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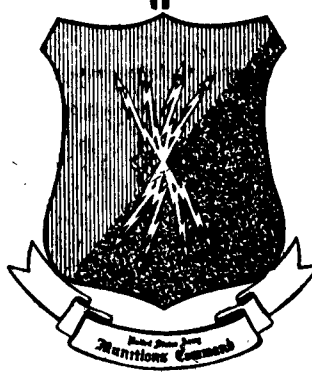
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TECHNICAL REPORT 3058

MALFUNCTION INVESTIGATION
OF
CARTRIDGE, 81 - MILLIMETER: HE, M43A1
AND
M43A1B1, W/VARIOUS FUZES
AND

CARTRIDGE, 81 - MILLIMETER: SMOKE, WP, M57A1,
W/FUZE, TSQ, M77

JOHN MC PARTLAND

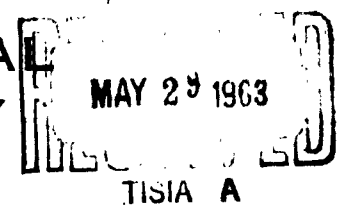
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TECHNICAL REPORT 3058
AMMUNITION GROUP
MALFUNCTION INVESTIGATION
OF
CARTRIDGE, 81-MILLIMETER: HE, M43A1 AND M43A1B1, W/VARIOUS FUZES
AND
CARTRIDGE, 81-MILLIMETER: SMOKE, WP, M57A1, W/FUZE, TSQ, M77

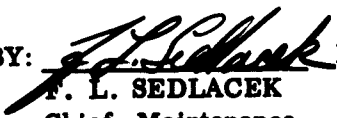
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AMCMS 4230.1.8839.10

FEBRUARY 1963

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SECTION I

INTRODUCTION

A. Purpose

This series of investigations was conducted to:

- 1. Determine the cause of the malfunctions.**
- 2. Devise procedures for the disposal of defective rounds.**
- 3. Determine the corrective action necessary to prevent recurrence of the malfunctions.**

B. History

1. Training exercises using 81mm mortars and 106mm Recoilless Rifles were in process at Fort Campbell, Kentucky on 8 March 1960 when a short-range round of CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-78A or Lot MA-4-269A) occurred. (Because this phase of the exercises was conducted at rapid-fire, it was not possible to determine from which of these two lots the malfunctioning round had been taken.) At the beginning of this phase of the exercises the two weapon positions were separated by approximately 600 yards--with the 106mm rifle position forward and to the left of the 81mm position--outside of the surface danger area. As the exercise progressed, the positions were changed to what appeared to be the positions shown on the range overlay with respect to azimuth and coordinates. The firing from the second position of the 81mm mortar was at night and at rapid-fire. During this phase of the mission one round fell within 15 yards of the 106mm position, injuring

three enlisted men. At the time that the original investigation of the accident was conducted, the range overlay was compared with the range map to determine the actual position occupied at the time the accident occurred. It was determined that the position for the 106mm Rifle had been miscalculated and located approximately 700 yards forward and 10 degrees to the left of a direct line to the target area from the 81mm position. One may have been dropped from the round during rapid-fire, thus reducing the range from 1,025 to 700 yards (FT-81-B-5), which would put it in the immediate vicinity of the 106mm position. No fragments were found but it was determined that the accident was not due to unauthorized modification or alteration to the round involved.

2. Training exercises using Mortar, M29 and CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot MA-4-226A) were underway at Fort Bragg, North Carolina on 14 July 1960 when a malfunction occurred. The mortar was being fired at an elevation of 1018 mils, Charge 5 for a range of 2,700 yards. According to observers, the malfunctioning round left the tube with a "plop," had just enough power to travel 100 yards, and failed to detonate upon impact. The round was recovered by the Explosive Disposal Unit and was found to have the bore-riding pin still in place. The propellant increments were scattered around the gun position unburned, but the primer had functioned in a normal manner. Remnants of the paper case of the ignition cartridge could be seen through the holes in the round but no evidence of unburned ignition powder was found. The paint on the fin assembly was not burned off. At the time of the accident the ambient temperature was 85° F and light rain was falling.

The weapon was set up in a cleared area in the normal manner. As a result of the malfunction, this lot was suspended from issue and use.

3. Three misfires and one short-range round of CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot KOP-9-189A) occurred in October 1960 during firing exercises being held by the 3rd Marine Division. The Mortar, M29 was fired at 1058 mils elevation, Charge 2, for a range of 1,275 yards. The short-range round travelled less than 100 yards and failed to detonate upon impact. Upon removal from the original containers, the ammunition was found to be rusty and to contain excessive moisture in its ignition cartridges. At the time of the malfunctions, the weather was clear and the temperature between 69° and 70° F. Seventy-nine rounds were fired prior to the final incident and 1,450 rounds remained unfired. The lot was then suspended from issue and use.

4. During a routine training mission at Fort Richardson, Alaska on 7 December 1960, a malfunction occurred involving CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, w/fuze, M77 (Lot RD-7-37A). The round, with its propellant increment appearing to be burning excessively as it left the tube, was low and wobbly in flight and landed approximately 75 yards in front of the gun without functioning. Unburned powder was found in the tube after the malfunction. A prefiring inspection of the Mortar, M29 had been made and the weapon found to be clean and in excellent condition. There had been no deviations from the instructions contained in FM 23-90. The

exercise was conducted at slow-fire, the gun set at an elevation of 1099 mils for a range of 1,500 yards, the fuze was set for super-quick, and 39 rounds were fired from this weapon on the day of the mishap. Operation of the weapon was normal, the weather was overcast with a temperature of 33° F, there was approximately four inches of snow on the ground and the terrain was level with no obstructions in the line-of-fire. The ammunition had been packed in its original containers and stored in igloo-type magazines until issued for this exercise. The time interval between removal of the round from its container and its being fired was three minutes. One round from this lot had been fired prior to the malfunctioning round and had functioned normally. The lot was immediately withdrawn from all units and was suspended from issue and use.

5. On 25 January 1961 at Vieques, Puerto Rico a malfunction involving CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 occurred. The mortar was fired at an elevation of 1102 mils, Charge 4, range 2,100 yards. When fired, the round left the tube with the burning increments falling off. It travelled eight feet and landed without detonating. Upon inspection, it was found that the bore-riding pin was out, the safety wire cut, and the increments burned out. The ammunition was taken from Lot MA-4-101. Five hundred and ninety-nine rounds had been fired and 1,540 remain in Navy stores.

6. On 31 January 1961, four malfunctions involving CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-87B) occurred at Fort Riley, Kansas. In addition to the rounds which actually malfunctioned, there were many suspected rounds. Specifi-

cally, the tail fin broke off of the body to which it is attached. In two instances, the fin was left in the mortar tube after the propelling charge fired. The flight of some of these rounds was so erratic as to fall 300 to 400 meters short. Charges used varied from Charge 1 to Charge 4. Range to the target was 1,000-2,500 yards. Four hundred and sixty-four rounds had been fired at the time of the final malfunction and 4,536 rounds of this lot remained at the time of the Unsatisfactory Equipment Report (UER).

7. On 6 February 1961 at Fort Benning, Georgia a short round occurred involving Lot OA-1-271C of Cartridge, 81 MILLIMETER: HE, M43A1B1. The 15th of a series of rounds was fired and immediately the 16th round was dropped into the tube. The 15th round was heard and observed to fall 200 yards from the firing point. This round detonated high order. The 16th round failed to leave the tube. Upon investigation, it was discovered that the primer of the 16th round had not been hit, due to one-third of the M3 Fin Assembly from the 15th round having remained in the tube after firing. There was no evidence of unburned powder in the tube. The mortar was fired at elevation 1291 mils, Charge 2, range 925 yards. The temperature was 44° F. At the time of the malfunction, 2,226 rounds from this lot had been fired and 271 rounds remained.

8. Training exercises involving CARTRIDGE, 81 MILLIMETER: HE, M43A1 from Lot MA-4-242A were underway at Fort Benning, Georgia on 5 April 1961 when 13 duds and 28 erratic rounds occurred of 120 fired. Some of these rounds

fell 200 to 1,000 meters short of the intended impact area. Witnesses reported hearing unusual noises from the in-flight projectiles from which they concluded that fins were ripping loose from some of the rounds. Propellant increments on some of the rounds were still burning 10 feet from the muzzle. No abnormal residue was noted. Two hundred eighty-six rounds had been fired and 4,704 rounds remained of this lot after the final malfunction. Range varied from 1,300 to 2,000 meters, Charge 4, elevation varied from 1050 to 1230 mils, and there were two weapons in use.

9. On 1 August 1961 at Fort Amador, Canal Zone troops firing CARTRIDGE, 81 MILLIMETER: HE, M43A1 from Lot MA-4-222A experienced seven misfires, six duds, and 12 short rounds of 74 rounds fired. Eleven rounds were approximately 1,100 yards short each and one round fell approximately 75 yards from the tube. Range to the target was 2,800 yards, Charge 6, elevation unknown. After the malfunctions, a test-firing was conducted. The M3 Primers were replaced in 20 rounds by those taken from Lot WC-21-1 and M8 Ignition Cartridges with some taken from Lot FL-2-11. Then the fuzes in these rounds were lubricated. The test resulted in 100% accurate range--no misfires or duds.

10. Fort Richardson, Alaska was holding exercises involving the simultaneous firing of two Mortars, M29, on 24 October 1961 when one round fell 300 yards short of its intended impact area, killing one and injuring several men. It was not possible to determine from which lot the short-range round had come because three lots were used without maintenance of lot integrity (WC-34-32D, WC-34-34C, and OA-1-113A

of CARTRIDGE, 81 MILLIMETER: HE, M43A1). Gun #1 was set at 1301 miles for a range of 1220.8 yards and Gun #2 at 1289 miles for a range of 1160.5 yards -- Charge 3 was used by both guns. One hundred twenty-six rounds had been fired prior to the malfunction and six rounds were fired subsequent to the mishap. Prior to use, the ammunition had been stored on top of empty ammunition cases because of four to five inches of snow on the ground. All rounds had been set for Charge 3 and placed in two rows-one on top of the other. The Fort Richardson ammunition inspector had pointed out to the Officer-in-Charge that this was unsafe practice because of the danger of dislodging one or more propellant increments when removing a round from the stack. (If this had occurred in this instance the round would have landed 900 yards from the firing point, thus accounting for the short-range round.) On 25 October 1961 a firing test of this ammunition was conducted by personnel of Fort Richardson, using the same guns and lay as used the day of the malfunction. Eleven rounds were fired using Charge 3 -- all rounds landed on-target. Five rounds were fired using Charge 2 -- all rounds landed approximately 900 yards from the guns. It was further determined that the crater where the men were killed or injured was not caused by the delayed explosion of a dud which had been fired previous to the day of the malfunction. It was therefore concluded that the cause of the short-range round was the loss of one charge during loading.

11. On 17 April 1962 at Schofield Barracks, Hawaii three mortars were fired simultaneously at rapid-fire. The ammunition used was the 81mm HE Cartridge,

M43A1 from Lot IOP-21-20B and had been prepared with only one propellant increment. The range was 550 yards. One round fell only 260 yards from the gun emplacements, superficially wounding one enlisted man. There were no deviations from instructions contained in Technical Manuals and there were no obstructions around the guns nor in the line of fire. It is not known from which gun the short-round was fired and no fragments were found. The ammunition appeared in good condition when inspected prior to firing and had been unpackaged approximately 45 minutes prior to firing. No unburned powder residue or excessive oil was found in the mortar tube. This ammunition lot had been inspected 100% in January 1962 and found to be in good condition. Out of 3,900 rounds of this ammunition fired by Schofield Barracks since 1954 this was the first malfunction. Based upon the foregoing information, authorities at Schofield Barracks concluded that the short round was due to omission of the one propellant charge when the round was hastily dropped into the tube during rapid-fire exercises. According to FT 81-AB-1, the range of a round fired without a propellant increment (Charge 0) at 1331 mils elevation would be 275 yards, approximately the distance the malfunctioning round traveled.

C. Description

1. CARTRIDGE, 81 MILLIMETER: HE, M43A1 AND M43A1B1, W/VARIOUS FUZES (Figure 1)

Both the M43A1 and the M43A1B1 HE 81mm Cartridges are lightweight rounds for use against personnel or light material targets and which have both fragmentation

and blast effect. The complete round consists of a shallow-cavity steel projectile containing a TNT bursting charge, a PD Fuze of the M525 series, an M6 or M8 Ignition Cartridge, and a M34 Percussion Primer. The fuze is assembled and staked to the internally-threaded projectile nose at the time of manufacture. At the same time the fin assembly is assembled and staked to the internally-threaded projectile base. The hollow, perforated fin assembly shaft is internally threaded at its base end to receive the ignition cartridge and screw-in type percussion primer. The ignition cartridge flash is transmitted to the propellant increment charges through the perforations in the fin assembly shaft. A cellophane-wrapped propellant increment charge is inserted between the blades of each fin and is held in position by a spring-clip increment holder. Any or all of these propellant charges may be removed for fire adjustment (charge firing) by pulling them out of the increment holder clips. The weight of the complete round without the safety-wire and propellant charge but with the M525 PD Fuze is 7.15 pounds. The length of the complete round is 13.32 inches. The maximum ranges (Charge 0 - Charge 6) are 500, 1000, 1550, 2000, 2475, 2900, and 3300, yards respectively.

2. CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE TSQ
M77 (Figure 2)

The WP Cartridge, M57A1 is intended for use as a producer of screening smoke. The complete round consists of a relatively thin-walled steel projectile body containing a white phosphorous smoke filler; a point fuze; Fin Assembly, M4A1; Propellant Increment Charges, M2A1; Ignition Cartridge, M6 and Percussion

Primer, M34. The nose of the projectile is provided with a steel adapter which serves as a seal for the chemical filler and as a seat for the burster assembly. The burster assembly consists of a Burster Charge, M1 and Burster Casing, M2. The Burster Charge, M1 is a thin-walled steel tube filled with a small charge of tetryl. The burster charge is held in the Burster Casing, M2 which is press-fitted into the steel nose adapter of the projectile cavity. The burster charge ruptures the projectile body and disperses the chemical filler upon functioning of the fuze. This cartridge may also be loaded with FS, a liquid smoke producer which acts spontaneously upon contact with the air. The WP Cartridge, M57 differs from the M57A1 only in the Fin Assembly, M4 assembled to the projectile in the M57 model. The Fin Assembly, M4 differs from the M4A1 only in manufacturing details. The weight of the complete round w/TSQ Fuze, M77 is 12.46 pounds and is 24.39 inches long. The maximum ranges for Charges 1 - 4 are: 700, 1,300, 1,800, and 2,372 yards, respectively.

SECTION II

SUMMARY

A. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lots MA-4-269A and MA-4-78A)

At Fort Campbell, Kentucky on 8 March 1960 training exercises were being conducted involving 81mm Mortars and 106mm Recoiless Rifles. These exercises, conducted at night and at rapid-fire, required that the guns be fired then change position and fire again. After the move, the 106mm Rifles were forward and to the left of the position occupied by the 81mm Mortars. Shortly after firing recommenced a round of 81mm ammunition from one of the above-cited lots landed near the crew of the 106mm Rifles, wounding three men. The exact lot is unknown since lot integrity is not kept during such exercises. Investigation of the accident disclosed that:

1. The actual target location was not the same as that shown on the map used by the Officer-in-Charge.
2. The Forward Observation Post and the 106mm Rifle team were inside the impact area due to a miscalculation by the Officer-in-Charge.
3. Rounds were fired over the Forward Observation Post in violation of Section III, Paragraph 11(c) (1) of AR 385-63.
4. Neither the 81mm Mortar nor the 106mm Recoiless Rifle were in the proper position as called for on the overlay.

5. Since the exercise was conducted at night, at rapid-fire, and for record, it is highly probable that one of the increments was inadvertently dropped in handling. According to FT-81-B-5, the loss of one increment charge at the elevation used would have given the round the range which would have caused the short round to land approximately where it did.

Evaluation of all available data led to the conclusion that the short round was not due to faulty ammunition but to loss of one of the two increment charges being used and that closer adherence to safety regulations and more efficient handling of ammunition in loading would prevent recurrence of such incidents. In accordance with this conclusion, suspension was lifted on these two lots of ammunition.

B. CARTRIDGE, 81 MILLIMETER: HE, M43A1, W/FUZE M525A1 (Lot MA-4-226A)

This malfunction occurred at Fort Bragg, North Carolina on 13 July 1960. A mortar was fired at elevation 1018 mils, Charge 5, range 2,700 yards. The malfunctioning round left the tube with a "plop", travelled about 100 yards, and landed without detonating. When recovered, the round had the bore-riding pin still in place. The propellant increments were found scattered around the gun emplacement unburned. Primer function was normal. Remnants of the paper case of the ignition cartridge could be seen through the holes in the fin assembly shaft. No evidence of unburned ignition powder was found. The paint on the fin assembly was not burned off. Temperature was 85° F and a light rain was falling. Inspection of 68 cartridges

from this lot disclosed that one cartridge had been exposed to excessive moisture, resulting in a great deal of corrosion and wet propellant increments. It was concluded that the short-range round was due to its being in this same wet condition, and that it was caused by exposure to the light rain which was falling at the time of the firing exercises. Since there were no other items in the lot at Fort Bragg, it was recommended that the remainder of the lot be released for issue and use and that more care be taken to follow instructions regarding protection of ammunition during firing exercises.

C. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot KOP-9-189A)

During training exercises with the 81mm Mortar using this ammunition, the 3rd Marine Division experienced three misfires and one short round. The short round was a dud. Inspection of the round prior to firing and at the time it was removed from its packaging disclosed that it was rusty and that the ignition cartridge was wet. Subsequent inspection by Picatinny Arsenal of sixty-eight cartridges from this lot disclosed that this same condition existed in forty-three cartridges. It was therefore concluded that the misfires and the dud was caused by this condition and that the ammunition had been exposed to moisture during storage. It was therefore recommended that the remaining cartridges of this lot be given a 100% inspection for wet increments and that any found be replaced. It was also recommended that the Primer, M34 and the Ignition Cartridge, M8 be replaced in all cartridges remaining in Lot KOP-9-189A by those taken from acceptable lots.

**D. CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE, TSQ, M77
(Lot RD-7-37A)**

During firing exercises at Fort Richardson, Alaska on 7 December 1960 there occurred a short-range round involving this ammunition. The round was low and wobbly in flight and fell approximately 75 yards in front of the mortar from which it was fired. After the malfunction, unburned powder was found in the tube of the weapon. A series of tests using 62 samples from this lot was conducted at Aberdeen Proving Ground. The results of these tests are outlined in Table 1 & 2. Analysis of the data contained therein led to these conclusions:

1. The extremely short round reported was most likely caused by wet propellant, as evidenced by the unburnt powder left in the tube after firing. The consistent values of pressure and velocity of the 62 samples from Alaska indicate that the propellant and ignition systems have not been affected by moisture. This indicates that the defect which caused the malfunction is not characteristic of the lot. It is possible that the defective round had lain in the wet snow before it was fired.
2. The five short rounds which occurred during the Aberdeen tests were not caused by defective ignition nor unbalanced ammunition due to voids in the WP charge.
3. A photograph taken of a short round when it was ten feet from the muzzle of the weapon did not show broken fins, although broken fins were found when the round was recovered. Most rounds have their fins broken off upon impact (Figure 3 & 4). It is therefore concluded that the broken fins did not cause the five short-range rounds at Aberdeen.

The 81mm Cartridge, Smoke, WP, M57A1 is known to have an unstable flight characteristic and is of marginal design. It is being replaced by Cartridge, 81mm, Smoke, WP, M370. TB 9-AMM 2, Table II, Part 79, August 1961 specifies that the M57A1 Cartridge not be fired over the heads of troops. It is considered that this ammunition is not dangerous if used as specified. It was therefore recommended that Lot RD-7-37A be released for issue and use.

E. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-101)

During firing exercises at Vieques, Puerto Rico on 25 January 1961 one cartridge in 599 fired fell short--eight feet from the weapon. When fired it left the gun with burning increments falling off. The round did not detonate; therefore, there were of injuries to personnel nor damage to property. Sixty-eight cartridges from Lot MA-4-101 were inspected by Picatinny Arsenal engineers. The only defect found was that various parts for all 68 items were corroded. This, with green deposits found around black powder pellets in the primer bodies (Figure 5, top row), indicated that the items had been exposed to excessive moisture during storage. In view of these findings, it is considered that the short-range round was caused by excessively damp ignition system, and that this condition exists throughout this lot. The condition of the primer indicates that reliable performance cannot be expected from this lot. It is therefore recommended that the entire lot be renovated by substituting Primers, M34 and Ignition Cartridges, M8 from reliable lots for those in cartridges from Lot MA-4-101. After this is accomplished and any wet propel-

lant increments are replaced, it is recommended that the lot be released for issue and use.

F. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-87B)

During firing exercises at Fort Riley, Kansas on 31 January 1961, four rounds malfunctioned and several more were suspected of having malfunctioned. In two cases, the fin section was left in the mortar tube after the round had been fired. The flight of some of these rounds was so erratic that they fell 300 - 400 meters short of the intended impact area. There was no indication of unburned propellant. Charges used varied from Charge 1 to Charge 4 and the ranges from 1000 - 2500 yards.

A series of tests were conducted at Picatinny Arsenal using samples from this lot. The condition of the primers indicated that the ignition systems have been exposed to excessive moisture (Figure 5, top row) and that reliable performance cannot be expected from any of the primers in this lot. The result of the pull-tests indicated that the welds on the fin assemblies are not consistently acceptable. Mil Spec MIL-F-20500 requires that the welds on the fins be capable of sustaining a load of 2500 pounds. The tests conducted during this investigation indicated that such a load can easily be sustained by high quality welds, but that if high quality workmanship is not maintained during the fabrication of the fins, structural failure of the weld can be expected to occur during firing, which will result in short-range rounds. As a result of this investigation, it was recommended that the Fin Assemblies, M3, Primers, M34, and ignition cartridges in all remaining items in Lot MA-4-87B be replaced with

those from acceptable lots. It was further recommended that all items be given a 100% visual inspection for wet increments and that those found be replaced. Upon completion of this renovation, it was recommended that the lot be released for issue and use.

A new ignition system to replace the Primer, M34 and Ignition Cartridge, M8, is being developed by Picatinny Arsenal, which will have improved moisture resistance qualities. The new 81mm Cartridge which will replace the M43A1B1 has an extruded aluminum fin assembly which does not rely on quality control for spot welds.

G. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot OA-1-271C)

During firing exercises at Fort Benning, Georgia on 6 February 1961 with the 81mm Mortar using this ammunition, the fifteenth round fell short and the sixteenth round failed to leave the tube. The malfunctioning round fell 200 yards from the firing point and exploded high order. There were no injuries to personnel or damage to property. Investigation disclosed that one-third of the Fin Assembly, M3 from the fifteenth round was left in the tube, the presence of which prevented round sixteen from firing.

Picatinny Arsenal Engineers conducted a series of tests using ammunition from the lot from which the malfunctioning round had come. The condition of the primers (Figure 5, bottom row), ignition cartridges, propellant increments, and the complete rounds indicated that the ammunition had not been exposed to excessive moisture.

The result of the ballistic tests indicated that the ignition system and propellant increments were in good condition. Pull tests disclosed that the welds on the fin assemblies were far below the standards of Mil Spec MIL-F-20500 ("Welds of fins must be capable of sustaining a load of 2500 pounds"). Tests conducted by Picatinny Arsenal on similar ammunition from other lots indicated that this load can easily be sustained by high quality welds, but that if the weld is substandard, structural failure can be expected during firing, resulting in short-range rounds. It is recommended that the Fin Assemblies, M3 on remaining rounds of this lot be exchanged for those from acceptable lots and that the renovated ammunition be released for issue and use. The new 81mm HE Shell which will replace the M43A1 has an extruded aluminum fin assembly which does not rely on quality control of welds for good functioning.

H. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot MA-4-242A)

During firing exercises on 5 April 1961 at Fort Benning, Georgia, 13 duds and 28 erratic (short) rounds occurred at 120 rounds of this ammunition fired. Personnel reported hearing unusual noises in the case of the erratic rounds, and were of the opinion that some of the fins were coming off. Propellant increments on some of the rounds were still burning when the rounds were 10 feet from the tube.

A series of tests using ammunition from the malfunctioning lot were conducted by Picatinny Arsenal. The condition of the primers (Figure 5, top row) indicated that the ignition system had been exposed to excessive moisture; therefore, reliable

functioning cannot be expected from primers in this lot. The dud rate found in ballistic tests combined with those reported by Fort Benning, is within the limits set by Ltr, ORDBB-NR4, 18 November 1960, Subj. Fuze, PD, M525A1. Pull tests disclose that fins are within the allowable limits as set forth by Mil Spec MIL-F-20500. The Primers, M4, and Ignition Cartridges, M34 should be replaced in all remaining ammunition from this lot, a 100% visual inspection should be made of the propellant increments, replacing all wet ones, and, after this renovation is completed, the lot should be released for issue and use.

I. CARTRIDGE: 81 MILLIMETER: HE, M43A1, W/FUZE PD, M525A1 (Lot MA-4-222A)

On 1 August 1961, 74 rounds of this ammunition was fired during exercises being held at Fort Amador, Canal Zone. Of these, seven misfired, six were duds, and twelve were short-range rounds. Eleven of the short rounds were 1,100 yards short of the impact area and the other fell within 75 yards of the firing gun. At a later date, authorities at Fort Amador altered 20 rounds from this lot by replacing the Primers, M34 and Ignition Cartridges, M8 with those from acceptable lots and lubricating the fuzes. Test-firings of these rounds resulted in 100% accurate range, no misfires and no duds. Since only 200 rounds from this lot remain, and since Picatinny Arsenal feels that the tests by Fort Amador are satisfactory for determining the cause of the malfunction, it is not considered economically justifiable to conduct further tests. It is therefore recommended that this lot be renovated as done by Fort Amador and

upon completion, the remainder of the lot be released for issue and use.

J. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lots WC-34-32D, WC-34-34C or OA-1-113A)

During firing exercises conducted at Fort Richardson, Alaska on 24 October 1961 one short-range round occurred out of 126 fired. Since three weapons and three lots of ammunition were in use, the exact gun and lot from which the malfunctioning round came was not determinable. After the malfunction, test-firings were conducted using the same weapons and the same three lots of ammunition. Rounds were fired using both Charge 3 (correct for range) and Charge 2 at the same elevation as was used during initial firings. It was discovered that where Charge 3 was used, the rounds fell in the proper impact area, but that where Charge 2 was used, the rounds fell in approximately the same area as did the short-range round. This finding is in accordance with FT 81-AB-1. It is therefore considered that the short round was caused by the inadvertent omission or loss of one of the three increments necessary at this range and elevation. This type of error can be avoided if proper attention is given to removing the correct number of propellant increments and if care is taken in handling the ammunition. It is recommended that these lots be released for issue and use.

K. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot IOP-21-20B)

On 17 April 1962 at Schofield Barracks, Hawaii during rapid-fire exercises using

three mortars and this ammunition, one round fell only 260 yards from the firing point although the range to the target area was 550 yards. Three thousand nine hundred rounds from this lot had been previously fired by that command without incident. Officials at Schofield Barracks conjectured that the malfunction was caused by the inadvertent leaving off or dropping of the propellant charge. According to FT 81-AB-1 this would account for the short-range round landing where it did. Picatinny Arsenal evaluated the data, concurred with this conclusion, and recommended that the lot be released from suspension and authorized for issue and use. This type of accident can be avoided if care is taken in removing propellant charges and in handling the ammunition.

SECTION III
CONCLUSIONS

A. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot MA-4-78A or MA-4-269A)

After evaluation of the data obtained in the investigation of this malfunction it was concluded that:

1. The short-range round was caused by the omission or loss of one propellant increment during the rapid-fire exercises.
2. There is no evidence to support the theory that the malfunction was due to faulty ammunition.

B. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-226A)

Evaluation of the data by Picatinny Arsenal led to the conclusion that:

1. The short-range round was caused by propellant increment becoming wet because the ammunition was inadequately protected from the light rain which was falling during the exercises.
2. No evidence exists in support of the theory that the accident was due to faulty ammunition.

C. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot KOP-9-189A)

After an investigation by Picatinny Arsenal it was concluded that:

1. The three misfires and one short-range round were caused by excessively damp ignition systems.

2. That the remainder of this lot is in a like condition therefore, reliable performance cannot be expected from any of the ammunition it contains.

D. CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE, TSQ, M77
(Lot RD-7-37A)

The result of tests conducted by Aberdeen Proving Grounds led to these conclusions:

1. The extremely short round was probably caused by wet propellant increments.

2. The defect that caused this malfunction is not characteristic of the entire lot.

3. The five short rounds which occurred during the Aberdeen tests were not caused by defective ignition or unbalanced ammunition due to voids in the WP charge.

4. These five short rounds were not caused by broken fins.

5. The defects found during this investigation are not dangerous when the ammunition is used as specified in TB9-AMM 2, Table II, Part 79, August 1961 (Ammunition not to be fired over the heads of troops).

E. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-101)

As a result of the tests conducted during this investigation it was concluded that the malfunction was due to an excessively damp ignition system and that this condition existed throughout this lot. The condition of the primer indicates that reliable performance cannot be expected from the ammunition in this lot.

F. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-87B)

The result of a series of tests conducted by Picatinny Arsenal using ammunition of this lot obtained from Red River Arsenal led to the following conclusions:

1. The ignition systems had been exposed to excessive moisture and that reliable performance cannot be expected from ammunition in this condition.
2. Short-range rounds were due to lack of high quality workmanship during fabrication of the fin assemblies, resulting in low-quality welds, and subsequent structural failure.

G. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot OA-1-271C)

A series of tests conducted by Picatinny Arsenal using samples of this lot obtained from Fort Benning, Georgia led to these conclusions:

1. The condition of the primers, ignition cartridges, propellant increments, and the complete rounds indicated that the items had not been exposed to excessive moisture.

2. Ballistic tests showed that the ignition systems and propellant increments were in good condition.

3. That the short rounds were due to structural failures of fin assembly welds, which were far below allowances shown in Military Specification MIL-F-20500, which specifies that fins must be capable of withstanding a minimum load of 2,500 pounds.

H. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot MA-4-242A)

The result of a series of tests conducted by Picatinny Arsenal using samples of this lot obtained from Red River Arsenal led to these conclusions:

1. Malfunctions were due, in part, to excessive moisture in the ignition system.

2. The combined dud rate of the ballistic tests and the firing at Fort Benning is low enough to be considered acceptable in accordance with Ltr, ORDBB-NR4, 18 November 1960, Subject: Fuze, PD, M525A1.

3. Welds on the Fin Assemblies are acceptable under Mil Spec MIL-F-20500.

I. CARTRIDGE, 81 MILLIMETER: HE, M43A1, W/FUZE PD, M525A1 (Lot MA-4-222A)

The test results and conclusions obtained by Fort Amador, Canal Zone--that the cause of the malfunction was failure of the M34 Primers contained in this lot and that replacement by primers from acceptable lots would correct the deficiency--was

SECTION IV
RECOMMENDATIONS

A. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lots MA-4-269A and MA-4-78A)

1. Recommendations

It was recommended that greater care be taken in handling ammunition and that Safety Regulations be followed more closely.

2. Action Taken

Ordnance Ammunition Command was advised of the findings and recommendations (Ltr, 22 September 1961, Appendix C1-2).

B. CARTRIDGE, 81 MILLIMETER: HE, M43A1, W/FUZE M525A1 (Lot MA-4-226A)

1. Recommendations

(a) That instructions contained in FM 23-90 (Chapter 6, Paragraph 17) be more carefully followed in future exercises and firings.

(b) That the remainder of this lot be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was notified of the findings, conclusions, and recommendations (Ltr, 14 March 1962, Appendix C3-4).

C. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot KOP-9-189A)

1. Recommendations

It was recommended that the remaining cartridges in this lot be given a 100% inspection for wet increments and that any found be replaced. It was further recommended that the Primer, M34 and the Ignition Cartridge, M8 be replaced by those taken from acceptable lots. Upon completion of this action, it was recommended that the lot be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr, 2 March 1962, Appendix C5-6).

D. CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE TSQ, M77 (Lot RD-7-37A)

1. Recommendations

It was recommended that this lot be released for issue and use but that troops be rewarned to follow the caution contained in TB 9-AMM 2, Table II, Part 79, August 1961 to the effect that this ammunition not be fired over the heads of troops.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr 12 June 1962, Appendix C6-7).

E. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-101)

1. Recommendations

It was recommended that all Primers, M34 and Ignition Cartridges, M8 in this lot be replaced with those from acceptable lots, that the entire lot be given a 100% visual inspection for wet propellant increments, that any found be replaced, and upon completion of the recommended renovation the lot be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was advised of the findings, conclusions, and recommendations (Ltr, 16 March 1962, Appendix C8-9).

F. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-87B)

1. Recommendations

It was recommended that the M3 Fin Assemblies in all cartridges remaining in Lot OA-1-271C be replaced with those from acceptable lots, that the propellant increments be given a 100% visual inspection for wet increments and any found be replaced, and then the renovated cartridges be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr, 23 March 1962, Appendix C10-11).

G. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot OA-1-271C)

1. Recommendations

It was recommended that the Fin Assemblies, M3 be replaced with those from acceptable lots in all cartridges remaining in this lot and then the lot be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr, 27 March 1962, Appendix C12-13).

H. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot MA-4-242A)

1. Recommendations

It was recommended that the Primers, M34 and Ignition Cartridges, M8 be replaced with those from acceptable lots in all items remaining in this lot, that the propellant increments be given a 100% visual inspection for wetness and all wet increments be replaced. Upon completion of this renovation, it is recommended that the lot be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr, 3 April 1962, Appendix C14-15).

I. CARTRIDGE, 81 MILLIMETER: HE, M43A1, W/FUZE PD, M525A1 (Lot MA-4-222A)

1. Recommendations

It was recommended that the Primers, M34 and Ignition Cartridges, M8 be replaced with those from an acceptable lot in all cartridges remaining in this lot and that the lot then be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr, 8 November 1961, Appendix C16-17).

J. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lots WC-34-32D, WC-34-34C, & OA-1-113A)

1. Recommendations

It was recommended that greater care be taken in removing propellant increments and in handling ammunition prior to firing, and that this lot be released for issue and use.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr, 31 January 1962, Appendix C18-19).

K. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot IOP-21-20B)

1. Recommendations

It was recommended that this lot be released for issue and use and that greater care be taken in removing propellant increments and in handling ammunition prior to firing.

2. Action Taken

Ordnance Ammunition Command was informed of the findings, conclusions, and recommendations (Ltr, 4 June 1962, Appendix C20-21).

SECTION V

STUDY

A. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lots MA-4-269A and MA-4-78A)

On 8 March 1960, Company C, 506th Infantry, 1st Airborne Battle Group was conducting training exercises involving 81mm Mortars and 106mm Recoilless Rifles at Fort Campbell, Kentucky. The problem involved firing from one position, then changing positions and firing again at rapid-fire. At the beginning of the exercise the weapon positions were separated by approximately 600 yards, with the 106mm position forward and to the left of the 81mm position--outside of the surface danger area. As the exercise progressed, the positions were changed to what appeared to correspond to the positions shown on the range overlay with respect to azimuth and coordinates. Firing from this second position was at night and at a rapid rate of fire. During the firing mission, one 81mm Mortar Cartridge fell short and within 15 yards of the 106mm position, injuring three enlisted men. Investigation at the time of the accident included a comparison of the range overlay to the range map to determine the actual positions occupied by the two teams at the time the short round fell. It was disclosed that a miscalculation had been made and that the 106mm position was 700 yards forward and 10 degrees to the left of a direct line to the target from the 81mm position. Since this mission was conducted at night and at rapid-fire, the original investigators determined that a possibility existed that one charge was dropped from the round, thus reducing the range from 1,025 yards to 700 yards. This would be in

accord with FT-81-B-5 and would account for the short-range round.

From 29 March to 1 April 1960 a Picatinny Arsenal engineer visited Fort Campbell to assist in the investigation of this accident. In addition to verification of the above facts, the following information was gained:

1. Fort Campbell uses FT 81-B-5 for the 81mm Mortar M29 with the 81mm HE M43A1 Cartridge. For a range of 1,025 yards, this table prescribes an elevation of 1246 mils and a charge of two increments. If a charge of one increment were used at this elevation, a range of 700 yards could be expected, according to this Firing Table.

2. Two lots of ammunition were in use (MA-4-78A and MA-4-269A) during this exercise. Since lot integrity was not maintained due to rapid-fire, it could not be determined from which lot the short-range round had been taken. Three thousand five hundred eighteen rounds from the two lots had been fired prior to the malfunction with no report of malfunctions other than this one.

3. The M29 Mortar weapons involved were forwarded to the Post Ordnance Shop and given a thorough examination. No evidence of excessive scoring of the tubes, nor damage to the firing pins was found. The elevating and traversing mechanisms were examined and appeared to be in normal condition.

4. The rounds had been stored in an underground magazine with no temperature or humidity controls; however, temperatures had been recorded daily. Normal procedure at Fort Campbell is to withdraw ammunition from the magazine not more

than one day in advance of use and to immediately dispatch it to the range area. If it is not immediately dispatched to the range, a tarpaulin-covered truck is used. All items unloaded at the range are required to be covered by a tarpaulin.

5. A surveillance inspection had been made at the time Lot MA-4-78A had been received (29 October 1959). Three rounds were visually inspected and found to be in good condition. Normal maintenance would not be required for from three to five years. Lot MA-4-269A had been received in 31 July 1958 and given a similar inspection with the same results. No ballistic surveillance tests are performed on rounds in storage at Fort Campbell.

6. Overlay maps are prepared in accordance with safety practices specified by AR 385-63 "Regulations for Firing Ammunition for Training Target Practice and Combat." The map is distributed to all company commanders two weeks in advance of a training exercise.

7. Since the Army Training Test (ATT) is scored on a time basis, the company commanders sometime overlook some of the safety rules. With rapid-fire missions the rounds are removed from their fiber containers in advance of the actual mortar-loading time. They are put into the wood box and moved from position to position. It is possible that an increment may be lost during this process. The fiber containers are very tight and in wet weather it takes two men to open the container.

8. The Range Safety Officer had been firing ATT's for approximately two years. The platoon involved in this problem had been on the problem for two weeks.

9. The weather on the night of the accident was cold and damp. Due to tight schedules, missions are not cancelled in the event of inclement weather. The possibility thus existed that one increment may have gotten wet.

10. Round lot integrity is never maintained in exercises of this type because to do so the rounds must be reloaded into fiber containers and returned to storage. Time limitations preclude such action.

11. Correct weapon position may be determined to within 200 yards by stadia markings placed on the range.

12. The 81mm Mortar team and the 106mm Rifle team were in constant radio contact. Agreement upon new locations for the weapons by this means was thus possible.

On the basis of data compiled and evaluated by Picatinny Arsenal, it was concluded that the cause of the short-range round was a missing propellant increment. This condition was most likely due to rough handling prior to loading or faulty loading of the projectile.

It was recommended that because of the seriousness of the malfunction, the two lots be given a 100% inspection to assure that the short-range round was not caused by defective ammunition. This inspection should include screening for: missing or loose increments, damaged increment bags, loose or cracked fin assemblies. All defective ammunition should be forwarded to Picatinny Arsenal for determination of

exact cause of the malfunction and of corrective action to be taken. After elimination of defective rounds, if any, the two lots should be released from suspension.

B. CARTRIDGE, 81 MILLIMETER: HE, M43A1, W/FUZE M525A1 (Lot MA-4-226A)

On 13 July 1960 at a ROTC summer incampment training exercise held at Fort Bragg, North Carolina, a short-range round occurred. The Mortar, M29 was fired at an elevation of 1018 mils, Charge 5, range 2,700 yards. The malfunctioning round left the tube with a "plop", travelled only 100 yards, and landed without detonating. Upon recovery the bore-riding pin of the malfunctioning round was found to be still in place. Unburned propellant increments were found scattered around the gun emplacement. Primer function was normal. Remnants of the paper case of the ignition cartridge could be seen through the holes in the fin assembly shaft. No evidence of unburned ignition powder was found. The paint on the fin assembly was not burned off. At the time of the accident, the temperature was 85° F and a light rain was falling.

Picatinny Arsenal obtained 68 cartridges of Lot MA-4-226A from Fort Bragg and subjected them to various tests. Visual inspection disclosed that one of these rounds was heavily corroded on the front end of the shell and on the fin assembly. The propellant increments on this round had moisture on their entire surface, and on the Fin Assembly to the rear of the increments. Corrosion had caused one of the

propellant holders to break off, losing the increment. Primers were removed from five of the rounds and inspected with their onion-skin discs removed. Each primer had a trace of corrosion on the brass body near the black powder pellet. According to tests described in Section XVII of Surveillance Branch Monthly Progress Report, February 1954 (not included with this report) a short-range could be expected when firing a wet cartridge such as that just described. A ballistic test was run on thirty of the sixty-four rounds, using an elevation of 77° and a Charge 2. The rounds were fired at an ambient temperature of 32° F. Average pressure was 1450 psi, average velocity was 401 fps. All samples landed within a 700 yard area plus or minus 100 ft. This indicates that the performance of the test rounds was satisfactory. It was concluded that the cause of the short-range round was a dampened condition similar to the round described above, caused by the propellant being exposed to the rain which was falling at the time of the exercise. Such dampness can be avoided if the instructions contained in FM23-90, Chapter 6, Paragraph 17 are strictly followed. It was recommended that since no other items remain in the lot at Fort Bragg, the remainder of Lot MA-4-226A be released for issue and use.

C. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot KOP-9-189A)

During training exercises being held by 3rd Marine Division three misfires and one short-range round occurred of 79 rounds fired. The weapon used was Mortar, M29, and the ammunition was CARTRIDGE, 81¹ MILLIMETER: HE, M43A1B1 from Lot KOP-9-189A. The short-range round landed between 50 and 100 yards from the

gun emplacement and did not explode upon impact. This round was rusty and had a wet ignition cartridge at the time it was removed from its original container.

Picatinny Arsenal obtained 68 cartridges from the lot from which the malfunctioning rounds had been taken and submitted them to inspection. Forty-three of these rounds had small rust spots on the fin assembly and/or increment holders. The primers of five of these rounds were inspected with their onion-skin discs removed. Heavy corrosion was found on the brass body near the black powder propellant and there were green and white deposits around the edge of the pellet (Figure 5), top row)-- indicating that the items had been exposed to excessive moisture during storage.

In view of these findings, it was concluded that the misfires and the short-range round were caused by an excessively damp ignition system. It is considered that this condition exists in the remainder of the lot. The condition of the primer indicates that reliable performance cannot be expected from the ammunition contained in this lot. Recommendation was therefore made that the Primer, M34 and the Ignition Cartridge, M8 be replaced with primers and ignition cartridges from acceptable lots in the remaining cartridges in Lot KOP-9-189A and that the lot be 100% inspected for wet increments and all found be replaced. Upon completion of this renovation the lot should be released for issue and use.

D. CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE, TSQ, M77
(Lot RD-7-37A)

Training exercises involving Mortar, M29 and Cartridge, 81mm, Smoke, WP,

M57A1, W/Fuze, TSQ, M77 (Lot RD-7-37A) were conducted by Company A, 1st Battle Group, 23rd Infantry at Fort Richardson, Alaska, on 7 December 1962 when a short-range round occurred. Elevation was 1099 mils and the range to the target was 1,500 yards. As the projectile emerged from the tube the propellant increments appeared to be burning excessively. The flight of the round was low and wobbly and it landed only 75 yards from the gun and failed to explode upon impact. After the malfunction, unburned powder was found in the tube. There were no deviations from instructions contained in FM 23-90. The gun had been checked out prior to firing and found to be in excellent condition. The ammunition had been packed in the original sealed containers and stored in igloo-type magazines until issued for training. Three minutes elapsed between removal of the ammunition from its container and its being fired. One round from this lot had been fired previously and function was normal. At the time of firing, the weather was overcast with an ambient temperature of 33° F. The terrain was level with approximately four inches of snow on the ground. There were no obstructions in the line of fire. There were no injuries to personnel. Due to the snow cover, it was not possible to recover the defective round. Ammunition was immediately withdrawn from units and placed under local suspension.

An engineer from Picatinny Arsenal visited Aberdeen Proving Ground, Maryland on 15 March 1962 to witness the test-firing of 36 samples from the lot from which the malfunctioning round had come. The test rounds were fired at an ambient temperature of 45° F at an elevation of 1099 mils, Charge 3, range 1,500 yards. Velocity, range, and the average of two pressure readings (copper) were recorded for each round fired

(Table 1). The average velocity for 36 rounds was 465 fps, average pressure was 3,430 psi. The expected velocity for Charge 3, according to FT 81-AB-1, is 466 fps. Projectiles 4, 8, 12, and 14 fell substantially short of the intended range. The projectiles from Sample 4, 8, 12, and 14 were recovered and inspected. Sample 8 and 14 each were found to have had one fin blade broken off at the base (Figure 3). Six blades from Sample 4 and seven blades from Sample 12 were broken off in the same way (Figure 3). All samples had fallen into a soft, marshy area. Pictures of the four broken fin assemblies were taken. The consistent values found for pressures and velocities indicate that the ignition system and the propellant increments had not been affected by moisture. The broken fins found on all four short-range rounds were indicative of the probable cause of the malfunction. However, when the impact area was safe to enter, the fin assemblies from 11 projectiles which reached a range of 1,500 yards were recovered. It was found that 10 of the 11 assemblies had broken fin blades (Figure 4).

Additional test-firings of the 26 remaining samples were conducted at Aberdeen Proving Ground on 19 April 1962. These samples had been X-rayed and inspected for location of center of gravity. Some voids and unbalanced items were noted in these tests, however, the test-firings indicated that the items had acceptable ballistic characteristics. The test rounds were fired at an ambient temperature of 57° F and the same elevation, charge, and range as the first test-firings. Velocity, range, and the average of two pressure readings (copper) were recorded for each round

fired (Table 2). In addition, smear photographs were taken of each item approximately 10 feet from the muzzle. The average velocity for all 26 rounds was 464 fps and the average pressure was 3,375 psi. Projectile 19 fell substantially short of the intended range. When the fin assembly from this round was recovered it was found that some of the fins had broken off. However, examination of the photographs proved that the fins were intact when the projectile was leaving the tube.

The data obtained from the malfunction report, the results of the tests run at Aberdeen Proving Ground, and other evidence led to the conclusion that the short-range round reported from Fort Richardson, Alaska was most likely caused by wet propellant, as evidenced by the unburnt propellant in the tube after firing. However, the consistent values of pressure and velocity found by Aberdeen Proving Ground in testing the 62 samples received from Fort Richardson indicate that their ignition systems and propellant had not been affected by exposure to moisture. It was therefore concluded that the defect which had caused the short-range round was not characteristic of the lot. The defective round may have become wet due to exposure to snow immediately prior to being fired.

In regard to the five short-range rounds experienced during the tests at Aberdeen Proving Ground, Maryland the following conclusions were reached:

1. These malfunctions were not caused by defective ignition nor unbalanced ammunition due to voids in the WP charge.
2. Fins on most rounds are broken on impact with the ground. The photo-

graph taken of the short round when ten feet from the tube did not show broken fins. It is therefore concluded that the five short-range rounds were not caused by broken fins.

3. Cartridge, 81 MILLIMETER: SMOKE, WP, M57A1 has an unstable flight characteristic and is of marginal design. This item is being replaced by CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M370. TB9-AMM 2, "Ammunition: Restricted or Suspended" specifies that the M57A1 shall not be fired over the heads of troops. Therefore, it is considered that the defects found during this investigation are not dangerous when used as specified and it is recommended that Lot RD-7-37A be released for issue and use.

E. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-101)

On 25 January 1961 the 81mm Mortar Platoon, H&S Company, 3rd Battalion, 2nd Marine Division, 24th Marine Expeditionary Unit was engaged in a training mission at Vieques, Puerto Rico involving Mortar, M29 and Cartridge, 81mm, HE, M43A1B1 (Lot MA-4-101) when a short-range round occurred. The rounds were being fired at elevation 1102 mils, Charge 4, volley fire at a range of 2,100 yards when the 600th round left the tube with its burning propellant increments falling off. It travelled approximately eight yards and landed without detonating. Upon examination it was found that the bore-riding safety pin was out, the safety wire cut, and the propellant increments burned out. The malfunctioned round was not available for inspection by Picatinny Arsenal engineers because, due to the hazards involved

at the site of the accident, it was destroyed in place by EOD personnel. According to the report by Marine personnel, there were no obstructions either in the tube or in the line-of-fire, there was no evidence of residue in the tube, no non-standard conditions existed, and there were no deviations from the instructions contained in the pertinent technical manual. Of 1199 rounds fired during the exercises no other malfunctions reported. The ammunition had been withdrawn from storage the evening prior to the exercise and left in a truck overnight. It was removed from its containers and stored under a tarpaulin approximately two hours prior to being fired. The weather at the time of the firing was clear and warm. The area near the gun was clear and the muzzle was not close enough to the ground to allow foreign matter to be blown into the tube by a previous shot. Sixty-eight rounds from this lot were inspected by Picatinny Arsenal Engineers. Small rust spots were found on the fin assemblies and/or propellant-increment holders. The primers from five rounds were removed and inspected with their onion-skin discs removed. Corrosion was found on the brass body near the black powder pellets on all five primers, and green deposits were found around the edge of one of the pellets (Figure 5, top row). These factors indicate that the ammunition had been exposed to excessive moisture during storage. Evaluation of available data led to the conclusion that the short-range round was caused by a wet ignition system and that this condition exists in the remainder of the lot. The condition of the primer indicates that reliable performance cannot be expected from this lot. Recommendations were made that the ammunition in Lot MA-4-101 be renovated by replacing the Primer, M34 and the Ignition Cartridge M8

with those from acceptable lots and that a 100% inspection be given the lot to determine if any rounds have wet propellant increments--replacing any that are found. Upon completion of this renovation, the lot should be released for issue and use.

F. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot MA-4-87B)

A malfunction investigation report received from Fort Riley, Kansas indicated that several malfunctions involving the 81mm Cartridge, M43A1B1 (Lot MA-4-87B) were experienced during training exercises which were in process on 31 January 1961. Although there were only four incidents which could be definitely identified as malfunctions, numerous rounds were suspected of having malfunctioned. In those rounds which definitely malfunctioned, sections of the fins had broken off. In two cases, portions of the fins had been left in the mortar tube after the propelling charge had been fired. Some of the rounds were so erratic in flight that they fell 300 to 400 meters short of the intended range. No evidence of unburned propellant was found. Charges used varied from Charge 1 to Charge 4 and the range from 1,000 yards to 2,500 yards. Ambient temperature was 48° F.

Ammunition from this lot was obtained from Red River Arsenal and tested by Picatinny Arsenal. Significant points of these test-results include: The conditions of the primers indicated that the rounds had been subjected to excessive moisture during storage (Figure 5, top row), and that reliable performance cannot be expected from ammunition taken from this lot. Data obtained by the pull-tests indicate that the welds on the fins are not consistently acceptable. Mil Spec MIL-F-20500 pre-

scribed that these welds be capable of sustaining a load of at least 2,500 pounds. Results of these tests indicate that such a load can be sustained by the fins only if high-quality workmanship is maintained throughout the manufacturing process. If such high-quality workmanship is not maintained, structural failure of the weld will result and short-range rounds can be expected upon firing the ammunition.

Recommendation was made that the Primers, M34, the Fins, M3, and the Ignition Cartridges, M8, be replaced in all ammunition remaining in this lot with those from acceptable lots, that a 100% visual inspection be given the lot for wet propellant increments, that all wet increments found be replaced, and that, upon completion of this renovation, the lot be released for issue and use.

A new ignition system to replace the Primer, M34 and Ignition Cartridge, M8 is being developed by Picatinny Arsenal which will have improved moisture-resisting qualities. The new 81mm Cartridge which will replace the M43A1B1 has an extruded aluminum fin assembly which does not rely upon quality control of spot welds.

G. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lot OA-1-271C)

On 6 February 1961 training exercises involving the firing of the Mortar, M29 and Cartridge, 81mm, HE, M43A1B1 (Lot OA-1-271C) were being held at Fort Benning, Georgia. One phase of the exercises called for rapid-fire. As the 16th round of this series was dropped into the tube, it was reported that the 15th round had been short-range. The 16th round failed to leave the tube. The mortar was being fired at

elevation 1391 mils, Charge 2, for a range of 925 yards. The short-range round travelled only 200 yards and detonated high order. No injuries to property or personnel resulted. Upon investigation it was discovered that portions of the fin assembly of round 15 had broken off in the tube--which accounted for both the short-range round and the failure of the 16th round to leave the tube. No evidence of unburnt propellant was found in the tube.

A representative sample of this ammunition taken from Lot OA-1-271C was obtained from Fort Benning, Georgia and tested by Picatinny Arsenal. The significant data obtained through these tests included:

1. The condition in which the primers (Figure 5, bottom row), ignition cartridges, propellant increments, and the complete rounds were found indicates that the ammunition had not been exposed to excessive moisture.
2. The results obtained from the ballistic tests indicate that the ignition system and propellant increments are in good condition.
3. The results obtained from the pull tests indicate that the welds on the fin assemblies of cartridges from this lot are far below acceptable standards as set forth in Mil Spec MIL-F-20500 "Fins, Steel, For Smooth bore Mortar Shell," which specify that these fin assemblies be capable of sustaining a minimum load of 2,500 pounds. Tests which have been conducted at this Arsenal using similar ammunition from lots other than OA-1-271C prove that high-quality welds are capable of meeting this standard. If, however, poor quality welds are used, structural failure is likely to result and short-range rounds will be obtained.

Recommendation was made that the Fin Assemblies, M3 be replaced in each cartridge remaining in this lot and that, upon completion of this renovation, the lot be released for issue and use.

H. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot MA-4-242A)

Of 120 rounds of this Ammunition fired during exercises held at Fort Benning, Georgia on 5 April 1961 28 were short-range rounds, and 13 were duds. Both slow and rapid-fire was used (malfunctions occurred during both methods) at elevations ranging from 1050 to 1230 mils, ranges from 1,300 to 2,000 meters, and, for the most part, Charge 4 was used. The short-range rounds were short by 200 to 1000 meters. Personnel present reported hearing strange noises while the projectiles were in flight and observers were of the opinion that the fins were coming off. In some cases, the propellant increments were observed to be still burning after the rounds had left the tube.

Samples from the lot from which the malfunctioning rounds had come were obtained from Red River Arsenal, Texas and tested by Engineers of Picatinny Arsenal. Evaluation of this data resulted in these conclusions and recommendations:

1. The condition in which the primers were found indicated that the ignition system had been exposed to excessive moisture (Figure 5, top row), therefore, reliable function cannot be expected from this lot of primers.

2. The combined dud-rate of these tests and those reported by Fort Benning is low enough to be considered as acceptable according to the standards set forth by

Ltr, ORDBB-NR4, 18 November 1960, Subject: Fuze, PD, M525A1.

3. Results of the pull-tests indicate that the welds on the fin assemblies meet the minimum standards set forth in MIL Spec MIL-F-20500 (Welds will be capable of withstanding a minimum stress of 2,500 pounds).

4. It was recommended that the Primers, M34 and the Ignition Cartridges, M8 be replaced by those from acceptable lots in all cartridges remaining in Lot MA-4-242A and that each round therein be inspected for the presence of wet propellant increments and that any found be replaced. Upon completion of this renovation it is recommended that the lot be released for issue and use.

I. CARTRIDGE, 81 MILLIMETER: HE, M43A1, W/FUZE, PD, M525A1 (Lot MA-4-222A)

During firing exercises being held on 1 August 1961 at Fort Amador, Canal Zone 74 rounds of this ammunition were fired. Of these, seven misfired, six were duds, and 12 were short-range rounds. Of the 12 short-range rounds, 11 fell short of the 2,800 yard range by approximately 1,100 yards and one landed only 75 feet from the gun-emplacement. Later, authorities at Fort Amador conducted firing tests after renovating 20 rounds from this lot by lubricating the fuzes and by replacing the primers and ignition cartridges with those from acceptable lots. There were no malfunctions or other undesirable results from these tests.

Engineers at Picatinny Arsenal consider the test results obtained by Fort Amador personnel to be valid and conclusive proof that ammunition contained in this lot, if

renovated as just described, will give satisfactory service. Therefore, it was not considered economically justified or otherwise desirable to conduct further tests or investigations. It is therefore recommended that the remainder of the ammunition in this lot be renovated in accordance with the method described above and that, upon completion thereof, the lot be released for issue and use.

J. CARTRIDGE, 81 MILLIMETER: HE, M43A1B1 (Lots WC-34-32D, WC-34-34C or OA-1-113A

Firing exercises involving this ammunition were in process at Fort Richardson, Alaska on 24 October 1961 when one round fell 325 yards short of the target, killing one man and injuring several others. Since two guns and three lots of ammunition were in use, it was not possible to determine from which gun the short-range round was fired, nor from which lot the round had been taken. The elevation on gun number one was 1301 mils and that on number two was 1289 mils. Range to the target was 1220.8 and 1160.3 yards respectively and Charge 3 was being used on both guns. After the malfunction occurred, three rounds were fired from each gun using Charge 3 and an equal number using Charge 2. All rounds fired at Charge 3 landed on target and all fired with Charge 2 landed in the area where the original malfunction occurred. The same elevations used in the original problem were also used in the test. These results are in accordance with those predicted in similar cases by FT 81-AB-1. In view of these results, Engineers at Picatinny Arsenal concurred in the conclusions reached by authorities at Fort Richardson that the cause of the short-range round was

that Charge 2 was inadvertently used instead of the required Charge 3. Pertinent personnel were advised that this type of accident can be avoided if proper attention is given to the removal of the correct number of propellant increments and if the care prescribed by FM 23-90 is taken in handling the ammunition prior to firing. No further testing or investigation by Picatinny Arsenal personnel was deemed necessary or advisable and it was recommended that these lots be released for issue and use.

K. CARTRIDGE, 81 MILLIMETER: HE, M43A1 (Lot IOP-21-20B)

On 17 April 1962 at Schofield Barracks, Hawaii Company B, 14th Infantry, 1st Battle Group, 25th Infantry Division was undergoing firing exercises involving Mortar, M29 and using this ammunition when a short-range round occurred. Firing was concentrated and rapid. Three guns were in use simultaneously at an elevation of 1331 mils, Charge 1, range 550 yards. The gun from which the malfunctioning round came was not determinable. The malfunctioning round fell 260 yards short of the intended impact area. There were no obstructions in the gun or in the line-of-fire and no deviations from instructions in appropriate technical and field manuals were made. One man was injured. No fragments from the short-range round were recovered. When unpackaged approximately 45 minutes prior to being fired, the ammunition appeared to be in good condition. A 100% inspection of all ammunition in this lot had been performed in January of 1962 and found to be in good condition. Since 1954, 3,900 rounds of 81mm Mortar have been fired by Schofield Barracks personnel without incident. No unburned powder or excessive oil was found in the mortar tube

following the incident. Authorities at Schofield Barracks concluded from the above information that the cause of the malfunction had been the inadvertent removal of the one propellant increment during the hasty loading involved in rapid-fire exercises. The data contained in FT 81-AB-1 confirms this conclusion. (Cartridges fired at this elevation at Charge 0 would be expected to land in the approximate area where the short-range round actually landed.) Engineers at Picatinny Arsenal who evaluated the foregoing data concurred in this conclusion and recommended that this lot be released for issue and use without further investigation or testing. Authorities at Schofield Barracks were advised that such accidents can be avoided in the future if greater care is taken to remove the correct number of propellant increments and if greater care is taken in handling the ammunition prior to firing.

APPENDICES

APPENDIX A
DATA TABLES

TABLE 1

Function Test of CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1 (Lot RD-7-37A) Conducted at Aberdeen Proving Ground, Maryland.

Note: Tests were conducted with Ammunition as received. Charge 3, Elevation 1099 Mils, Range 1500 Yards, Ambient Temperature 45°

Number	Velocity (f. p. s.)	Pressure (p. s. i.)	Range (yards)	Remarks
1	466	3500	1500	All samples landed on target except nos. 4, 8, 12, and 14.
2	467	3450	1500	
3	469	3450	1500	
4	463	3350	900	
5	465	3250	1500	Average Velocity: 465 f. p. s.
6	467	3400	1500	Maximum Velocity: 471 f. p. s.
7	469	3450	1500	Minimum Velocity: 460 f. p. s.
8	471	3500	900	Average Pressure: 3430 p. s. i. Maximum Pressure: 3550 p. s. i. Minimum Pressure: 3150 p. s. i.
9	465	3500	1500	
10	464	3500	1500	
11	463	3300	1500	
12	463	3200	1200	*Through error, the same set of gauges were used on samples 14 & 16.
13	466	3400	1500	
14	467	3650*	750	
15	466	3450*	1500	
16	465	3650*	1500	No duds
17	468	3300	1500	
18	469	3250	1500	
19	464	3400	1500	
20	464	3400	1500	
21	463	3400	1500	
22	466	3400	1500	

TABLE 1 (Continued)

Number	Velocity (f. p. s.)	Pressure (p. s. i.)	Range (yards)	Remarks
23	460	3400	1500	
24	467	3300	1500	
25	466	3350	1500	
26	469	3350	1500	
27	462	3350	1500	
28	464	3400	1500	
29	467	3250	1500	
30	463	3250	1500	
31	462	3300	1500	
32	466	3150	1500	
33	465	3400	1500	
34	465	3250	1500	
35	464	3550	1500	
36	465	3550	1500	

TABLE 2

Function Test (Second Phase) of CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, Lot RD-7-37A

Tests were conducted at Aberdeen Proving Ground, Maryland, as received, Charge 3, Elevation 1099 Mils, Range 1500 yards, Ambient Temperature 57° F

Number	Pressure (p. s. i.)	Velocity (f. p. s.)	Range	Remarks
1	3500	463	1500	All samples landed on target except number 19.
2	3450	468	1500	
3	3400	468	1500	
4	3300	467	1500	Average Velocity: 464 f.p.s.
5	3450	464	1500	Average Pressure: 3375 p.s.i.
6	3150	465	1500	Maximum Velocity: 472 f.p.s.
7	3400	464	1500	Maximum Pressure: 3600 p.s.i.
8	3600	463	1500	Minimum Velocity: 456 f.p.s.
9	3600	472	1500	Minimum Pressure: 2900 p.s.i.
10	3400	466	1500	No Duds
11	3200	460	1500	
12	3500	464	1500	
13	3150	456	1500	
14	2900	458	1500	
15	3200	467	1500	
16	3500	464	1500	
17	3500	463	1500	
18	3400	467	1500	
19	3400	462	1000	
20	3500	465	1500	
21	3200	464	1500	
22	3500	462	1500	

TABLE 2 (Continued)

Number	Pressure (p. s. i.)	Velocity (f. p. s.)	Range	Remarks
23	3250	459	1500	
24	3400	463	1500	
25	3450	463	1500	
26	3400	466	1500	

APPENDIX B
FIGURES

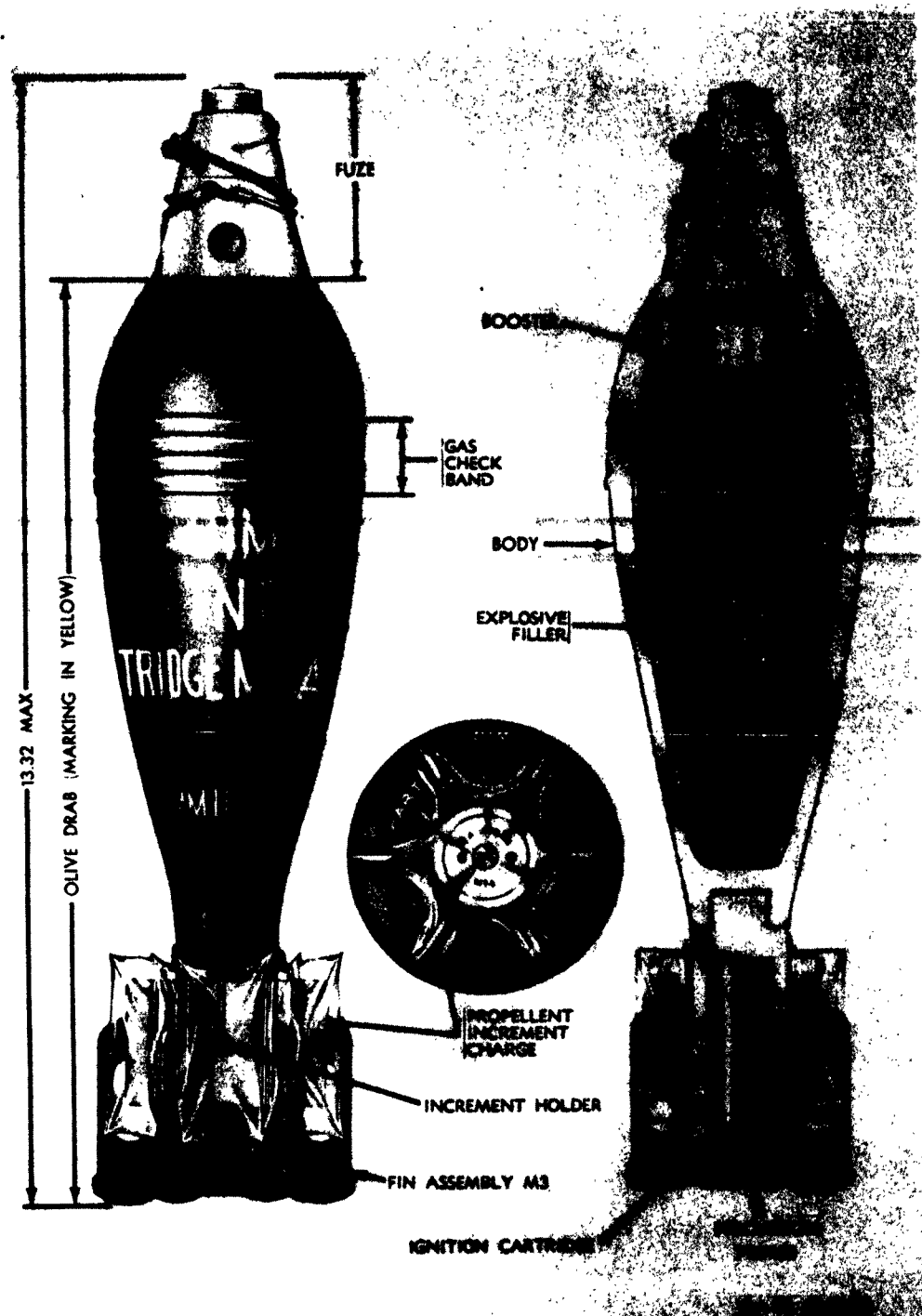


Figure 1. CARTRIDGE, 81 MILLIMETER: HE, M43A1--Overall and Cutaway Views

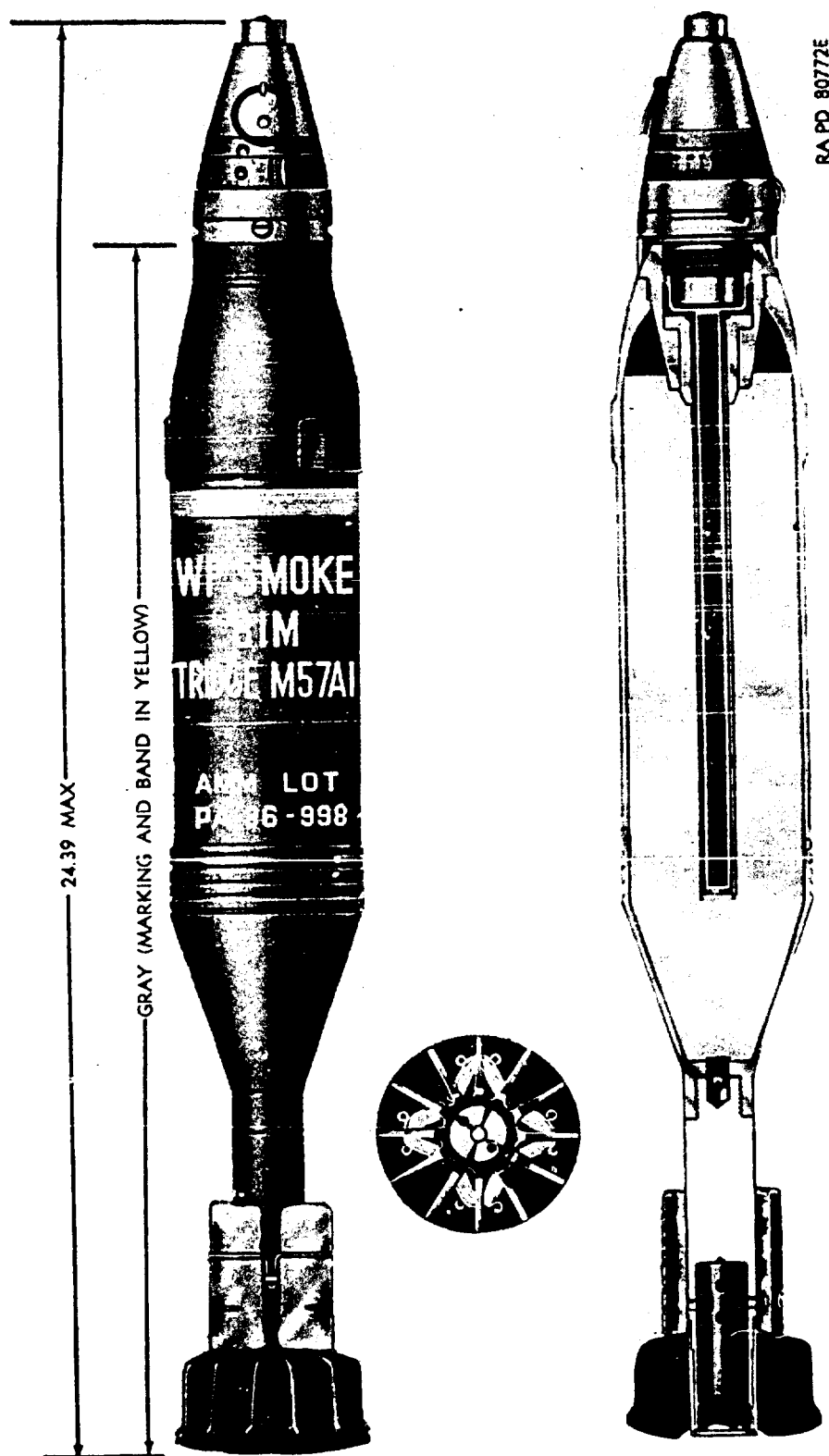


Figure 2. CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1--Overall and Cutaway Views

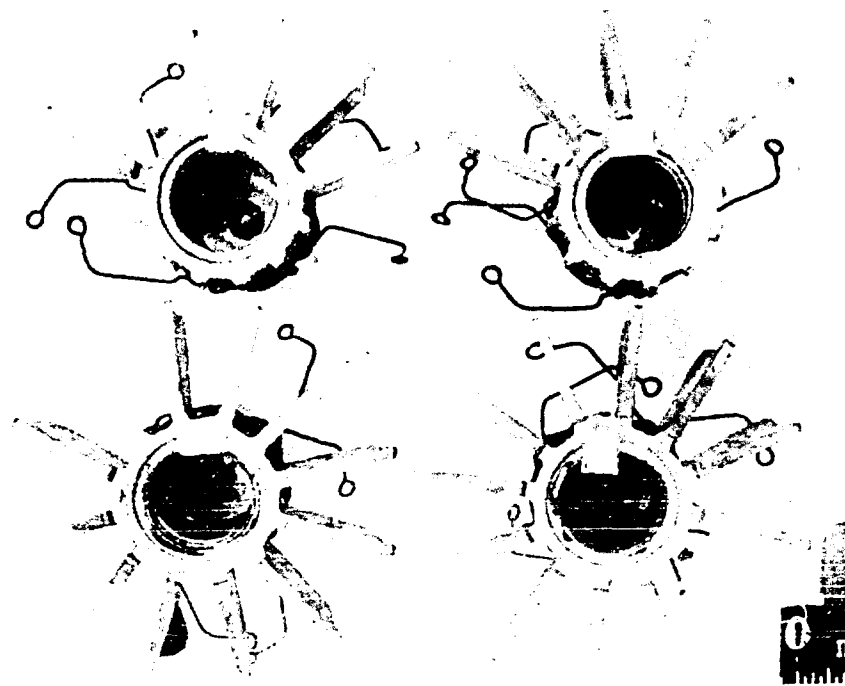


Figure 3. Condition of Fin Assemblies Recovered from Short-Range Rounds
(Test Round Numbers Are Indicated)



Figure 4. Condition of Fin Assemblies Recovered from Normal-Range Rounds
(Test Round Numbers Are Indicated)

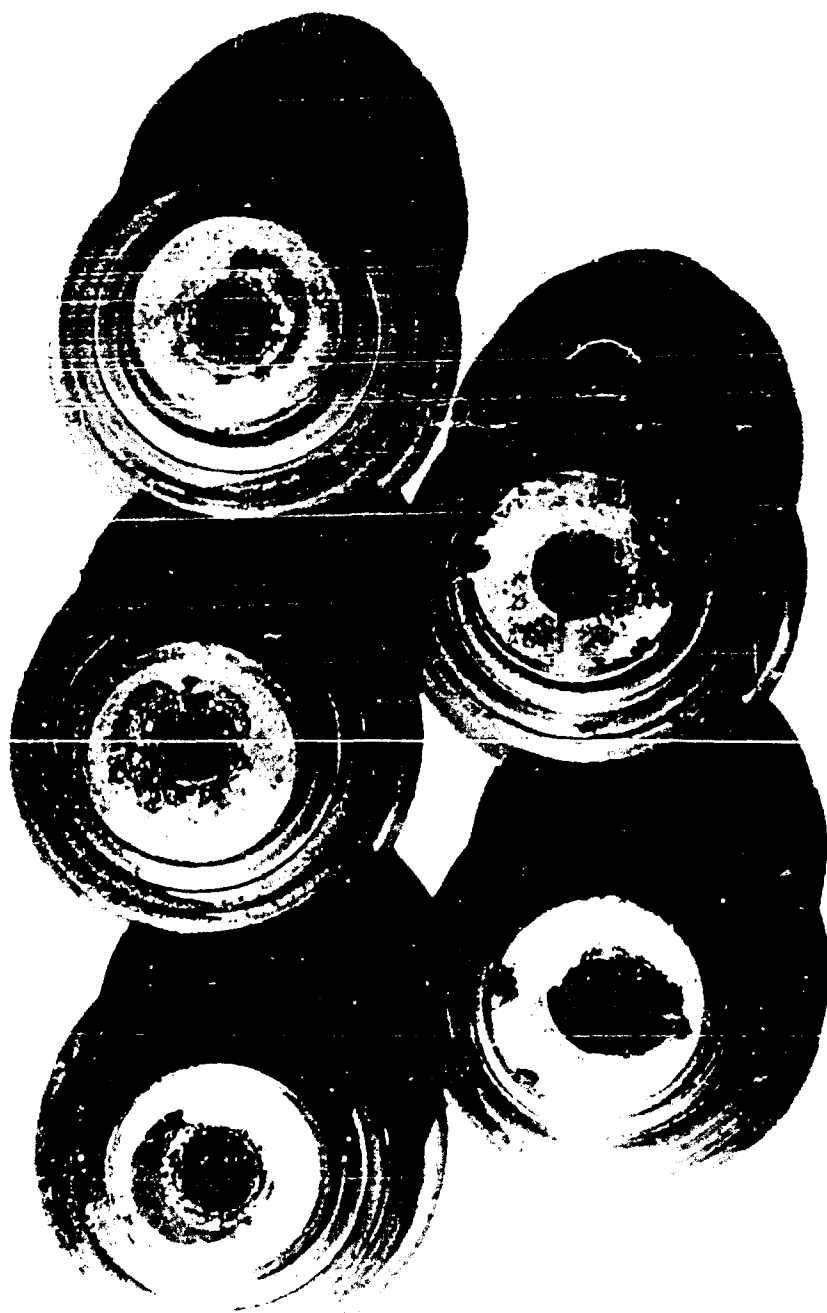


Figure 5. Primer, M34

APPENDIX C

LETTERS

COPY

Mr ELoPresti/bt/73180

22 September 1961

Ammunition Group
ORDBB-DC5

SUBJECT: Short Range Cartridge, 81MM, HE, M43A1 of Lots
MA-4-78A and MA-4-269A (MIF A-33-60)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-Q
Joliet, Illinois

1. Subject malfunction has been evaluated by this Arsenal.
2. The data indicates that the probable cause was that an increment was missing at the time of firing as the range of the short round corresponded to that obtained if one increment was missing. This could have been caused by either faulty loading of the round or an increment falling off during handling. In view of the seriousness of the malfunction, it is considered that 100% inspection of subject lots is necessary to assure that the defect is not attributable to the ammunition. The lots should be released for use after completion of the screening for the following defects:
 - a. Missing increments.
 - b. Loose increments.
 - c. Damaged increment bags.
 - d. Loose fin assemblies.
 - e. Cracked fin assemblies.
4. Upon completion of the screening, it is requested that the data and defective components if any be forwarded to this Arsenal so that the exact cause of the malfunction and corrective action can be determined.
5. Subject MIF is being returned to your Command as completed.

FOR THE COMMANDER:

S. Fleischnick
Assistant

C-1

COPY

Mr. McPartland/rms/73180

MAR 14 '62-1:00PM

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, M43A1B1
(MIF A-98-60)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. Surveillance Branch Monthly Progress Report,
Section XVII, February 1954

b. FM-23-90, 81MM Mortar M29, Chapter 6, Paragraph 77

1. Subject Malfunction Investigation Folder reports that during firing exercises at Fort Bragg one cartridge out of 400 fired landed 100 yards from the weapon. The exercise was being conducted during a light rain.

2. Sixty-eight (68) cartridges of Lot MA-4-226A from Fort Bragg were inspected at this Arsenal. One round showed heavy corrosion on the front end of the shell and on the fin assembly. The propellant increments on this cartridge had moisture on their entire surface. There was moisture on the fin assembly behind the increments. One increment had fallen off due to a broken holder. The holder had been broken off by corrosion. The other 64 cartridges were in good condition. Five primers were inspected with the onion skin disc removed. There was a trace of corrosion on the brass body, near the black powder pellet of each primer. The tests described in paragraph d of Reference a indicates that a critically short range round would occur if a cartridge in the condition of the wet cartridge described above were fired.

3. A ballistic test of 30 samples from Lot MA-4-226A was conducted at this Arsenal, using elevation 77°, Charge 2. Rounds were fired at ambient temperature (32° F). Average pressure was 1450 psi. Average velocity was 401 fps. All samples landed within a 100 foot area + 700 yards. This test indicates satisfactory performance of test rounds.

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AMMUNITION GROUP

ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, M43A1B1
(MIF-A-98-60)

4. In view of the above, it is considered that the short round that was reported was in the same wet condition as the cartridge described above, and was caused by the propellant becoming wet when exposed to the rain during the firing exercises. If the instructions given in Reference b are carefully followed such an accident could not occur.

5. No other items from Lot MA-4-226A remain at Fort Bragg. It is recommended that the remainder of the lot be released for issue and use.

6. Malfunction Investigation Folder A-98-60 is being returned to your Command as completed.

FOR THE COMMANDER:

Correction to original letter: Paragraph 3, Line 5: "100 foot area + 700 yards" should read: "700 yards $\pm$ 100 feet."

J.J. MATT
Assistant

COPY

Mr JMcPartland/bjf/73180

2 March 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, MA43A1B1,
Lot KOP-9-189A (MIF A-150-60)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

1. Subject Malfunction Investigation Folder reports that during firing exercises, three misfires and one short range round occurred out of 79 cartridges fired. The short round travelled approximately 50 to 100 yards and was a dud. When the cartridge that traveled the short range was removed from its original container it was found to be rusty and the ignition cartridge was wet.

2. Sixty-eight cartridges from Lot KOP-9-189A were inspected at this Arsenal. Forty-three of these cartridges had small rust spots on the fin assembly and/or increment holders. Five primers were inspected with the onion skin disc removed. There was heavy corrosion on the brass body near the black powder pellet. There were also green and white deposits around the edge of the pellet, indicating that the items had been exposed to excessive moisture during storage.

3. In view of the above, it is considered that the short range round and misfires that were reported were caused by an excessively damp ignition system. It is also considered that this condition exists in the remainder of the lot. The condition of the primer indicates that reliable performance cannot be expected from this lot.

4. It is recommended that the Primer M34 and the Ignition Cartridge M8 in all items remaining in Lot KOP-9-189A be replaced with primers and ignition cartridges from acceptable lots. It is further recommended that the lot be 100% visually inspected for wet propellant increments and any wet increments be replaced. When the renovation is completed, it is recommended that the lot be released for issue and use.

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AMMUNITION GROUP

ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, MA43A1B1,
Lot KOP-9-189A (MIF A-150-60)

5. A new ignition system, that will replace Primer M34 and Ignition Cartridge M8, is being developed at this Arsenal. The new ignition system will have improved moisture resistance qualities.

6. MIF A-150-60 is being returned to your Command as completed.

FOR THE COMMANDER:

JOSEPH J. MATT
Assistant

COPY

Mr JMcPartland/qjc/73180

12 June 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, Smoke, WP, M57A1,
Lot RD-7-37A (MIF-A-192-60)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. Ammunition: Restricted or Suspended. TB 9-AMM 2,
Table II, Part 79, August 1961

1. Subject Malfunction Investigation Folder reports that during firing exercises a short range round occurred. The round was low and wobbly in flight and fell approximately 75 yards in front of the gun position. Unburned powder was found in the tube of the weapon after the malfunction. One round from subject lot was fired previous to the defective round and functioned normally. A total of 1600 items of Lot RD-7-37A remain in Europe.

2. A series of tests were conducted at Aberdeen Proving Ground using 62 samples from subject lot. The results of the tests are outlined in Inclosure 1. From these tests the following conclusions can be made:

a. The extremely short round reported was most likely caused by wet propellant, as evidenced by the unburnt propellant in the tube after firing. The consistent values of pressure and velocity of the remaining 62 samples from Alaska indicate that the propellant and ignition systems have not been effected by moisture. It is therefore concluded that the defect that caused the malfunction is not characteristic of the lot. The defective round may have been in the wet snow before it was fired.

b. The five short rounds that occurred during the tests were not caused by defective ignition or unbalanced ammunition due to the voids in the WP charge.

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AMMUNITION GROUP

ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, Smoke, WP, M57A1,
Lot RD-7-37A (MIF A-192-60)

c. Fins on most rounds are broken on ground impact. The photograph of the short round taken at 10 feet from the muzzle did not show the fins broken off as was later found when the fin assembly was recovered. It is therefore concluded that the five short rounds were not caused by broken fins.

3. The Cartridge, 81MM, Smoke, WP, M57A1 has an unstable flight characteristic, and is of marginal design. This item is being replaced by Cartridge, 81MM, Smoke, WP, M370. Reference a specifies that subject item shall not be fired over the heads of troops. It is therefore considered that the defects found during this investigation are not dangerous when used as specified.

4. In view of the above it is recommended that Lot RD-7-37A be released for issue and use.

5. MIF A-192-60 is being returned to your Command as completed.

FOR THE COMMANDER:

JOSEPH J. MATT
Assistant

COPY

Mr JMcPartland/bjf/73180

16 March 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, M43A1,
with Fuze, M525A1 (MIF A-13-61)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

1. Subject Malfunction Investigation Folder reports that during firing exercises at Vieques, Puerto Rico, one cartridge out of 599 fired, landed 8 feet from the weapon. When the round was fired it came out of the tube with the burning propellant increments falling off. The round did not detonate.

2. Sixty-eight (68) cartridges of Lot MA-4-101 were inspected at this Arsenal. The only defect observed was that all items had small rust spots on the fin assembly and/or propellant increment holders. Five primers were inspected with the onion skin disc removed. There was considerable corrosion on the brass body near the black powder pellet on all five primers. There were also green deposits around the edge of one of the black powder pellets, indicating that the items had been exposed to excessive moisture during storage.

3. In view of the above, it is considered that the short range round that was reported was caused by an excessively damp ignition system. It is also considered that this condition exists in the remainder of the lot. The condition of the primer indicates that reliable performance cannot be expected from this lot.

4. It is recommended that the Primer M34, and the Ignition Cartridge M8 in all items remaining in Lot MA-4-101 be replaced with primers and ignition cartridges from acceptable lots. It is further recommended that the lot be 100% visually inspected for wet propellant increments and any wet increments be replaced. When the renovation is completed it is recommended that the lot be released for issue and use.

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AMMUNITION GROUP

ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, M43A1,
with Fuze, M525A1 (MIF A-13-61)

5. A new ignition system that will replace the Primer M34 and Ignition Cartridge M8 is being developed at this Arsenal. The new ignition system will have improved moisture resistance qualities.

6. MIF A-13-61 is being returned to your Command as completed.

FOR THE COMMANDER:

JOSEPH J. MATT
Assistant

COPY

Mr JMcPartland/bjf/73180

23 March 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81mm, HE,
M43A1B1, Lot MA-4-87B (MIF A-18-61)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. Military Specification, MIL-F-20500, Fins, Steel,
for Smooth-Bore Mortar Shell

1. Subject Malfunction Investigation Folder indicates that during firing exercises at Fort Riley, Kansas, sections of fins broke off the fin assemblies of some of the ammunition when fired. Out of 464 cartridges fired, there were four positive incidents and numerous suspected incidents. In two cases the fin section was left in the mortar tube after the propelling charge fired. Some of these rounds were so erratic that they fell 300 to 400 meters short. There was no indication of unburned propellant. Charges used varied from charge 1 to charge 4. Range to target was 1000 to 2500 yards. The temperature was 48° F. A total of 6000 items remain in the lot.

2. A series of tests were conducted at this Arsenal using samples of subject lot from Red River Arsenal. The results of the tests are outlined in Inclosure 1. From these tests the following conclusions can be made.

a. The condition of the primers indicates that the ignition systems have been exposed to excessive moisture, and that reliable performance cannot be expected from this lot of primers.

b. The results of the pull tests indicate that the welds on the fin assemblies are not consistently acceptable. Reference a, requires that the welds on the fins sustain a load of 2500 pounds. The tests conducted during this investigation

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AMMUNITION GROUP

ORDBB-DC5

**SUBJECT: Malfunction Investigation of Cartridge, 81mm, HE,
M43A1B1, Lot MA-4-87B (MIF A-18-61)**

indicate that this load can easily be sustained by high quality welds. If high quality workmanship is not maintained during the fabrication of the fins, structural failure of the weld can be expected to occur during firing, resulting in short range rounds.

3. It is recommended that the M3 Fin Assemblies, M34 Primers and M8 Ignition Cartridges in all items remaining in Lot MA-4-87B be replaced with fins, primers and cartridges from accepted lots. It is further recommended that the propellant increments be 100% visually inspected for wet increments, and any wet increments be replaced. When the renovation is completed it is recommended that the lot be released for issue and use.

4. A new ignition system that will replace the M34 Primer and M8 Ignition Cartridge is being developed at this Arsenal. The new ignition system will have improved moisture resistance qualities. The new 81mm, HE, Shell that will replace subject item has an extruded aluminum fin assembly that does not rely on quality control of spot welds for good functioning.

5. MIF A-18-61 is being returned to your Command as completed.

FOR THE COMMANDER:

S. FLEISCHNICK
Assistant

COPY

Mr JMcPartland/bjf/73180

27 March 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81mm, HE, M43A1B1,
Lot OA-1-271C (MIF A-19-61)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. Military Specification, MIF-F-20500, Fins, Steel,
For Smooth-Bore Mortar Shell

1. Subject Malfunction Investigation Folder indicates that during firing exercises one-third of the fin assembly from the 15th round fired broke off in the tube and the round fell 200 yards from the weapon. There was no evidence of unburned propellant in the tube. The mortar was being fired at elevation 1291 mils, charge 2, range 925 yards. The temperature was 44° F. There are 5400 items remaining in subject lot.

2. A series of tests were conducted at this Arsenal using samples of subject lot from Fort Benning. The results of the tests are outlined in Inclosure 1. From these tests the following conclusions can be made:

a. The condition of the primers, ignition cartridges, propellant increments and the complete rounds indicate that the items have not been exposed to excessive moisture.

b. The results of the ballistic tests indicate that the ignition system and propellant increments are in good condition.

c. The results of the pull tests indicate that the welds on the fin assemblies are far below acceptable requirements of Reference a. Reference a, requires that the welds on the fins sustain a load of 2500 pounds. Tests conducted at

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AMMUNITION GROUP

ORDBB-DC5

**SUBJECT: Malfunction Investigation of Cartridge, 81mm, HE, M43A1B1,
Lot OA-1-271C (MIF A-19-61)**

this Arsenal on other lots of fin assemblies indicate that this load can easily be sustained by high quality welds. If the weld is unsatisfactory, structural failure of welds can be expected during firing, resulting in short range rounds.

3. It is recommended that the M3 Fin Assemblies in all items remaining in Lot OA-1-271C be replaced with fin assemblies from an accepted lot. It is also recommended that the same primers, ignition cartridges, and propellant increments be reassembled in the renovated lot. When the renovation is completed it is recommended that the lot be released for issue and use.

4. The new 81mm, HE, Shell that will replace subject item has an extruded aluminum fin assembly that does not rely on quality control of welds for good functioning.

5. MIF A-19-61 is being returned to your Command as completed.

FOR THE COMMANDER:

S. FLEISCHNICK
Assistant

COPY

Mr JMcPartland/bjf/73180

3 April 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81mm, HE, M43A1B1,
with Fuze, PD, M525A1, Lot MA-4-242A (MIF A-50-61)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. Ltr, ORDBB-NR4, 18 Nov 60, subj: Fuze, PD, M525A1
b. Military Specification, MIF-F-20500, Fins, Steel,
For Smooth-Bore Mortar Shell

1. Subject Malfunction Investigation Folder indicates that during firing exercises at Fort Benning 13 duds and 28 erratic rounds (200 to 1000 meters short) occurred out of 120 cartridges fired. Firing personnel reported hearing an unusual noise in flight and the observers opinions were that some fins were coming off. Propellant increments on some rounds were still burning approximately 10 feet from the muzzle. There are 4500 items remaining in subject lot.

2. A series of tests were conducted at this Arsenal using samples of subject lot from Red River Arsenal. The results of the tests are outlined in Inclosure 1. From these tests the following conclusions can be made:

a. The condition of the primers indicate that the ignition system has been exposed to excessive moisture, and that reliable functioning cannot be expected from this lot of primers.

b. The dud rate found in the ballistic tests, combined with the dud rate reported by Fort Benning is low enough to consider the lot acceptable in accordance with Reference a.

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AMMUNITION GROUP

ORDBB-DC5

**SUBJECT: Malfunction, Investigation of Cartridge, 81mm, HE, M43A1B1,
with Fuze, PD, M525A1, Lot MA-4-242A (MIF A-50-61)**

c. The results of the pull tests indicate that the welds on the fin assemblies are well above minimum acceptable quality. Reference b, requires that the welds on the fins sustain a load of 2500 pounds.

3. It is recommended that the M34 Primers and M8 Ignition Cartridges in all items remaining in Lot MA-4-242A be replaced with primers and cartridges from accepted lots. It is further recommended that the propellant increments be 100% visually inspected for wet increments, and any wet increments be replaced. When the renovation is completed it is recommended that the lot be released for issue and use.

4. A new ignition system that will replace the M34 Primer and M8 Ignition Cartridge is being developed at this Arsenal. The new ignition system will have improved moisture resistance qualities.

5. MIF A-50-61 is being returned to your Command as completed.

FOR THE COMMANDER:

JOSEPH J. MATT
Assistant

COPY

Mr JMcPartland/bjf/73180

8 November 1961

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE,
M43A1, w/Fuze, PD, M525A1 (MIF A-114-61)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. TT 10-1038, ORDLY-QFSB, 25 Oct 61

1. A detailed report from Fort Amador, Canal Zone, contained in subject Malfunction Investigation Folder, indicated that out of 74 rounds of subject item fired, 7 misfired, 6 were duds and 12 were short rounds. Eleven of the short rounds fell approximately 1100 yards short and one round fell approximately 75 yards from the gun. Range to target was 2800 yards. The ammunition was from Lot MA-4-222A. A test firing was later conducted at Fort Amador, using 20 rounds after replacing the M34 Primers with Lot WC-21-1 and M8 Ignition Cartridges with Lot FL-2-11, and lubricating the fuzes. The test resulted in 100% accurate range, no misfires or duds. The report stated that approximately 200 rounds from the lot remain on hand. Reference a, indicates that these are the only known quantities remaining in Lot MA-4-222A.

2. It is considered that the test described above is a valid indication that reliable performance can be expected if the primers and ignition cartridges of the rounds remaining in the lot are replaced and the fuzes lubricated. Further testing of Lot MA-4-222A is not considered economical.

3. In view of the above, this Arsenal concurs with the action taken by your Command in releasing Lot MA-4-222A after renovation is completed.

4. Subject Malfunction Investigation Folder is being returned to your Command as completed.

FOR THE COMMANDER:

H.D. RUTKOVSKY
Assistant

C-17

COPY

Mr JMcPartland/map/73180

31 January 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, M43A1B1
(MIF A-161-61)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. Firing Tables, FT81-AB-1, Mortar, 81MM, M20 and M1
b. FM 23-90, 81MM, Mortar M29, Chapter 6, Par. 77

1. Subject malfunction investigation folder reports that during firing exercises at Fort Richardson, Alaska, one round out of 126 rounds fired landed 325 yards short of target. The range to target was 1,130 yards, and the elevations were 1301 mils on gun number 1 and 1239 mils on gun number 2. It was reported that Charge 3 was fired from both guns. Ammunition from Lots WC-34-32D, WC-34-34C and OA-1-113A was used during the exercise, and it is not known which lot is involved nor from which gun the short round was fired.

2. The malfunction report further states that after the short round occurred, three rounds with Charge 3 was test fired from each gun, and three rounds with Charge 2 was test fired from each gun, using the same elevations that were used during the exercise. All rounds fired from the guns with Charge 3 landed on the target area. All rounds fired from the guns with Charge 2 landed near the scene of the reported short round. The results of the firing test is in close accord with Reference a.

3. In view of the above, it is considered that the short round that was reported was caused by Charge 2 being fired instead of Charge 3. This type of error can be avoided if proper attention is given to removing the correct number of propellant increments and if the ammunition is carefully handled prior to firing, in accordance with Reference b.

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AMMUNITION GROUP
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE, M43A1B1
(MIF A-161-61)

4. It is recommended that Lots WC-34-32D, WC-34-34C and OA-1-113A be released for issue and use.

5. Malfunction Investigation Folder A-161-61 is being returned to your Command as completed.

FOR THE COMMANDER:

JOSEPH J. MATT
Assistant

COPY

Mr JMcPartland/mfg/73180

4 June 1962

Ammunition Group
ORDBB-DC5

SUBJECT: Malfunction Investigation of Cartridge, 81MM, HE,
M43A1, Lot IOP-21-20B (MIF A-71-62)

TO: Commanding Officer
Ordnance Ammunition Command
ATTN: ORDLY-QFS
Joliet, Illinois

REFERENCE: a. FM23-90, 81MM, Mortar M29, Chapter 6, Par. 77

1. Malfunction Investigation Folder A-71-62 indicates that during firing exercises one projectile from Lot IOP-21-20B fell 260 yards from the three mortars being fired. The mortars were being fired at elevation 1331 mils, charge 1, range 550 yards. One man received a superficial wound in his right leg. No unburned powder residue or excessive oil was found in the mortar tube. There have been 3900 rounds from subject lot fired by the reporting Command without incident. The report indicates that the probable cause of the short round was due to the inadvertent omission of the one propellant charge when the round was hastily dropped into the tube during the rapid firing exercises. Based on information shown in the firing tables, FT 81-AB-1, the range of a projectile fired without propellant increments at 1331 mils elevation would have a range of 275 yards. This corresponds to the range obtained by the projectile which fell short.

2. This Arsenal has reviewed subject report and concurs with the conclusions outlined above. This type of error can be avoided if proper attention is given to removing the correct number of propellant increments and if the ammunition is carefully handled prior to firing, in accordance with Reference a.

3. It is, therefore, recommended that Lot IOP-21-20B be released for issue and use.

4. MIF A-71-62 is being returned to your Command as completed.

FOR THE COMMANDER:

JOSEPH J. MATT
Assistant

C-21

ABSTRACT DATA

ABSTRACT

Accession No. _____ AD _____

Picatinny Arsenal, Dover, New Jersey

MALFUNCTION INVESTIGATION OF
CARTRIDGE, 81-MILLIMETER: HE,
M43A1 AND M43A1B1, W/VARIOUS
FUZES AND CARTRIDGE, 81-MILLI-
METER: SMOKE, WP, M57A1,
W/FUZE, TSQ, M77.

John McPartland

Technical report 3058, February 1963
79pp, figures, tables
Unclassified report from the Ammuni-
tion Engineering Laboratory, Ammuni-
tion Group.

An investigation was conducted to
determine the cause of malfunctions
which occurred at various installations,
during training exercises, involving 14
different lots of Cartridge, 81mm: HE,
M43A1 and M43A1B1, w/various fuzes
and Cartridge, 81mm: Smoke, WP,
M57A1 w/Fuze, TSQ, M77.

After the recommended corrective
actions were taken, the remaining
cartridges were released for issue and
use.

Ordnance Ammunition Command,
Joliet, Illinois, was informed of the
findings, conclusions and recommenda-
tions.

UNCLASSIFIED

1. High explosive cartridges --
Failure

I. McPartland, John

II. M43A1 and M43A1B1
Cartridge

III. M57A1 Cartridge

UNITERMS

Malfunction

Failure

HE Cartridge

81mm

M43A1

M43A1B1

Smoke

M57A1

Fuze

M77

McPartland, J.

Accession No. _____ AD _____
Picatinny Arsenal, Dover, New Jersey

MALFUNCTION INVESTIGATION OF CARTRIDGE, 81-MILLIMETER: HE, M43A1 AND M43A1B1, W/VARIOUS FUZES AND CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE, TSQ, M77.

John McPartland

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(over)

UNCLASSIFIED

I. High explosive cartridges - Failure

I. McPartland, John
II. M43A1 & M43A1B1 Cartridge

III. M57A1 Cartridge

UNITERMS

Malfunction

Failure

HE Cartridge

81 mm

M43A1

M43A1B1

UNCLASSIFIED

Accession No. _____ AD _____
Picatinny Arsenal, Dover, New Jersey

MALFUNCTION INVESTIGATION OF CARTRIDGE, 81-MILLIMETER: HE, M43A1 AND M43A1B1, W/VARIOUS FUZES AND CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE, TSQ, M77.

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(over)

UNCLASSIFIED

I. High explosive cartridges - Failure

I. McPartland, John
II. M43A1 & M43A1B1 Cartridge

III. M57A1 Cartridge

UNITERMS

Malfunction

Failure

HE Cartridge

81 mm

M43A1

M43A1B1

UNCLASSIFIED

Accession No. _____ AD _____
Picatinny Arsenal, Dover, New Jersey

MALFUNCTION INVESTIGATION OF CARTRIDGE, 81-MILLIMETER: HE, M43A1 AND M43A1B1, W/VARIOUS FUZES AND CARTRIDGE, 81 MILLIMETER: SMOKE, WP, M57A1, W/FUZE, TSQ, M77.

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(over)

UNCLASSIFIED

I. High explosive cartridges - Failure

I. McPartland, John
II. M43A1 & M43A1B1 Cartridge

III. M57A1 Cartridge

UNITERMS

Malfunction

Failure

HE Cartridge

81 mm

M43A1

M43A1B1

UNCLASSIFIED

UNCLASSIFIED

I. High explosive cartridges - Failure

I. McPartland, John
II. M43A1 & M43A1B1 Cartridge

III. M57A1 Cartridge

UNITERMS

Malfunction

Failure

HE Cartridge

81 mm

M43A1

M43A1B1

UNCLASSIFIED

After the recommended corrective actions were taken, the remaining cartridges were released for issue and use. Ordnance Ammunition Command, Joliet, Illinois, was informed of the findings, conclusions and recommendations.	UNCLASSIFIED UNITERMS Smoke M57A1 Fuze M77 McPartland, J.
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