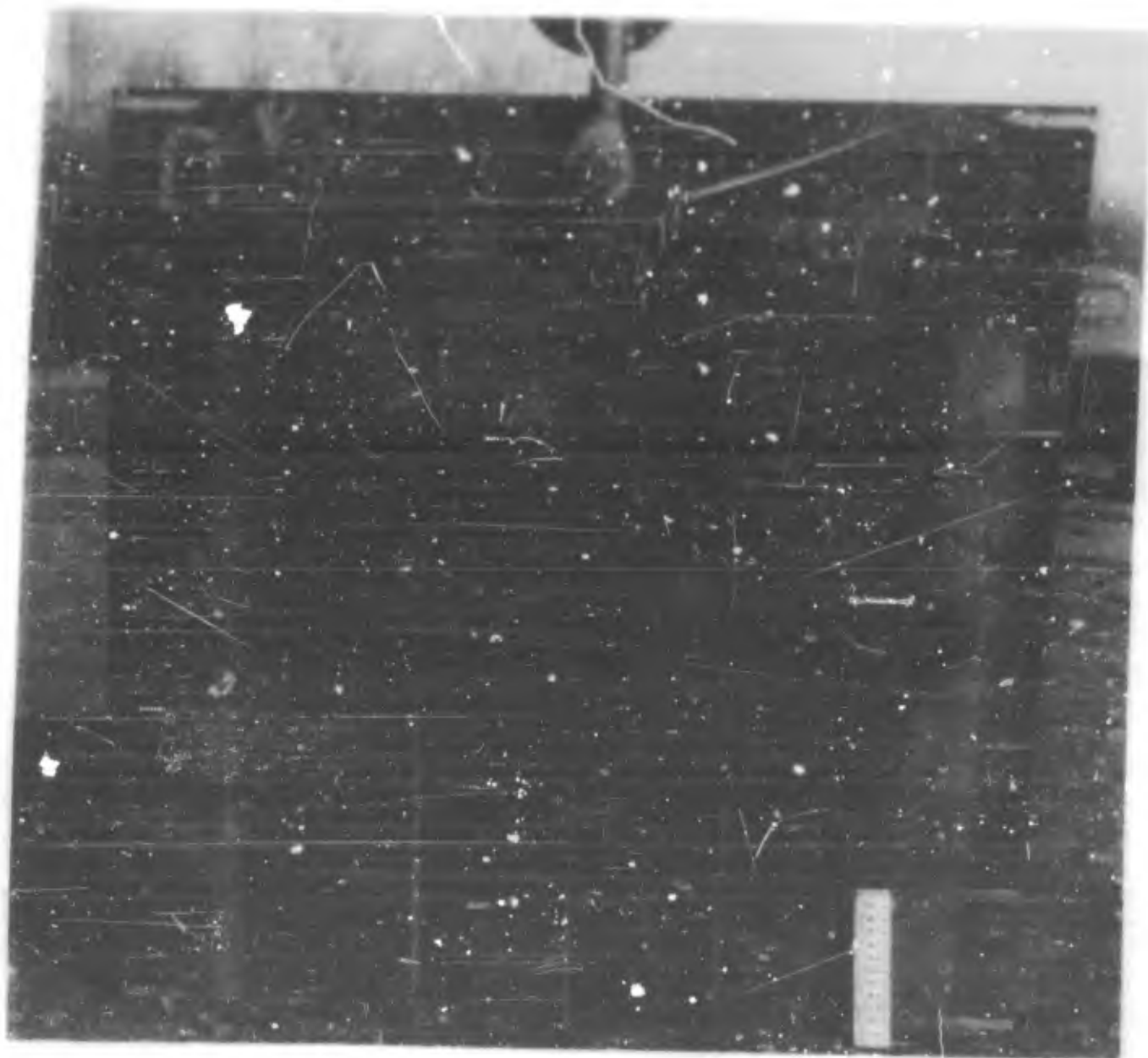


B23815 - Penetrations in 1 inch thick witness plate positioned 5 inches behind 5 inch thick target plate.

B-3

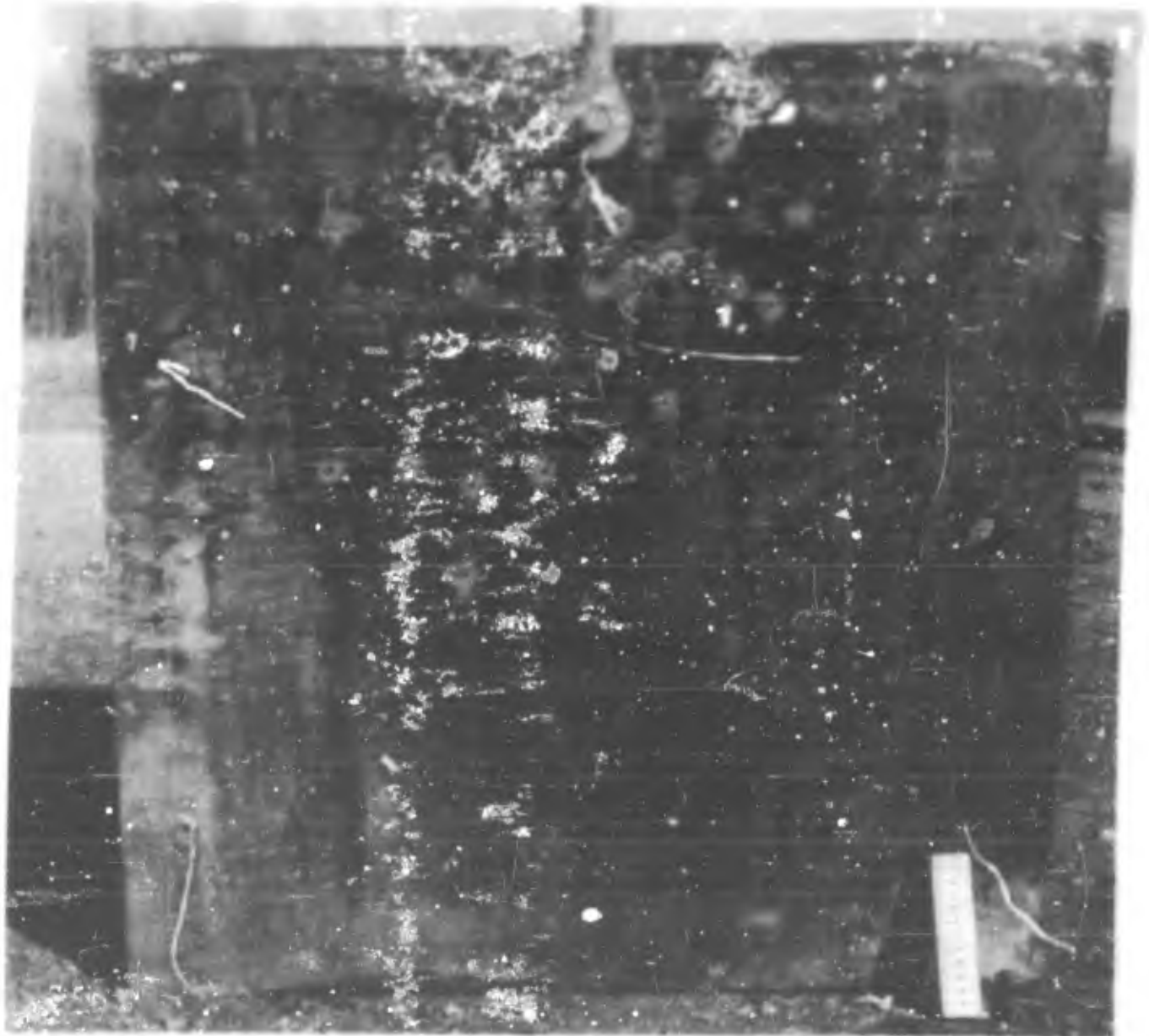
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B23816 - Penetrations in 5 inch target plate with ammunition conditioned at  $-40^{\circ}\text{F}$ . Plate normal to line of fire.

CONFIDENTIAL

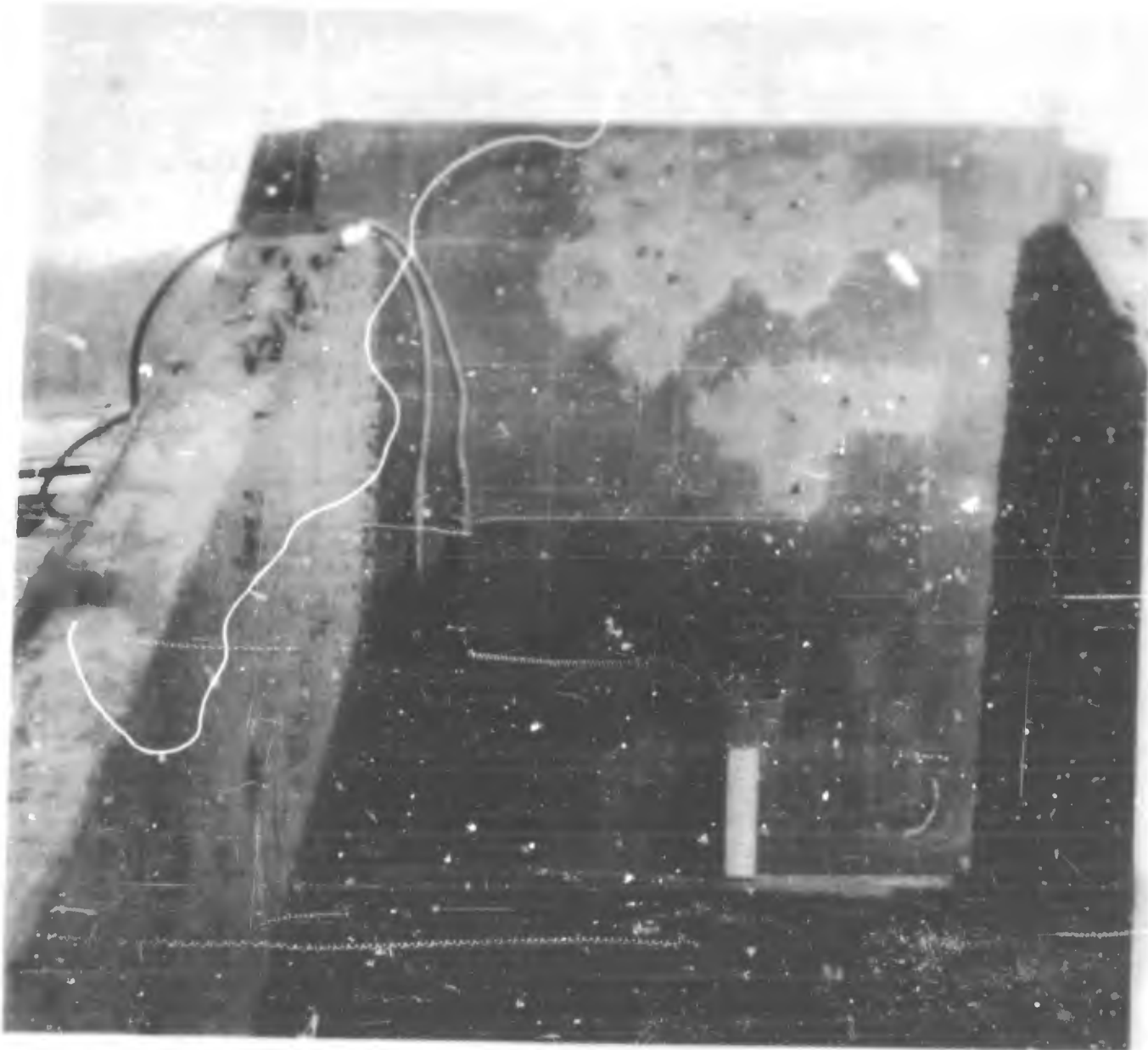


B23817 - Penetrations in 5 inch target plate with ammunition conditioned at -40°F. Plate normal to line of fire.

B-10

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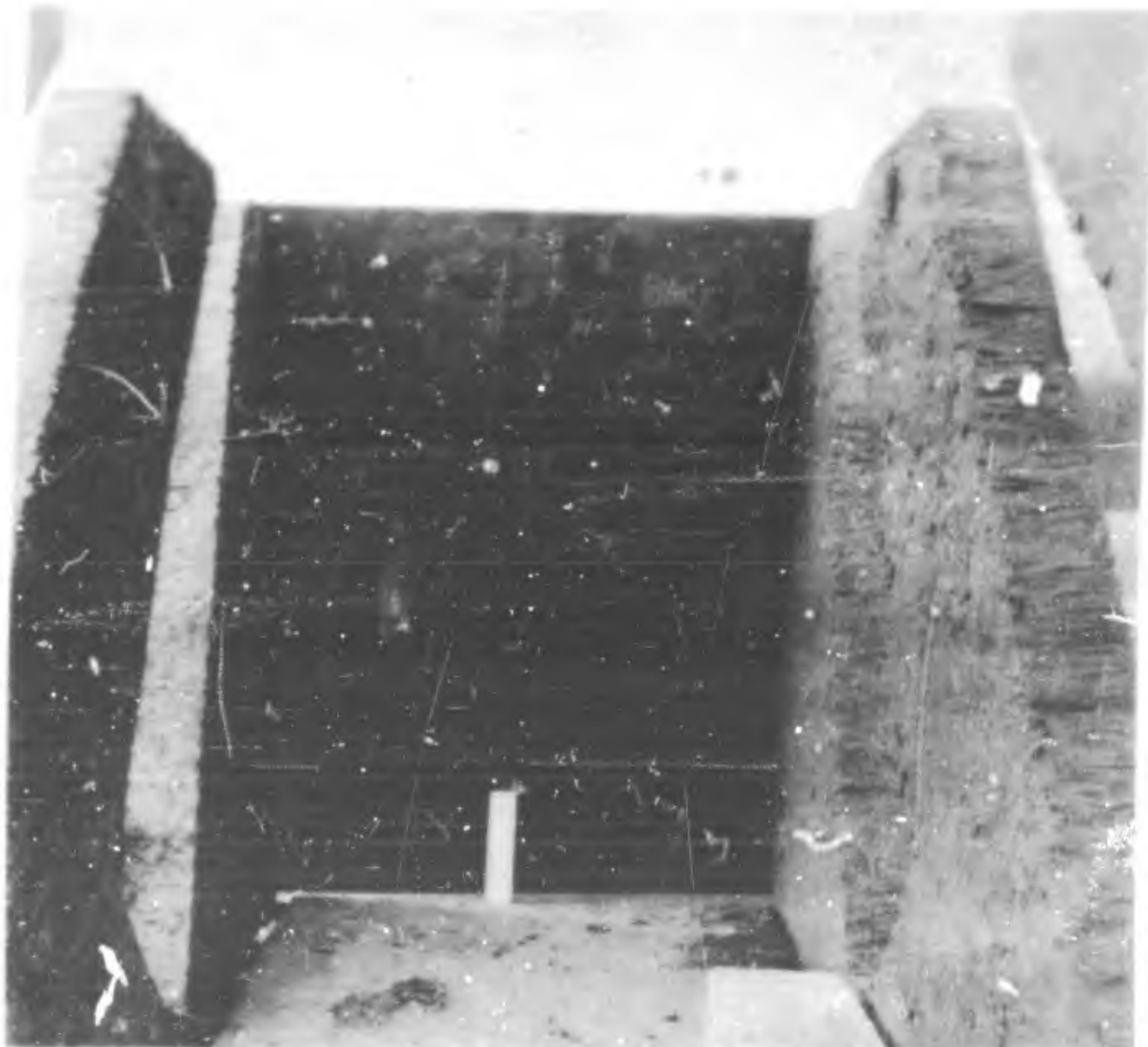


B23818 - Penetrations in 1 inch thick witness plate positioned  
5 inches behind 5 inch thick target plate.

B-11  
CONFIDENTIAL



CONFIDENTIAL

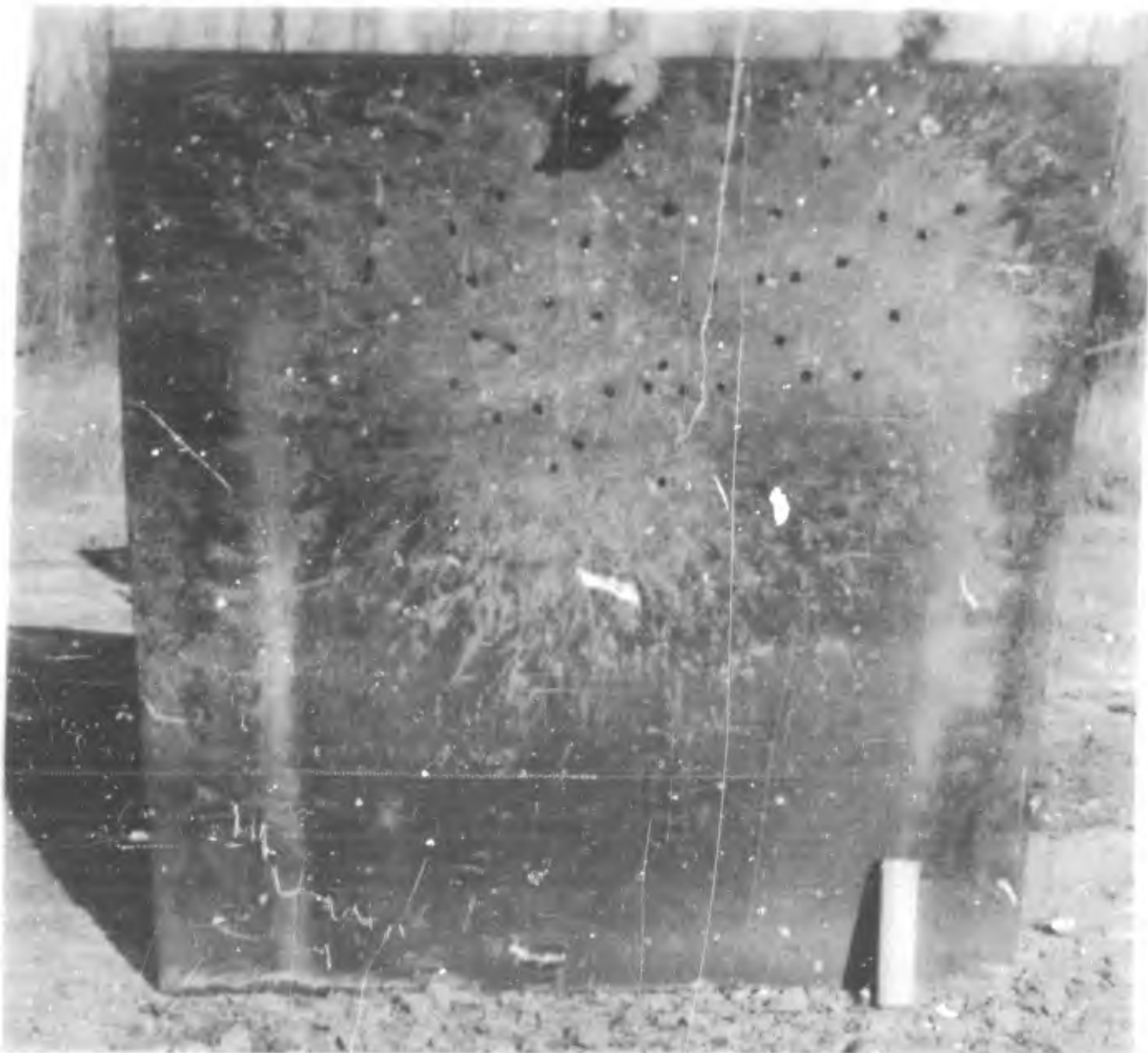


B23819 - Penetrations in 1 inch thick witness plate positioned  
5 inches behind 5 inch thick target plate.

B-12

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D23820 - Penetrations in 4 inch thick target plate with rounds:  
1-21 conditioned to: -65°F and 22-45 conditioned to:  
-40°F. Plate normal to line of fire.

B-13

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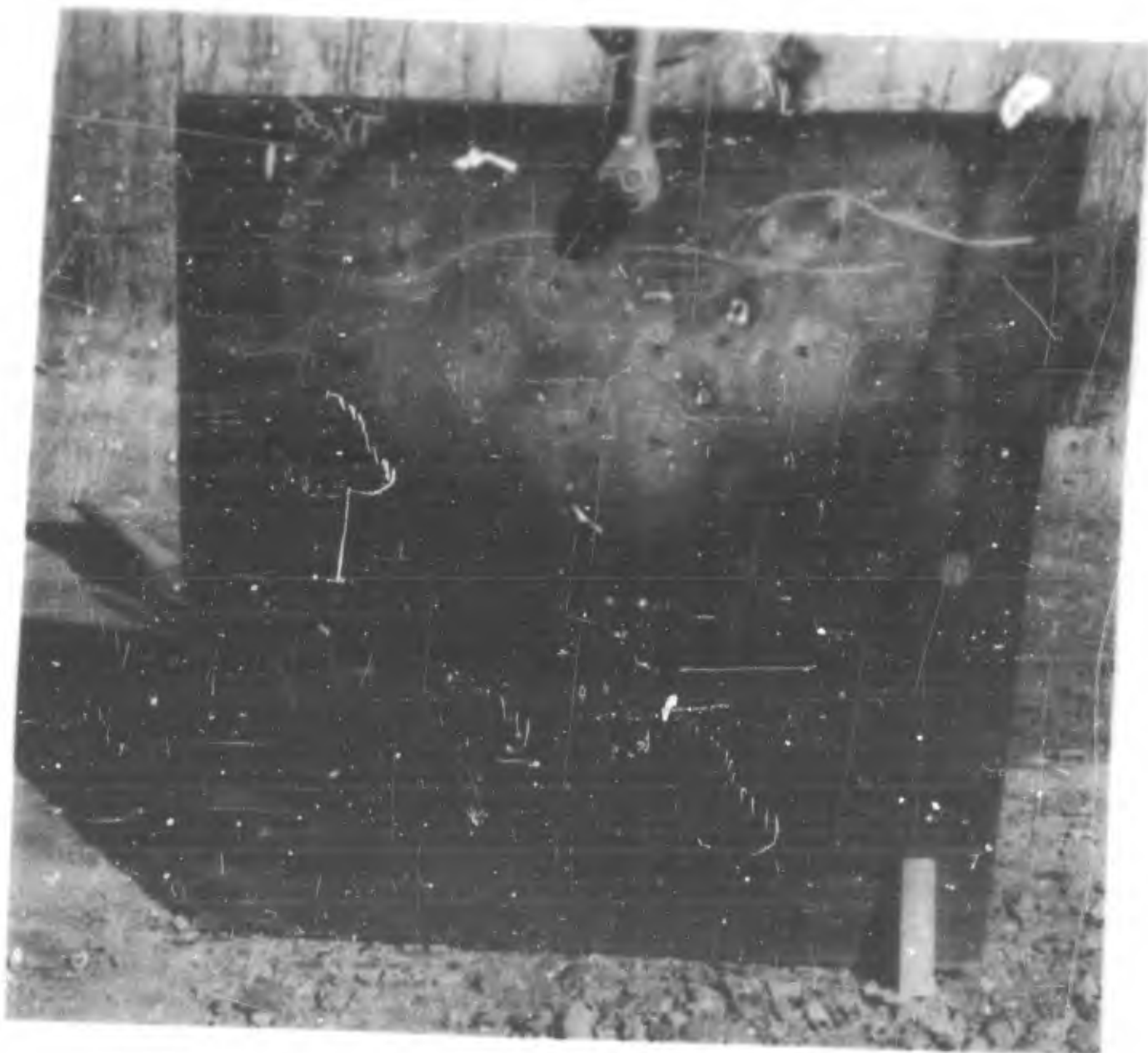


B23821 - Penetrations in 4 inch thick target plate with rounds:  
1-21 conditioned to: -65°F and 22-45 conditioned to:  
-40°F. Plate normal to line of fire.

B-14

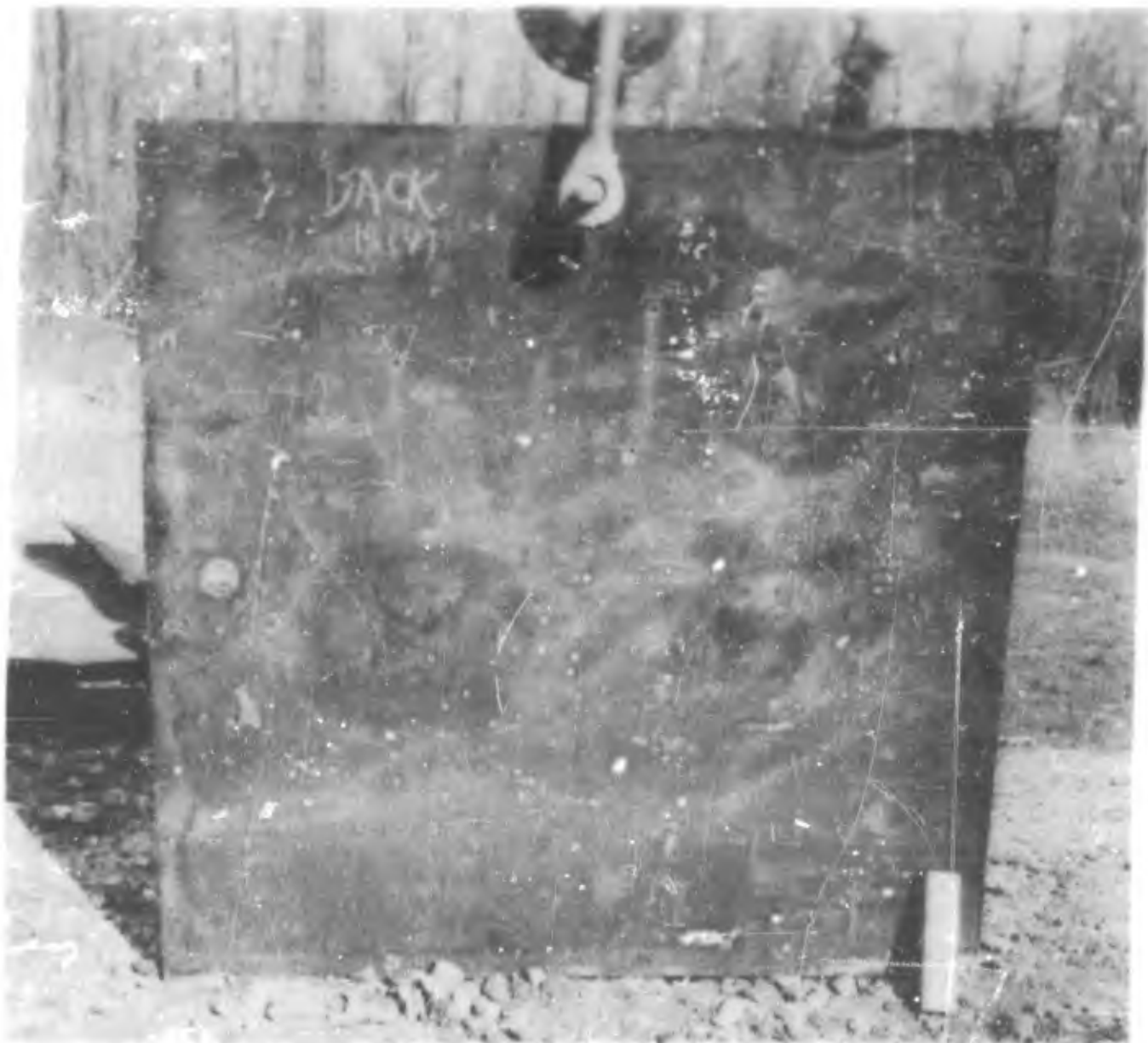
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B23822 - Penetrations in 1 inch thick witness plate positioned 6 inches behind 4 inch thick target plate.

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P23823 - Penetrations in 1 inch thick witness plate positioned 6 inches behind 4 inch thick target plate.

ATTACHMENT C

EXPERIMENTAL AMMUNITION DATA CARD

|                                                                    |           |                  |               |
|--------------------------------------------------------------------|-----------|------------------|---------------|
| Cartridge, 825T, KUTHA (Mod) With Fuse PL, M90A1<br>For 57MM Rifle |           | 150              |               |
| 75-1-211                                                           | 8-11-55   | 7A3-586          | October, 1956 |
| 75-1-211                                                           | 14.16 mm* | 1000 lbs./sq in. | October, 1956 |

REMARKS: Packed: 1 Cartridge/fiber container; 4 fiber containers/wood box.  
 \*Wt of Projectile 2.75 lbs. Shell loaded in accordance with drawing FX-33-1641 dated 28 January 1954. Pellet Booster Fuse. 75-14-472C manufactured of PBX minimum density 1.60. Liner and Tube Assembly are numbered and this number is stenciled on outside of each shell. To be tested at AFG in accordance with test program request No. 4605. Tes. of 2C rounds at PA: 6 rounds at ambient temp, 7 rounds conditioned at -65°F for 16 hours and fired (Over)

| COMPONENT         | Case Cartrg | Primer    | Liner        | Powder     | Shell HEAT   | Fuse PD   | Spacer     |
|-------------------|-------------|-----------|--------------|------------|--------------|-----------|------------|
| KIND              | 57MM        | Perc      | Polyethylene | Propellant | M307A1 (Mod) | M90A1     | Felt       |
|                   | M30A1B1     | M30A1     |              | M10        | 57MM MPTS    |           |            |
| DRG. NO.          | FD-15205    | 7A-2-68   | 71-2-153     |            | FX-13-1462   | 73-2-236  | 75-14-472D |
| DRG. DATE OR REV. | Rev. 7      | Rev. 7    | 9-14-52      |            | 9-8-53       | Rev. 1    | Rev. 7     |
| MFG'D. BY         | PA          | Kingsbury | unk          | Indiana    | WW           | PA        | PA         |
| DATE              | 1949        | 1954      | unk          | 1953       | 1956         | 1951      | 1956       |
| LOT NO.           | PA-4-2      | KOP-59-3  | unk          | IA-39015   | none         | PA-403-10 | None       |

PREPARED BY A. Kurtulik CERTIFIED TO BY: W. Kishpaugh INSPECTOR  
Ars Opers Inspection  
 DIVISION DIVISION

Card No. 83539

REMARKS: at -65°F, and 7 rounds conditioned at 125°F for 16 hours and fired at 125°F. 3" Class B Homogeneous Armor Plate used as target for all rounds. M18 Rifle placed 150 ft. away from the target plate with line of fire at angle of 36° with a perpendicular to the plate (i.e. an angle of 54° between the plane of the plate and the line of fire).  
 Two 1" thick mild steel witness plates placed together and parallel to the armor plate. 6" Air space between armor plate and witness plates. Depth of penetration produced by each round measured by probing to nearest 0.1". Non-functioning or mal-functioning recorded. \*\*Shells mfg'd by PA and Mod by PA. Liner and Tube Assembly furnished by SFAL.

|                   |            |            |
|-------------------|------------|------------|
| COMPONENT         | Pellet     | Charge     |
| KIND              | Booster    | Bursting   |
|                   | PBX        |            |
| DRG. NO.          | 75-14-472C |            |
| DRG. DATE OR REV. |            |            |
| MFG'D. BY         | PA         | Holston    |
| DATE              | 1956       | 1956       |
| LOT NO.           | none       | HOL-7-1694 |

Exp. Amm. Data Card No. 83539 - Lot No. PA-E-24034



## APPENDIX C

| EXPERIMENTAL AMMUNITION DATA CARD                       |                   |               |                   |                |                      | NO. 83540                 |
|---------------------------------------------------------|-------------------|---------------|-------------------|----------------|----------------------|---------------------------|
| Cartridge, HEAT, M307A1 With Fuse, PI, M90A1 57MM Rifle |                   |               |                   |                |                      | ARM LOT NO.<br>PA-E-24035 |
| 75-1-215                                                |                   |               |                   |                |                      | QUANTITY IN LOT<br>25     |
| DRG. NO.                                                | DRG. DATE OR REV. | ALLOT. ADVICE | PROJECT NO.       | RAB OR EPO NO. | QUANTITY IN SHIPMENT |                           |
| 75-1-215                                                | 4-25-55           |               | TA3-5204          |                |                      |                           |
| P.A.I.O.                                                | PROP. CHARGE      | EXPECTED M.V. | EXPECTED PRESSURE | ASSEMBLED BY   | DATE OF ASSEMBLY     |                           |
| 3056-06-300                                             | 14.16 ozs*        | 1200 ft/sec.  | 5000 lbs/sq in    | PA             | October, 1956        |                           |

REMARKS: Packed: 1 Cartridge/fiber container; 4 fiber containers/wood box.  
 \*Wt Projectile 2.75 lb-. Shell loaded in accordance with Dwg 75-14-472, Rev. 4-28-53 with ANR'S 24208 and 24951. Pallet Booster Pcmk. 75-14-472C mfg'd Inert. To be tested at AFG in accordance with Test Program request No. 4605. Shell loaded in accordance with Dwg. 75-14-472 Rev. 4-28-53/ANR'S 24208 and 24951.

(Over)

| COMPONENT         | Case Cartg  | Primer    | Liner        | Pwd Prop | Shell HEAT  | Fuze PI  | Spacer     |
|-------------------|-------------|-----------|--------------|----------|-------------|----------|------------|
| KIND              | 57MM M30A1B | Perc.     | Polyethylene | M10      | M307A1 57MM | M90A1    |            |
|                   |             | M60A1     |              |          | MPTS        |          |            |
| DRG. NO.          | FD-15105    | 74-2-68   | 71-2-153     |          | 75-2-353    | 73-2-236 | 75-14-472D |
| DRG. DATE OR REV. | Rev. 7      | Rev. 7    | 9-14-53      |          | 4-28-53     | Rev. 7   |            |
| MFG'D BY          | FA          | Kingsbury | unk          | Indiana  | FA          | PA       | PA         |
| DATE              | 1949        | 1954      | unk          | 1953     | unk         | 1951     | 1956       |
| LOT NO.           | FA-4-2      | KOP-59-3  | unk          | IA-39015 | Mixed       | PA-40910 | none       |

PREPARED BY A. KurtulikCERTIFIED TO BY: W. Kishpaugh INSPECTORAns Opers  
DIVISIONPICATINNY ARSENAL 916  
DOVER, NEW JERSEYInspection  
DIVISION

Card No. 83540

|                   |            |            |
|-------------------|------------|------------|
| COMPONENT         | Pellet     | Charge     |
| KIND              | Booster    | Bursting   |
|                   | Inert      | Comp. B    |
| DRG. NO.          | 75-14-472C |            |
| DRG. DATE OR REV. |            |            |
| MFG'D BY          | PA         | Holston    |
| DATE              | 1956       | 1956       |
| LOT NO.           | none       | HOL-7-1694 |

Exp. Amm. Data Card No. 83540 - Lot No. PA-E-24035



[illegible]

Drawing No. P-86890

~~D-2~~  
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RECEIVED 08/01  
PICATINNY ARSENAL  
DOVER, NEW JERSEY

ATTACHED 1

IN REPLY  
REFER TO:

SAFETY FILTHAM AMMUNITION LABORATORIES

ORDB-TJ1 472.5/6-91 AFG(C)472/306 1956

Dr. C. E. Jacobson/gja/TJ1  
OCT 16 '56 - 11 AM

WD-32-254-10

SUBJECT: Test Program Request Number TJ-1 Cartridge,  
HEAT, 57 mm, MORTAL (Modified) (U)

TO: Commanding General  
Aberdeen Proving Ground  
Maryland  
ATTENTION: ORDBG-DPS

1. Inclosed is Test Program Request Number TJ-1 (C), D/A Priority 1B, for testing of subject items. These items, the descriptions of which are furnished in the inclosed test program request, will be shipped to your Proving Ground during the week of 8 October 1956.

2. Funding Data

Funds are available under Sub-Project Order No. 70405530-01-30901-01, and Job Order No. 3056-06-901. The inclosed TPR was initially identified as No. 4605 but has been renumbered as TJ-1 (C).

3. Coordination

- a. OCC-ORDTA
- b. AFG-D&PS
- c. AFG-BRL, Dr. R. J. Eichelberger
- d. Picatinny Arsenal - Engineer primarily responsible for the test is Mr. C. E. Jacobson, phone Picatinny Arsenal, Extension 5220.

4. Notification for Test Attendance

Mr. C. E. Jacobson will attend the tests. Notice, ten days prior to the firings, is requested.

FOR THE COMMANDER:

/s/

C. S. DAVIS  
Assistant

1 Incl

- 1. TPR No. TJ-1  
w/incls (6 cys)

CC

OCC-ORDTA w/incl 1  
AFG- Comp Office w/incl 1

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FROM INCLOSURES"

E-1

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TEST PROGRAM PURPOSE (PRELIMINARY ENGINEERING OR DEVELOPMENT TEST)

C.E. Jacobson/gsk/5220  
Test Program Request No. TJ-1(C)  
(Job Order No. 3056-06-901)  
Picatinny Arsenal, Dover, N.J.  
5 October 1956

1. Material for Test:

- a. 180 - Cartridge, HEAT, 57mm, M307A1 (Modified), Dwg 75-1-215, rev 8/25/55, except for shell, Pcmk P-8689C2, which contains a PBX booster pellet; Lot PA-E-24034, Data Card No. 83539
- b. 100 - Shell, HEAT, 57mm, M307A1 (Modified), Pcmk P-86890C, except that shell contains a PBX booster pellet and a dummy auxiliary detonator in the fuze; Lot PA-E-24035, Data Card No. 83540
- c. 25 - Cartridge, HEAT, 57mm, M307A1, Dwg 75-1-215, rev 8/25/55, except that shell contains an inert booster pellet; Lot PA-E-24037, Data Card No. 83542

2. Project Authority:

- a. Ordnance Project Number: TA3-5204
- b. Department of the Army Number: D/A 5104-07-001
- c. Funds available under Sub-Project Order Number 70405530-01-30901-01, and Job Order Number indicated above.
- d. D/A Priority 1B

3. Object of Development or Experiment:

To determine the effectiveness of 57mm HEAT ammunition containing shaped charge liners made by the rubber-covered-punch process.

4. History Sketch:

It is known that spin-stabilized HEAT ammunition gives poorer performance when fired dynamically than when fired statically without rotation. This has been found to be caused by rotation and spreading of the jet from the liner. To counteract rotational effects, a number of methods of spin-compensation have been devised. Both theoretical considerations and initial experimental tests indicated that a fluted liner was the best means

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TRN No. 72-2 (C) (Class)

1 October 1956

of compensating for spin. A number of test firings have been conducted with 57mm shell containing fluted liners made by the rubber-covered-punch process. The results obtained indicated superiority over 57mm shell containing the standard hemispherical liner (See para 10 - Reference). Further static tests were performed to determine the optimum wall thickness and forming pressure of fluted liners made by the rubber-covered-punch process.

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

There have been no proving ground tests conducted under this project.

6. Local Tests:

Static spin and dynamic tests have been conducted (See para 10 - Reference). Additional static spin tests showed that fluted liners made with a forming load of 200 tons from blanks having an .065" wall gave optimum penetration values.

7. Object of Test:

a. To determine the effectiveness in dynamic tests of 57mm HEAT shell containing rubber-covered-punch process liners formed at 200 tons load and having an .065" wall.

b. To determine if the M90A1 fuze will initiate the Composition B bursting charge in an inert-boosted shell.

8. Precautions in Handling and Testing:

All precautions ordinarily taken when assembling and firing HEAT shell which may burst prematurely should be observed.

9. Recommended Test Program:

Fire all shell in this program using an M18 rifle at a range of 150 ft against an armor plate target placed perpendicular to the line of flight. Set up a 1" thick witness plate 6" behind the target. Detailed firing instructions are given below:

a. Fire 180 cartridges of Lot PA-E-24034 as follows:

- (1) Subject 90 cartridges to conditioning at  $70^{\circ} \pm 5^{\circ}\text{F}$  for at least 16 hours. Fire 45 of these cartridges against 4" Class B armor plate and the remaining 45 cartridges against 5" Class B armor plate.



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DS No. 75-4 (2) (Rev)

3 October 1956

- (2) Subject 95 cartridges to conditioning at  $-65^{\circ} \pm 5^{\circ}\text{F}$  for at least 16 hours. Fire 45 of these cartridges against 4" Class I armor plate and the remaining 45 cartridges against 7" Class I armor plate.
- (3) Observe and record the depth and character of penetration and note any premature bursts. Also record any instances in which the point of impact of any shell is closer than 3 hole diameters from the edge of the plate or another impact.

b. Assemble the 100 shell of Lot PA-E-24037 (See Dwg 75-1-215, rev 8/25/55) with cartridge cases containing enough propellant to develop 7280 psi which is 112% of the maximum rated pressure for the round. This pressure must be developed when the round is fired at a temperature of  $125^{\circ}\text{F} \pm 5^{\circ}\text{F}$ . Subject the cartridges to conditioning at  $125^{\circ}\text{F} \pm 5^{\circ}\text{F}$  for a minimum of 40 hours just before they are fired. Fire them for land impact and observe for evidence of functioning. Recovery of duds is not desired.

c. Subject the 25 cartridges of Lot PA-E-24035 to conditioning at  $70^{\circ} \pm 5^{\circ}\text{F}$  for a minimum of 16 hours. Fire the cartridges against any available target plate. Record evidence of smoke, flash, or noise at impact and depth of penetration obtained, if any.

d. All cartridges, when fired, shall be as close to the conditioning temperature as possible.

10. Reference:

Clift, G.D., Performance of 57mm Shell Containing Fluted Liners Coined by the Rubber-Covered-Punch Process (C), Picatinny Arsenal Technical Report 2293, July 1956.

11. Report Distribution:

- a. Test Report security classification - Confidential.
- b. 1 Copy - OCO-ARDA, Mr. M. F. Massey  
1 Copy - OCO-ORDS, Mr. M. C. Miller  
1 Copy - APG, D&PS  
1 Copy - APG, BRL, Dr. R. J. Eichelberger  
3 Copies - Picatinny Arsenal:  
1 Copy - Attn: Inspection Division  
1 Copy - Attn: ORDBB-TJ1  
1 Copy - Attn: ORDBB-TB8

2 Incls

1. Dwg No. 75-1-215
2. Dwg No. P-86890

/s/ P. B. Tweed  
for D. R. BERMAN  
Acting Director, Samuel Feltman  
Ammunition Laboratories

/s/ C. S. DAVIS  
Assistant

3  
REGRADE DATA CANNOT BE PREDETERMINED

E-4

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ORIG 471.1/31  
ATTN: ORIG-1/1  
AFG 471.1/31

2d Ind

Mr. C. E. Jackson/via/31

SUBJECT: Ballistic tests of Modified M307A1 57mm Shell

Ord Corps, Picatinny Arsenal, Dover, N. J., OCT 2 '56 11 AM

TO: Commanding General, Aberdeen Proving Ground, Md.,  
ATTN: ORLBO-DP-TA

1. The \$3650. required to perform the subject tests is being transferred to your proving ground. The project on which this work is to be done is TA3-5204. The Job Order No. is 3056-06-901.
2. The question raised in paragraph 2 of the 1st Indorsement was answered during a telephone call from Mr. B. A. Rausch of this Arsenal to Mr. J. C. Moore of D & PS on 24 September 1956. As was explained then, this Arsenal will furnish the 25 standard M307A1 57mm HEAT cartridges. The 100 modified M307A1 57mm HEAT shell, referred to in paragraph 1c of the basic letter, will be furnished as fused projectiles. It will be necessary for your proving ground to furnish the other components, such as cartridge cases, primers, and propellant, and to assemble the complete round.
3. Due to a change in Arsenal procedures, the Test Program Request for this work has been renumbered as Test Program Request No. TJ-1. It is expected that the Test Program Request will be transmitted to Aberdeen Proving Ground in about two weeks.

FOR THE COMMANDER:

/s/

PAUL B. TWEED  
Assistant

ADG-IP-M  
AA 471.1/361  
PA 471.1/31

1st Ind

Mr. J. Moore/jlw/32154

SUBJECT: Ballistic Tests of Modified M307A1 57mm Shell

Ord Corps, Development and Proof Services, Aberdeen Proving Ground, Md.

TO: Commanding Officer, Picatinny Arsenal, Dover, New Jersey SEP 17 1956  
ATTN: ORDBB-TJ7.

1. Reference is made to Paragraph 1 of basic communication. The cost estimate of the tests as outlined is \$3650.00.

2. A review of the stock records at this proving ground has indicated that there are not any Pentolite loaded M307A1 (original) shell available for the firings referred to in Paragraph 1.c. It is, therefore, requested that your arsenal furnish the twenty-five standard Cartridge, HEAT, Pentolite loaded, M307A1, 57mm Rifle; M28A1, along with the 280 modified Shell, HEAT, M307A1.

3. Your arsenal will be notified of the firing schedule in advance so that interested personnel may be present.

/s/

T. F. COLLIERAN  
Director

ORDNANCE CORPS  
PICATINNY ARSENAL  
DOVER, NEW JERSEY

IN REPLY  
REFER TO:

SAMUEL FELTMAN AMMUNITION LABORATORIES  
ORDBB-TJ1 47L.1/31

Mr. B. A. Rausch/vka/6275

APG 47L.1/361 (1956)

SUBJECT: Ballistic Tests of Modified M307A1 57mm Shell

TO: Commanding General  
Aberdeen Proving Ground  
Maryland

ATTENTION: Development and Proof Services

1. A test program has been planned to evaluate ballistically a number of modified M307A1 57mm shell. This Arsenal requests an estimate of the cost of the following tests:

a. Firing of 180 Modified M307A1 57mm HEAT cartridges, 90 against 4" and 90 against 5" homogeneous armor plate (Class B). Six inches behind the armor plate and parallel to it, there should be a 1" thick mild steel witness plate. A record of depth and character of penetration will be required.

b. Firing of 100 Modified M307A1 57mm HEAT shell at 125°F for ground impact. In preparation for firing these shell are to be assembled by Aberdeen Proving Ground with cartridge cases and enough propellant to give 7280 psi, which is 112% of the maximum rated pressure for the round. Any pressures shall be recorded.

c. Firing of 25 Standard M307A1 57mm HEAT cartridges against 4" armor plate. No witness plate is necessary. A record of depth and character of penetration will be required.

2. Picatinny Arsenal Test Program Request No. 4605 giving a detailed description of the work outlined above is being prepared and will be transmitted to Aberdeen Proving Ground in the near future.

FOR THE COMMANDER:

/s/  
C. S. DAVIS  
Assistant

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