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AT1507
11 AUG 04

STUDENT HANDOUT

M220E4 TOW2 WEAPON SYSTEM FAILURE TO LAUNCH PROCEDURES

1. TERMINAL LEARNING OBJECTIVES

a. Given an M220E4 TOW2 weapon system with a hangfire, as an anti-tank team, while wearing fighting loads, perform M220E4 TOW2 weapon system hangfire procedures by clearing the malfunction and returning the weapon into action. (52TR.03.06)

b. Given an M220E4 TOW2 weapons system with a misfire, as an anti-tank team, while wearing fighting loads, perform M220E4 TOW2 weapons system misfire procedures by clearing the malfunction and returning the weapon into action. (52TR.03.07)

2. ENABLING LEARNING OBJECTIVES

a. Given a ground mounted M220E4 TOW2 weapon system with a hangfire, as an anti-tank team, while wearing fighting loads, perform hangfire procedures for a grounded mounted M220E4 TOW2 weapon system by clearing the malfunction and returning the weapon into action. (52TR.03.06a)

b. Given a vehicle mounted M220E4 TOW2 weapon system with a hangfire, as an anti-tank team, while wearing fighting loads, perform hangfire procedures for a vehicle mounted M220E4 TOW2 weapon system by clearing the malfunction and returning the weapon into action. (52TR.03.06b)

c. Given a ground mounted M220E4 TOW2 weapon system with a misfire, as an anti-tank team, while wearing fighting loads, perform misfire procedures for a ground mounted M220E4 TOW2 weapon system by clearing the malfunction and returning the weapon into action. (52TR.03.07a)

d. Given a vehicle mounted M220E4 TOW2 weapon system with a misfire, as an anti-tank team, while wearing fighting loads, perform misfire procedures for a vehicle mounted M220E4 TOW2 weapon system by clearing the malfunction and returning the weapon into action. (52TR.03.07b)

BODY

1. **LAUNCH SEQUENCE TIMING.** Like the cycle of operation for the M16A2 service rifle, (firing, unlocking, extracting, ejecting, cocking, feeding chambering, locking), the TOW missile goes through a sequence

of events once the trigger is pressed and the missile leaves the launch tube:

Time (Seconds)	Event
0.0	The gunner presses the trigger, and the system sends the prefire current to the missile. This fires the thermal batteries, which in turn blow the explosive off the gyro nitrogen bottle. The gyro starts to spin and the thermal beacon ignites.
1.5	The gyro reaches 42,000 + rpms and disengages. The system sends electrical current to the launch motor, and the motor fires.
1.56	The missile exits the launch tube.
1.58	The number 2 wing switch closes and the xenon beacon fires.
1.60	The number 4 wing switch closes. The helium bottle opens initiating the timed fire part of the arming sequence.
1.65	The delay switch changes state. The flight motor ignites. The safety and arming device is powered.
1.68	The safety and arming unlocks. The missile accelerates to 19 G's causing the unlocking of the Warhead Rotor. For TOW2B, this occurs at 2.15 seconds.
2.03	The safety and arming clock mechanism rotates and aligns the Detonator with the warhead, arming the missile. For TOW 2B, this occurs at 2.50 seconds.
3.10	The flight motor burns out. The missile is now fully armed and traveling at maximum velocity. It will coast to the target, being kept aloft by the wings and control surfaces.
3.50	TOW2B reaches its offset height, 7.5 feet, above the gunner's line of sight.

2. MALFUNCTION. A malfunction is any time a weapon fails to function as designed. To be a proficient TOW gunner, you must know the procedures for dealing with four specific malfunctions. One deals with the TOW system itself, and the other three deals with the missile. These four malfunctions are:

a. Hangfire. A Hangfire is an unexpected delay in the functioning of the TOW missile. The pre-fire events occur, but the firing events do not. The pre-fire current is sent, the thermal batteries begin to burn, the explosive squibs burst, and the gyros begin to spin, but the

launch motor does not ignite. A hangfire may be caused by a faulty internal missile circuit, poor internal missile electrical connections, or by faulty components in the ignition or propellant systems. Most TOW hangfires are caused by faulty propellant that has hardened or crystallized. If all pre-fire events occur but the missile does not leave the launch tube, you classify the malfunction as a hangfire. Hangfires are particularly dangerous because the missile might fire up to 30 minutes after pressing the trigger.

b. Misfire. A misfire is the failure of any pre-fire and fire signals to occur. Quite simply, nothing happens when you press the trigger. The missile receives no pre-fire or fire instructions from the launcher, and the audible pop from the explosive squib does not occur. A misfire may be caused by a faulty circuit, loss of electrical power, poor electrical connections, a short circuit, or by faulty components in the ignition or propellant systems. Dead battery assemblies (BB-287) or the failure to remove the dust cover from the missile's electrical connector causes most TOW misfires. If no pre-fire functions are heard, you then classify the malfunction as a misfire.

c. Erratic Missile. An erratic missile is any missile that does not respond to the tracking commands originating from the MGS. An erratic missile may occur as a result of any of the following:

- (1) Shorted out or broken command-link wire or wires.
- (2) Defective missile wing or control surfaces.
- (3) Defective flight or launch motor.
- (4) Excessively hard and extreme gunner course corrections.

d. Dud Missile. A dud missile is any missile that has properly left the launch tube, but whose warhead fails to detonate upon impact. A dud may occur as a result of any of the following:

- (1) Faulty war head.
- (2) Faulty safety and arming device.
- (3) Faulty crush switch.

3. IMMEDIATE ACTION. Immediate action is the procedure that is performed on the spot to correct weapons malfunctions. As opposed to remedial action, which is usually conducted in an area, designated for lengthy repairs. There are three main reasons why a weapon may require Immediate Action:

- a. The weapon, and/or individual components may be dirty or defective.
- b. The weapon may not be properly assembled.
- c. The ammunition may dirty or defective.

The TOW system will from time to time, require you to identify and correct minor problems. Remedial Action is designed to correct whatever repairs may be required.

4. GROUND MOUNTED M220E4 TOW2 WEAPON SYSTEM HANGFIRE PROCEDURES. When the gunner hears the explosive squibs burst, and the gyros begin to spin but the missile does not exit the launch tube a hangfire has occurred. The team must perform the following procedures to clear the malfunction:

a. Step 1. The gunner will state, "hangfire", and the a-gunner will repeat "hangfire".

b. Step 2. The gunner states, "tracking for one minute", while the a-gunner states, "timing for one minute". The a-gunner must use a watch to ensure an entire minute expires. At the end of one full minute, the a-gunner states, "minute up".

c. Step 3. If the missile fails to launch after one minute, the gunner closes the trigger protective cover, the a-gunner lowers the arming lever, and the gunner locks the system down.

d. Step 4. The gunner and a-gunner will both stand with the gunner on left side and a-gunner on right side of system. They will face each other then do an about face. They will walk away from the system at 90-degree angle, walk 50 meters, turn 90-degrees up range, walk 100 meters, turn 90-degrees back inboard, meet in the middle, and notify the range safety officer (RSO) who will then notify explosive ordnance disposal (EOD).

e. Step 5. Thirty minutes later, the a-gunner and RSO will return to the weapon system following the same steps as the gunner and a-gunner used. The a-gunner will open the bridge clamp and remove the encased Missile from the launch tube. The a-gunner ensures that the missile is pointed down range at all times, places the missile in a dud pit or where the RSO designates.

f. Step 6. The crew reloads another missile.

g. In combat, steps 4 and 5 are not performed. The hangfire missile is removed as quickly as possible and replaced with a new one. The bad missile is placed on the deck with the nose end pointed toward the enemy, until the tactical situation allows you the time to deal with it.

5. VEHICLE MOUNTED M220E4 TOW2 WEAPON SYSTEM HANGFIRE PROCEDURES.

When the M220E4 TOW2 weapon system is vehicle mounted the team must perform the following procedures to clear the malfunction:

a. Step 1. The gunner will state, "hangfire", and the a-gunner will repeat "hangfire".

b. Step 2. The gunner states, "tracking for one minute", while the a-gunner states, "timing for one minute". The a-gunner must use a watch to ensure an entire minute expires. At the end of one full minute, the a-gunner states, "minute up".

c. Step 3. If the missile fails to launch after one minute, the gunner closes the trigger protective cover, lowers the arming lever, and locks the system down.

d. Step 4. The gunner and a-gunner will both exit the vehicle, staying clear of the back blast area. With the a-gunner on the left side and the gunner on the right side of the vehicle, they will then do an about face. and walk away from the system at 90-degree angle and notifying the range safety officer (RSO) who will then notify explosive ordnance disposal (EOD).

e. Step 5. Thirty minutes later, the gunner, a-gunner, and RSO will return to the vehicle. The gunner will mount the vehicle staying clear of the back blast area. The gunner will open the bridge clamp and remove the encased missile from the system. The gunner will then hand the encased missile to the a-gunner. The a-gunner will then place the missile in a dud pit or wherever designated by the RSO.

f. Step 6. The crew reloads another missile.

g. In combat, steps 4 and 5 are not performed. The hangfire missile is removed as quickly as possible and replaced with a new one. The bad missile is placed on the deck with the nose end pointed toward the enemy, until the tactical situation allows you the time to deal with it.

6. GROUND MOUNTED M220E4 TOW2 WEAPON SYSTEM MISFIRE PROCEDURES. When the gunner presses the trigger and nothing happens. A misfire has occurred. The team must perform the following procedures to clear the malfunctions:

a. Step 1. The gunner states, "misfire", and the a-gunner repeats "misfire".

b. Step 2. The gunner states, "tracking for one minute" while the a-gunner states, "timing for one minute". The a-gunner must use a watch to ensure an entire minute expires.

c. Step 3. At the end of one full minute the a-gunner states, "minute up". He then rechecks the back blast area, and states, "back blast area all secure".

d. Step 4. the a-gunner inspects the arming lever on the bridge clamp to ensure it is at a 90-dgree angle, and inspects the bridge clamp locking lever to ensure it is closed properly. Then taps the gunner on the shoulder and states, "gun up".

e. Step 5. The gunner attempts to fire for a second time. If nothing happens continue below to step five. If the weapons fires then the gunner should continue with the mission.

f. Step 6. The gunner restates, "misfire", and the a-gunner repeats, "misfire". The gunner states, "tracking for one minute", while the a-gunner states, "timing for one minute". At the end of one full minute, the a-gunner states, "minute up".

g. Step 7. The gunner closes the trigger protective cover, and continues tracking the target.

h. Step 8. The a-gunner lowers the arming lever, he drops down on one knee and checks the battery assembly (BB-287) to ensure it's seated in the MGS (AN/TSQ-136) properly. He checks the coil cable to ensure it is connected properly to the j1 connector. Then he presses the tests operate switch and performs a modified system self-test just to see if the battery assembly passes. If the battery assembly fails, replace it. After replacing the battery assembly, the a-gunner rechecks the back blast area and announces, "back blast area all secure" and rearms the system. Then taps the gunner on the shoulder, and states "gun up".

i. Step 9. The gunner raises the trigger protective cover and attempts to fire for the third time. If the missile still fails to launch, the gunner states, "misfire", and the a-gunner repeats, "misfire".

j. Step 10. The gunner states, "tracking for one minute", while the a-gunner states, "timing for one minute". At the end of one minute, the a-gunner states, "minute up".

k. Step 11. The gunner closes the trigger protective cover, the a-gunner lowers the arming lever, and the gunner locks the system down.

l. Step 12. The gunner and a-gunner will both stand with the gunner on left side and a-gunner on right side of system and face each other, do an about face, and walk away from the vehicle at 90-degree angle, walk 50 meters, turn 90-degrees up range, walk 100 meters, turn 90-degrees back inboard, meet in the middle, notifying the range safety officer (RSO) who will then notify explosive ordnance disposal (EOD).

m. Step 13. Thirty minutes later, the a-gunner and RSO will return to the weapon system following the same steps that the gunner and a-gunner used. The a-gunner will open the bridge clamp and remove the encased Missile from the launch tube. Ensuring that the missile is pointed down range at all times and the a-gunner places the missile in the dud pit or where the RSO designates.

n. Step 14. The crew loads another missile.

o. In combat, steps 12 and 13 are not performed. The misfire missile is removed as quickly as possible and replaced with a new one. The bad missile is placed on the deck with the nose end pointed toward the enemy, until the tactical situation allows you the time to deal with it.

7. VEHICLE MOUNTED M220E4 TOW2 WEAPON SYSTEM MISFIRE PROCEDURES. When the M220E4 TOW2 weapon system is vehicle mounted the team must perform the following procedures to clear the malfunction:

a. Step 1. The gunner states, "misfire", and the a-gunner repeats "misfire".

b. Step 2. The gunner states, "tracking for one minute" while the a-gunner states, "timing for one minute". The a-gunner must use a watch to ensure an entire minute expires.

c. Step 3. At the end of one full minute the a-gunner states, "minute up". The gunner rechecks the back blast area, and states, "back blast area all secure".

d. Step 4. The gunner inspects the arming lever on the bridge clamp to ensure it is at a 90-degree angle, and inspects the bridge clamp locking lever to ensure it is closed properly. Then he states, "Gun up".

e. Step 5. The gunner attempts to fire for a second time. If nothing happens continue below to step five. If the weapons fires then the gunner should continue with the mission.

f. Step 6. The gunner restates, "misfire", and the a-gunner repeats, "misfire". The gunner states, "tracking for one minute", while the a-gunner states, "timing for one minute". At the end of one full minute, the a-gunner states, "minute up".

g. Step 7. The gunner closes the trigger protective cover, and lowers the arming lever. He then checks the battery assembly (BB-287) to ensure it's seated in the MGS (AN/TSQ-136) properly, checking the coil cable to ensure it is connected properly to the j1 connector. Then he presses the tests operate switch and performs a modified system self-test to see if the battery assembly passes. If the battery assembly fails, replace it. After replacing the battery assembly, the gunner rechecks the back blast area and announces, "back blast area all secure". The gunner then raises the arming lever and states "gun up".

h. Step 8. The gunner raises the trigger protective cover and attempts to fire for the third time. If the missile still fails to launch, the gunner states, "misfire", and the a-gunner repeats, "misfire".

i. Step 9. The gunner states, "tracking for one minute", while the a-gunner states, "timing for one minute". At the end of one minute, the a-gunner states, "minute up".

j. Step 10. The gunner closes the trigger protective cover, lowers the arming lever, and locks the system down.

k. Step 11. The gunner and a-gunner will both exit the vehicle, staying clear of the back blast area. With the a-gunner on the left side and the gunner on the right side of the vehicle, they will then do an about face. They will walk away from the vehicle at 90-degree angle and notify the range safety officer (RSO) who will then notify explosive ordnance disposal (EOD).

l. Step 12. Thirty minutes later, the gunner, a-gunner, and RSO will return to the vehicle. The gunner will mount the vehicle staying clear of the back blast area. The gunner will open the bridge clamp and remove the encased missile from the system. The gunner will then hand the encased missile to the a-gunner. Keeping the missile pointed

down range the a-gunner will place the missile in a dud pit or wherever designated by the RSO.

m. Step 13. The crew loads another missile.

n. In combat, steps 11 and 12 are not performed. The misfire missile is removed as quickly as possible and replaced with a new one. The bad missile is placed on the deck with the nose end pointed toward the enemy, until the tactical situation allows you the time to deal with it.

8. IN-FLIGHT MALFUNCTIONS. There are two types of in-flight malfunctions, erratic flight and dud missile

a. Erratic Flight. If the missile fail to respond to your guidance commands then perform the following procedures to clear the malfunction.

(1) The gunner will immediately rotate the control knobs downward to ground the missile. Open the bridge clamp, remove the empty encased missile, and replace it.

b. Dud Missile. If the missile impacts the target but does not detonate then perform the following procedures to clear the malfunction.

(1) The only things you can do with a dud missile are record the serial number , lot number, and inform the explosive ordnance disposal (EOD) of the location of the dud. In combat, you will immediately load, arm and fire another missile. The kinetic properties of dud TOW missile may very well immobilize a thin-skinned vehicle.

REFERENCES: TM 9-1425450-12 Operator's and Organizational Maintenance Manual for the TOW2 Weapons System; Page 2-142 through 2-146, and 2-408.1 through 2-408.10

PERFORMANCE EXAMINATION CHECKLIST

EXAM TITLE: M220E4 TOW2 Weapon System Hangfire Procedures Performance Examination.

EXAM ID: AGM1407P1

TLO/ELO: 52TR.03.06

STUDENT INSTRUCTIONS:

1. You are an anti-tank team and must perform hangfire procedures for a M220E4 TOW2 weapon system.
2. There is no time limit for this task.
3. To achieve mastery, you must perform each of the performance steps correctly and in order.

PERFORMANCE STEPS AND/OR PERFORMANCE STANDARDS:

Performance Steps	1 st ATTEMPT		2 nd ATTEMPT		3 rd ATTEMPT	
	M	NM	M	NM	M	NM
1. Gunner sounds off, "Hangfire" when the trigger is pressed, the gyros spin, and the missile does not fire.						
2. Driver/assistant gunner repeats "Hangfire".						
3. Gunner continues to track the target for one minute.						
4. Driver/assistant gunner times for one minute, and then sound off, "minute up".						
5. Gunner closes the trigger protective cover, and locks the traversing unit with the azimuth and elevation locks.						
6. Driver/assistant gunner lowers the arming lever on the bridge clamp.						
7. Gunner and the driver/assistant gunner walk away from the system at a 90-degree angle.						
8. Driver/assistant gunner waits 30 minutes and then walks back to the system.						
9. Driver/assistant gunner raises the bridge clamp locking lever and then raises the bridge clamp.						
10. Driver/assistant gunner lifts the aft end of the missile and then pulls the missile out of the launch tube.						
11. Driver/assistant gunner cradles the missile and ensures that the missile is pointed down range in a safe direction.						
12. Driver/assistant gunner carries the missile to a designated area safely away from the crew and other personnel.						

13. The crew reloads another missile.						
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PERFORMANCE EXAMINATION CHECKLIST

EXAM TITLE: M220E4 TOW2 Weapon System Misfire Procedures Performance Examination

EXAM ID: AGM1407P2

TLO/ELO: 52TR.03.07

STUDENT INSTRUCTIONS:

1. You are an anti-tank team and must perform misfire procedures for a M220E4 TOW2 weapon system.
2. There is no time limit for this task.
3. To achieve mastery, you must perform each of the performance steps correctly and in order.

PERFORMANCE STEPS AND/OR PERFORMANCE STANDARDS:

Performance Steps	1 st		2 nd		3 rd	
	ATTEMPT		ATTEMPT		ATTEMPT	
	M	NM	M	NM	M	NM
1. Gunner sounds off, "misfire" when the trigger is pressed and nothing happens.						
2. Driver/assistant gunner repeats, "misfire".						
3. Gunner continues to track the target for one minute.						
4. Driver/assistant gunner times for one minute, and then sound off, "minute up".						
5. Driver/assistant gunner visually rechecks the firing danger zone in front of the weapons system, and the back-blast area behind the weapon system.						
6. The driver/assistant gunner will sound off, "back-blast area all secure".						
7. Driver/assistant gunner checks to make sure that the bridge clamp locking lever is closed properly and inspects the arming lever to ensure it is in the up position at a 90-degree angle and sound off, "gun up".						
8. Driver/assistant gunner will face the rear of the weapons system and observe the back-blast area.						
9. Gunner will raise the trigger protective cover and sound off, "launch", and attempt to fire by pressing the trigger.						
10. Gunner sounds off, "misfire" when the trigger is pressed and nothing happens.						
11. Driver/assistant gunner repeats, "misfire".						
12. Gunner continues to track the target for one minute.						

13. Driver/assistant gunner times for one minute, and then sound off, "minute up".						
14. Gunner closes the trigger protective cover, and continues to track the target.						
15. Driver/assistant gunner will lower the arming lever on the bridge clamp to disarm the system.						
16. Driver/assistant gunner checks to make sure that the battery assembly is secured properly on the missile guidance set.						
17. Driver/assistant gunner presses the test operator switch to ensure that the battery passes.						
18. Driver/assistant gunner checks the coil cable attached to the missile guidance set to ensure that the J1 connector is fully seated onto the electrical connector.						
19. Driver/assistant gunner visually rechecks the firing danger zone in front of the weapons system, and the back-blast area behind the weapon system.						
20. The driver/assistant gunner will sound off, "back-blast area all secure".						
21. Driver/assistant gunner will raise the arming lever on the bridge clamp, and sound off, "gun up".						
22. Driver/assistant gunner will face the rear of the weapons system and observe the back-blast area.						
23. Gunner will raise the trigger protective cover and sound off, "launch", and attempt to fire by pressing the trigger.						
24. Gunner sounds off, "misfire" when the trigger is pressed and nothing happens.						
25. Driver/assistant gunner repeats, "misfire".						
26. Gunner continues to track the target for one minute.						
27. Driver/assistant gunner times for one minute, and then sound off, "Minute up".						
28. Gunner closes the trigger protective cover, and locks the traversing unit with the azimuth and elevation locks.						
29. Driver/assistant gunner lowers the arming lever on the bridge clamp.						
30. Gunner and the driver/assistant gunner walk away from the system at a 90-degree angle.						
31. Driver/assistant gunner waits 30 minutes and then walks back to the system.						
32. Driver/assistant gunner raises the bridge clamp locking lever and then raises the bridge clamp.						
33. Driver/assistant gunner lifts the aft end of the missile and then pulls the missile out of the launch tube.						

34. Driver/assistant gunner cradles the missile and ensures that the missile is pointed down range in a safe direction.							
35. Driver/assistant gunner carries the missile to a designated area safely away from the crew and other personnel.							
36. The crew reloads another missile.							