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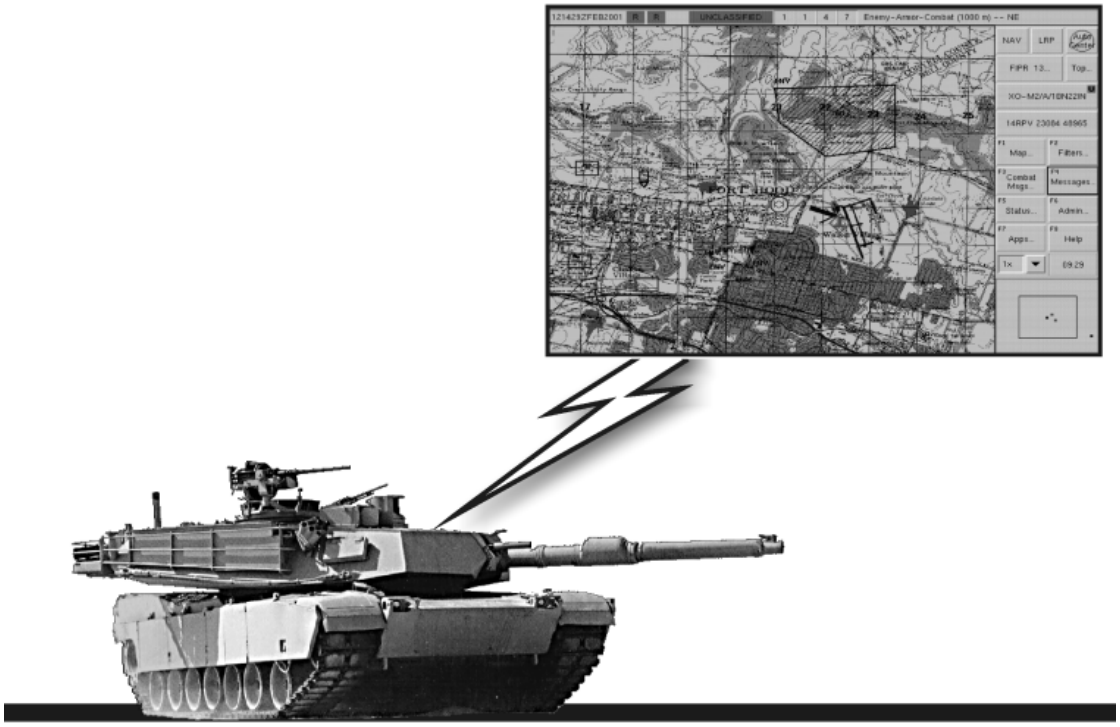
TANK GUNNERY (ABRAMS)



HEADQUARTERS, DEPARTMENT OF THE ARMY

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TANK GUNNERY (ABRAMS)

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Preface

This manual describes how the Abrams tank crew and tank platoon train for combat weapon system proficiency. It provides principles and techniques for use by the individual, crew, section (tank with wingman), and platoon to engage and destroy enemy targets efficiently in combat.

This manual is designed for tank commanders, platoon sergeants, platoon leaders, master gunners, S3s, and the chain of command of Armor units equipped with Abrams tanks.

This manual outlines Abrams tank system gunnery tables designed to attain and sustain crew through platoon tactical gunnery proficiency. The tasks, conditions, and standards on the gunnery tables are based on a thorough analysis of gunnery engagement factors and reflect the actual hit or kill probabilities of U.S. tanks versus enemy tanks or antitank weapons. Most of the tasks can be found in the MOS 19K soldier's manuals and mission training plans. All Armor units are encouraged to recommend ideas to upgrade the tasks, conditions, and standards in this manual.

The tactical tables, which are essential to combined arms tactical training, are included in this manual.

The proponent of this publication is HQ TRADOC. Submit changes for improving this publication on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward it to Director, Directorate of Training and Doctrine Development, U.S. Army Armor Center and Fort Knox, ATTN: ATZK-TDD-G, Fort Knox, KY 40121-5000. Additional information is available at (502) 624-5505/5765 or DSN 464-5505/5765.

Chapter 1

Introduction

To defeat the enemy force and survive, Abrams tank crews must have a thorough knowledge of their tanks' functional capabilities, the techniques of acquiring targets, and the effective use of all crew-served weapons. In addition, tank crews must develop and sustain tactical crew skills that will allow them to maneuver effectively and survive on the battlefield. This combination of crew gunnery and tactical skills is essential for total weapon system proficiency.

This manual provides a systematic way to train Abrams tank weapon system proficiency. It includes an application of combined gunnery skills in gunnery tables and is intended to be used with the tank tactical tables. This version of the manual provides basic guidance on tank employment and crew-level tactics.

CONTENTS

Scope

This manual outlines Abrams tank system gunnery tables designed to attain and sustain crew through platoon tactical gunnery proficiency. This manual describes how to—

- Boresight the weapon systems.
- Perform armament accuracy checks (AACs).
- Conduct a live-fire accuracy screening test (L-FAST).
- Detect, acquire, identify, and classify targets.
- Use direct-fire engagement techniques.
- Employ machine guns.
- Employ the Abrams tank.
- Compensate for the loss of a crew member or a malfunction in the fire control system.
- Develop a tank gunnery training program.
- Integrate training devices into tank gunnery training and crew duty training.
- Establish new training sites for tank combat training.

It also describes the—

- Characteristics, capabilities, and employment of ammunition used on the Abrams tank.
- Tasks, conditions, standards, and administrative guides for the Tank Crew Gunnery Skills Test (TCGST).
- Gunnery tables and tactical tables used to determine individual, crew, and platoon gunnery proficiency.

Notes. Critical procedural information contained in the operator's manuals, TM 9-2350-255-10-1/-2 (M1), TM 9-2350-264-10-1/-2 (M1A1), TM 9-2350-288-10-1/-2 (M1A2), and TM 9-2350-388-10 (M1A2 SEP) may be repeated in this manual for emphasis.

Some procedures in this manual differ from those in the operator's manual. The procedures that are different are designed to be both safe and combat effective. The operator's manual provides correct technical procedures; the field manual provides correct doctrinal procedures.

In accordance with FM 25-101, doctrinal manuals provide leaders with the correct procedures and principles needed to conduct training properly. Field manuals also provide common doctrine and standard operational methods needed to permit rapid adjustment on the battlefield.

Individual through tank platoon-level training involving both gunnery and tactical tables is essential to combined arms tactical training at platoon, company team, and battalion task force levels. The tactical tables allow integration of maneuver training with gunnery training using the tank weapons gunnery simulation system (TWGSS), which is the primary gunnery-training device.

Chapter 2

Boresighting

Boresighting is the key to tank main gun accuracy. For survival and success on the battlefield, tank crews must train as they will fight. Boresighting, if not the most critical skill for tank crews, is certainly one of the most important. Therefore, tank crews must become proficient in boresighting their weapon system under any circumstance and environmental condition (such as air temperature and barometric pressure). Commanders must make sure that crews can, without assistance, boresight accurately and prepare their tanks to fire in accordance with this manual and the appropriate TM.

CONTENTS

Muzzle Boresight Device (MBD) Collimation

An MBD may be collimated to the particular tank on which it will be used. When an MBD is collimated to a particular tank, boresighting the tank is faster and more accurate.

COLLIMATION CHECK

The tank crew should conduct a collimation check periodically during routine maintenance to make sure the MBD is correctly collimated and to determine if it needs to be turned in for repair. The tank crew conducts the collimation check; however, the company/troop master gunner has overall responsibility for the collimation of the MBDs. The crew conducts a collimation check using the following steps:

Notes. Make sure the turret power is on and the turret hydraulic pressure gauge reads between 1,500 and 1,700 psi.

Before conducting a collimation check, select a target with a well-defined aiming point as close as possible to 1,200 meters. (Use the eyesight parallax shield [optic cover with hole] to reduce the eyesight parallax. If no parallax shield is available, do not conduct a collimation check at ranges less than 500 meters.)

Make sure the end of the tube, as far in as the MBD is inserted, is clean.

1. Tell the gunner to lay the gun on the upper left corner of the target.
2. Move the FIRE CONTROL MODE switch to MANUAL.
3. Insert the MBD, and make sure the index mark on the tapered muzzle cone is at the 12 o'clock position by aligning it with the 12 o'clock witness mark on the face of the gun tube.

CAUTION

Never hold the eyepiece while turning the operating handle.

4. While holding the tapered muzzle cone firmly, tighten the operating handle finger tight, and make sure the eyepiece is positioned at the 3 o'clock position.

Note. With the eyepiece at the 3 o'clock position, the light port used for night boresighting is pointed up. During bright days, the sun may shine through this port and cause blurring of the MBD reticle; use one hand to shield the light port from the sun.

5. With a pencil, mark the operating handle at the 12 o'clock position (on line with the index mark) to make sure the operating handle is tightened to the same position each time the MBD is repositioned. (Once boresighting is complete, erase the mark. A new mark should be used each time the tank is boresighted or the MBD is collimated.)

Note. Focus the eyepiece and turn it so the reticle lines of the MBD are parallel to the edges of the boresight target.

6. Without touching the gun or the MBD, sight through the MBD eyepiece and direct the gunner to traverse the turret and elevate the main gun, using manual controls, to lay the aiming reticle of the MBD on the target aiming point.
7. Without disturbing the lay of the gun, hold the tapered muzzle cone firmly and loosen the operating handle two complete turns to unseat the MBD; remove the MBD.
8. Rotate the MBD 180 degrees; make sure that the index mark on the tapered muzzle cone is at the 6 o'clock position by aligning it with the 6 o'clock witness mark on the face of the gun tube.
9. While holding the tapered muzzle cone firmly, tighten the operating handle two turns until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. (*If the device is positioned correctly, the eyepiece will be at the 9 o'clock position. If the pencil mark does not line up with the index mark on the tapered muzzle cone, erase the pencil mark and start boresight device collimation check procedures over*.)
10. Without disturbing the lay of the gun, look through the MBD eyepiece to make sure the reticle is on the target aiming point.

Note. If the MBD reticle is on the target aiming point, the MBD is collimated (see Figure 2-1 on page 2-3). If the reticle is off the target aiming point more than one reticle line width in azimuth or elevation, collimate the MBD (M26A1 and M27A1).

COLLIMATION PROCEDURES (M26A1/M27A1)

Collimation procedures should be performed on an MBD when it fails the collimation check. Meticulous adjustments are required during collimation to ensure the MBD reticle is laying directly on the target aiming point. Tools required to collimate an MBD are—

- Spline key kit (Part #6257, NSN 5120-00-087-6415).
- Two jeweler screwdrivers (NSN 5120-00-288-8739).

Use the following procedures to collimate an MBD (M26A1 and M27A1):

1. With the MBD eyepiece still at the 9 o'clock position, use the spline key wrench to loosen the collar (spline) screw behind the optical eyepiece and rotate the collar to expose the three (or four) collimation screws.
2. Without disturbing the lay of the gun, look through the eyepiece and make a mental note of where the reticle is laying (in relation to the target aiming point) (see Figure 2-1 on page 2-3).
3. Using the jeweler screwdrivers, adjust the collimation screws to move the MBD reticle half the distance to the target aiming point. (*Read the following notes carefully before making any adjustments*.)

Notes. Use two jeweler screwdrivers simultaneously, to adjust collimation screws.

Adjust the collar and collimation screws carefully to make sure the screws are not stripped while adjusting the MBD.

Reticle movement occurs when an adjustment screw is turned clockwise while an opposing screw is, simultaneously, turned counterclockwise.

Depending on the tolerance of both the MBD and the gun tube, the collimation screws may not turn enough to move the reticle close enough to the target aiming point. This does not necessarily mean that the MBD cannot be collimated; try the MBD on another tank. If an MBD cannot be collimated on two different tanks, turn the MBD in to maintenance for repair.

The following table provides general guidance for reticle adjustment with either a three- or four-screw MBD.

Table 2-1. Reticle Adjustment Guide.

Desired Reticle Movement	Adjustment Screw (Turn Clockwise)	Opposing Screw (Turn Counterclockwise)
Four Adjustment Screws		
Down and Right	Upper Left	Lower Right
Down and Left	Upper Right	Lower Left
Up and Right	Lower Left	Upper Right
Up and Left	Lower Right	Upper Left
Three Adjustment Screws		
Left	Lower Right	Lower Left
Right	Lower Left	Lower Right
Up	Lower Left or Right	Top
Down	Top	Lower Left or Right
Down and Right	Top	Lower Right
Down and Left	Top	Lower Left
Up and Right	Lower Left	Top
Up and Left	Lower Right	Top

4. Once the reticle moves half the distance to the target aiming point (see illustration below), use the jeweler screwdrivers to tighten the collimation screws finger tight before rotating the MBD. (This eliminates further reticle movement.)

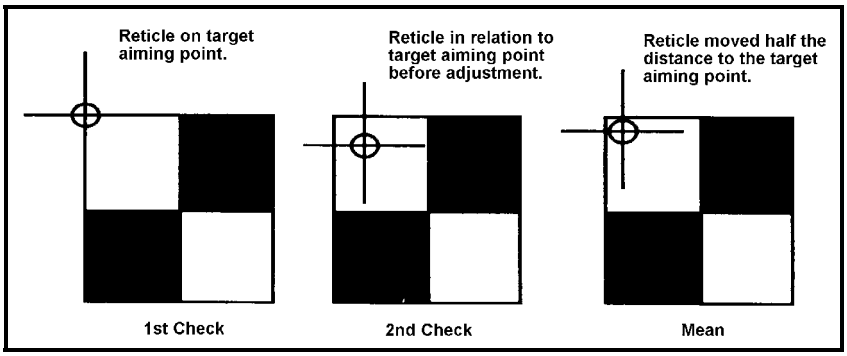


Figure 2-1. Target Aiming Point.

5. With the index mark on the tapered muzzle cone in the 6 o'clock position, hold the tapered muzzle cone firmly and loosen the operating handle two turns to unseat the MBD; remove the MBD.
6. Rotate the MBD 180 degrees and insert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 12 o'clock position.
7. While holding the tapered muzzle cone firmly, tighten the operating handle two turns until finger tight; make sure the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. (If the MBD is positioned correctly, the eyepiece will be at the 3 o'clock position.)
8. Looking through the MBD with the eyepiece at the 3 o'clock position (index mark at the 12 o'clock position), direct the gunner to use the manual controls to move the gun to the target aiming point.

9. While holding the tapered muzzle cone firmly, loosen the operating handle two complete turns to unseat the MBD; remove the MBD.
10. Rotate the MBD 180 degrees and insert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 6 o'clock position.
11. While holding the tapered muzzle cone firmly, tighten the operating handle two turns until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. (*If the MBD is positioned correctly, the eyepiece should be at the 9 o'clock position*.)
12. Without disturbing the lay of the gun, look through the MBD eyepiece to make sure the reticle is on the target aiming point.

Note. If the MBD reticle is on the target aiming point, the collimation procedures are complete. If not, repeat the collimation procedures (steps 2 through 12) until the reticle is on the target aiming point with the muzzle cone in both the 12 o'clock (eyepiece at 3 o'clock) and 6 o'clock (eyepiece at 9 o'clock) positions. Normally, several adjustments have to be made to collimate an MBD.

13. Once collimation is complete, view through the eyepiece and carefully tighten the collimation screws *without moving the reticle off the target aiming point*. (Do *not* over tighten and strip the screws.)
14. Perform a final collimation check (pages 2-1 and 2-2).
15. Rotate the collar to the closed position and tighten the locking screw.
16. Remove the MBD from the tube.

Note. If the MBD loses collimation, these procedures will have to be performed again. Loss of collimation may be caused by—

- Loose collimation screws.
- Stripped collimation screws.
- Inoperative MBD.
- Gun tube wear.
- Mishandling the MBD.

Boresighting the M1 and M1A1

Boresighting establishes a definite relationship between the axis of the bore of the gun and the sights at zero super elevation, providing a basis for all sight alignment. When the tank is boresighted at a known range, the fire control system provides system parallax corrections to the GPS and the TIS at other ranges. It is impossible to fire accurately without sight alignment; therefore, boresighting is fundamental in tank gunnery.

The numbers in the CCP display change as the reticle is adjusted during boresighting. Using the RETICLE ADJUST toggle switch can induce reticle movement of 7.5 mils in any direction; however, with a cold gun, no more than 2 to 3 mils movement in any direction should be required to boresight. If the reticle must be moved more than 5 mils off center to reach boresight alignment, recheck the procedure. Look for uncontrolled reticle drift, and perform a computer self-test.

The main gun, GPS, TIS, MRS, and GAS should be boresighted each time the gunner or TC is changed, when loss of boresight occurs, or as the situation permits. In training, perform complete boresight procedures before firing each table. In combat, boresight before anticipated contact and after extended movement. The gunner should adjust the browpad to fit his face snugly. This will limit the movement of the gunner's head and reduce sight parallex.

COMPUTER CORRECTION FACTORS AND AMMUNITION SUBDESIGNATIONS

CCFs refine the computer ballistic solutions, which are calculated using ballistic data from stationary tanks and fixed gun mount test firings. These factors correct the ballistic data for part of the mean jump error not considered during these test firings.

The Abrams CEU is capable of storing and providing zero information (CCF) for any ammunition type designed to be fired from the tank. Because the ballistic characteristics of different models of a particular type of ammunition can vary, the CEU can also store and provide zero information (CCF) for different ammunition by its subdesignation.

MUZZLE BORESIGHT PROCEDURES (M26A1/M27A1 MBD)

The MBD method of boresighting the main gun is preferred over the two-point (string) method. Tank cannons are long and heavy; therefore, droop slightly due to gravitational pull. Using the two-point method of boresighting, this droop error is neither properly measured nor properly compensated. The MBD measures the axis of the gun at the muzzle end; therefore, muzzle boresighting compensates for this droop and more reliably reflects where rounds will impact.

For best firing consistency, to standardize procedures, and to ensure devices are used properly, the muzzle boresight procedure must be followed carefully.

Table 2-2. M1 and M1A1 Computer Correction Factors.

Ammunition	Subdesignation	Azimuth	Elevation
M1 (105mm)			
HEAT	0(M456A2)	0.0	-0.6(U)
HEAT	1(M490A1)	0.0	-0.6(U)
HEP	0(M393A2)	0.0	+1.0(D)
HEP	1(M393A1)	0.0	+1.0(D)
Sabot	0(M735)	0.0	-0.5(U)
Sabot	0(M774)	-0.1(L)	+0.2(D)
Sabot	0(M833)	-0.2(L)	+0.3(D)
Sabot	0(M900)	-0.2(L)	-0.4(U)
Sabot	1(M392A2/M724A1)	0.0	0.0
Sabot	3(M728)	0.0	0.0
M1A1 (120mm)			
HEAT	0(M830)	-.25(L)	+.37(D)
HEAT	1(M831)	+.15(R)	+.35(D)
HEAT	1 (M831A1)	+.15(R)	-.15(U)
MPAT	0(M830A1)	+.05(R)	-.60(U)
Sabot	0(M829)	-.13(L)	-.65(U)
Sabot	1(M865)	+0.10(R)	-0.50(U)
Sabot	1(M865-IP)*	+.15(R)	-.60(U)
Sabot	5(M829A1)	0.0	-.45(U)
Sabot	6(M829A2)	-.05(L)	-.85(U)

*See second note under TARGET-PRACTICE AMMUNITION, page 4-14 for instructions to identify M865-IP.

Note. These values reflect numeric data entered into the CEU. If the CCFs are entered using the numeric keypad, the negative values correspond to up and left movements of the reticle (negative values are entered by pressing the minus [-] key first); positive values correspond to down and right movements. The CCFs can be toggled into the CEU using the RETICLE ADJUST toggle switch. For example, the M831 HEAT elevation correction of +0.35 can be toggled into the CEU as 0.35 down.

Note. Before boresighting, make sure all preventive maintenance checks and services (PMCS) have been completed (TM 9-2350-255-10-1 [M1] or TM 9-2350-264-10-1 [M1A1], Table 2-1), to include entering the CCF (M1 and M1A1) and tube wear (M1).

1. Position the tank on as level terrain as possible with the gun tube over the front slope.
2. Clear all weapons and leave the main gun breech open.
3. Make sure the end of the gun tube is clean.
4. Select a boresight target with a clearly defined aiming point (always a right angle). Any part of the boresight panel may be used. Make sure all crew members involved in boresighting the vehicle know which target aiming point will be used.

Note. In operational situations, the tank may be boresighted at any known distance between 200 and 4,000 meters.

5. With the engine running, make sure the turret hydraulic pressure gauge shows 1,500 to 1,700 psi. (If unable to operate the engine, move the AUX HYDR POWER switch to ON and make sure the pressure gauge shows 1,150 to 1,500 psi.)
6. Make sure the GUN SELECT switch is set on MAIN and both ballistic doors are open.
7. Move the GPS MAGNIFICATION to 10X.
8. Move the FLTR/CLEAR/SHTR switch to CLEAR.
9. Insure MBD has been collimated; if not, perform an MBD collimation check (see pages 2-1 and 2-2).
10. Move the FIRE CONTROL MODE switch to EMERGENCY, squeeze one of the palm switches on the GPCH, and check for drift. (If more than 0.5 mil of drift in 20 seconds is observed, notify organizational maintenance.)
11. Move the FIRE CONTROL MODE switch to NORMAL, squeeze one of the palm switches on the GPCH, and check for drift. Remove all drift.
12. With the GPCH, lay the GPS aiming dot on the boresight target, and lase. Make sure the LRF is returned to the SAFE position before continuing. If lasing is not possible, with a palm switch depressed, index the known tank-to-target range into the CCP.
13. Move the FIRE CONTROL MODE switch to MANUAL.
14. Move the THERMAL MODE switch on the TIS to STBY and, if the tank is equipped with an ANTI-GLARE knob, turn the ANTI-GLARE knob to position 1.
15. Insert the MBD into the muzzle of the main gun and make sure the index mark on the tapered muzzle cone is at the 12 o'clock position by aligning it with the 12 o'clock witness mark on the face of the gun tube.

Notes. All movements of the main gun will be made using manual controls. The *last* movement of the main gun will be up.

Always use a clearly defined right angle on the target as the aiming point.

If a boresight device is not available, refer to *Boresight Main Gun—Alternate* method under *Unusual Conditions* in the operator's manual.

CAUTION

Never hold the MBD eyepiece while turning the operating handle.

16. While holding the tapered muzzle cone firmly, tighten the operating handle finger tight and make sure the MBD eyepiece is positioned at the 3 o'clock position.

Note. With the MBD eyepiece at the 3 o'clock position, the light port used for night boresighting is pointed up. During bright days, the sun may shine through this port and cause blurring of the MBD reticle; use one hand to shield the light port from the sun.

17. With a pencil, mark the operating handle at the 12 o'clock position (on line with the index mark) to make sure the operating handle is tightened to the same position each time the MBD is rotated. (Once boresighting is complete, erase the mark. A new mark should be used each time the tank is boresighted or the MBD is collimated.)

Note. Focus the eyepiece and turn it so the reticle lines of the MBD are parallel to the edges of the boresight target.

18. Without touching the gun or the MBD, sight through the MBD eyepiece and direct the gunner to traverse the turret and elevate the main gun using manual controls to lay the reticle of the MBD on the target aiming point, with the last movement being up.
19. Move the FIRE CONTROL MODE switch to EMERGENCY.
20. Ensure the GUN SELECT switch is set to MAIN.
21. Open the CCP door and turn the PWR switch to ON.
22. Press and release the BORESIGHT push button on the CCP; make sure the BORESIGHT light comes on.
23. Viewing through the GPS, the gunner uses the RETICLE ADJUST toggle switch to move the GPS aiming dot to the boresight target aiming point.
24. Viewing through the GPS, the gunner uses a *G* pattern to lay off the target manually and re-lay the GPS aiming dot on the target aiming point, with the last movement being up.
25. Make sure the MBD reticle is on the defined target aiming point. If the reticle aiming points are still on target, record the boresight readings from the CCP display and proceed to step 26. If the MBD reticle is *not* on the target aiming point, at least one of the following is true:
    - The gunner has made an incorrect referral.
    - The gunner has made an incorrect lay.
    - The fire control system is faulty.

Note. If any fault is identified, correct it immediately and start boresight procedures over.

CAUTION

Rotating the MBD inside the main gun may damage the gun or leave the device improperly aligned.

26. Without disturbing the lay of the gun, hold the tapered muzzle cone firmly and loosen the operating handle to unseat the MBD (two complete turns); remove the MBD.
27. Rotate the MBD 180 degrees and reinsert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 6 o'clock position by aligning it with the 6 o'clock witness mark on the face of the gun tube.
28. While holding the tapered muzzle cone firmly, tighten the operating handle until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. (*If the device is positioned correctly, the MBD eyepiece will be at the 9 o'clock position. If the pencil mark does not line up with the index mark on the tapered muzzle cone, erase the mark and start boresight procedures over.*)

29. Check the reticle of the MBD to see if it is still on the target aiming point.

    a. If the MBD reticle is on the target aiming point, record the azimuth (AZ) and elevation (EL) readings from the CCP display on DA Form 2408-4; proceed to step 36.

    b. If the MBD aiming reticle is not within one reticle line width of the target aiming point, perform collimation procedures (M26A1 and M27A1) (see page 2-2). Once collimation is complete, start boresight procedures over. If collimation procedures are impractical, proceed to step 30 to determine the mean boresight reading.

30. Direct the gunner onto the target aiming point, as in step 18. (The gunner must use the manual controls.)

31. Viewing through the GPS, the gunner uses the RETICLE ADJUST toggle switch to move the GPS aiming dot to the target aiming point.

32. Record the boresight readings from the CCP display.

    a. If the boresight readings for both AZ and EL are within .2 mil of the first readings (step 29a), proceed to step 33.

    b. If the boresight readings for both AZ and EL are *not* within .2 mil of the first readings (step 29a), and the MBD has been collimated, start boresight procedures over.

    c. If the boresight readings for AZ and/or EL are not within .2 mil of the first readings and the MBD is not collimated, proceed to step 33 to determine mean readings.

33. Determine the mean AZ and EL of the two sets of boresight readings.

Notes. If the azimuth readings are in the same direction, use the *same direction calculation technique* in paragraph 33a below to determine the mean. If azimuth readings are in the opposite direction, use the *opposite direction calculation technique* in paragraph 33b below to determine the mean.

If the elevation readings are in the same direction, use the *same direction calculation technique* in paragraph 33a below to determine the mean. If the elevation readings are in the opposite direction, use the *opposite direction calculation technique* in paragraph 33b below to determine the mean.

a. Same direction calculation technique (see Examples 1 and 2 on next page):

   (1) Add the two readings.

   (2) Divide the result by 2.

   (3) Round off to two digits, if necessary.

b. Opposite direction calculation technique (see Examples 2 and 3 on next page):

   (1) Ignore the +, -, L, R, U, and D labels, and subtract the smaller reading from the larger reading.

   (2) Divide the result by 2.

   (3) Round off to two digits, if necessary.

   (4) The direction will be the same as the larger number from step (1) (+, -, L, R, U, or D).

EXAMPLE 1

First reading: AZ: +1.8(R), EL: +1.8(D)
Second reading: AZ: +2.0(R), EL: +1.6(D)

Since both azimuth and elevation readings are in the same direction, use *same direction calculation technique* (para 33a) for both. For example:

AZ		EL	
First reading:	+1.8(R)	First reading:	+1.8(D)
Second reading:	+2.0(R)	Second reading:	+1.6(D)
Add (1st + 2d)	+3.8(R)	Add (1st + 2d)	+3.4(D)
Divide by 2:	+3.8(R) ÷ 2 = +1.9(R)	Divide by 2:	+3.4(D) ÷ 2 = +1.7(D)
Mean reading: AZ:	+1.9(R)	Mean reading: EL:	+1.7(D)

EXAMPLE 2

First reading: AZ: +.05(R), EL: -.10(U)
Second reading: AZ: -.10(L), EL: -.05(U)

In this case, since the azimuth readings are in the opposite directions, use the *opposite direction calculation technique* (para 33b). Since the elevation readings are in the same direction, use the *same direction calculation technique* (para 33a). For example:

AZ		EL	
Larger reading:	-.10(L)	First reading:	-.10(U)
Smaller reading:	+.05(R)	Second reading:	-.05(U)
Subtract (lg - sm)	.05	Add (lg + sm)	-.15(U)
Divide by 2:	.05 ÷ 2 = .025	Divide by 2:	-.15(U) ÷ 2 = -.075(U)
Round off to two digits:	.025 = .03.	Round off to two digits:	-.075(U) = -.08(U)
Assign direction taken from larger number in step 1:	-.03(L)		
Mean reading: AZ:	-.03(L)	Mean reading: EL:	-.08(U)

EXAMPLE 3

First reading: AZ: +.05(R), EL: -.10(U)
Second reading: AZ: -.15(L), EL: +.05(D)

Since both azimuth and elevation readings are in the opposite direction, use *opposite direction calculation technique* (para 33b) for both. For example:

AZ		EL	
Larger reading:	-.15(L)	Larger reading:	-.10(U)
Second reading:	+.05(R)	Second reading:	+.05(D)
Subtract (lg - sm):	.10	Subtract (lg - sm):	.05
Divide by 2:	.10 ÷ 2 = .05	Divide by 2:	.05 ÷ 2 = .025
Assign direction taken from larger number in step 1:	-.05(L)	Round off to two digits:	.025 = .03
		Assign direction taken from larger number in step 1:	-.03(U)
Mean reading: AZ:	-.05(L)	Mean reading: EL:	-.03(U)

34. The gunner uses the RETICLE ADJUST toggle switch until the AZ and EL mean readings are shown on the CCP display.
35. Record the AZ and EL readings from the CCP display on DA Form 2408-4.
36. Press the ENTER push button on the CCP.
37. Press the BORESIGHT push button on the CCP and make sure the proper data is displayed on the CCP display.
38. Make sure the BORESIGHT light is still illuminated. The gunner, using manual controls, aligns the GPS aiming dot to the boresight target aiming point.
39. Using the GAS boresight knobs, the gunner aligns the GAS boresight aiming cross to the boresight target aiming point and, making sure the GAS boresight knobs are fully seated, slips the scales to 0 and 0.
40. Make sure the GPS aiming dot, GAS boresight cross, and MBD are still aligned on the target aiming point.
    a. If the GPS aiming dot, GAS boresight cross, and MBD are still aligned on the target aiming point, continue boresight procedures with step 41.
    b. If a mean boresight reading was not determined in step 33 and the GPS aiming dot, GAS boresight cross, and MBD are not still aligned on the target aiming point, start boresight procedures over.
    c. If a mean boresight reading was determined in step 33, the MBD reticle will not be aligned with the target aiming point.
41. Move the THERMAL MODE switch to ON and the FLTR/CLEAR/SHTR switch to SHTR.
42. Unlock the TIS BORESIGHT knobs. Align the TIS (10X magnification) RETICLE to the target aiming point.
43. Lock the TIS BORESIGHT knobs and record the settings.
44. Move the THERMAL MODE switch to STBY and the FLTR/CLEAR/SHTR switch to CLEAR.
45. Remove the MBD from the muzzle of the main gun.

WARNING

Do not use the LRF when operating the MRS.

46. Press the ENTER push button on the CCP.
47. Perform MRS boresight.
    a. Move the FIRE CONTROL MODE switch to NORMAL.

Note. Make sure the LRF is on SAFE.

    b. Move the MRS lever to IN. (The MRS light on the CCP should illuminate and 0.0 should be displayed on the CCP display; if not, notify organizational maintenance.)
    c. Press and release the BORESIGHT push button on the CCP; make sure the BORESIGHT light comes on.
    d. Grasp and hold the GPCH for approximately 5 seconds, after the gun goes to zero elevation, release the GPCH.
    e. Use the RETICLE ADJUST toggle switch to align the GPS reticle within the MRS reticle. (If unable to obtain a clear picture of both the GPS and MRS reticles, notify organizational maintenance.)
    f. Record the AZ and EL readings from the display. (If unable to align the GPS and MRS, notify organizational maintenance.)
    g. Push the MRS lever to OUT; make sure the display has cleared and the BORESIGHT and MRS lights have gone out.

48. Make sure the KE and HEAT AMMO SUBDES are correct (for example, the appropriate service round subdesignation for wartime conditions or AMMO SUBDES 1 [M865 and M831] for the training environment).
49. Make sure the following fire control inputs are correct:
    - Air temperature. (**Note.** If current temperature is not available, see Table 2-8 on page 2-36.)
    - Ammunition temperature.
    - Barometric pressure. (**Note.** If current barometric pressure is not available, see Table 2-9 on page 2-37.)
    - Tube wear data (M1).
    - CCFs.
50. Conduct precision alignment of the GAS (see steps below).

PRECISION ALIGNMENT OF THE GAS

1. Zero the CROSSWIND: Press the CROSSWIND, 0, and ENTER push buttons; the CROSSWIND light will stay on.
2. Zero the CANT: Press the CANT, 0, and ENTER push buttons; the CANT light will stay on.
3. Zero the LEAD: press the LEAD, 0, and ENTER push buttons; the LEAD light will stay on.
4. Move the AMMUNITION SELECT switch on the GPS to SABOT. With the palm switches pressed, re-lase or manually index the range to the boresight target and, using manual controls, lay the GPS aiming dot on the target aiming point. The boresight panel may be at any range; however, it should be at battlesight range for the primary ammunition to be used.

Note. The boresight panel must be placed at a range that corresponds to a range line on the GAS reticle.

5. Without slipping the scales on the GAS BORESIGHT knobs, refer the GAS KE/STAFF reticle to the range line at which you have boresighted. Record the readings from the GAS AZ and EL knobs; be sure to place these readings on the GAS when firing sabot.
6. Using the GAS AZ and EL knobs, return the settings to 0 and 0. Turn the RETICLE select knob on the GAS to HEAT.
7. Move the AMMUNITION SELECT switch on the GPS to MPAT/HEAT and re-lase or, with the palm switches pressed, manually index the range to the boresight target. Release the palm switches, then using manual controls, re-lay the GPS aiming dot on the target aiming point.
8. Without slipping the scales on the GAS BORESIGHT knobs, refer the GAS HEAT to the range line at which you have boresighted. Record the readings from the GAS AZ and EL knobs; be sure to place these readings on the GAS when firing HEAT.

Note. At this point, to use a particular reticle (sabot or HEAT), select the correct reticle and add the information for that reticle to the GAS BORESIGHT knobs for the ammunition being used.

9. To reenable CROSSWIND, CANT, and LEAD automatic inputs to the computer, press the CROSSWIND push button, then the CANT push button, then the LEAD push button; the keys should no longer be illuminated.
10. Turn off the CCP by closing and latching the CCP door.

NIGHT BORESIGHTING

Night boresighting can be accomplished following normal boresighting procedures. The boresight target must have an illuminated and heated reference point that can be seen through the MBD, GPS, GAS, and TIS. The TC can use a chemlight or filtered flashlight to illuminate the MBD aiming reticle. (M26A1 and M27A1 MBDs have a built-in light port to facilitate night boresighting.)

Most training ranges are equipped with targets that allow the crew to boresight at night. The following are examples of field-expedient boresight targets for tactical situations:

- Caliber .50 ammunition can with charcoal (for heating) and a chemlight or flashlight for the reference point.
- Any POL container with charcoal (for heating) and a chemlight or flashlight for the reference point.
- A small boresight panel (18 inches by 18 inches) quartered, colored with sand and olive drab paint, with a visible and heated aiming point, and a chemlight or flashlight for the reference point.
- Any object in the tank's sector that has a clearly defined right angle for use as a reference point when viewed through the TIS. Place a chemlight on that point as a reference point for the MBD, GPS, and GAS.

BORESIGHTING THE GAS (GPS AND TIS INOPERATIVE) USING THE M26A1/M27A1 MBD

In some tactical situations (because of mechanical breakdown or the effects of ballistic shock), the tank crew must use the GAS. The crew can boresight the tank and, with accurate range determination, still fire effectively.

Notes. These procedures are only to be used in tactical situations.

The GAS can be boresighted at any range.

The parallax caused by boresighting at any range will be minimal. These procedures are best used with the boresight panel at the battlesight range for your primary service KE ammunition.

1. Insert the MBD into the muzzle of the main gun, and make sure the index mark on the tapered muzzle cone is at the 12 o'clock position by aligning it with the 12 o'clock witness mark on the face of the gun tube.

CAUTION

Never hold the MBD eyepiece while turning the operating handle.

2. While holding the tapered muzzle cone firmly, tighten the operating handle finger tight, and make sure the MBD eyepiece is positioned at the 3 o'clock position.

Note. With the MBD eyepiece at the 3 o'clock position, the light port used for night boresighting is pointed up. During bright days, the sun may shine through this port and cause blurring of the MBD reticle; use one hand to shield the light port from the sun's rays.

3. With a pencil, mark the operating handle at the 12 o'clock position (on line with the index mark) to make sure the operating handle is tightened to the same position each time the MBD is repositioned. (Once boresighting is complete, erase the mark. A new mark should be used each time the tank is boresighted or the MBD is collimated.)
4. Without touching the gun or the MBD, sight through the MBD eyepiece, and direct the gunner to use manual controls to traverse the turret and elevate the main gun to lay the reticle of the MBD on the target aiming point.
5. Using the GAS boresight knobs, the gunner aligns the GAS boresight cross to the boresight target aiming point, making sure the knobs are fully seated.
6. Slip the AZ and EL scales on the GAS to 0 and 0.

CAUTION

Rotating the MBD inside the gun tube may damage the gun or leave the device improperly aligned.

7. Without disturbing the lay of the gun, hold the tapered muzzle cone, loosen the operating handle two complete turns to unseat the MBD, and remove the MBD from the gun tube.

8. Rotate the MBD 180 degrees and reinsert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 6 o'clock position by aligning it with the 6 o'clock witness mark on the face of the gun tube.
9. While holding the tapered muzzle cone firmly, tighten the operating handle until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. *(If the device is positioned correctly, the MBD eyepiece will be at the 9 o'clock position. If the mark does not line up with the index mark on the tapered muzzle cone, erase the mark and start boresight procedures over.)*
10. Check the reticle of the MBD to see if it is still on the target aiming point.
    a. If the MBD reticle is on target, proceed to step 16.
    b. If the MBD reticle is *not* on the target aiming point, collimate the MBD (see page 2-2). If the MBD cannot be collimated, continue boresight procedures.
11. Direct the gunner onto the target aiming point. (The gunner must use the manual controls.)
12. Using the GAS boresight knobs, the gunner will align the GAS boresight cross to the boresight target aiming point, making sure the knobs are fully seated.
13. The gunner will record the readings from the GAS AZ and EL boresight knobs and divide the readings by 2.

    Example. AZ(R)0.4 ÷ 2 = (R)0.2

    EL(L)0.6 ÷ 2 = (L)0.3
14. The gunner will move the AZ and EL boresight knobs on the GAS to the readings determined in step 13.
15. Without moving the GAS boresight knobs, slip the scales to 0 and 0.
16. Apply the appropriate SCF for the round to be fired (see Table 2-3 on next page).

Note. To apply new SCFs when changing battlecarry ammunition or firing a different type of ammunition, return the GAS boresight knobs to AZ and EL readings of 0 and 0 before applying the new SCF.

Table 2-3. M1 and M1A1 Sight Correction Factors.

Ammunition	Azimuth	Elevation
M1		
HEAT (M456/M456A1/M456A2)	0.0	0.6(L)
HEAT (M490/M490A1)	0.0	0.8(L)
HEP (M393)	0.0	1.0(R)
Sabot (M735)	0.0	0.6(L)
Sabot (M774)	0.0	0.2(L)
Sabot (M833)	0.2(R)	0.4(L)
Sabot (M392A2/M724/M728)	0.0	0.0
Sabot (M900)	0.2(L)	0.4(L)
M1A1		
HEAT (M830)	0.2(R)	0.6(R)
HEAT (M831)	0.2(L)	0.6(R)
HEAT (M831A1)	0.2(L)	0.0
MPAT (M830A1)	0.0	0.4(L)
Sabot (M829)	0.2(R)	0.8(L)
Sabot (M829A1)	0.0	0.2(L)
Sabot (M829A2)	0.0	1.2(L)
Sabot (M865)	0.2(L)	0.2(L)
Sabot (M865-IP)*	0.2(L)	0.2(L)

*See second note under TARGET-PRACTICE AMMUNITION, page 4-14 for instructions to identify M865-IP.

Note. Left (L) and right (R) symbols indicate the direction to turn the GAS boresight knobs.

BORESIGHT LOSS

Boresighting is simply an alignment process by which the gun and sighting system are referred to the same point. Any movement of the gun or sights away from that alignment is a loss of boresight. The gun may move out of alignment because—

- The gun temperature has changed since boresighting.
- Firing, or other shocks to the system (such as extensive road travel or enemy round impacts) disturbed the sight alignment.

For the tank crew in combat, it is not important how boresight loss occurs, just that it does. While the tank has a system to correct for artificial boresight loss (MRS), the most reliable method of correcting boresight loss is to reboresight the system. In training, boresight before every firing table. In a hostile environment, boresight whenever the tactical situation permits.

BORESIGHT CHECK

During the long periods between the time the system is boresighted and the time the tank is fired, boresight loss may occur due to changes in weather conditions. Crews can check for boresight loss by conducting a boresight check.

1. Select a target as close as possible to the range at which the tank was boresighted.
2. Lase or manually index the range to target.
3. Press the BORESIGHT push button on the CCP.
4. Lay the GPS reticle on a clearly defined aiming point.
5. Insert the MBD into the gun tube.
6. Note the position of the MBD reticle.
   a. If the MBD reticle is on the same target aiming point determined during boresighting, no boresight loss has occurred.
   b. If the MBD reticle is *not* on the target aiming point and a collimated MBD was used, boresight has been lost: reboresight the tank.
   c. If the MBD reticle is *not* on the target aiming point, and a noncollimated MBD was used, remove the MBD and rotate it (180 degrees). If the midpoint between the first and second reticle positions coincides with the gunner's aiming point, the tank is still boresighted. If it does not, boresight has been lost; reboresight the tank.

MRS CONFIRMATION

An MRS update is used to correct for boresight loss when reboresighting or a boresight check cannot be performed. An MRS update can be accomplished only if the tank sights and the MRS have been properly boresighted.

Armament accuracy check 6 determines only whether the MRS can correct an artificial boresight loss induced by the crew.

During live-fire training, crews can monitor the performance of their MRS to determine if the MRS performs within tolerance. Upon completion of a live-fire event, perform the following procedures:

1. Perform an MRS update and record the readings. (If the MRS update indicates no change, perform a boresight check.) Move the MRS lever to the OUT position.
2. Select a target as close as possible to the range at which the tank was boresighted.
3. Lase or manually index the range to target.
4. Press the BORESIGHT push button on the CCP.
5. Using manual controls, lay the GPS aiming dot on the target aiming point.
6. Insert the MBD into the gun tube.

7. Note the position of the MBD reticle.
   a. If the MBD reticle is on the same target aiming point determined during boresighting, the MRS performed correctly.
   b. If the MBD reticle is not on the target aiming point, and a noncollimated MBD was used to boresight, remove and rotate the MBD 180 degrees. If the midpoint between the first and second positions of the reticle coincides with the gunner's aiming point, the MRS performed correctly.
   c. If the MBD reticle is not on the target aiming point as described in step 7a or b, use the RETICLE ADJUST toggle switch and refer the GPS aiming dot to the target aiming point.
   d. To determine if the MRS is within tolerance, compare the new boresight readings to the previous boresight readings or MRS update readings established in step 1. If the difference in either AZ or EL is greater than .15 mil, the MRS is out of tolerance; notify organizational maintenance.

EMERGENCY BORESIGHT PROCEDURES

If immediate return fire is not required, attempt an MRS update; then at the first opportunity, move the tank to a position where it can be reboresighted. If boresighting with an MBD is not possible, initiate emergency boresight procedures using the alternate method described in the operator's manual.

When a component of the fire control system malfunctions or is damaged by fire, the remaining components should be boresighted. (Refer also to the DU considerations warning in Chapter 11, page 11-6.)

Boresighting the M1A2

Boresighting establishes a definite relationship between the axis of the bore of the gun and the sights at zero super elevation, providing a basis for all sight alignment. When the tank is boresighted at a known range, the fire control system provides system parallax corrections to the GPS and the TIS at other ranges. It is impossible to fire accurately without sight alignment; therefore, boresighting is fundamental in tank gunnery.

The numbers in the GCDP change as the reticle adjusts during boresighting. Reticle movements of 7.5 mils in any direction may be induced by using the four-way switch on the GCDP; however, with a cold gun and the GPS properly mounted, no more than 2 to 3 mils movement in any direction should be required to boresight. If the reticle must be moved more than 5 mils off center to reach boresight alignment, recheck the procedure. Look for uncontrolled reticle drift and perform a fire control system test.

The main gun, GPS, TIS, CITV, MRS, and GAS should be boresighted each time the gunner or TC changes, loss of boresight occurs, or as the situation permits. In training, perform complete boresight procedures before each firing table. In combat, boresight before anticipated contact and after movement.

COMPUTER CORRECTION FACTORS AND AMMUNITION SUBDESIGNATIONS

CCFs refine the computer ballistic solutions, which are calculated using ballistic data from stationary tanks and fixed gun mount test firings. These factors correct the ballistic data for part of the mean jump error not considered during these test firings.

Because the ballistic characteristics of different models of a particular type of ammunition can vary, the TEU can store zero information (CCF) for every ammunition type designed to be fired from the tank.

To enter the AMMO SUBDES into the FCS, press the ADJUST push button on the main menu of the GCDP, then the AMMO SUBDES push button. Use the four-way switch on the GCDP to highlight the desired ammunition. Press the ENT key on the GCDP numeric keypad to store the AMMO SUBDES in the TEU. Repeat this procedure for each ammunition to be fired.

The CCFs and AMMO SUBDES are entered into the FCS manually during before-operation checks. To apply CCFs, go to the ADJUST menu, press the ZERO push button and, using the four-way switch (or keypad) on the GCDP, display the desired values in the GCDP window. Press the ENT key on the GCDP numeric keypad to store the values in the TEU.

MUZZLE BORESIGHT PROCEDURES (M27A1 MBD)

The MBD method of boresighting the main gun is preferred over the old two-point (string) method. Tank cannons are long and heavy; therefore, droop slightly due to gravitational pull. Using the two-point method of boresighting, this droop is neither measured nor compensated for. The MBD measures the axis of the gun at the muzzle end; therefore, muzzle boresighting compensates for this droop and more reliably reflects where rounds will impact.

For best firing consistency, to standardize procedures, and to ensure devices are used properly, the muzzle boresight procedure must be followed carefully.

Table 2-4. M1A2 Computer Correction Factors.

Ammunition	Subdesignation	Azimuth	Elevation
M1A2 (120mm)			
HEAT	M830	-0.25(L)	+0.37(D)
HEAT	M831	+0.15(R)	+0.35(D)
HEAT	M831A1	+0.15(R)	-0.15(U)
MPAT	M830A1	+0.05(R)	-0.60(U)
Sabot	M829	-0.13(L)	-0.65(U)
Sabot	M829A1	0.00	-0.45(U)
Sabot	M829A2	-0.05(L)	-0.85(U)
Sabot	M865	+0.10(R)	-0.60(U)
Sabot	M865-PIP*	+0.15(R)	-0.60(U)

*See second note under TARGET-PRACTICE AMMUNITION, page 4-14 for instructions to identify M865-IP.

Note. These values reflect numeric data entered into the TEU. If the CCFs are entered using the numeric keypad, the negative values correspond to up and left movements of the reticle (negative values are entered by pressing the minus [-] key first); positive values correspond to down and right movements. The CCFs can be toggled into the TEU using the gunner's four-way adjust switch; for example, the M831 HEAT elevation correction of +0.35 can be toggled into the TEU as 0.35.

Note. Before boresighting, make sure all PMCS have been completed (TM 9-2350-288-10-1, Table 2-1), to include entering the CCFs.

1. Position the tank on as level terrain as possible with the gun tube over the front slope.
2. Clear all weapons and leave the main gun breech open.
3. Make sure the end of the gun tube is clean.
4. Select a boresight target with a clearly defined aiming point (preferably a right angle) on the upper left corner to be used as the aiming point.

Note. In operational situations, the tank may be boresighted at any known distance between 200 and 5,000 meters.

5. With the engine running, make sure the turret hydraulic pressure gauge shows 1,500 to 1,750 psi. (If unable to operate the engine, move the AUX HYDR POWER switch to ON and make sure the pressure gauge shows 900 to 1,750 psi.)
6. Make sure the GUN SELECT switch is turned to MAIN and both ballistic doors are open.
7. Move the GPS MAGNIFICATION switch to 10X.
8. Move the FLTR/CLEAR/SHTR switch to CLEAR.
9. Make sure the MBD has been collimated; if not, perform an MBD collimation check (see pages 2-1 and 2-2).

10. Move the FIRE CONTROL MODE switch to EMERGENCY, squeeze one of the palm switches on the GPCH, and check for drift. (If more than 0.5 mil of drift in 20 seconds is observed, press the MAINT push button, then the DRIFT push button, to null out the EMERGENCY mode drift.)
11. Move the FIRE CONTROL MODE switch to NORMAL, squeeze one of the palm switches on the GPCH, and check for drift. Remove all drift, if any is present.
12. Power up the CID, and prepare the CITV for operation.
13. Press the PRE/POST push button, then the AUX SYSTEMS push button on the CID.
14. Press the CITV SETUP push button on the AUX SYSTEMS menu.
15. Make sure the CITV is in the CITV GUN LOS mode (the CITV and GUN LOS SIGHT MODE push buttons on the CITV are illuminated).
16. Pressing the FOV button on the CCHA, change the FOV to NFOV.
17. With the GPCH, lay the GPS aiming dot on the boresight target, and lase. Make sure the LRF is returned to the SAFE position before continuing. If lasing is not possible, with a palm switch depressed, index the known tank-to-target range into the GCDP.
18. Move the FIRE CONTROL MODE switch to MANUAL.
19. Move the THERMAL MODE switch on the TIS to STBY, and turn the ANTI-GLARE knob to position 1.
20. Move the THPD circuit breaker switch to OFF.
21. Press RETURN twice.
22. Grasp the GPCH to make sure there is no hydraulic power present.
23. Insert the MBD into the muzzle of the main gun, and make sure the index mark on the tapered muzzle cone is at the 12 o'clock position.

Notes. All movements of the main gun will be made using manual controls. The *last* movement of the main gun will be up.
Always use a clearly defined right angle on the target as the aiming point.
If a boresight device is not available, refer to *Boresight Main Gun—Alternate* method under *Unusual Conditions* in the operator's manual.

CAUTION

Never hold the MBD eyepiece while turning the operating handle.

24. While holding the tapered muzzle cone firmly, tighten the operating handle finger tight and make sure the MBD eyepiece is positioned at the 3 o'clock position.

Note. With the MBD eyepiece at the 3 o'clock position, the light port used for night boresighting is pointed up. During bright days, the sun may shine through this port and cause blurring of the MBD reticle. Use one hand to shield the light port from the sun.

25. With a pencil, mark the operating handle at the 12 o'clock position (on line with the index mark) to make sure the operating handle is tightened to the same position each time the MBD is repositioned. (Once boresighting is complete, erase the mark. A new mark should be used each time the tank is boresighted or the MBD is collimated.)

Note. Focus the eyepiece and turn it so the reticle lines of the MBD are parallel to the edges of the boresight target.

26. Without touching the gun or the MBD, sight through the MBD eyepiece and direct the gunner to traverse the turret and elevate the main gun using manual controls to lay the reticle of the MBD on the target aiming point, with the last movement being up.
27. Move the FIRE CONTROL MODE switch to EMERGENCY.
28. Move the GUN SELECT switch to MAIN.
29. With the GCDP on the MAIN MENU, press the ADJUST push button.
30. Press the BORESIGHT push button on the ADJUST menu.

31. Press the GPS push button on the BORESIGHT menu.
32. Viewing through the GPS, the gunner uses the four-way switch on the GCDP to move the GPS reticle aiming dot to the boresight target aiming point.
33. Viewing through the GPS, the gunner uses a *G* pattern to lay off the target manually and re-lay the GPS aiming dot on the target aiming point with the last movement being up.
34. Make sure the MBD reticle is on the defined target aiming point. If the reticle aiming points are still on target, record the boresight readings from the GCDP, and proceed to step 35. If the MBD reticle is not on the target aiming point, at least one of the following is true:
    - The gunner has made an incorrect referral.
    - The gunner has made an incorrect lay.
    - The fire control system is faulty.

Note. If any fault is identified, correct it immediately and start boresight procedures over.

CAUTION

Rotating the MBD inside the main gun may damage the gun or leave the device improperly aligned.

35. Without disturbing the lay of the gun, hold the tapered muzzle cone firmly and loosen the operating handle two complete turns to unseat the MBD; remove the MBD.
36. Rotate the MBD 180 degrees and reinsert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 6 o'clock position.
37. While holding the tapered muzzle cone firmly, tighten the operating handle until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. *(If the device is positioned correctly, the MBD eyepiece will be at the 9 o'clock position. If the pencil mark does not line up with the index mark on the tapered muzzle cone, erase the mark and start boresight procedures over.)*
38. Check the reticle of the MBD to see if it is still on the target aiming point.
    a. If the MBD reticle is on the target aiming point, record the AZ and EL readings from the GCDP on DA Form 2408-4; proceed to step 45.
    b. If the MBD aiming reticle is not within one reticle line width of the target aiming point, perform collimation procedures (M27A1) (see page 2-2). Once collimation is complete, start boresight procedures over.
    c. If collimation procedures are impractical, proceed to step 39 to determine the mean boresight reading.
39. Direct the gunner onto the target aiming point, as in step 26. (The gunner must use the manual controls.)
40. Viewing through the GPS, the gunner uses the four-way switch on the GCDP to move the GPS reticle to the target aiming point.
41. Record the boresight readings from the GCDP.
    a. If the boresight readings for both AZ and EL are within .2 mil of the first readings (step 38a), proceed to step 42.
    b. If the boresight readings for both AZ and EL are ***not*** within .2 mil of the first readings (step 38b), and the MBD is collimated, start boresight procedures over.
    c. If the boresight readings for AZ and/or EL are not within .2 mil of the first readings and the MBD is not collimated, proceed to step 42 to determine mean readings.

42. Determine the mean AZ and EL of the two sets of boresight readings.

Notes. If the azimuth readings are in the same direction, use the *same direction calculation technique* in paragraph 42a below to determine the mean. If azimuth readings are in the opposite direction, use the *opposite direction calculation technique* in paragraph 42b below to determine the mean.

If the elevation readings are in the same direction, use the *same direction calculation technique* in paragraph 42a below to determine the mean. If the elevation readings are in the opposite direction, use the *opposite direction calculation technique* in paragraph 42b below to determine the mean.

a. Same direction calculation technique (see Examples 1 and 2, page 2-9):
   (1) Add the two readings.
   (2) Divide the result by 2.
   (3) Round off to two digits, if necessary.

b. Opposite direction calculation technique (see Examples 2 and 3, page 2-9):
   (1) Ignore the +, -, L, R, U, and D labels, and subtract the smaller reading from the larger reading.
   (2) Divide the result by 2.
   (3) Round off to two digits, if necessary.
   (4) The direction will be the same as the larger number from step (1) (+, -, L, R, U, or D).

43. The gunner uses the four-way switch on the GCDP to enter the mean reading for AZ and EL.

44. Record AZ and EL readings from the GCDP on DA Form 2408-4.

45. Press the ENT key on the GCDP keypad twice to enter the AZ and EL readings; then verify the boresight numbers on the GPS menu.

46. Using the manual controls, re-lay the GPS reticle aiming dot on the target aiming point.

47. Make sure the GUN LOS and CITV push buttons on the CITV are lit. (Make sure the CITV and GUN LOS lights are illuminated.)

48. Use the cursor controller and select the CITV boresight from the CITV set-up menu on the CID.

49. Align the CITV (NFOV) reticle aiming dot to the target aiming point using the four-way switch on the CID.

Note. No adjustments of the CITV picture can be made when in the CITV BORESIGHT MODE.

50. Record the AZ and EL readings from the CITV (indicated on the CITV set-up menu) on DA Form 2408-4.

51. Press the ENT key on the CID keypad twice to enter the AZ and EL readings; then verify the CITV boresight numbers on the CITV set-up menu.

52. Prior to boresighting the GAS or TIS, make sure the GPS, CITV, and MBD are still on the target aiming point.

53. Using the GAS boresight knobs, the gunner aligns the GAS boresight aiming cross to the boresight target aiming point and, making sure the GAS boresight knobs are fully seated, slips the scales to 0 and 0.

54. Make sure the GPS aiming dot, GAS boresight cross, and MBD are still aligned on the target aiming point.

a. If the GPS aiming dot, GAS boresight cross, and MBD are still aligned on the target aiming point, continue boresight procedures with step 55.

b. If a mean boresight reading was not determined (step 42) and the GPS aiming dot, GAS boresight cross, and MBD are not still aligned on the target aiming point, start boresight procedures over.

c. If a mean boresight reading was determined in step 42, the MBD reticle will *not* be aligned with the target aiming point.

55. Move the THERMAL MODE switch to ON and the FLTR/CLEAR/ SHTR switch to SHTR.
56. Unlock the TIS BORESIGHT knobs. Align the TIS (10X magnification) RETICLE to the target aiming point.
57. Lock the TIS BORESIGHT knobs and record the settings.
58. Move the THERMAL MODE switch to STBY and the FLTR/CLEAR/SHTR switch to CLEAR.
59. Press the RETURN push button on the GCDP.
60. Press the RETURN push button on the CID.
61. Remove the MBD from the muzzle of the main gun.
62. Move the THPD circuit breaker to ON.

WARNING

Do not use the LRF when operating the MRS.

63. Perform MRS boresight.

Note. Make sure the LRF is on SAFE.

a. Move the FIRE CONTROL MODE switch to NORMAL.

b. With the GCDP on the BORESIGHT menu, press the MRS push button on the GCDP.

c. Grasp and hold the GPCH for five seconds, then release; the gun will go to zero degrees elevation.

d. Use the four-way switch on the GCDP to align the GPS reticle within the black MRS reticle. (If unable to obtain a clear picture of both the GPS and MRS reticles, notify organizational maintenance.)

e. Record the AZ and EL readings from the display. (If unable to align the GPS and MRS, notify organizational maintenance.)

f. Press the ENT key on the GCDP keypad twice to store the AZ and EL readings for the MRS boresight data, then verify the AZ and EL readings for the MRS boresight.

g. Press the RETURN push button on the GCDP three times to return to the MAIN menu.

64. Make sure the following fire control inputs are correct:
    - Air temperature. (**Note.** If current temperature is not available, see Table 2-8 on page 2-36.)
    - Ammunition temperature.
    - Barometric pressure. (**Note.** If current barometric pressure is not available, see Table 2-9 on page 2-37.)
    - CCFs.
65. To verify data stored in the TEU, press the ADJUST push button on the MAIN menu of the GCDP. Press the BORESIGHT push button on the ADJUST menu and make sure the GPS, CITV, and MRS boresight readings coincide with previously recorded boresight readings.
66. Make sure the KE and HEAT ammunition subdesignations are correct (for example, the appropriate service round subdesignation for wartime conditions or AMMO SUBDES 1 [M865 and M831] for the training environment).
67. Perform precision alignment of the GAS (see steps below).

PRECISION ALIGNMENT OF THE GAS

1. With the GCDP at the MAIN menu, select METRL DATA, CROSSWIND, and MANUAL, enter the number 0, press the ENT push button on the GCDP keypad, and press RETURN two times.

2. With the GCDP at the MAIN menu, select SENSORS, press the ATTD and CANT push buttons, select MANUAL, enter the number 0, and press RETURN three times.
3. With the GCDP at the main menu, press the SENSORS push button. At the sensors menu, push the LEAD push button and the MANUAL push button. Press the 0 push button and the ENTER push button on the key pad. Press the RETURN push button twice to return to main menu.
4. Push the SABOT push button on the AMMUNITION SELECT panel on the GPS. With the palm switches pressed, re-lase or manually index the range to the boresight target and, using manual controls, lay the GPS aiming dot on the target aiming point.

Note. The boresight panel must be placed at a range that corresponds to a range line on the GAS reticle.

5. Without slipping the scales on the GAS BORESIGHT knobs, refer the GAS KE/STAFF reticle 1200-meter aiming dot (or the range line at which you have boresighted) to the target aiming point. Record the readings from the GAS AZ and EL knobs; be sure to place these readings on the GAS when firing sabot.
6. Using the GAS AZ and EL knobs, return the settings to 0 and 0. Turn the RETICLE select knob on the GAS to HEAT.
7. Push the HEAT push button on the AMMUNITION SELECT panel on the GPS and re-lase or, with the palm switches pressed, manually index range to the boresight target. Re-lay the GPS reticle aiming dot on the target aiming point.
8. Without slipping the scales on the GAS BORESIGHT knobs, refer the GAS MPAT/HEAT reticle 1,200-meter aiming point (or the range line at which you have boresighted) to the target aiming point. Record the readings from the GAS AZ and EL knobs; be sure to place these readings on the GAS when firing HEAT.

Note. At this point, to use a particular reticle (sabot or HEAT), select the correct reticle and add the information for that reticle to the GAS BORESIGHT knobs for the ammunition being used.

9. Reenable CROSSWIND: With the GCDP at the MAIN menu, select METRL DATA, CROSSWIND, and AUTO, and press RETURN two times.
10. Reenable CANT: With the GCDP at the MAIN menu, select SENSORS, press the ATTD and CANT push buttons, select AUTO, and press RETURN three times.
11. Reenable LEAD: With the GCDP at the MAIN menu, press the SENSORS push button. At the SENSORS menu, push the LEAD, then AUTO push buttons, and press RETURN twice to return to the MAIN menu.

Note. After boresighting and before screening, verify plumb and synchronization IAW TM 9-2350-288-10-2, Appendix F.

NIGHT BORESIGHTING

Night boresighting can be accomplished following normal boresighting procedures. The boresight target must have an illuminated and heated reference point that can be seen with the MBD, GPS, CITV, GAS, and TIS. The TC can use a chemlight or filtered flashlight to illuminate the MBD aiming reticle. (M27A1 MBDs have a built-in light port for night boresighting.)

Most training ranges are equipped with targets that allow the crew to boresight at night. The following are examples of field-expedient boresight targets for tactical situations:

- Caliber .50 ammunition can with charcoal (for heating) and a chemlight or flashlight for the reference point.
- Any POL container with charcoal (for heating) and a chemlight or flashlight for the reference point.
- A small boresight panel (18 inches by 18 inches) quartered, colored with sand and olive drab paint, with a visible and heated aiming point using a chemlight or flashlight for the reference point.
- Any object in the tank's sector that has a clearly defined right angle for use as a reference point when viewed through the TIS. Place a chemlight on that point as a reference point for the MBD, GPS, and GAS.

BORESIGHTING THE GAS (GPS AND TIS INOPERATIVE) USING THE M27A1 MBD

In some tactical situations (because of mechanical breakdown or the effects of ballistic shock), the tank crew must use the GAS. The crew can boresight the tank and, with accurate range determination, still fire effectively.

Notes. These procedures are only to be used in tactical situations.
The GAS can be boresighted at any range.
The parallax caused by boresighting at any range will be minimal. These procedures are best used with the boresight panel at the battlesight range for your primary service KE ammunition.

1. Insert the MBD into the muzzle of the main gun and make sure the index mark on the tapered muzzle cone is at the 12 o'clock position by aligning it with the 12 o'clock witness mark on the face of the gun tube.

CAUTION

Never hold the MBD eyepiece while turning the operating handle.

2. While holding the tapered muzzle cone firmly, tighten the operating handle finger tight, and make sure the MBD eyepiece is positioned at the 3 o'clock position.

Note. With the MBD eyepiece at the 3 o'clock position, the light port used for night boresighting is pointed up. During bright days, the sun may shine through this port and cause blurring of the MBD reticle; use one hand to shield the light port from the sun's rays.

3. With a pencil, mark the operating handle at the 12 o'clock position (on line with the index mark) to make sure the operating handle is tightened to the same position each time the MBD is repositioned. (Once boresighting is complete, erase the mark. A new mark should be used each time the tank is boresighted or the MBD is collimated.)
4. Without touching the gun or the MBD, sight through the MBD eyepiece, and direct the gunner to use manual controls to traverse the turret and elevate the main gun to lay the reticle of the MBD on the target aiming point.
5. Using the GAS boresight knobs, the gunner aligns the GAS boresight cross to the boresight target aiming point, making sure the knobs are fully seated.
6. Slip the AZ and EL scales on the GAS to 0 and 0.

CAUTION

Rotating the MBD inside the gun tube may damage the gun or leave the device improperly aligned.

7. Without disturbing the lay of the gun, hold the tapered muzzle cone, loosen the operating handle two complete turns to unseat the MBD, and remove the MBD from the gun tube.
8. Rotate the MBD 180 degrees and reinsert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 6 o'clock position by aligning it with the 6 o'clock witness mark on the face of the gun tube.
9. While holding the tapered muzzle cone firmly, tighten the operating handle until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. *(If the device is positioned correctly, the MBD eyepiece will be at the 9 o'clock position. If the mark does not line up with the index mark on the tapered muzzle cone, erase the mark and start boresight procedures over.)*
10. Check the reticle of the MBD to see if it is still on the target aiming point.
    a. If the MBD reticle is on target, proceed to step 16.
    b. If the MBD reticle is *not* on the target aiming point, collimate the MBD (see page 2-2). If the MBD cannot be collimated, continue boresight procedures.

11. Direct the gunner onto the target aiming point. (The gunner must use the manual controls.)
12. Using the GAS boresight knobs, the gunner will align the GAS boresight cross to the boresight target aiming point, making sure the knobs are fully seated.
13. The gunner will record the readings from the GAS AZ and EL boresight knobs and divide the readings by 2.

    Example. AZ(R)0.4 ÷ 2 = (R)0.2
    EL(L)0.6 ÷ 2 = (L)0.3
14. The gunner will move the AZ and EL boresight knobs on the GAS to the readings determined in step 13.
15. Without moving the GAS boresight knobs, slip the scales to 0 and 0.
16. Apply the appropriate SCF for the round to be fired (see Table 2-5 below).

Note. To apply new SCFs when changing battlecarry ammunition or firing a different type of ammunition, return the GAS boresight knobs to AZ and EL readings of 0 and 0 before applying the new SCF.

Table 2-5. M1A2 Sight Correction Factors.

Ammunition	Azimuth	Elevation
M1A2		
HEAT (M830)	0.2(R)	0.6(R)
HEAT (M831)	0.2(L)	0.6(R)
HEAT (M831A1)	0.2(L)	0.0
MPAT (M830A1)	0.0	0.4(L)
Sabot (M829)	0.2(R)	0.8(L)
Sabot (M829A1)	0.0	0.2(L)
Sabot (M829A2)	0.0	1.2(L)
Sabot (M865)	0.2(L)	0.2(L)
Sabot (M865-IP)*	0.2(L)	0.2(L)

*See second note under TARGET-PRACTICE AMMUNITION, page 4-14 for instructions to identify M865-IP.

Note. Left (L) and right (R) symbols indicate the direction to turn the GAS boresight knobs.

BORESIGHT LOSS

Boresighting is simply an alignment process by which the gun and sighting system are referred to the same point. Any movement of the gun or sights away from that alignment is a loss of boresight. The gun may move out of alignment because—

- The gun temperature has changed since boresighting.
- Firing or other shocks to the system (such as extensive road travel or enemy round impacts) disturbed the sight alignment.

For the tank crew in combat, it is not important how boresight loss occurs, just that it does. While the tank has boresight retention equipment (MRS), the most reliable method of correcting boresight loss is to reboresight the system. In training, boresight before every firing table. In a hostile environment, boresight whenever the tactical situation permits.

BORESIGHT CHECK

During the long periods between the time the system is boresighted and the time the tank is fired, boresight loss may occur. Crews can check for boresight loss by conducting a boresight check.

1. Select a target as close as possible to the range at which the tank was boresighted.
2. Lase or manually index the range to target.

Note. To manually index a range, press the SENSORS push button on the MAIN menu of the GCDP. Press the RANGE push button on the SENSORS menu. Manually index the known range using the keypad on the GCDP. When the known range is displayed on the RANGE menu, hold the palm switches on the GPCH and press ENT on the GCDP keypad.

3. With the GCDP on the MAIN menu, press the ADJUST push button.
4. Press the BORESIGHT push button on the ADJUST menu.
5. Press the GPS push button on the BORESIGHT menu.
6. Manually lay the GPS reticle aiming dot on a clearly defined aiming point, with last movement up.
7. Insert the MBD into the gun tube.
8. Note the position of the MBD reticle.
   a. If the MBD reticle is on the same target aiming point determined during boresighting, no boresight loss has occurred.
   b. If the MBD reticle is not on the target aiming point, and a collimated MBD was used, boresight has been lost: reboresight the tank.
   c. If the MBD reticle is *not* on the target aiming point, and a non-collimated MBD was used, remove the MBD and rotate it (180 degrees). If the midpoint between the first and second reticle positions coincides with the gunner's aiming point, the tank is still boresighted. If it does not, boresight has been lost; reboresight the tank.

MRS CONFIRMATION

When reboresighting, or when a boresight check cannot be performed, an MRS update is used to correct for boresight loss. An MRS update can be accomplished only if the tank sights and MRS have been properly boresighted.

Armament accuracy check 6 determines only whether the MRS can correct an artificial boresight loss induced by the crew.

During live-fire training, crews can monitor the performance of their MRS to determine if the MRS performs within tolerance. Upon completion of a live-fire event, perform the following procedures:

1. Perform an MRS update and record the readings. (If the MRS update indicates no change, perform a boresight check.)
2. Select a target as close as possible to the range at which the tank was boresighted.
3. Lase or manually index the range to target.
4. With the GCDP on the MAIN menu, press the ADJUST push button.
5. Press the BORESIGHT push button on the ADJUST menu.
6. Press the GPS push button on the BORESIGHT menu.
7. Using the manual controls, lay the GPS reticle aiming dot on the target aiming point, with last movement up.
8. Insert the MBD into the gun tube.

9. Note the position of the MBD reticle.
   a. If the MBD reticle is on the same target aiming point determined during boresighting, the MRS performed correctly.
   b. If the MBD reticle is *not* on the target aiming point, and a noncollimated MBD was used, remove the MBD and rotate it (180 degrees). If the midpoint between the first and second reticle positions coincides with the gunner's aiming point, the MRS performed correctly.
   c. If the MBD reticle is not on the target aiming point (as described in steps 9a or b), use the gunner's four-way adjust switch and refer the GPS aiming dot to the target aiming point.
   d. To determine if the MRS is within tolerance, compare the new boresight readings to the previous boresight readings or MRS update readings established in step 1. If the difference in either AZ or EL is greater than .15 mil, the MRS is out of tolerance; notify organizational maintenance.

EMERGENCY PROCEDURES

If immediate return fire is not required, attempt an MRS update; then at the first opportunity, move the tank to a position where it can be reboresighted. If boresighting with an MBD is not possible, initiate emergency boresight procedures using the alternate method described in the operator's manual.

When a component of the fire control system malfunctions or is damaged by fire, the remaining components should be boresighted. (Refer also to the DU considerations warning in Chapter 11, page 11-6.)

Boresighting the M1A2 SEP

Boresighting establishes a definite relationship between the axis of the bore of the gun and the sights at zero super elevation, providing a basis for all sight alignment. When the tank is boresighted at a known range, the fire control system provides system parallax corrections to the GPS and the TIS at other ranges. It is impossible to fire accurately without sight alignment; therefore, boresighting is fundamental in tank gunnery.

The numbers in the GCDP change as the reticle adjusts during boresighting. Reticle movements of 7.5 mils in any direction may be induced by using the four-way switch on the GCDP; however, with a cold gun and the GPS properly mounted, no more than 2 to 3 mils movement in any direction should be required to boresight. If the reticle must be moved more than 5 mils off center to reach boresight alignment, recheck the procedure. Look for uncontrolled reticle drift and perform a fire control system test.

The main gun, GPS, TIS, CITV, MRS, and GAS should be boresighted each time the gunner or TC changes, loss of boresight occurs, or as the situation permits. In training, perform complete boresight procedures before each firing table. In combat, boresight before anticipated contact and after movement.

COMPUTER CORRECTION FACTORS AND AMMUNITION SUBDESIGNATIONS

CCFs refine the computer ballistic solutions, which are calculated using ballistic data from stationary tanks and fixed gun mount test firings. These factors correct the ballistic data for part of the jump error not considered during these test firings.

Because the ballistic characteristics of different models of a particular type of ammunition can vary, the TEU can store zero information (CCF) for every ammunition type designed to be fired from the tank.

To enter the AMMO SUBDES into the FCS, press the ADJUST push button on the main menu of the GCDP, then the AMMO SUBDES push button. Use the four-way switch on the GCDP to highlight the desired ammunition. Press the ENT key on the GCDP numeric keypad to store the AMMO SUBDES in the TEU. Repeat this procedure for each ammunition to be fired.

The CCFs and AMMO SUBDES are entered into the FCS manually during before-operation checks. To apply CCFs, go to the ADJUST menu, press the ZERO push button and, using the four-way switch (or keypad) on the GCDP, display the desired values in the GCDP window. Press the ENT key on the GCDP numeric keypad to store the values in the TEU.

MUZZLE BORESIGHT PROCEDURES (M27A1 MBD)

The MBD method of boresighting the main gun is preferred over the old two-point (string) method. Tank cannons are long and heavy; therefore, droop slightly due to gravitational pull. Using the two-point method of boresighting, this droop is neither measured nor compensated for. The MBD measures the axis of the gun at the muzzle end; therefore, muzzle boresighting compensates for this droop and more reliably reflects where rounds will impact.

For best firing consistency, to standardize procedures, and to ensure devices are used properly, the muzzle boresight procedure must be followed carefully.

Table 2-6. M1A2 SEP Computer Correction Factors.

Ammunition	Subdesignation	Azimuth	Elevation
M1A2 SEP			
HEAT	M830	-0.25(L)	+0.37(D)
HEAT	M831	+0.15(R)	+0.35(D)
HEAT	M831A1	+0.15(R)	-0.15(U)
MPAT	M830A1	+0.05(R)	-0.60(U)
Sabot	M829	-0.13(L)	-0.65(U)
Sabot	M829A1	0.00	-0.45(U)
Sabot	M829A2	-0.05(L)	-0.85(U)
Sabot	M865	+0.10(R)	-0.60(U)
Sabot	M865-PIP*	+0.15(R)	-0.60(U)

*See second note under TARGET-PRACTICE AMMUNITION, page 4-14 for instructions to identify M865-IP.

Note. These values reflect numeric data entered into the TEU. If the CCFs are entered using the numeric keypad, the negative values correspond to up and left movements of the reticle (negative values are entered by pressing the minus [-] key first); positive values correspond to down and right movements. The CCFs can be toggled into the TEU using the gunner's four-way adjust switch; for example, the M831 HEAT elevation correction of +0.35 can be toggled into the TEU as 0.35.

Note. Before boresighting, make sure all PMCS have been completed (TM 9-2350-388-10, Table 2-1), to include entering the CCFs.

1. Position the tank on as level terrain as possible with the gun tube over the front slope.
2. Clear all weapons and leave the main gun breech open.
3. Make sure the end of the gun tube is clean.
4. Select a boresight target with a clearly defined aiming point (preferably a right angle) on the upper left corner to be used as the aiming point

Note. In operational situations, the tank may be boresighted at any known distance between 200 and 5,000 meters.

5. With the engine or UAAPU running, make sure the turret hydraulic pressure gauge shows 1,500 to 1,750 psi. (If unable to operate the engine or UAAPU, move the AUX HYDR POWER switch to ON and make sure the pressure gauge shows 900 to 1,750 psi.)
6. Make sure the GUN SELECT switch is turned to MAIN and both ballistic doors are open.
7. Move the GPS MAGNIFICATION switch to 10X.
8. Move the FLTR/CLEAR/SHTR switch to CLEAR.
9. Make sure the MBD has been collimated; if not, perform an MBD collimation check (see pages 2-1 and 2-2).

10. Move the FIRE CONTROL MODE switch to EMERGENCY, squeeze one of the palm switches on the GPCH, and check for drift. (If more than 0.5 mil of drift in 20 seconds is observed, press the DRIFT push button on the SETUP menu, and null out the EMERGENCY mode drift using the four-way switch.)
11. Move the FIRE CONTROL MODE switch to NORMAL, squeeze one of the palm switches on the GPCH, and check for drift. Remove all drift, if any is present.
12. Turn on the CITV, make sure the CITV is in CITV GLOS mode, move the CITV to NFOV 13X, move the FILTERS ANTI GLARE to AUTO, and move the FRAME INTEGRATION switch to SEARCH.
13. With the GPCH, lay the GPS aiming dot on the boresight target, and lase. Make sure the LRF is returned to the SAFE position before continuing. If lasing is not possible, with a palm switch depressed, index the known tank-to-target range into the GCDP.
14. Move the FIRE CONTROL MODE switch to MANUAL.
15. Move the THERMAL MODE switch to STBY, turn the ANTI-GLARE knob to AUTO CLEAR, and turn the SEARCH/STARE knob to SEARCH.
16. Set the THPD VALVE AZ DRIVE and THPD VALVE EL DRIVE circuit breakers to OFF.
17. Press RETURN twice.
18. Move the FIRE CONTROL MODE switch to NORMAL, grasp the GPCH to make sure there is no hydraulic power present, and move the FIRE CONTROL MODE switch to MANUAL.
19. Insert the MBD into the muzzle of the main gun, and make sure the index mark on the tapered muzzle cone is at the 12 o'clock position.

Notes. All movements of the main gun will be made using manual controls. The *last* movement of the main gun will be up.

Always use a clearly defined right angle on the target as the aiming point.

If a boresight device is not available, refer to *Boresight Main Gun—Alternate* method under *Unusual Conditions* in the operator's manual.

CAUTION

Never hold the MBD eyepiece while turning the operating handle.

20. While holding the tapered muzzle cone firmly, tighten the operating handle finger tight and make sure the MBD eyepiece is positioned at the 3 o'clock position.

Note. With the MBD eyepiece at the 3 o'clock position, the light port used for night boresighting is pointed up. During bright days, the sun may shine through this port and cause blurring of the MBD reticle. Use one hand to shield the light port from the sun.

21. With a pencil, mark the operating handle at the 12 o'clock position (on line with the index mark) to make sure the operating handle is tightened to the same position each time the MBD is repositioned. (Once boresighting is complete, erase the mark. A new mark should be used each time the tank is boresighted or the MBD is collimated.)

Note. Focus the eyepiece and turn it so the reticle lines of the MBD are parallel to the edges of the boresight target.

22. Without touching the gun or the MBD, sight through the MBD eyepiece and direct the gunner to traverse the turret and elevate the main gun using manual controls to lay the reticle of the MBD on the target aiming point, with the last movement being up.
23. Move the FIRE CONTROL MODE switch to EMERGENCY.
24. Move the GUN SELECT switch to MAIN.
25. With the GCDP on the MAIN MENU, press the ADJUST push button.
26. Press the BORESIGHT push button on the ADJUST menu.
27. Press the GPS push button on the BORESIGHT menu.

28. Viewing through the GPS, the gunner uses the four-way switch on the GCDP to move the GPS reticle aiming dot to the boresight target aiming point.
29. Viewing through the GPS, the gunner uses a *G* pattern to lay off the target manually and re-lay the GPS aiming dot on the target aiming point with the last movement being up.
30. Make sure the MBD reticle is on the defined target aiming point. If the reticle aiming points are still on target, record the boresight readings from the GCDP, and proceed to step 31. If the MBD reticle is not on the target aiming point, at least one of the following is true:
    - The gunner has made an incorrect referral.
    - The gunner has made an incorrect lay.
    - The fire control system is faulty.

Note. If any fault is identified, correct it immediately and start boresight procedures over.

CAUTION

Rotating the MBD inside the main gun may damage the gun or leave the device improperly aligned.

31. Without disturbing the lay of the gun, hold the tapered muzzle cone firmly and loosen the operating handle two complete turns to unseat the MBD; remove the MBD.
32. Rotate the MBD 180 degrees and reinsert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 6 o'clock position.
33. While holding the tapered muzzle cone firmly, tighten the operating handle until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. *(If the device is positioned correctly, the MBD eyepiece will be at the 9 o'clock position. If the pencil mark does not line up with the index mark on the tapered muzzle cone, erase the mark and start boresight procedures over.)*
34. Check the reticle of the MBD to see if it is still on the target aiming point.
    a. If the MBD reticle is on the target aiming point, record the AZ and EL readings from the GCDP on DA Form 2408-4; proceed to step 41.
    b. If the MBD aiming reticle is not within one reticle line width of the target aiming point, perform collimation procedures (M27A1) (see page 2-2). Once collimation is complete, start boresight procedures over.
    c. If collimation procedures are impractical, proceed to step 35 to determine the mean boresight reading.
35. Direct the gunner onto the target aiming point, as in step 22. (The gunner must use the manual controls.)
36. Viewing through the GPS, the gunner uses the four-way switch on the GCDP to move the GPS reticle to the target aiming point.
37. Record the boresight readings from the GCDP.
    a. If the boresight readings for both AZ and EL are within .2 mil of the first readings (step 30), proceed to step 38.
    b. If the boresight readings for both AZ and EL are not within .2 mil of the first readings (step 30), and the MBD is collimated, start boresight procedures over.
    c. If the boresight readings for both AZ and EL are not within .2 mil of the first readings and the MBD was not collimated, proceed to step 38 to determine mean reading.
38. Determine the mean AZ and EL of the two sets of boresight readings.

Notes. If the azimuth readings are in the same direction, use the *same direction calculation technique* in paragraph 38a below to determine the mean. If azimuth readings are in the opposite direction, use the *opposite direction calculation technique* in paragraph 38b below to determine the mean.

If the elevation readings are in the same direction, use the *same direction calculation technique* in paragraph 38a below to determine the mean. If the elevation readings are in the opposite direction, use the *opposite direction calculation technique* in paragraph 38b below to determine the mean.

a. Same direction calculation technique (see Examples 1 and 2, page 2-9):

(1) Add the two readings.

(2) Divide the result by 2.

(3) Round off to two digits, if necessary.

b. Opposite direction calculation technique (see Examples 2 and 3, page 2-9):

(1) Ignore the +, -, L, R, U, and D labels, and subtract the smaller reading from the larger reading.

(2) Divide the result by 2.

(3) Round off to two digits, if necessary.

(4) The direction will be the same as the larger number from step (1) (+, -, L, R, U, or D).

39. The gunner uses the four-way switch on the GCDP to enter the mean reading for AZ and EL.

40. Record AZ and EL readings from the GCDP on DA Form 2408-4.

41. Press the ENT key on the GCDP keypad twice to enter the AZ and EL readings; then verify the boresight numbers on the GPS menu.

42. Using the manual controls, re-lay the GPS reticle aiming dot on the target aiming point.

43. Press the CITV SETUP push button on the VEHICLE SYSTEMS menu.

44. Press the BORESIGHT push button on the CITV SETUP menu.

45. Align the CITV (NFOV) reticle aiming dot to the target aiming point using the four-way switch.

46. Record the AZ and EL readings from the CITV (indicated on the CITV set-up menu) on DA Form 2408-4.

47. Press the ENT key twice to enter the AZ and EL readings; then verify the CITV boresight numbers on the BORESIGHT menu and on GCDP BORESIGHT MENU.

48. Press the GPS push button on the BORESIGHT menu.

49. Prior to boresighting the GAS or TIS, make sure the GPS, CITV, and MBD are still on the target aiming point.

50. Using the GAS boresight knobs, the gunner aligns the GAS boresight aiming cross to the boresight target aiming point and, making sure the GAS boresight knobs are fully seated, slips the scales to 0 and 0.

51. Make sure the GPS aiming dot, GAS boresight cross, and MBD are still aligned on the target aiming point.

a. If the GPS aiming dot, GAS boresight cross, and MBD are still aligned on the target aiming point, continue boresight procedures with step 52.

b. If a mean boresight reading was not determined (step 38) and the GPS aiming dot, GAS boresight cross, and MBD are not still aligned on the target aiming point, start boresight procedures over.

c. If a mean boresight reading was determined in step 38, the MBD reticle will *not* be aligned with the target aiming point.

52. Move the THERMAL MODE switch to ON or BIOC OFF position.

53. Move the MODE switch to BS, move the MAGNIFICATION switch to 13X, and move the POLARITY switch to W/H or B/H, as desired.

54. Adjust the picture to the desired levels.
55. Look in the GPS eyepiece and make sure the reticle is still on the target aiming point of the boresight panel.
56. Align the TIS reticle aiming dot on target aiming point of the boresight target using the BORESIGHT switch.
57. Move the MODE switch to NORMAL, and move the THERMAL MODE switch to the required position.
58. Press the RETURN push button on the GPS BORESIGHT menu.
59. Remove the MBD from the muzzle of the main gun.
60. Move the THPD circuit breakers to ON.

WARNING

Do not use the LRF when operating the MRS.

61. Perform MRS boresight.

Note. Make sure the LRF is on SAFE.

a. Move the FIRE CONTROL MODE switch to NORMAL.
b. With the GCDP on the BORESIGHT menu, press the MRS push button on the GCDP.
c. Grasp and hold the GPCH and palm switches for five seconds, then release; the gun will go to zero degrees elevation.
d. Use the four-way switch on the GCDP to align the GPS reticle within the black MRS reticle. (If unable to obtain a clear picture of both the GPS and MRS reticles, notify organizational maintenance.)
e. Record the AZ and EL readings from the display. (If unable to align the GPS and MRS, notify organizational maintenance.)
f. Press the ENT key on the GCDP keypad twice to store the AZ and EL readings for the MRS boresight data.
g. Press the RETURN push button on the GCDP three times to return to the MAIN menu.

62. Make sure the following fire control inputs are correct:
    - Air temperature. (**Note.** If current temperature is not available, see Table 2-8 on page 2-36.)
    - Ammunition temperature.
    - Barometric pressure. (**Note.** If current barometric pressure is not available, see Table 2-9 on page 2-37.)
    - CCFs.
63. To verify data stored in the TMPU, press the ADJUST push button on the MAIN menu of the GCDP. Press the BORESIGHT push button on the ADJUST menu and make sure the GPS, CITV, and MRS boresight readings coincide with previously recorded boresight readings.
64. Make sure the KE and HEAT ammunition subdesignations are correct (for example, the appropriate service round subdesignation for wartime conditions or AMMO SUBDES 1 [M865 and M831] for the training environment).
65. Perform precision alignment of the GAS (see steps below).

PRECISION ALIGNMENT OF THE GAS

1. With the GCDP at the MAIN menu, select METRL DATA, CROSSWIND, and MANUAL, enter the number 0, press the ENT push button on the GCDP keypad, and press RETURN two times.
2. With the GCDP at the MAIN menu, select SENSORS, press the ATTD and CANT push buttons, select MANUAL, enter the number 0, and press RETURN three times.

3. With the GCDP at the main menu, press the SENSORS push button. At the sensors menu, push the LEAD push button and the MANUAL push button. Press the 0 push button and the ENTER push button on the key pad. Press the RETURN push button twice to return to main menu.
4. Push the SABOT push button on the AMMUNITION SELECT panel on the GPS. With the palm switches pressed, re-lase or manually index the range to the boresight target and, using manual controls, lay the GPS aiming dot on the target aiming point.

Note. The boresight panel must be placed at a range that corresponds to a range line on the GAS reticle.

5. Without slipping the scales on the GAS BORESIGHT knobs, refer the GAS KE/STAFF reticle 1200-meter aiming dot (or the range line at which you have boresighted) to the target aiming point. Record the readings from the GAS AZ and EL knobs; be sure to place these readings on the GAS when firing sabot.
6. Using the GAS AZ and EL knobs, return the settings to 0 and 0. Turn the RETICLE select knob on the GAS to HEAT.
7. Push the HEAT push button on the AMMUNITION SELECT panel on the GPS and re-lase or, with the palm switches pressed, manually index range to the boresight target. Re-lay the GPS reticle aiming dot on the target aiming point.
8. Without slipping the scales on the GAS BORESIGHT knobs, refer the GAS MPAT/HEAT reticle 1,200-meter aiming point (or the range line at which you have boresighted) to the target aiming point. Record the readings from the GAS AZ and EL knobs; be sure to place these readings on the GAS when firing HEAT.

Note. At this point, to use a particular reticle (KE/STAFF or MPAT/HEAT), select the correct reticle and add the information for that reticle to the GAS BORESIGHT knobs for the ammunition being used.

9. Reenable CROSSWIND: With the GCDP at the MAIN menu, select METRL DATA, CROSSWIND, and AUTO, and press RETURN two times.
10. Reenable CANT: With the GCDP at the MAIN menu, select SENSORS, press the ATTD and CANT push buttons, select AUTO, and press RETURN three times.
11. Reenable LEAD: With the GCDP at the MAIN menu, press the SENSORS push button. At the SENSORS menu, push the LEAD, then AUTO push buttons, and press RETURN twice to return to the MAIN menu.

Note. After boresighting and before screening, verify plumb and synchronization IAW TM 9-2350-388-10, Appendix F.

NIGHT BORESIGHTING

Night boresighting can be accomplished following normal boresighting procedures. The boresight target must have an illuminated and heated reference point that can be seen with the MBD, GPS, CITV, GAS, and TIS. The TC can use a chemlight or filtered flashlight to illuminate the MBD aiming reticle. (M27A1 MBDs have a built-in light port for night boresighting.)

Most training ranges are equipped with targets that allow the crew to boresight at night. The following are examples of field-expedient boresight targets for tactical situations:

- Caliber .50 ammunition can with charcoal (for heating) and a chemlight or flashlight for the reference point.
- Any POL container with charcoal (for heating) and a chemlight or flashlight for the reference point.
- A small boresight panel (18 inches by 18 inches) quartered, colored with sand and olive drab paint, with a visible and heated aiming point using a chemlight or flashlight for the reference point.
- Any object in the tank's sector that has a clearly defined right angle for use as a reference point when viewed through the TIS. Place a chemlight on that point as a reference point for the MBD, GPS, and GAS.

BORESIGHTING THE GAS (GPS AND TIS INOPERATIVE) USING THE M27A1 MBD

In some tactical situations (because of mechanical breakdown or the effects of ballistic shock), the tank crew must use the GAS. The crew can boresight the tank and, with accurate range determination, still fire effectively.

Note. These procedures are only to be used in tactical situations. The GAS can be boresighted at any range. The parallax caused by boresighting at any range will be minimal. These procedures are best used with the boresight panel at the battlesight range for your primary service KE ammunition.

1. Insert the MBD into the muzzle of the main gun, and make sure the index mark on the tapered muzzle cone is at the 12 o'clock position by aligning it with the 12 o'clock witness mark on the face of the gun tube.

CAUTION

Never hold the MBD eyepiece while turning the operating handle.

2. While holding the tapered muzzle cone firmly, tighten the operating handle finger tight, and make sure the MBD eyepiece is positioned at the 3 o'clock position.

Note. With the MBD eyepiece at the 3 o'clock position, the light port used for night boresighting is pointed up. During bright days, the sun may shine through this port and cause blurring of the MBD reticle; use one hand to shield the light port from the sun's rays.

3. With a pencil, mark the operating handle at the 12 o'clock position (on line with the index mark) to make sure the operating handle is tightened to the same position each time the MBD is repositioned. (Once boresighting is complete, erase the mark. A new mark should be used each time the tank is boresighted or the MBD is collimated.)
4. Without touching the gun or the MBD, sight through the MBD eyepiece, and direct the gunner to use manual controls to traverse the turret and elevate the main gun to lay the reticle of the MBD on the target aiming point.
5. Using the GAS boresight knobs, the gunner aligns the GAS boresight cross to the boresight target aiming point, making sure the knobs are fully seated.
6. Slip the AZ and EL scales on the GAS to 0 and 0.

CAUTION

Rotating the MBD inside the gun tube may damage the gun or leave the device improperly aligned.

7. Without disturbing the lay of the gun, hold the tapered muzzle cone, loosen the operating handle two complete turns to unseat the MBD, and remove the MBD from the gun tube.
8. Rotate the MBD 180 degrees and reinsert it into the muzzle of the main gun; make sure the index mark on the tapered muzzle cone is at the 6 o'clock position by aligning it with the 6 o'clock witness mark on the face of the gun tube.
9. While holding the tapered muzzle cone firmly, tighten the operating handle until finger tight and the pencil mark on the operating handle is aligned with the index mark on the tapered muzzle cone. *(If the device is positioned correctly, the MBD eyepiece will be at the 9 o'clock position. If the mark does not line up with the index mark on the tapered muzzle cone, erase the mark and start boresight procedures over.)*
10. Check the reticle of the MBD to see if it is still on the target aiming point.
    a. If the MBD reticle is on target, proceed to step 16.
    b. If the MBD reticle is *not* on the target aiming point, collimate the MBD (see page 2-2). If the MBD cannot be collimated, continue boresight procedures.
11. Direct the gunner onto the target aiming point. (The gunner must use the manual controls.)

12. Using the GAS boresight knobs, the gunner will align the GAS boresight cross to the boresight target aiming point, making sure the knobs are fully seated.
13. The gunner will record the readings from the GAS AZ and EL boresight knobs and divide the readings by 2.

    Example. AZ(R)0.4 ÷ 2 = (R)0.2
    EL(L)0.6 ÷ 2 = (L)0.3

14. The gunner will move the AZ and EL boresight knobs on the GAS to the readings determined in step 13.
15. Without moving the GAS boresight knobs, slip the scales to 0 and 0.
16. Apply the appropriate SCF for the round to be fired (see table below).

Note. To apply new SCFs when changing battlecarry ammunition or firing a different type of ammunition, return the GAS boresight knobs to AZ and EL readings of 0 and 0 before applying the new SCF.

Table 2-7. M1A2 SEP Sight Correction Factors.

Ammunition	Azimuth	Elevation
M1A2		
HEAT (M830)	0.2(R)	0.6(R)
HEAT (M831)	0.2(L)	0.6(R)
HEAT (M831A1)	0.2(L)	0.0
MPAT (M830A1)	0.0	0.4(L)
Sabot (M829)	0.2(R)	0.8(L)
Sabot (M829A1)	0.0	0.2(L)
Sabot (M829A2)	0.0	1.2(L)
Sabot (M865)	0.2(L)	0.2(L)
Sabot (M865-IP)*	0.2(L)	0.2(L)

*See second note under TARGET-PRACTICE AMMUNITION, page 4-14 for instructions to identify M865-IP.

Note. Left (L) and right (R) symbols indicate the direction to turn the GAS boresight knobs.

BORESIGHT LOSS

Boresighting is simply an alignment process by which the gun and sighting system are referred to the same point. Any movement of the gun or sights away from that alignment is a loss of boresight. The gun may move out of alignment because—

- The gun temperature has changed since boresighting.
- Firing or other shocks to the system (such as extensive road travel or enemy round impacts) disturbed the sight alignment.

For the tank crew in combat, it is not important how boresight loss occurs, just that it does. While the tank has boresight retention equipment (MRS), the most reliable method of correcting boresight loss is to reboresight the system. In training, boresight before every firing table. In a hostile environment, boresight whenever the tactical situation permits.

BORESIGHT CHECK

During the long periods between the time the system is boresighted and the time the tank is fired, boresight loss may occur. Crews can check for boresight loss by conducting a boresight check.

1. Select a target as close as possible to the range at which the tank was boresighted.
2. Lase or manually index the range to target.

Note. To manually index a range, press the SENSORS push button on the MAIN menu of the GCDP. Press the RANGE push button on the SENSORS menu. Manually index the known range using the keypad on the GCDP. When the known range is displayed on the RANGE menu, hold the palm switches on the GPCH and press ENT on the GCDP keypad.

3. With the GCDP on the MAIN menu, press the ADJUST push button.
4. Press the BORESIGHT push button on the ADJUST menu.
5. Press the GPS push button on the BORESIGHT menu.
6. Manually lay the GPS reticle aiming dot on a clearly defined aiming point, with last movement up.
7. Insert the MBD into the gun tube.
8. Note the position of the MBD reticle.
    a. If the MBD reticle is on the same target aiming point determined during boresighting, no boresight loss has occurred.
    b. If the MBD reticle is not on the target aiming point, and a collimated MBD was used, boresight has been lost: reboresight the tank.
    c. If the MBD reticle is *not* on the target aiming point, and a non-collimated MBD was used, remove the MBD and rotate it (180 degrees). If the midpoint between the first and second reticle positions coincides with the gunner's aiming point, the tank is still boresighted. If it does not, boresight has been lost; reboresight the tank.

MRS CONFIRMATION

When reboresighting, or when a boresight check cannot be performed, an MRS update is used to correct for boresight loss. An MRS update can be accomplished only if the tank sights and MRS have been properly boresighted.

Armament accuracy check 6 determines only whether the MRS can correct an artificial boresight loss induced by the crew.

During live-fire training, crews can monitor the performance of their MRS to determine if the MRS performs within tolerance. Upon completion of a live-fire event, perform the following procedures:

1. Perform an MRS update and record the readings. (If the MRS update indicates no change, perform a boresight check.)
2. Select a target as close as possible to the range at which the tank was boresighted.
3. Lase or manually index the range to target.
4. With the GCDP on the MAIN menu, press the ADJUST push button.
5. Press the BORESIGHT push button on the ADJUST menu.
6. Press the GPS push button on the BORESIGHT menu.
7. Using the manual controls, lay the GPS reticle aiming dot on the target aiming point, with last movement up.
8. Insert the MBD into the gun tube.
9. Note the position of the MBD reticle.
    a. If the MBD reticle is on the same target aiming point determined during boresighting, the MRS performed correctly.
    b. If the MBD reticle is *not* on the target aiming point, and a noncollimated MBD was used, remove the MBD and rotate it (180 degrees). If the midpoint between the first and second reticle positions coincides with the gunner's aiming point, the MRS performed correctly.

c. If the MBD reticle is not on the target aiming point (as described in steps 9a or b), use the gunner's four-way adjust switch and refer the GPS aiming dot to the target aiming point.

d. To determine if the MRS is within tolerance, compare the new boresight readings to the previous boresight readings or MRS update readings established in step 1. If the difference in either AZ or EL is greater than .15 mil, the MRS is out of tolerance; notify organizational maintenance.

EMERGENCY PROCEDURES

If immediate return fire is not required, attempt an MRS update; then at the first opportunity, move the tank to a position where it can be reboresighted. If boresighting with an MBD is not possible, initiate emergency boresight procedures using the alternate method described in the operator's manual.

When a component of the fire control system malfunctions or is damaged by fire, the remaining components should be boresighted. (Refer also to the DU considerations warning in Chapter 11, page 11-6.)

Air Temperature and Atmospheric (Barometric) Pressure

The firing table solutions are simple main gun corrections based on standard environmental conditions. Air density affects accuracy. Standard air temperature is 59 degrees Fahrenheit and barometric pressure is 29.92 inches of mercury. As air pressure increases, air density generally increases. This slows rounds, which may cause them to strike low on the target. Firing when air density is less than average has the opposite effect. The tank's computer compensates for this effect, using values input into the system.

Recommended standard inputs for major geographical areas, by seasons, in the following table should be used whenever current information is not available. Always use the current, local barometric pressure and temperature, if it is available. Temperature should be updated whenever it deviates more than 10 degrees Fahrenheit from the indexed value; barometric pressure should be updated whenever it deviates more than one inch from the indexed value.

Table 2-8. Nominal Temperature Values for M1, M1A1, M1A2, and M1A2 SEP Fire Control Input.

Location	Season	Air Temp (ºF)
Central USA	Nov-Apr	42
	May-Oct	70
Southwest USA	Nov-Apr	59
	May-Oct	83
Southeast USA	Nov-Apr	59
	May-Oct	77
Central Europe	Nov-Apr	38
	May-Oct	59
Middle East	Nov-Apr	63
	May-Oct	77
Korea	Nov-Apr	41
	May-Oct	70

Table 2-9. Barometric Pressure Values for M1, M1A1, M1A2, and M1A2 SEP Fire Control Input.

Meters Above Sea Level	Barometric Pressure (Inches)
0	29.92
100	29.57
200	29.22
300	28.87
400	28.53
500	28.19
600	27.85
700	27.52
800	27.19
900	26.86
1,000	26.54
1,100	26.22
1,200	25.90
1,300	25.59
1,400	25.28
1,500	24.97
1,600	24.66
1,700	24.36
1,800	24.06
1,900	23.77
2,000	23.47
2,100	23.19
2,200	22.90
2,300	22.61
2,400	22.33
2,500	22.05
2,600	21.78
2,700	21.51
2,800	21.24
2,900	20.97
3,000	20.71

Whenever barometric pressure information is available, but is from a location that is at a significantly different elevation, the barometric pressure values can be converted. If your elevation is lower, *add* 0.30 for each 100 meters of elevation difference. If your elevation is higher, *subtract* 0.30 for each 100 meters of elevation difference. For example, if you receive a barometric reading of 30.04 from an airfield that is at 2,070 feet (631 meters) elevation and your elevation is 1,400 meters, subtract 2.40 from 30.24, which will give you a barometric reading of 27.84. Sample computations are as follows:

- *Step 1*. 1,400m (your elevation) - 631m (airfield elevation) = 769m (round to 800m) (difference in elevation).
- *Step 2*. 800 ÷ 100 = 8.
- *Step 3*. 8 X 0.30 = 2.40.
- *Step 4*. 30.24 (reading from airfield) - 2.40 (you are higher, so subtract) = 27.84 (FCS input).

Note. If you get pressure readings from an airfield, make sure you get *actual* barometric pressure, not barometric pressure corrected to sea level that pilots need.

Chapter 3

Armament Accuracy Checks

AACs help to ensure that the fire control system is fully operational and special inputs and the ballistic solutions are implemented properly for fire control components and all main gun ammunition. They also verify that the MRS can correct an artificially induced boresight loss. These checks are designed to be performed by the crew monthly.

Before performing the AACs, complete a thorough PMCS (see the operator's manual) and bleed air from the hydraulic system (grasp the GPCH in one hand and the manual crank handle in the other hand; turn the manual crank handle fully in one direction and the GPCH in the opposite direction).

Perform Checks 1 through 6 in sequence.

Record faults found during each check on DA Form 2404 or ULLS Form 5988E (Equipment Inspection and Maintenance Worksheet) and notify organizational maintenance. Further diagnostics require the use of test, measurement, and diagnostic equipment (TMDE). All faults must be corrected before performing the next check.

CONTENTS

Check 1 (M1) — Main Accumulator Pressure

PURPOSE

The main accumulator pressure check ensures that the system is maintaining proper hydraulic pressure.

CONDITIONS

1. All personnel are clear of the main gun.
2. The engine is off, the TURRET POWER is on, and the AUX HYDR POWER is off.
3. The turret is positioned with the main gun over the number 1 (right) road wheel.

PROCEDURE

1. Slowly elevate and depress the main gun with the power controls while watching the hydraulic pressure gauge needle. The pressure should slowly decrease to 830-550 psi, based on the ambient temperature as outlined in the chart below, then drop rapidly to 0 psi.

Nitrogen Gas Temperature vs Precharge Pressure Chart									
TEMP (F)	-70	-50	-25	0	+25	+50	+75	+100	+125
PRECHARGE (PSI)	550	580	620	650	685	720	755	790	830

2. Check the reservoir fluid gauge behind the loader's position beneath the turret ring. If the fluid level is below the ADD 1 GAL mark, add fluid per the vehicle's lubrication order.
3. Make sure the two indicators to the left above the fluid-level gauge have not popped out. If they are out, push them in.
4. Turn the auxiliary hydraulic pump on, and watch the pressure gauge needle. If the pop-out indicators were reset in Step 3, recheck to make sure they did not pop out again; if they did, notify organizational maintenance.

Note. The auxiliary hydraulic pump should shut off when the pressure reaches 1,500 to 1,700 psi.

Check 2 (M1) — Power Elevation and Elevation Cylinder

PURPOSE

The power elevation and elevation cylinder check ensure that the main gun elevation cylinder responds to elevation inputs.

CONDITIONS

1. Check 1 has been completed and the hydraulic system is pressurized to at least 1,500 psi.
2. The engine is off; TURRET POWER and AUX HYDR POWER are on.

PROCEDURE

1. Position the turret with the main gun over the front or side of the hull.
2. Turn the manual elevation handle, depressing the gun until the handle can no longer be turned easily with one hand.

3. With the FIRE CONTROL MODE set at NORMAL, check for smooth operation of the gun by raising and lowering the cannon with the GPCH. (Always center the controls before releasing the palm switches.)
4. Look through the GPS and lay on a distant aiming point.
5. While in NORMAL mode, null out all reticle drift.
6. Set the FIRE CONTROL MODE switch to MANUAL (this will prevent injury to personnel because of accidental turret movement).
7. Level the gun tube and lay on a distant aiming point. Have one crew member push the muzzle up and release. Repeat the muzzle movement in vertical and horizontal planes while observing a distant aiming point through the GPS. (The reticle will move. Upon release of pressure at the muzzle, the sight should return to its original aiming point.)
9. Record deficiencies on DA Form 2404 or ULLS Form 5988E.

Check 3 (M1) — Fault Indicator

PURPOSE

The fault indicator check verifies that the fire control system's continuous malfunction detection system and computer self-test have not identified faults that affect direct-fire precision.

CONDITIONS

1. Checks 1 and 2 have been completed.
2. The RANGE switch on the LRF is in the SAFE position.
3. The TURRET POWER is on and the FIRE CONTROL MODE is in the NORMAL position.
4. The circuit breakers to the TNB are set at ON and the LAMP RESET button is pressed.
5. All cable connectors in the fire control system are securely installed.

PROCEDURE

1. Check the displayed data in the GPS field of view. (If the fire control fault symbol [F] appears, the continuous malfunction detection system has detected one of two faults: Electrical continuity within the fire control system is interrupted or a malfunction signal has been generated by the TIS, crosswind sensor, LRF, or computer system. The *Causes of Fault Indication in the GPS Field of View* table on page 3-4 describes the kinds of faults that can cause an *F* symbol to be displayed.)
2. If an *F* symbol is present in the GPS field of view, recheck the conditions for this check. Turn the TURRET POWER off, then on again, and see if an *F* symbol appears.
3. Check the TIS fault indicator. If it is on, notify organizational maintenance.
4. Cover up the crosswind sensor, then call up the crosswind value on the CCP. If the value is less than 3 mph, uncover the crosswind sensor and proceed to step 5. If the value is over 3 mph, clean the crosswind sensor and perform the test again. If the crosswind sensor still does not function properly, notify organizational maintenance. Uncover the crosswind sensor.
5. Run the computer self-test. (In most cases, the self-test will indicate the source of the fault. The *Causes of Computer Self-Test Failure* table on page 3-4, describes the kinds of faults that trigger a self-test failure. If, after a self-test pass, the *F* symbol shows in the GPS, a problem may exist in the TNB, which controls the malfunction detection system. Organizational-level test equipment must be used to find this kind of fault.)

Note. Run the self-test two or three times to ensure consistency of results. The computer self-test evaluates system response based on threshold values preprogrammed into the computer. If the tank fails two out of three times with the same fault, notify organizational maintenance.)

Table 3-1. Causes of Fault Indication in the GPS Field of View.

Electrical continuity interrupted at:	Principal fire control components. Interconnecting cables. Power control handles, gyros. Azimuth and elevation servos. Loader's knee switch and door-closed sensor. Coax solenoid. Zero-degree elevation switch. Crosswind sensor.
TIS fault warning due to:	Power supplies out of tolerance. Disabled scan capability. Electrical current levels out of tolerance.
Crosswind fault warning due to:	Power supplies out of tolerance. Ion emitter/resistor elements inoperable or dirty.
Computer fault warning due to:	Analog-digital conversion circuits out of tolerance. Unexplained changes in stored data values. Inoperable reticle drive in GPS. Any failure of last computer self-test.
LRF fault warning due to:	Laser pulse signal out of tolerance. Inoperable laser firing circuit. Range counters not biased. (The LRF continuous monitor will evaluate the LRF circuit when the laser button is depressed with RANGE set at SAFE.)

Table 3-2. Causes of Computer Self-Test Failure.

Subsystem Tested	Test Seq	Fault Code (CCP)	Test Seq	Fault Code (CCP)	Description
CEU	1	1	1	1	Tolerance test of known value solutions and power supplies. A fault here will stop the self-test immediately.
Cant Sensor	2	2	2	2	Deflects the pendulum and reflects the amount of movement to ensure the pendulum returns to original value in one second. If a fault is detected, self-test stops until the gunner presses CANT, then ENTER.
Crosswind Sensor	3	3	3	3	Electrically simulates predetermined wind value, then checks response. If a fault is detected, self-test stops until the gunner presses CROSSWIND, then ENTER.
400 Hz Reference	NA	NA	NA	NA	Ensures 400 Hz reference signal is present. If 400 Hz signal fails, the self-test stops.
Turret Drive (AZ)	4	4	5	4	Initializes the lead angle circuits for subsequent ballistic computations (an important prepare-to-fire check); causes the turret to move, imparting a deliberate lead solution, and checks the tolerance of the resulting rate of traverse. If a fault is detected, self-test stops until the gunner presses LEAD, then ENTER.
Sight Stabilization (EL)	5	5	6	5	Elevation rate tolerance test in line of sight and gun/turret drive; checks data link after elevation rate test.
Gunner's Servo	6	6	7	6	Displaces reticle a fixed amount and checks response time.
Data Link (DCT)	7	7	8	7	The CEU commands an elevation input rate of 5 mils per second; then checks the output voltage from the DCT. The self-test will continue if this test fails.
LRF	8	8	9	8	The LRF runs its own internal self-test, verifying that the counter chains are functioning, power supplies are within limits, and last transmitted energy output was within limits. If the LRF is functional, it transmits a known range to the computer.

Check 4 (M1) — Special Input

PURPOSE

The special input check verifies the proper function of manual and automatic inputs. This check ensures all individually tested component circuits are operational prior to testing full solution data.

Note. Checks 4 and 5 do not test components of the fire control system; they test the ability of the CEU to compensate for the values received from these components and determine a ballistic solution for a given round.

CONDITIONS

1. The tank is on level ground with the solution board 100 meters (±3 meters) from the front edge of the tank.
2. Checks 1, 2, and 3 have been completed.
3. The horizontal reference line on the solution board is level with the gun trunnions. (Level criterion is achieved when the horizontal reference line on the solution board and the center horizontal reference line in the primary sight reticle is aligned with the gun at zero elevation. An easy way to check this is to move the MRS lever to IN and squeeze the palm switches on the power control handles [the main gun will move to zero elevation]. Move the MRS lever to OUT and align the reference line on the solution board with the center horizontal reference line in the primary sight reticle.) (Figure 3-1, Abrams Combined Solution Board, on page 3-8 is a scale drawing of the solution board to be used.)
4. An MBD is available.
5. The engine is off; the VEHICLE MASTER POWER, TURRET POWER, and AUX HYDR POWER are on; the CCP power is on; and the FIRE CONTROL MODE switch is in the NORMAL position.

Note. Checks 4 and 5 must be performed with the AUX HYDR POWER on. Performing checks 4 and 5 at zero pressure does not test the fire control system's ability to apply offsets to the gun.

PROCEDURE

WARNING

Range solutions must be entered manually with the CCP data key during checks 4 and 5. Do *not* use the LRF; it may expose unprotected personnel to injury.

1. Record the GPS boresight, zero data (CCF), MRS update, and MRS boresight numbers from the CCP before conducting check 4.
2. Set zero data for all AMMO SUBDES, MRS update, and MRS boresight to 0 and 0 before conducting check 4. (Failure to do so may cause a failure of check 4.)
3. Grip one of the palm switches; then (with the palm switch pressed) press the RANGE push button, index 1,200 meters into the CCP, and press the ENTER push button. Hold the palm switch for five seconds, then release. (When conducting the special input check, the range values must be entered with the palm switch pressed. Failure to enter range with the palm switch pressed will result in a failure of check 4.)
4. Put the FCS in the BORESIGHT mode by pressing the BORESIGHT push button on the CCP.

Note. Do *not* rotate the MBD during checks 4 and 5.

5. Insert the MBD and direct the gunner to lay the main gun manually on the center of the target marked GUN on the solution board, with last movement up.

Note. When using the MBD at this distance, make sure the GPS browpad is adjusted to the gunner's face and the eyesight parallax shield (optic cover with hole) is used to reduce eyesight parallax.

6. When the main gun is properly laid for direction, the gunner toggles the GPS reticle to the center of the target marked GPS on the solution board.
7. Store the boresight data by pressing ENTER on the CCP.

Note. The gunner may refer the GAS boresight cross to the gun box as a reference for gun position, as well as the MBD.

8. Check the boresight solution.
   a. Grip the palm switches for five seconds and release.
   b. Press the BORESIGHT push button, and using a G pattern and manual controls, re-lay the sight on the GPS target, with last movement up. (The MBD aiming dot reticle should be pointing to the original aiming point of the GUN target on the solution board.)
   c. Cancel the BORESIGHT mode by pressing the ENTER push button.
9. Enter the fire control inputs from Table 3-3.
   a. Enter the *basic* solution.

Note. The *basic* solution has all manual and automatic inputs set at neutral values. Do *not* try the other solutions if the *basic* solution fails; notify organizational maintenance.

   (1) Manually enter the data inputs (except for range) into the CCP.

   (2) Index range, squeeze the GPCH, and press the ENTER push button. Hold the GPCH for five seconds.

   (3) Using a *G* pattern and manual controls, lay the GPS aiming dot back on the aiming point, with last movement up.

   (4) The crewman on the outside views through the MBD and confirms that the gun is on the correct block.

Notes. The crewman viewing through the MBD should make sure the aiming dot is on the appropriate block; if it is not, he should note that the MBD was not on the appropriate block.

If the MBD is not on the appropriate block, possible problems are—

- Incorrect boresight.
- Not taking the same sight picture with the MBD that was taken during boresighting.
- CCP not zeroed (for example, CCF).
- Incorrect entry of check data into the CCP.
- Problems with the FCS.

   (5) Record the position of the MBD aiming point (in relation to the target block) on the *Sample M1 AAC Data Sheet for Checks 4 and 5* on page 3-10.

Note. Repeat steps 9a(1) through (5) for each of the remaining solutions (cant, crosswind, and lead).

   b. Enter the *cant* solution. (If it fails, the cant value is incorrectly set or the computer is not processing the cant function.)
   c. Enter the *crosswind* solution. (If it fails, the crosswind value is incorrectly set or the computer is not processing the crosswind function.)
   d. Enter the *lead* solution. (If it fails, the lead value is incorrectly set or the computer is not processing the lead function.)

10. After completing check 4 (all faults have been corrected), proceed to check 5.

Table 3-3. M1 Ballistic Computer Inputs for Check 4.

Ammo Indexed: **HEAT** **AMMO SUBDES:** **1**				
CCF **Elevation** **Deflection**	 **(U) 0.6** **(R) 0.0**			
Wind	0.0	0.0	45.0	0.0
Cant	0.0	10.0	0.0	0.0
Lead	0.0	0.0	0.0	5.0
Ammo Temp	69.8	69.8	69.8	69.8
Air Pressure	29.92	29.92	29.92	29.92
Air Temp	59	59	59	59
*Tube Wear	0	0	0	0
Range	1,200	2,000	2,000	2,000
Solution From Board	Basic	Cant	Crosswind	Lead

*Record the original tube-wear value before changing it. The original value should be reentered in the computer after check 5 has been completed.

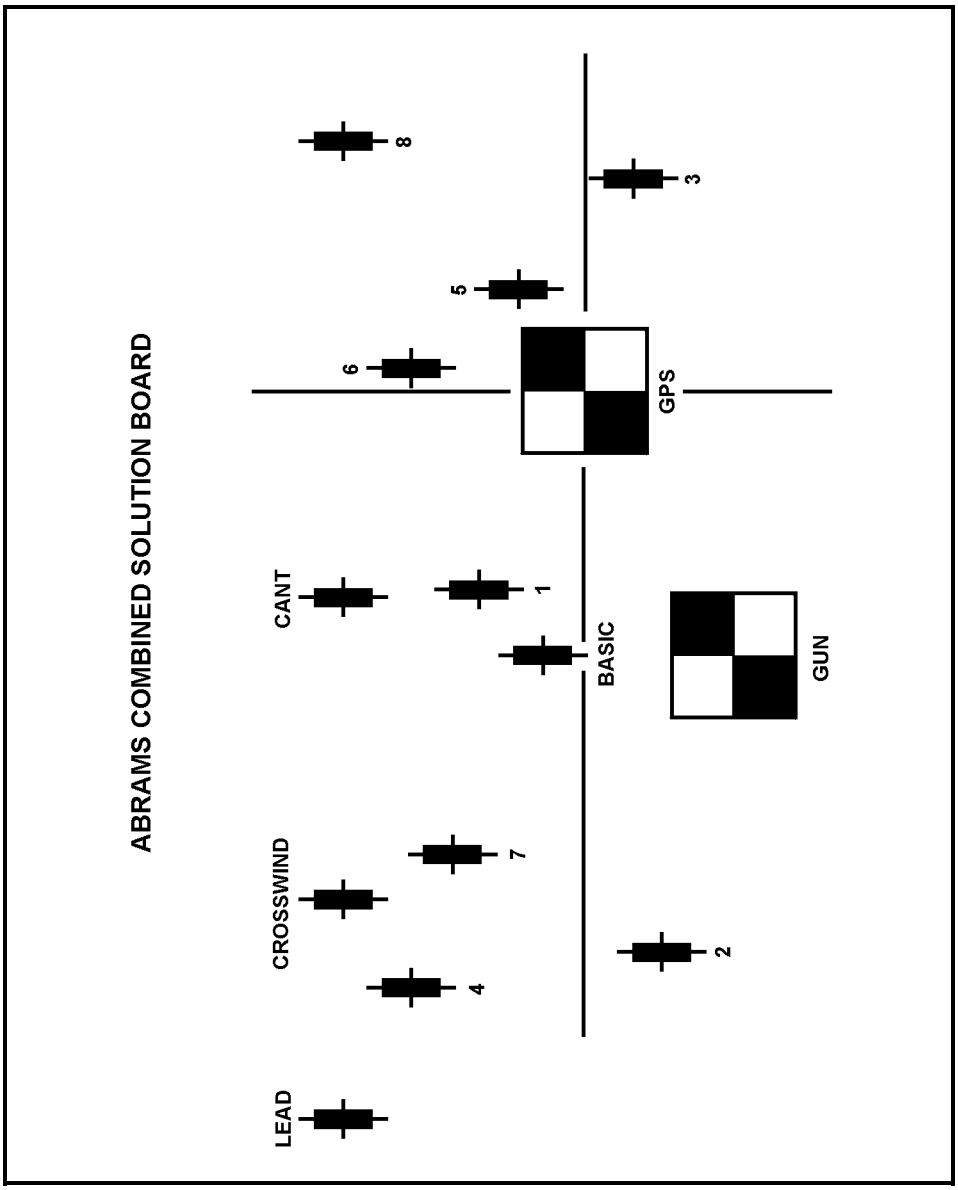
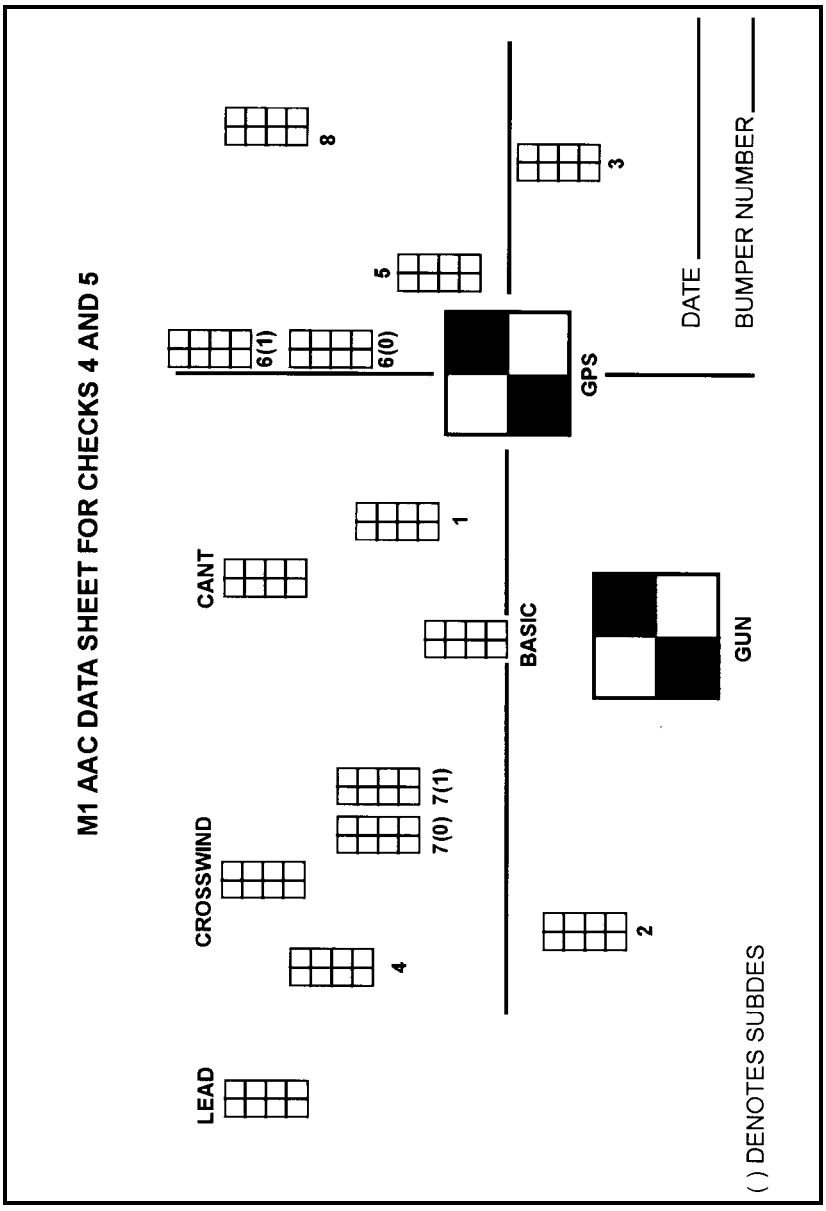


Figure 3-1. Abrams Combined Solution Board.
(continued on next page)

Figure 3-1. (continued from previous page.)

DIMENSIONS OF THE SOLUTION BOARD	
• Minimum solution board dimensions are 96 inches wide by 60 inches high. • GUN and GPS squares are 12 inches on each side. The upper right and lower left quadrants are dark colored. • The four solution rectangles are 2 inches by 4 inches, dark colored, with 6-inch horizontal and vertical lines through the center of each rectangle. • All lettering is at least 4 inches high. • Place the center of the GUN target right 48 inches and up 12 inches, from the lower left corner of the solution board. • All other measurements are from the center of the GUN target:	
To center of GPS	Right 22 inches, up 16 inches
To center of BASIC	Right 0 inches, up 19 inches
To center of CANT	Right 6 inches, up 39 inches
To center of CROSSWIND	Left 24 inches, up 39 inches
To center of LEAD	Left 46 inches, up 39 inches
To center of rectangle 1	Right 3 inches, up 26 inches
To center of rectangle 2	Left 33 inches, up 7 inches
To center of rectangle 3	Right 43 inches, up 12 inches
To center of rectangle 4	Left 38 inches, up 32 inches
To center of rectangle 5	Right 32 inches, up 20 inches
To center of rectangle 6	Right 24 inches, up 32 inches
To center of rectangle 7	Left 22 inches, up 29 inches
To center of rectangle 8	Right 46 inches, up 42 inches



Note. The number in parenthesis refers to the subdes being checked.

Figure 3-2. Sample M1 AAC Data Sheet for Checks 4 and 5.

Check 5 (M1) — Ballistic Solution

PURPOSE

The ballistic solution check verifies that the FCS is correctly implementing ballistic solutions in all main gun channels.

Note. Checks 4 and 5 do *not* test components of the FCS; they test the ability of the CEU to compensate for the values received from the components and determine a ballistic solution for a given round.

CONDITIONS

1. The ballistic input solution board is shown in Figure 3-1 (Abrams Combined Solution Board) on pages 3-8 and 3-9.
2. The engine is off; the VEHICLE MASTER POWER, TURRET POWER, and AUX HYDR POWER are on; and the FIRE CONTROL MODE switch is in the NORMAL position.

Note. Checks 4 and 5 must be performed with the AUX HYDR POWER on. Performing checks 4 and 5 at zero pressure does not test the FCS's ability to apply offsets to the gun correctly.

PROCEDURE

Note. If the tank passed check 4 and the current boresight is still valid, start at step 7. If maintenance was performed on the system or the boresight has changed, start at step 1.

1. Grip one of the palm switches; then (with the palm switch pressed) press the RANGE push button, index 1,200 meters into the CCP, and press the ENTER push button. Hold the palm switch for five seconds, then release. (The range values must be entered with the palm switch pressed. Failure to enter range with the palm switch pressed will result in a failure of check 5.)

Note. Do *not* rotate the MBD during checks 4 and 5.

2. Put the FCS in the BORESIGHT mode by pressing the BORESIGHT push button on the CCP.
3. Insert the MBD and direct the gunner to lay the main gun manually on the center of the target marked GUN on the solution board, with last movement up.

Note. When using the MBD at this distance, make sure the GPS browpad is adjusted to the gunner's face and the eyesight parallax shield (optic cover with hole) is used to reduce eyesight parallax.

4. When the main gun is properly laid for direction, the gunner toggles the GPS reticle to the center of the target marked GPS on the solution board.
5. Store the boresight data by pressing the ENTER push button on the CCP.

Note. The gunner may refer the GAS boresight cross to the gun box as a reference for gun position, as well as the MBD.

6. Check the boresight solution.
   a. Grip the palm switches for five seconds and release.
   b. Press the BORESIGHT push button, and using a G pattern and manual controls, re-lay the sight on the GPS target, with last movement up. (The MBD reticle should be pointing to the original aiming point of the GUN target on the solution board.)
   c. Press the ENTER push button to cancel the boresight mode.

7. Check the ten separate main gun solutions.
   a. Manually index the data inputs (except for range) into the CCP for a given solution as provided in the *M1 Ballistic Computer Inputs for Check 5* table on page 3-12.
   b. Grip one of the palm switches; then (with the palm switch pressed) press the RANGE push button, index the range into the CCP, and press the ENTER push button. Hold the palm switch for five seconds, then release. (The range values must be entered with the palm switch pressed. Failure to enter range with the palm switch pressed will result in a failure of check 5.)
   c. Using the *G* pattern and manual controls, lay the GPS reticle on the center of the GPS target on the solution board, with last movement up. (A parallax problem may be detected in the primary sight. This is a function of the short observation distance and does not indicate sight problems. The gunner must assume the same sight picture during each lay movement.)

Notes. The solution is correctly implemented if the MBD reticle is within the solution square identified in Table 3-4.

If a solution is failed, the crew should rerun the check a second time, paying close attention to make sure the correct procedures are used and the correct data is entered into the computer. (If a second try produces the same results, record the results on DA Form 2404 or ULLS Form 5988E and continue the check.)

   d. Record the position of the MBD aiming point (in relation to the target block) on the *Sample M1 AAC Data Sheet for Checks 4 and 5* on page 3-10.

Note. Be sure to reenter previously recorded data for GPS boresight, zero data (CCF), MRS boresight, and MRS update back into the CCP upon completion of check 5.

Table 3-4. M1 Ballistic Computer Inputs for Check 5.

SUBDES	Wind	Cant	Lead	Ammo Temp	Baro Press	Air Temp	Range	*Tube Wear	Solution from Board	CCF		CCP Difference Pass/Fail
										EL	DEF	
SABOT												
0	30	15	0	75	30	75	3,000	.000	1	U(-) 0.5	R(+) 0.0	
0	5	-15	5	100	28	100	2,000	.005	2			
0	-20	0	-10	25	24	25	1,500	.040	3			
1	35	10	5	50	28	50	2,500	.005	4	U(-) 0.0	R(+) 0.0	
1	-45	0	-5	25	30	25	2,000	.010	5			
HEAT												
0	40	5	-5	100	26	100	2,000	.010	6	U(-) 0.6	R(+) 0.0	
0	-10	10	5	75	26	75	1,500	.020	7			
1	40	5	-5	100	26	100	2,000	.010	6	U(-) 0.6	R(+) 0.0	
1	-10	10	5	75	26	75	1,500	.020	7			
HEP												
0	-5	15	-5	0	24	0	1,000	.010	8	D(+) 1.0	R(+) 0.0	

*Record the original tube wear value before changing it. The original value should be reentered into the computer after check 5 has been completed.

Check 6 (M1) — Muzzle Reference System

PURPOSE

The MRS check determines whether the MRS can correct an artificial boresight loss.

CONDITIONS

None.

PROCEDURE

1. Boresight the FCS at a known range. The GUN and GPS targets on the 100-meter solution board may be used if 1,200 meters is indexed into the computer.
2. Boresight the MRS and enter the data.
   a. Move the MRS lever to the IN position.
   b. Press the BORESIGHT push button on the CCP.
   c. Hold the GPCH for five seconds, then release.
   d. Refer the GPS to the MRS, record the readings.
   e. Move the MRS lever to the OUT position.
3. Move the MRS lever to the IN position. (The computer display panel should read zero, and the GPS reticle should be aligned with the MRS collimator on the muzzle; if not, notify organizational maintenance.)
4. Move the MRS lever to the IN position and the OUT position several times. The GPS reticle should align with the collimator each time. If it does not, notify organizational maintenance.
5. With the MRS lever turned to the OUT position, press the BORESIGHT push button.
6. Using the RETICLE ADJUST toggle switch, move the reticle up .5 mil, and enter the new value.
7. Move the MRS lever to the IN position, and update the MRS. (The result should have an elevation value between down 0.65 and down 0.35 and an azimuth value between left 0.15 and right 0.15.)
8. Using the RETICLE ADJUST toggle switch, move the MRS reticle so that the update display again reads 0.0 and 0.0. Move the MRS lever to the OUT position.
9. Press the BORESIGHT push button and take out the .5-mil error entered in step 6 by moving the reticle down .5 mil to its original boresight value. Then, introduce an azimuth boresight error by moving the reticle right .5 mil. Enter the new value.
10. Move the MRS lever to IN and update the MRS. (The result should have an azimuth value between left 0.65 and left 0.35 and an elevation value between up 0.15 and down 0.15.)
11. Move the MRS lever to the OUT position. Press the BORESIGHT push button and move the reticle .5 mil to the left. Enter the new value.

Notes. Failing to meet the criteria in steps 7 and 10 may mean the MRS collimator on the muzzle was not aligned when it was attached to the muzzle, or that the collimator has shifted since initial alignment. In either case, a turret mechanic must realign the collimator.

Except for realignment of the collimator by maintenance, there is no way to correct a failure of the MRS to restore a boresight reference. Crews should be aware that MRS updating is generally not as accurate as total system reboresighting.

12. Record the deficiencies on DA Form 2404 or ULLS Form 5988-E.

Check 1 (M1A1) — Main Accumulator Pressure

PURPOSE

The main accumulator pressure check ensures that the system is maintaining proper hydraulic pressure.

CONDITIONS

1. All personnel are clear of the main gun.
2. The engine is off, the TURRET POWER is on, and the AUX HYDR POWER is off.
3. The turret is positioned with the main gun over the number 1 (right) road wheel.

PROCEDURE

1. Slowly elevate and depress the main gun with the power controls while watching the hydraulic pressure gauge needle. The pressure should slowly decrease to 830-550 psi, based on the ambient temperature as outlined on the chart below, then drop rapidly to 0 psi.

Nitrogen Gas Temperature vs Precharge Pressure Chart									
TEMP (F)	-70	-50	-25	0	+25	+50	+75	+100	+125
PRECHARGE (PSI)	550	580	620	650	685	720	755	790	830

2. Check the reservoir fluid gauge behind the loader's position beneath the turret ring. If the fluid level is below the ADD 1 GAL mark, add fluid per the vehicle's lubrication order.
3. Make sure the two pop-out indicators to the left above the fluid-level gauge have not popped out. If they are out, push them in.
4. Turn the auxiliary hydraulic pump on, and watch the pressure gauge needle. If the pop-out indicators were reset in Step 3, recheck to make sure they did not pop out again; if they did, notify organizational maintenance.

Note. The auxiliary hydraulic pump should shut off when the pressure reaches 1,500 to 1,700 psi.

Check 2 (M1A1) — Power Elevation and Elevation Cylinder

PURPOSE

The power elevation and elevation cylinder check ensure that the main gun elevation cylinder responds to elevation inputs.

CONDITIONS

1. Check 1 has been completed and the hydraulic system is pressurized to at least 1,500 psi.
2. The engine is off; TURRET POWER and AUX HYDR POWER are on.

PROCEDURE

1. Position the turret with the main gun over the front or side of the hull.
2. Turn the manual elevation handle, depressing the gun until the handle can no longer be turned easily with one hand.

3. With the FIRE CONTROL MODE set at NORMAL, check for smooth operation of the gun by raising and lowering the cannon with the GPCH. (Always center the controls before releasing the palm switches.)
4. Look through the GPS and lay on a distant aiming point.
5. While in NORMAL mode, null out all reticle drift.
6. Set the FIRE CONTROL MODE switch to MANUAL (this will prevent injury to personnel because of accidental turret movement).
7. Level the gun tube and lay on a distant aiming point. Have one crew member push the muzzle up and release. Repeat the muzzle movement in vertical and horizontal planes while observing a distant aiming point through the GPS. (The reticle will move. Upon release of pressure at the muzzle, the sight should return to its original aiming point.)
8. Record deficiencies on DA Form 2404 or ULLS Form 5988E.

Check 3 (M1A1) — Fault Indicator

PURPOSE

The fault indicator check verifies that the fire control system's continuous malfunction detection system and computer self-test have not identified faults that affect direct-fire precision.

CONDITIONS

1. Checks 1 and 2 have been completed.
2. The RANGE switch on the LRF is in the SAFE position.
3. The TURRET POWER is on and the FIRE CONTROL MODE is in the NORMAL position.
4. The circuit breakers to the TNB are set at ON and the LAMP RESET button is pressed.

Note. On the M1A1 tank, TNB CB-3 may be left off.

5. All cable connectors in the fire control system are securely installed.

PROCEDURE

1. Check the displayed data in the GPS field of view. (If the fire control fault symbol [F] appears, the continuous malfunction detection system has detected one of two faults: Electrical continuity within the fire control system is interrupted or a malfunction signal has been generated by the TIS, crosswind sensor, LRF, or computer system. Table 3-1 on page 3-4 describes the kinds of faults that can cause an *F* symbol to be displayed.)
2. If an *F* symbol is present in the GPS field of view, recheck the conditions for this check. Turn the TURRET POWER off, then on again, and see if an *F* symbol appears.
3. Check the TIS fault indicator. If it is on, notify organizational maintenance.
4. Cover up the crosswind sensor, then call up the crosswind value on the CCP. If the value is less than 3 mph, uncover the crosswind sensor and proceed to step 5. If the value is over 3 mph, clean the crosswind sensor, and perform the test again. If the crosswind sensor still does not function properly, notify organizational maintenance. Uncover the crosswind sensor.
5. Run the computer self-test. (In most cases, the self-test will indicate the source of the fault. Table 3-2 on page 3-4 describes the kinds of faults that trigger a self-test failure. If, after a self-test pass, the *F* symbol shows in the GPS, a problem may exist in the TNB, which controls the malfunction detection system. Organizational-level test equipment must be used to find this kind of fault.)

Note. Run the self-test two or three times to ensure consistency of results. The computer self-test evaluates system response based on threshold values preprogrammed into the computer. If the tank fails two out of three times with the same fault, notify organizational maintenance.)

Check 4 (M1A1) — Special Input

PURPOSE

The special input check verifies the proper function of manual and automatic inputs. This check ensures all individually tested component circuits are operational prior to testing full solution data. Checks 4 and 5 correspond closely to the gunnery checks described in TM 9-2350-264-10-2, Appendix F.

Note. Checks 4 and 5 do *not* test components of the FCS; they test the ability of the CEU to compensate for the values received from these components and determine a ballistic solution for a given round.

CONDITIONS

1. The tank is on level ground with the solution board 100 meters (±3 meters) from the front edge of the tank's hull.
2. Checks 1, 2, and 3 have been completed.
3. The horizontal reference line on the solution board is level with the gun trunnions. (An easy way to check this is to move the MRS lever to IN and squeeze the palm switches on the GPCH [the main gun will move to zero elevation]. Move the MRS lever to OUT and align the reference line on the solution board with the center horizontal reference line in the GPS reticle.) (Figure 3-1, Abrams Combined Solution Board, on page 3-8 is a scale drawing of the solution board to be used.)
4. An MBD is available.
5. The engine is off; the VEHICLE MASTER POWER, TURRET POWER, and AUX HYDR POWER are on; the CCP power is on; and the FIRE CONTROL MODE switch is in the NORMAL position.

Note. Checks 4 and 5 must be performed with the AUX HYDR POWER on. Performing checks 4 and 5 at zero pressure does not test the FCS's ability to apply offsets to the gun.

PROCEDURE

WARNING

Range solutions must be entered manually with the CCP data key during checks 4 and 5. Do *not* use the LRF; it may expose unprotected personnel to injury.

1. Record the GPS boresight, zero data (CCF), MRS update, and MRS boresight numbers from the CCP before conducting check 4.
2. Set zero data for all AMMO SUBDES, MRS update, and MRS boresight to 0.0 and 0.0 before conducting check 4. (Failure to do so may cause a failure of check 4.)
3. Grip one of the palm switches; then (with the palm switch pressed) press the RANGE push button, index 1,200 meters into the CCP, and press the ENTER push button. Hold the palm switch for five seconds, then release. (When conducting the special input check, the range values must be entered with the palm switch pressed. Failure to enter range with the palm switch pressed will result in a failure of check 4.)
4. Put the FCS in the BORESIGHT mode by pressing the BORESIGHT push button on the CCP.

Note. Do *not* rotate the MBD while performing checks 4 and 5.

5. Insert the MBD and direct the gunner to lay the main gun manually on the center of the target marked GUN on the solution board, with last movement up.

Note. When using the MBD at this distance, make sure the GPS browpad is adjusted to the gunner's face to reduce eye/sight parallax, and use the MBD's eyesight parallax shield (optic cover with hole) to reduce eyesight parallax.

6. When the main gun is properly laid for direction, the gunner toggles the GPS reticle, using a *last movement up* pattern, to the center of the target marked GPS on the solution board.
7. Store the boresight data by pressing ENTER on the CCP.

Note. The gunner may refer the GAS boresight cross to the gun box as a reference for gun position, as well as the MBD.

8. Check the boresight solution.
   a. Grip the palm switches for five seconds and release.
   b. Press the BORESIGHT push button, and using a G pattern and manual controls, re-lay the sight on the GPS target, with last movement up. (The MBD aiming dot reticle should be pointing to the original aiming point of the GUN target on the solution board.)
   c. Press the ENTER push button to cancel the BORESIGHT mode.
9. Enter the fire control inputs from Table 3-5.
   a. Enter the *basic* solution.

Note. The *basic* solution has all manual and automatic inputs set at neutral values. If the *basic* solution fails, do *not* try the other solutions; notify organizational maintenance.

   (1) Manually enter the data inputs (except for range) into the CCP.
   (2) Index range, squeeze the GPCH, and press the ENTER push button. Hold the GPCH for five seconds.
   (3) Using a *G* pattern and the manual controls, lay the GPS aiming dot back on the aiming point, with last movement up.
   (4) The crewman on the outside views through the MBD and confirms that the gun is on the correct block.
   (5) Push the MAINT DATA push button, index 88, and press the ENTER push button.
   (6) Record the readings in the CCP display under the CCP column on Table 3-5.
   (7) Press the MAINT DATA push button, index 89, and press the ENTER push button.
   (8) Record the readings in the CCP display under the CCP column on Table 3-5.
   (9) Press the MAINT DATA push button, index 90, and press the ENTER push button (this takes you out of the MAINT DATA mode).
   (10) Compare the readings entered in the CCP column with the *actual* readings on Table 3-5.

Notes. Evaluate each column individually. If the differences for both 88 and 89 are equal to or less than .02, the tank will pass; however, if the difference for either 88 or 89 is greater than .02, the tank will fail. (If a solution fails, check for errors in boresighting and perform the failed solution a second time, paying strict attention to the values that are input into the computer.)

The crewman viewing through the MBD should make sure the aiming dot is on the appropriate block; if it is not, he should note that the MBD was not on the appropriate block.

Failures due to differences of .03 or greater indicate problems with the CEU. If the difference is .02 or less, but the MBD is not on the appropriate block, possible problems are—

- Incorrect boresight.
- Not taking the same sight picture with the MBD that was taken during boresighting.
- CCP not zeroed (for example, CCF).
- Incorrect entry of check data into the CCP.
- Problems with the FCS.

(11) Record the position of the MBD aiming point (in relation to the target block) on the *Sample M1A1 AAC Data Worksheet for Checks 4 and 5* on page 3-19.

Note. Repeat steps 9a(1) through (11) for each of the remaining solutions (cant, crosswind, and lead).

b. Enter the *cant* solution. (If it fails, the cant value is incorrectly set or the computer is not processing the cant function.)

c. Enter the *crosswind* solution. (If it fails, the crosswind value is incorrectly set or the computer is not processing the crosswind function.)

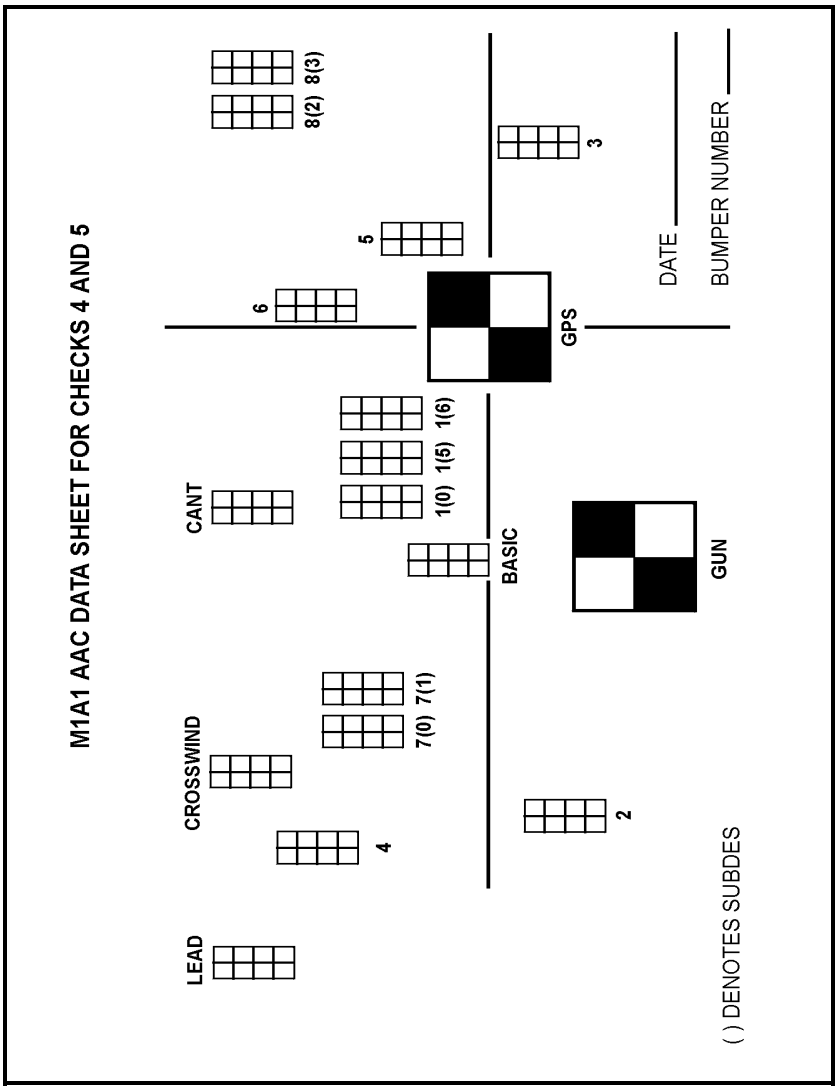
d. Enter the *lead* solution. (If it fails, the lead value is incorrectly set or the computer is not processing the lead function.)

10. After completing check 4 (all faults have been corrected), proceed to check 5.

Table 3-5. M1A1 Ballistic Computer Inputs for Check 4.

SUBDES	Wind	Cant	Lead	Ammo Temp	Baro Pressure	Air Temp	*Range	Solution from Board	Actual Solution		CCP Difference Pass/Fail
									Elevation 88	Azimuth 89	
HEAT											
1	0.0	0.0	0.1	69.8	29.92	59.0	1,030	Basic	4.82	0.0	
1	0.9	10.4	0.0	69.8	29.92	59.0	1,855	Cant	9.87	-1.50	
1	44.9	0.0	0.0	69.8	33.00	59.0	1,780	Cross-wind	9.87	6.02	
1	0.1	0.0	5.43	69.8	29.92	59.0	1,835	Lead	9.87	11.55	

*Range is the last input entered into the computer.



Note. The number in parenthesis indicates the ammunition subdes being used.

Figure 3-3. Sample M1A1 AAC Data Sheet for Checks 4 and 5.

Check 5 (M1A1) — Ballistic Solution

PURPOSE

The ballistic solution check verifies that the FCS is correctly implementing ballistic solutions in all main gun channels.

Note. Checks 4 and 5 do not test components of the FCS; they test the ability of the CEU to compensate for values received from these components and determine a ballistic solution for a given round.

CONDITIONS

1. The ballistic solution board is shown in Figure 3-1, Abrams Combined Solution Board, on page 3-8.
2. The engine is off; the VEHICLE MASTER POWER, TURRET POWER, and AUX HYDR POWER are on; and the FIRE CONTROL MODE switch is in the NORMAL position.

Note. Checks 4 and 5 must be performed with the AUX HYDR POWER on. Performing checks 4 and 5 at zero pressure does not test the FCS's ability to apply offsets to the gun correctly.

PROCEDURE

Note. If the tank passed check 4 and the current boresight is still valid, start at step 7. If maintenance was performed on the system or the boresight has changed, start at step 1.

1. Grip one of the palm switches; then (with the palm switch pressed) press the RANGE push button, index 1,200 meters into the CCP, and press the ENTER push button. Hold the palm switch for five seconds, then release. (The range values must be entered with the palm switch pressed. Failure to enter range with the palm switch pressed will result in a failure of check 5.)

Note. Do not rotate the MBD during checks 4 and 5.

2. Put the FCS in the BORESIGHT mode by pressing the BORESIGHT push button on the CCP.
3. Insert the MBD and direct the gunner to lay the main gun manually on the center of the target marked GUN on the solution board, with last movement up

Note. When using the MBD at this distance, make sure the GPS browpad is adjusted to the gunner's face and the eyesight parallax shield (optic cover with hole) is used to reduce eyesight parallax.

4. When the main gun is properly laid for direction, the gunner toggles the GPS reticle to the center of the target marked GPS on the solution board.
5. Store the boresight data by pressing the ENTER push button on the CCP.

Note. The gunner may refer the GAS boresight cross to the gun box as a reference for gun position, as well as the MBD.

6. Check the boresight solution.
   a. Grip the palm switches for five seconds and release.
   b. Press the BORESIGHT push button, and using a G pattern and manual controls re-lay the sight on the GPS target, with last movement up. (The MBD reticle should be pointing to the original aiming point of the GUN target on the solution board.)
   c. Press the ENTER push button to cancel the boresight mode.

Note. If the tank failed check 4 and maintenance was performed, make sure the zero data (CCF) for each AMMO SUBDES is set at 0.0 and 0.0, and the MRS update and boresight numbers are set at 0.0 and 0.0 before conducting check 5. Failure to do so will result in a failure of check 5.

7. Check the 12 separate main gun solutions.
   a. Manually index the data inputs (except for range) into the CCP for a given solution as provided in Table 3-6.
   b. Grip one of the palm switches; then (with the palm switch pressed) press the RANGE push button, index the range value into the CCP, and press the ENTER push button. Hold the palm switch for five seconds, then release. (The range value must be entered with the palm switch pressed. Failure to enter range with the palm switch pressed will result in a failure of check 5.)
   c. Using a G pattern and manual controls, lay the GPS aiming dot back on the aiming point, with last movement up.
   d. The crewman on the outside views through the MBD and confirms that the gun is on the correct block.
   e. Press the MAINT DATA push button, index 88, and press the ENTER push button.
   f. Record the readings in the CCP display under the CCP column in Table 3-6.
   g. Press the MAINT DATA push button, index 89, and press the ENTER push button.
   h. Record the readings in the CCP display under the CCP column in Table 3-6.
   i. Press the MAINT DATA push button, index 90, and press the ENTER push button (this takes you out of the MAINT DATA mode).
   j. Compare the readings entered in the CCP column with the readings in the *actual solution* column in Table 3-6.
   k. Record the position of the MBD aiming point (in relation to the target block) on the *Sample M1A1 AAC Data Worksheet for Checks 4 and 5* on page 3-19.

Notes. Evaluate each column individually. If the differences for both 88 and 89 are equal to, or less than, .02, the tank will pass; however, if the difference for either 88 or 89 is greater than .02, the tank will fail.

The crewman viewing through the MBD should make sure the aiming dot is on the appropriate block; if it is not, he should note that the MBD was not on the appropriate block.

Failures due to differences of .03 or greater indicate problems with the CEU. If the difference is .02 or less but the MBD is not on the appropriate block, possible problems are—

- Incorrect boresight.
- Not taking the same sight picture with the MBD that was taken during boresighting.
- CCP not zeroed (for example, CCF).
- Incorrect entry of check data into the CCP.
- Problems with the FCS.

Repeat steps 7b-k for each AMMO SUBDES to be checked.

The solution is correctly implemented if the MBD reticle is within the solution square identified in Table 3-6.

If a solution fails, the crew should rerun the check a second time, paying close attention to make sure the correct procedures are used and the correct data is put into the computer. (If a second try produces the same results, record the results on DA Form 2404 or ULLS Form 5988E and continue the check.)

Be sure to reenter previously recorded data for zero (CCF), MRS boresight, and MRS update back into the CCP upon completion of check 5.

Table 3-6. M1A1 Ballistic Computer Inputs for Check 5.

SUBDES	Wind	Cant	Lead	Ammo Temp	Baro Press	Air Temp	Range	Solution from Board	Actual Solution		CCP Difference Pass/Fail
									Elevation 88	Azimuth 89	
SABOT											
0	10.5	0	-0.60	75	30	75	3,531	1	6.58	-0.75	
1	5.5	0	16.3	100	30	100	816	2	1.74	8.21	
2	-22	0	-10.7	25	24	25	1,578	3	3.04	-10.79	
3	34.6	0	3.08	50	28	50	3,982	4	8.11	9.54	
4	-44.9	0	-2.68	25	30	25	1,970	5	5.07	-8.03	
5	10.5	0	-0.64	75	30	75	3,116	1	6.58	-0.75	
6	19.0	5	-0.40	90	30	90	3,720	1	6.59	-0.76	
HEAT											
0	38.6	5	-4.6	100	25	100	1,800	6	8.10	-6.02	
1	-9.1	10	5.1	100	26	100	1,385	7	7.35	5.52	
2	-4.9	0	-5.13	0	24	0	1,908	8	10.63	-11.54	
3	-4.8	0	-5.14	0	24	0	1,903	8	10.60	-11.52	
MPAT											
0	18.1	0	2.0	75	29.20	75	2,340	7	7.30	5.51	

Check 6 (M1A1) — Muzzle Reference System

PURPOSE

The MRS check determines whether the MRS can correct an artificial boresight loss.

CONDITIONS

None.

PROCEDURE

1. Boresight the FCS at a known range. The GUN and GPS targets on the 100-meter solution board may be used if 1,200 meters is indexed into the computer.
2. Boresight the MRS and enter the data.
   a. Move the MRS lever to the IN position.
   b. Press the BORESIGHT push button on the CCP.
   c. Hold the GPCH for five seconds, then release.
   d. Refer the GPS to the MRS, record the readings.
   e. Move the MRS lever to the OUT position.
3. Move the MRS lever to the IN position. (The computer display panel should read zero, and the GPS reticle should be aligned with the MRS collimator on the muzzle; if not, notify organizational maintenance.)
4. Move the MRS lever to the IN position and the OUT position several times. The GPS reticle should align with the collimator each time. If it does not, notify organizational maintenance.
5. With the MRS lever turned to the OUT position, press the BORESIGHT push button.

6. Using the RETICLE ADJUST toggle switch, move the reticle up .5 mil, and enter the new value.
7. Move the MRS lever to the IN position, and update the MRS. (The result should have an elevation value between down 0.65 and down 0.35 and an azimuth value between left 0.15 and right 0.15.)
8. Using the RETICLE ADJUST toggle switch, move the MRS reticle so that the update display again reads 0.0 and 0.0. Move the MRS lever to the OUT position.
9. Press the BORESIGHT push button and take out the .5-mil error entered in step 6 by moving the reticle down .5 mil to its original boresight value. Then, introduce an azimuth boresight error by moving the reticle right .5 mil. Enter the new value.
10. Move the MRS lever to IN and update the MRS. (The result should have an azimuth value between left 0.65 and left 0.35 and an elevation value between up 0.15 and down 0.15.)
11. Move the MRS lever to the OUT position. Press the BORESIGHT push button and move the reticle .5 mil to the left. Enter the new value.

Notes. Failing to meet the criteria in steps 7 and 10 may mean the MRS collimator on the muzzle was not aligned when it was attached to the muzzle, or that the collimator has shifted since initial alignment. In either case, a turret mechanic must realign the collimator.

Except for realignment of the collimator by maintenance, there is no way to correct a failure of the MRS to restore a boresight reference. Crews should be aware that MRS updating is generally not as accurate as total system reboresighting.

12. Record the deficiencies on DA Form 2404 or ULLS Form 5988E.

Check 1 (M1A2) — Main Accumulator Pressure

PURPOSE

The main accumulator pressure check ensures that the system is maintaining proper hydraulic pressure.

CONDITIONS

1. All personnel are clear of the main gun.
2. The engine is off, the TURRET POWER is on, and the AUX HYDR POWER is off.
3. The turret is positioned with the main gun over the number 1 (right) road wheel.

PROCEDURE

1. Slowly elevate and depress the main gun with the power controls while watching the hydraulic pressure gauge needle. The pressure should slowly decrease to 830-550 psi, based on the ambient temperature as outlined on the chart below, then drop rapidly to 0 psi.

Nitrogen Gas Temperature vs Precharge Pressure Chart									
TEMP (F)	-70	-50	-25	0	+25	+50	+75	+100	+125
PRECHARGE (PSI)	550	580	620	650	685	720	755	790	830

2. Check the reservoir fluid gauge behind the loader's position beneath the turret ring. If the fluid level is below the ADD 1 GAL mark, add fluid per the vehicle's lubrication order.
3. Make sure the two pop-out indicators to the left above the fluid-level gauge have not popped out. If they are out, push them in.

4. Turn the auxiliary hydraulic pump on, and watch the pressure gauge needle. If the pop-out indicators were reset in Step 3, recheck to make sure they did not pop out again; if they did, notify organizational maintenance.

Note. The auxiliary hydraulic pump should shut off when the pressure reaches 1,500 to 1,700 psi.

Check 2 (M1A2) — Power Elevation and Elevation Cylinder

PURPOSE

The power elevation and elevation cylinder check ensure that the main gun elevation cylinder responds to elevation inputs.

CONDITIONS

1. Check 1 has been completed, and the hydraulic system is pressurized to at least 1,500 psi.
2. The engine is off; TURRET POWER and AUX HYDR POWER are on.

PROCEDURE

1. Position the turret with the main gun over the front or side of the hull.
2. Turn the manual elevation handle, depressing the gun until the handle can no longer be turned easily with one hand.
3. With the FIRE CONTROL MODE set at NORMAL, check for smooth operation of the gun by raising and lowering the cannon with the GPCH. (Always center the controls before releasing the palm switches.)
4. Look through the GPS and lay on a distant aiming point.
5. While in NORMAL mode, null out all reticle drift.
6. Set the FIRE CONTROL MODE switch to MANUAL (this will prevent injury to personnel because of accidental turret movement).
7. Level the gun tube and lay on a distant aiming point. Have one crew member push the muzzle up and release. Repeat the muzzle movement in vertical and horizontal planes while observing a distant aiming point through the GPS. (The reticle will move. Upon release of pressure at the muzzle, the sight should return to its original aiming point.)
8. Record deficiencies on DA Form 2404 or ULLS Form 5988E.

Check 3 (M1A2) — Fault Indicator

PURPOSE

The fault indicator check verifies that the fire control system's continuous malfunction detection system and fire control system test identified faults that affect direct-fire precision.

CONDITIONS

1. Checks 1 and 2 have been completed.
2. The RANGE switch on the LRF is in the SAFE position.
3. The TURRET POWER is on and the FIRE CONTROL MODE is in the NORMAL position.
4. All the circuit breakers in the CID and the GCDP are set at ON.
5. All cable connectors in the fire control system are securely installed.

PROCEDURE

1. Check the displayed data in the GPS field of view. (If the fire control fault symbol [F] appears, the continuous malfunction detection system has detected one or more of the following FCS malfunctions:
   - The last fire control system test failed.
   - There is no laser range finder power.
   - The RANGE switch on the LRF was not in the SAFE position when the turret power was turned on.
   - There is no thermal imaging system power.
   - The automatic self test has detected a fault, and a caution message is displayed in the GCDP. (See TM 9-2350-288-10-1 for a complete list of GCDP caution messages.)
2. If an *F* symbol is present in the GPS field of view, recheck the conditions for this check. Turn the TURRET POWER off, then ON again, and see if an *F* symbol appears.
3. Check the TIS fault indicator. If it is on, notify organizational maintenance.
4. If the *F* symbol is still present, check the cautions and warnings and proceed to TM 9-2350-288-10-2, Caution/Warning Verification Procedure, and follow the instructions.
5. If the *F* symbol is still active, run the built-in-test and notify organizational maintenance.
6. Once the fault has been cleared, perform a fire control system test.

Note. There is no Check 4 for the M1A2 tank.

Check 5 (M1A2) — Ballistic Solution

PURPOSE

The ballistic solution check verifies that the FCS is correctly implementing ballistic solutions in all main gun channels.

Note. Ballistic solution checks do *not* test components of the FCS; they test the ability of the TEU to compensate for the values received from these components and determine a ballistic solution for a given round.

CONDITIONS

1. A fire control system test has been completed (see TM 9-2350-288-10-1).
2. The AUX HYDR POWER is on.
3. The FIRE CONTROL MODE switch is in EMERGENCY mode.
4. The commander's station, turret, and gunner's station are powered up.

PROCEDURE

1. Open the GPS left (DAY) ballistic door.
2. Move the FIRE CONTROL MODE switch to EMERGENCY, squeeze one of the palm switches on the GPCH, and check for drift. (If more than 0.5 mil of drift in 20 seconds is observed, press the MAINT push button, then the DRIFT push button, to null out the EMERGENCY mode drift.)
3. Move the FIRE CONTROL MODE switch to NORMAL, squeeze one of the palm switches on the GPCH, and check for drift. (If more than 0.5 mil of drift in 20 seconds is observed, null out the drift using the AZ and EL DRIFT knobs.)

Note. If the NORMAL mode drift and EMERGENCY mode drift are not nulled out before running the ballistic solution tests, false test results may occur.

4. Press the MAINT push button on the MAIN MENU screen.
5. Press the SET UP push button on the MAINTENANCE menu.
6. Press the BAL SOLN CHECK push button on the SET UP menu.
7. Use the keypad to enter the solution number; range of values is 1 to 30.
8. To start the test, squeeze and hold the palm switch, then press the START TEST button.

Notes. After pressing the START TEST push button, hold the palm switch for a minimum of 45 seconds, or until pass/fail results are displayed.

If a FAIL is displayed, rerun the test one time prior to recording the solution number. Make sure the gun is as close to zero elevation as possible.

Performing ballistic solutions for SABOT ammunition may change the SABOT AMMO SUBDES indexed on the GCDP. Check the AMMO SUBDES for SABOT after performing the ballistic solutions checks.

Check the ballistic solution chart on pages 3-27 and 3-28 for information concerning checks 1-30.

9. Repeat steps on BAL SOLN CHECK menu until all ballistic solutions have been run.

Note. If one or more FAILS were displayed during the test, notify unit maintenance.

10. Press the RETURN push button on the BAL SOLN CHECK menu three times to return to the MAIN MENU screen.

M1A2 BALLISTIC SOLUTION CHART FOR CHECK 5
FIRE CONTROL ACCURACY CHECK

B/S	Tracking Rate	L.O.S.	Ammo Type	Round Subdes	Xwind	Air Temp	Air Press	Ammo Temp	Cant	Range	GPS SE	GPS Lead	CITV SE	CITV Lead
1	0.00	0.00	SABOT	M829	0.00	59.0	29.92	69.8	-2.984	3578	7.175	0.159	7.238	0.562
2	0.00	0.00	SABOT	M829	18.58	59.0	29.92	69.8	0.000	3573	7.174	0.159	7.237	0.562
3	-15.03	0.00	SABOT	M829	0.00	59.0	29.92	69.8	0.000	911	2.259	-9.156	2.508	7.574
4	0.00	0.00	SABOT	M829	0.00	59.0	29.92	69.8	-9.277	3678	7.302	0.967	7.383	1.359
5	0.00	0.00	SABOT	M829	41.03	59.0	29.92	69.8	0.000	2613	5.207	0.291	5.293	0.842
6	-17.13	0.00	SABOT	M829	0.00	59.0	29.92	69.8	0.000	843	2.180	-9.665	2.448	-7.956
7	10.45	15.00	SABOT	M829	0.00	59.0	29.92	69.8	0.000	1746	3.460	10.877	3.596	11.702
8	27.00	0.00	SABOT	DM13	-23.60	-22.0	28.05	14.0	-6.400	1700	0.454	29.382	0.587	30.23
9	7.00	0.00	SABOT	DM13	4.00	-4.0	28.35	32.0	11.400	3400	10.446	14.384	10.513	14.808
10	-5.00	0.00	SABOT	DM28	-41.80	14.0	29.23	50.0	-4.900	4000	10.450	-15.618	10.507	-15.258
11	-23.00	0.00	SABOT	DM28	-11.00	32.0	29.53	68.0	7.100	2000	0.445	-30.617	0.558	-29.897
12	22.00	0.00	SABOT	M829	-30.80	50.0	30.12	41.0	11.000	2200	10.459	29.382	10.581	30.037
13	23.50	0.00	SABOT	M829	-1.70	68.0	30.41	23.0	-7.800	1000	0.458	14.382	0.683	15.822
14	-32.00	0.00	SABOT	M865	26.70	5.0	30.71	5.0	7.200	700	0.420	-15.57	0.75	-13.51
15	-12.00	0.00	SABOT	M865	-37.00	59.0	31.01	23.0	-4.900	2500	10.23	-30.15	10.32	-29.58

continued next page

Figure 3-4. M1A2 Ballistic Solution Chart for Check 5 (continued on next page).

M1A2 BALLISTIC SOLUTION CHART FOR CHECK 5
FIRE CONTROL ACCURACY CHECK (continued from previous page)

B/S	Tracking Rate	L.O.S.	Ammo Type	Round Subdes	Xwind	Air Temp	Air Press	Ammo Temp	Cant	Range	GPS SE	GPS Lead	CITV SE	CITV Lead
16	6.00	0.00	HEAT	M830	3.80	-13.0	28.20	22.0	3.000	3100	30.426	29.395	30.498	29.88
17	5.00	0.00	HEAT	M830	4.90	1.40	28.79	32.0	10.100	2500	20.457	14.378	20.548	14.954
18	0.00	0.00	HEAT	M831	-15.60	23.0	29.09	10.40	-8.600	3300	30.447	-0.628	30.515	-0.191
19	-4.00	0.00	HEAT	M831	-21.30	41.0	29.68	53.60	-8.800	2600	20.458	-15.594	20.545	-15.04
20	-8.50	0.00	HEAT	DM12A1	37.80	5.0	29.97	19.40	-2.300	3200	30.450	-30.617	30.52	-30.167
21	8.50	0.00	HEAT	DM12A1	-40.90	82.60	30.27	44.60	11.900	3600	40.465	29.378	40.528	29.778
22	3.00	0.00	HEAT	DM18	1.60	53.60	30.58	77.0	3.700	3400	30.438	14.398	30.502	14.819
23	0.00	0.00	HEAT	DM18	-10.30	10.40	30.88	32.0	-6.100	2650	20.449	-0.626	20.534	-0.084
24	-2.00	0.00	HEAT	M20	16.80	59.0	30.86	69.8	8.100	2000	29.994	-15.64	30.107	-14.92
25	-5.00	0.00	HEAT	M20	-0.90	59.0	29.92	69.8	5.900	2300	39.997	-30.641	40.095	-30.015
26	4.50	0.00	COAX	M240	0.00	59.0	29.92	69.8	-3.300	1500	60.360	29.81	50.47	30.37
27	2.00	0.00	COAX	M240	0.00	59.0	29.92	69.8	-8.300-	1600	40.370	14.54	40.51	15.44
28	0.00	0.00	SABOT	M829	0.00	59.0	29.92	69.8	0.000	1200	2.663	-0.817	2.852	0.583
29	0.00	0.00	HEAT	DM12A1	0.00	59.0	29.92	69.8	0.000	1200	6.174	-0.817	6.362	0.583
30	0.00	0.00	COAX	M240	0.00	59.0	29.92	69.8	0.000	1200	22.986	-0.337	23.174	0.664

Figure 3-4. M1A2 Ballistic Solution Chart for Check 5 (continued from previous page).

Check 6 (M1A2) — Muzzle Reference System

PURPOSE

The MRS check determines whether the MRS can correct an artificial boresight loss.

CONDITIONS

None.

PROCEDURE

1. Boresight the FCS at a known range. The GUN and GPS targets on the 100-meter solution board may be used if 1,200 meters is indexed into the computer.
2. Boresight the MRS and enter the data.
   a. Press the ADJUST push button at the main menu of the GCDP.
   b. Press the BORESIGHT push button at the ADJUST menu.
   c. Press the MRS push button at the BORESIGHT menu.
   d. Hold the GPCH for five seconds, the release.
   e. Refer the GPS reticle to the MRS collimator using the four-way switch, and record the readings.
   f. Press the ENTER push button twice.
   g. Press the RETURN push button.
3. With GCDP on MAIN MENU, press COMBAT push button. Press MRS UPDATE push button on COMBAT menu. Grasp GPCH for 5 seconds and then release. (The MRS UPDATE display should read 0.00 and 0.00, and the GPS reticle should be aligned with the MRS collimator on the muzzle; if not, notify organizational maintenance.)
4. Press the RETURN push button, then press the MRS UPDATE push button (repeat this several times). The GPS reticle should align with the collimator each time. If it does not, notify organizational maintenance. When complete, press the RETURN push button one time to return to the BORESIGHT menu.
5. Press the GPS push button at the BORESIGHT menu and, using the four-way switch, move the reticle up .5 mils. Enter the new value by pressing the ENTER push button twice. When complete, press the RETURN push button three times.
6. Press the COMBAT push button at the main menu, then press the MRS UPDATE push button. Grasp GPCH for 5 seconds and then release. Update the MRS using the four-way switch to realign the GPS reticle and the MRS collimator. (The result should have an elevation value between down .65 and down .35 and an azimuth value between left 0.15 and right 0.15.)
7. Using the four-way switch, move the MRS reticle so that the update display reads 0.00 and 0.00. Press the ENTER push button twice, then press the RETURN push button.
8. Press the ADJUST push button at the main menu, then press the BORESIGHT push button and the GPS push button. Remove the .5 mil error that was entered in step 5 by moving the reticle down .5 mil to its original boresight value. Introduce an azimuth boresight error by moving the reticle right .5 mil. Enter the new value by pressing the ENTER push button twice. When complete, press the RETURN push button three times.
9. Press the COMBAT push button at the main menu, then press the MRS UPDATE push button. Grasp the GPCH for 5 seconds and then release. Update the MRS. (The result should have an azimuth value between left .65 and left .35 and an elevation value between up 0.15 and down 0.15.)
10. Using the four-way switch, move the MRS reticle so that the update display reads 0.00 and 0.00. Press the ENTER push button twice, then press the RETURN push button.

11. Press the ADJUST push button at the main menu, then press the BORESIGHT push button and the GPS push button. Remove the .5 mil error that was entered in step 5 by moving the reticle left .5 mil to its original boresight value. Press the ENTER push button twice to enter the new value.

Notes. Failing to meet the criteria in steps 6 and 9 may indicate that the MRS collimator on the muzzle was not aligned when it was attached to the muzzle, or the collimator shifted after initial alignment. In either situation, a turret mechanic must realign the collimator.

Except for realignment of the collimator by a turret mechanic, there is no way to correct a failure of the MRS to restore boresight reference. MRS updating is generally not as accurate as total system reboresighting.

12. Record any deficiencies on DA Form 2404 or ULLS Form 5988E.

Chapter 4
Ammunition and Target Destruction

The success of U.S. armored forces depends on the effective use of the appropriate ammunition against battlefield targets. This chapter discusses the characteristics, capabilities, and employment of main gun, machine gun, and smoke grenade ammunition.

Note. For further information on ammunition see—
FT 105-A-4, Apr 96 (105-mm ammunition).
FT 120-D-2, 15 Apr 94 (120-mm ammunition).
FT .50-H-3 (caliber .50 ammunition).
FT 7.62-A-2 (7.62-mm ammunition).

CONTENTS

Main Gun Ammunition

CLASSIFICATION

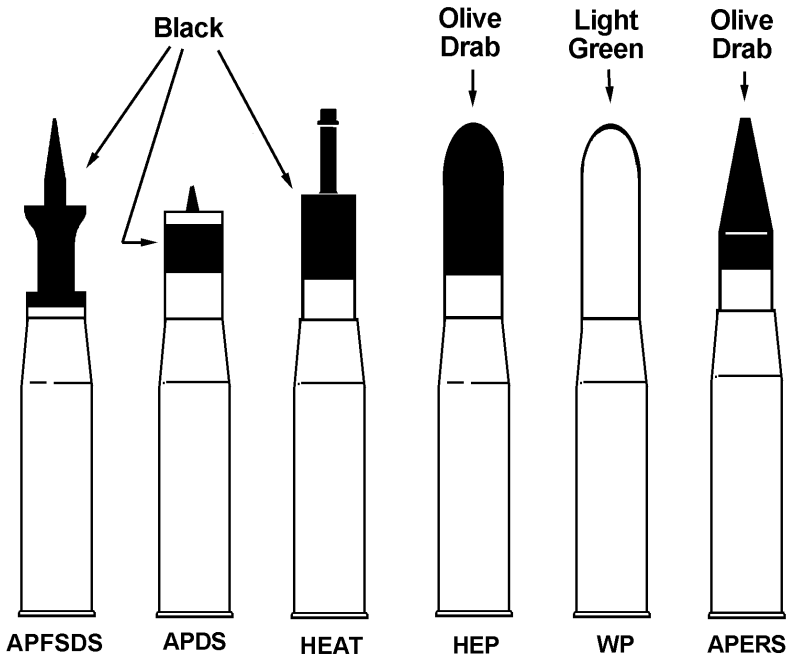
Conventional main gun ammunition is classified according to type and use.

- Armor-defeating ammunition:
  - Kinetic energy ammunition (sabot) is the primary round used against tank and tank-like targets. In a secondary role, it is used against helicopters.
  - Chemical energy ammunition (HEAT and MPAT) is the primary round used against lightly armored targets, field fortifications, and personnel. In a secondary role, it is used against tank and tank-like targets. When in air mode, MPAT is the primary round used against helicopters.
- Beehive and HEP ammunition. These rounds are used against troops or field fortifications.
- White phosphorus ammunition is used for marking and screening, and for incendiary purposes.
- Target practice ammunition is used for gunnery training. These rounds have ballistic characteristics similar to service ammunition.
- Dummy ammunition is used for practicing gunnery-related tasks; it has no propellant or explosive charge.

IDENTIFICATION

Main gun ammunition can be identified by shape, the projectile color code, and markings on the projectile. A standard NATO color code is used for main gun ammunition (see Figure 4-1, page 4-2 for 105-mm and Figure 4-2, page 4-3 for 120-mm). The projectile and the cartridge case have markings that provide additional information about the ammunition and the firing weapon:

- Tracer.
- Caliber and type of weapon.
- Type of filler.
- Type of projectile (round).
- Model of projectile (round).
- Ammunition lot number.
- Quick reference for round type.



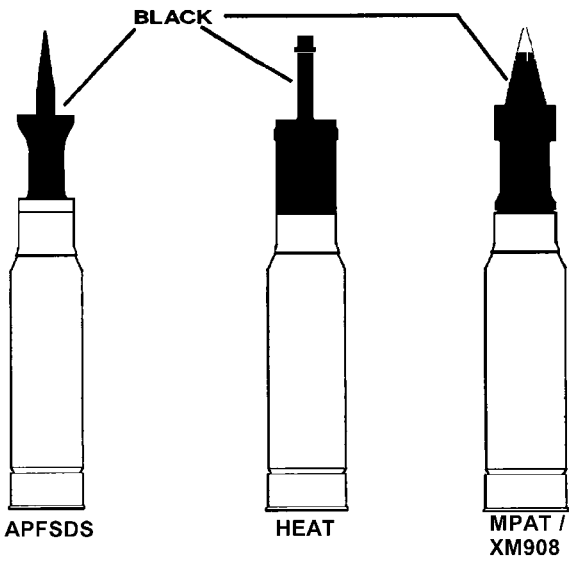
BASIC PROJECTILE COLOR INDICATES USE:

BLACK ..... Armor-defeating.
OLIVE DRAB..... Antipersonnel/antimateriel.
LIGHT GREEN..... Smoke.
LIGHT BLUE ..... Target practice.

COLORS INDICATING FILLER OR CHARGE:

WHITE LETTERS ..... Inert (no filler or charge).
YELLOW LETTERS ..... High-explosive filler.
RED LETTERS ..... Incendiary.
YELLOW BAND ..... Small amount of high-explosive charge.
WHITE DIAMONDS ..... Antipersonnel.
BLACK BAND ..... Secondary armor-defeating.
BLUE BAND..... Inert (explosive filler replaced with flaked lead and concrete).
BROWN ..... Low-explosive charge.

Figure 4-1. 105-mm Main Gun Round Projectile Color Code.



BASIC PROJECTILE COLOR INDICATES USE.

Black.....Armor-defeating.
Light Blue .....Target practice.

COLORS INDICATING FILLER OR CHARGE.

White Letters .....Inert (no filler or charge).
Yellow Letters.....High-explosive filler.

Figure 4-2. 120-mm Main Gun Round Projectile Color Code.

ROUND-TYPE QUICK REFERENCE MARKINGS

The M829A2, M830A1, and XM908 tactical rounds have special markings on the base case to help the loader quickly identify the types of rounds loaded in the ammunition racks (S2 for M829A2, MPAT for M830A1, and OR [obstacle-reducing] for XM908). Figure 4-3 shows how each marking appears on the base case.

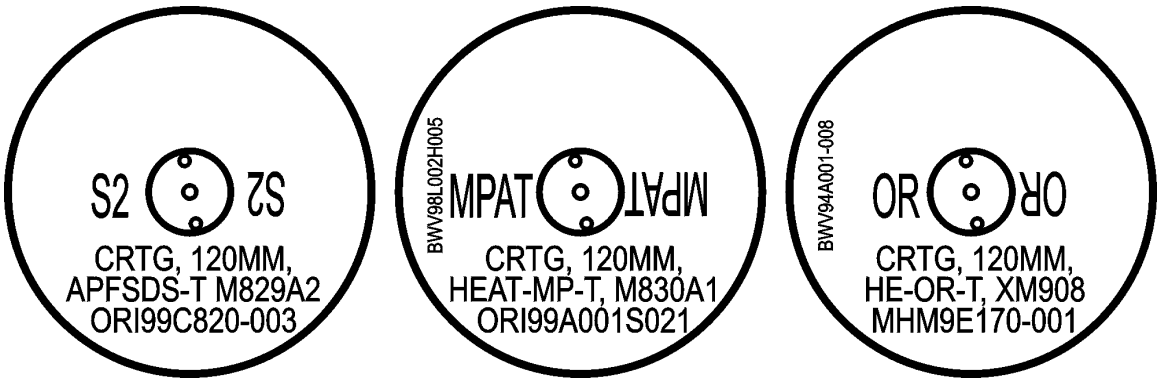
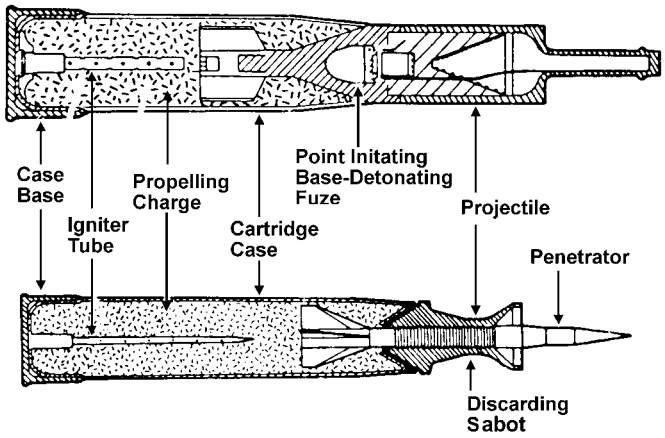


Figure 4-3. Aftcap Round-Type Quick Reference Markings.

COMPONENTS OF A MAIN GUN ROUND

A complete round of main gun ammunition is usually composed of the following basic parts; however, not all types of rounds will have every part listed:

- Cartridge case—the brass, steel, or combustible casing that contains the propellant and primer. When the round is fired, the cartridge case expands to seal the rear of the gun tube. (On the 120-mm round, the obturator on the base stub seals the rear of the gun tube.)
- Case base—the rear portion of the 120-mm ammunition that houses the primer, is ejected after firing, and provides rearward obturation.
- Propellant—the composition that burns, producing gas pressure that forces the projectile from the cartridge case toward the target.
- Primer—the cap in the base of the cartridge case that ignites the propellant charge.
- Projectile—the part of the round that travels through the gun tube.
- Subprojectile—the part of the projectile that travels to the target.
- Fuze—the part of the projectile that causes it to function upon impact or at a specific time (not currently used in kinetic-energy rounds).
- Ogive—the forward portion of the projectile. The ogive is designed to reduce air resistance and provide aerodynamic stability.
- Bourrelet—a raised metal or plastic ring around the outer forward surface of the projectile. Its purpose is to center the forward part of the projectile as it travels through the bore .
- Body—the part of the projectile between the bourrelet and the rotating bands. It contains either a subprojectile or an explosive chemical filler and fuze, or all three.
- Rotating band—the hard plastic or metallic ring(s) around the base of the projectile. It seals the propellant gas behind the base of the projectile and imparts spin (for rifled guns) to a spin-stabilized round, or absorbs spin on fin-stabilized rounds.
- Obturator—(105-mm sabot and all 120-mm rounds) the rubber seal that helps the rotating band seal the propellant gas behind the projectile.
- Tracer—an element inserted in the base of projectiles that, when ignited, burns and allows the projectile's trajectory and impact to be observed during flight.



Note. These drawings are meant to be generic in nature, not depicting any specific chemical or kinetic energy round.

Figure 4-4. Components of a Main Gun Round.

ARMOR-DEFEATING AMMUNITION

Armor-defeating projectiles use either kinetic energy or chemical energy to penetrate and destroy armored targets.

WARNING

Sabot, HEAT, MPAT, and HE-OR-T rounds will not be fired over friendly troops, unless troops are protected by adequate cover. Troops may be struck by the discarded components, or a full frontal impact switch may cause an air burst. The danger area extends to 1,000 meters (1,095 yards) from the gun and 70 meters (77 yards) on either side of the gun-target line.

ENVIRONMENTAL NOTE

The 105-mm service KE rounds contain either depleted uranium penetrators (M900, M833, M774) or tungsten alloy penetrators (M735, M728, M392A2). All U.S. 120-mm service KE rounds contain depleted uranium penetrators. After impacting a target, radioactive dust (DU rounds) and debris (both tungsten and DU) is created, which may cause heavy metal poisoning if ingested by personnel. When firing these combat-only rounds, commanders and crew members should take actions to minimize the environmental impact whenever possible.

- **In situations where time allows and the target can be destroyed by an alternate round, use of an alternate non-DU round not only conserves DU rounds, but is also less damaging to the environment.**
- **When operating OCONUS, host-nation regulations/agreements must also be taken into account.**
- **Radioactive materials and equipment must be handled and disposed of according to DA policy.**

SABOT

Sabot rounds are the primary armor-defeating round for both the 105-mm and 120-mm main guns and the most accurate of all tank ammunition. Sabot rounds use kinetic energy (the combined mass [weight] and velocity [speed] of the projectile) (no explosives are needed) to penetrate the target.

The effectiveness of sabot rounds depends on the density of the target surface; therefore, consider target armor thickness when selecting the appropriate armor-defeating round for a specific target—use sabot ammunition when faced with penetrating the thickest part of the target. Also, when possible, maneuver or situate your element to engage armored targets from the flank or rear where the armor is less dense.

Six types of 105-mm sabot rounds currently available for the M1 tank are (see Figures 4-6 through 4-8 on pages 4-7 through 4-9):

- M900 APFSDS-T.
- M833 APFSDS-T.
- M774 APFSDS-T.
- M735 APFSDS-T.
- M728 APDS-T.
- M392A2 APDS-T.

Three types of 120-mm sabot rounds currently available for the M1A1 and M1A2 tank are (see Figures 4-9 through 4-12 on pages 4-10 through 4-13):

- M829A2 APFSDS-T
- M829A1 APFSDS-T.
- M829 APFSDS-T.

HEAT

HEAT rounds are the secondary armor-defeating ammunition. The HEAT round is used primarily against lightly armored targets, field fortifications, and personnel. Each round consists of a steel body containing a high-explosive shaped charge, formed by a copper cone-shaped charge liner; the M830 (HEAT-MP-T) also includes a wave shaper. The projectile embodies a steel spike with a shoulder and nose switching mechanism for full frontal area functioning. Upon impact, one of the fuze sensors is activated. The fuze then detonates the high-explosive shaped charge, which collapses the cone assembly creating a high-velocity focused shock wave and a jet of metal particles that penetrate the target (see Figure 4-5). Fragmentation of the projectile body sidewall provides an antipersonnel capability.

Due to its slower muzzle velocity, HEAT rounds are not as accurate as sabot rounds at ranges beyond 2,000 meters. Since this round depends on chemical energy and not striking velocity, its ability to penetrate armor is as effective at 4,000 meters as it is at 200 meters.

Two types of 105-mm HEAT rounds, the M456A2 HEAT-MP-T and M456A1 HEAT-MP-T, are currently available for the M1 tank (see Figure 4-8 on page 4-9).

Two types of 120-mm HEAT rounds, the M830 HEAT-MP-T (see Figure 4-12 on page 4-13) and XM908 HE-OR-T (see Figure 4-24 on page 4-25), are available for the M1A1 and M1A2.

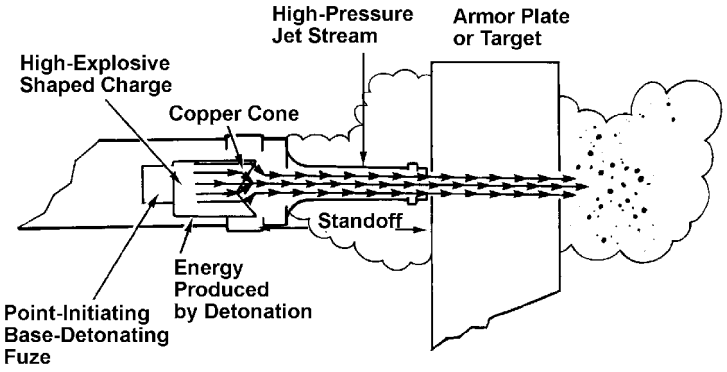


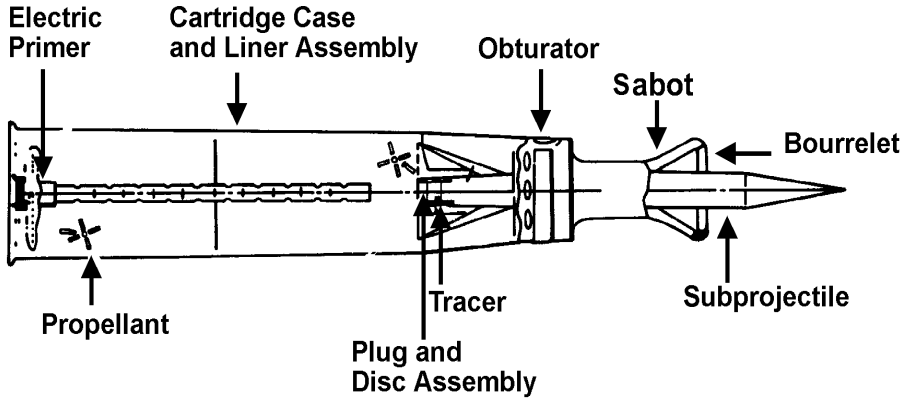
Figure 4-5. Chemical Energy Ammunition Effects.

MPAT

The 120-mm M830A1 MPAT round contains a high-explosive warhead equipped with a selectable proximity sensor and fuze that allows it to be fired in either AIR or GROUND mode. Its primary targets are light-armored ground targets, which are engaged with the fuze set to ground mode. It may also be used against bunkers, buildings, the side and rear of enemy tanks, and enemy personnel. With the fuze set to AIR mode, this round can be used in a self-defense role against enemy helicopters. When fired in the AIR mode, a black puff of smoke is produced when the proximity sensor and fuze function. This permits the crew to observe when and where the round functions in relation to the target. M830A1 cartridges are shipped to units with the fuze set to GROUND mode. The MPAT round is a fin-stabilized round with a three-piece discarding sabot, and is used in the 120-mm M256A1 smoothbore cannon (see Figure 4-11 on page 4-12).

TECHNICAL DATA

In the remainder of this chapter, there are pages that contain line drawings and some technical information for many of the 120-mm and 105-mm family of rounds. Storage, firing, and performance temperature limits are provided when available. The *storage temperature limits* are those limits that the round can withstand without damage, but the round must be returned to the *safe-to-fire temperatures* before firing. Rounds can be fired within the safe-to-fire temperature limits without damage to the round, tank, or crew, but performance may not meet certain requirements, for example, round-to-round dispersion. Within the *performance temperature limits*, rounds will meet all performance requirements.



Muzzle Velocity: 1,505 m/s (M900).
1,493 m/s (M833).
1,508 m/s (M774).
1,501 m/s (M735).

Penetrator Composition: Depleted uranium (M900, M833, and M774).
Tungsten carbide, nickel, and copper (M735).

Announced in fire command as: "SABOT" (pronounced SAY-BO).

Fuze: None.

Employment: Primary armor-defeating round against tanks or tank-like targets.

Projectile Color Code: Black with white letters.

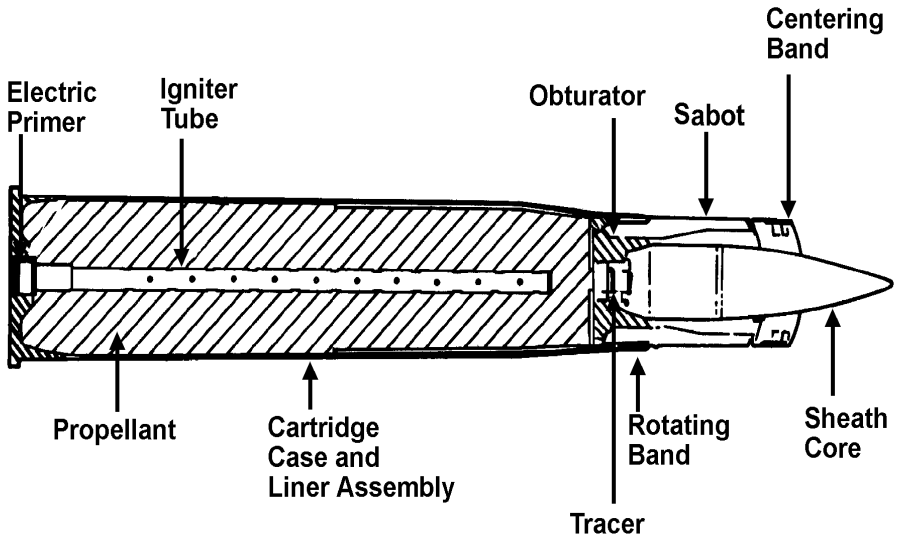
Weight: 40.8 lbs (M900).
38.2 lbs (M833).
37.8 lbs (M774).
39.5 lbs (M735).

Length: 39.5 in (M900).
39.3 in (M833).
35.8 in (M774).
37.9 in (M735).

Temperature Limits:

	Storage	Firing
M900	-35˚F to 145˚F	-20˚F to 120˚F
M833	-50˚F to 145˚F	-35˚F to 125˚F
M774	-70˚F to 160˚F	-35˚F to 125˚F
M735	-65˚F to 160˚F	-25˚F to 125˚F

Figure 4-6. M900/M833/M774/M735 APFSDS-T (105-mm).



Muzzle Velocity: 1,426 m/s (M728).
1,478 m/s (M392A2).

Penetrator Composition: Tungsten-carbide, nickel, and copper (M728).
Tungsten carbide (M392A2).

Announced in fire command as: "SABOT" (pronounced SAY-BO).

Fuze: None.

Employment: Against tanks or tank-like targets.

Projectile Color Code: Black with white letters.

Weight: 41.7 lbs (M728).
41.0 lbs (M392A2).

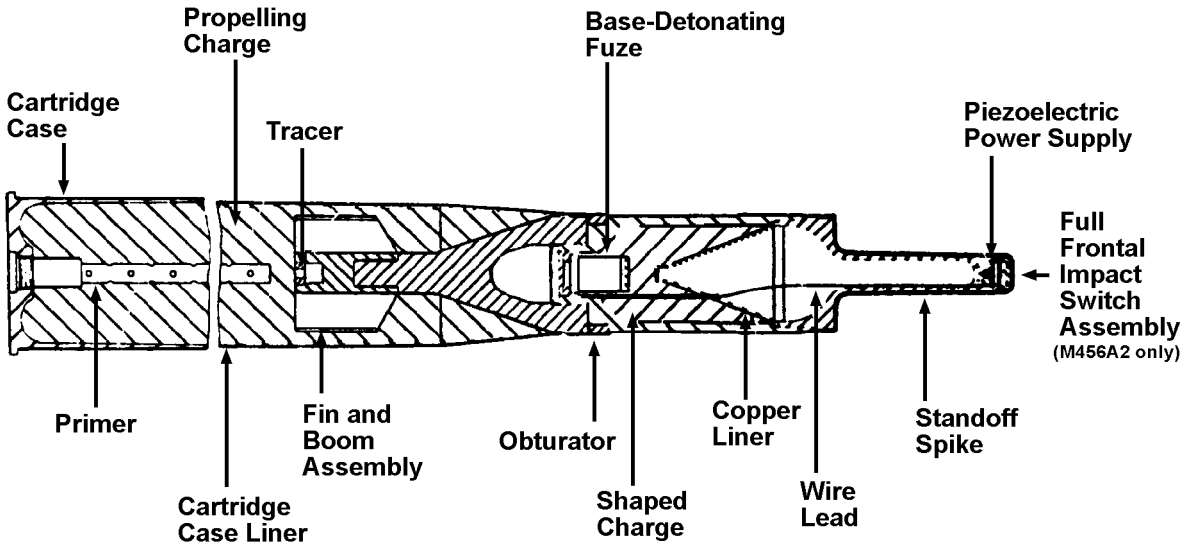
Length: 33.0 in maximum.

Temperature Limits:

	Storage	Firing
M728	-65˚F to 145˚F	-60˚F to 125˚F
M392A2	-80˚F* to 145˚F**	-40˚F to 125˚F

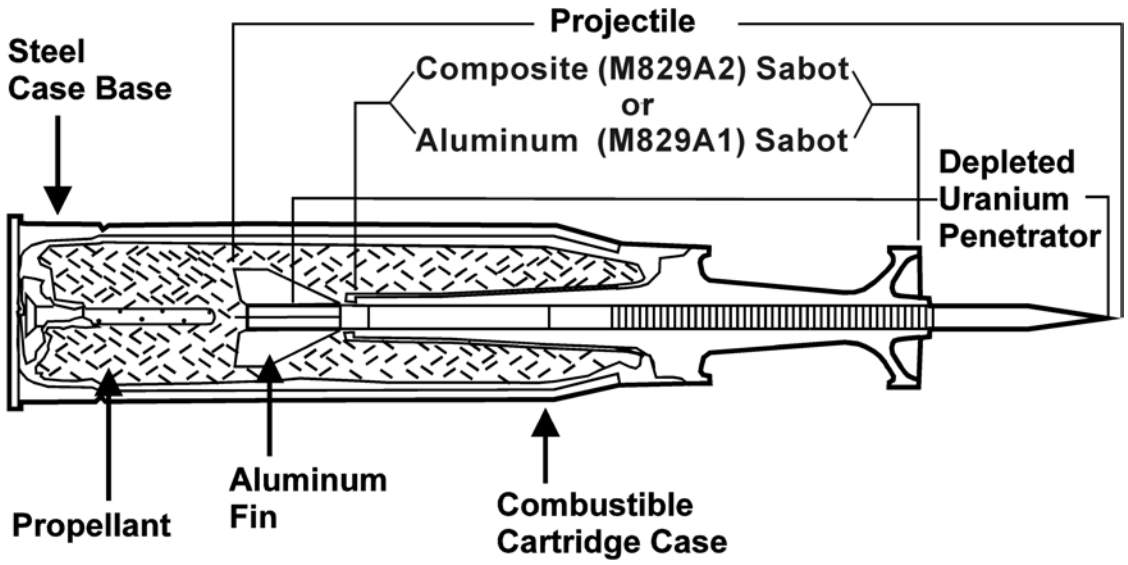
* Not more than three days.
** Not more than 4 hours per day.

Figure 4-7. M728/M392A2 APDS-T (105-mm).



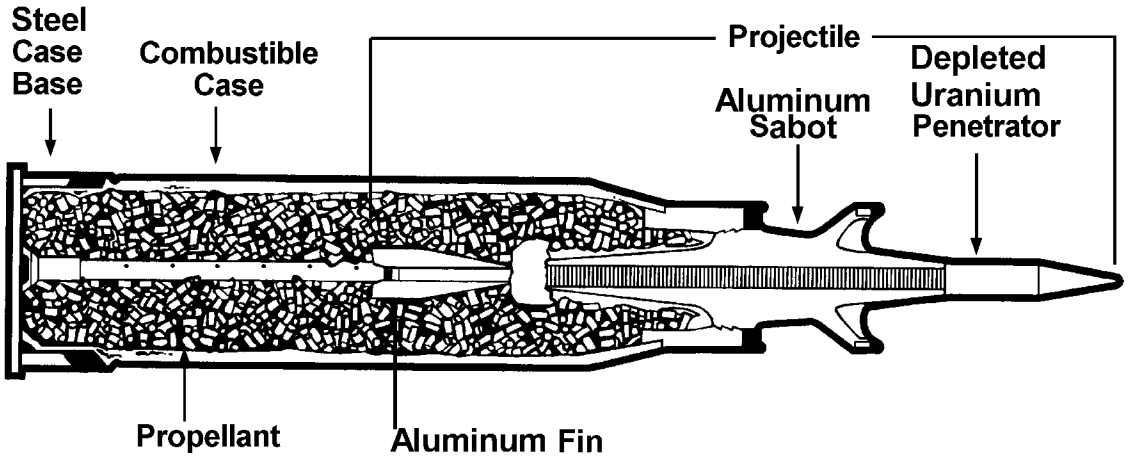
Muzzle Velocity:	1,173 m/s.
Announced in fire command as:	"HEAT."
Fuze:	Point-initiating, base-detonating (with full frontal area impact switch on the M456A2 only).
Employment:	Light-armored targets and field fortifications. Secondary round for tanks or tank-like targets.
Projectile Color Code:	Black with yellow letters.
Weight:	49.0 lbs.
Length:	39.6 in.
Storage Temperature Limits:	-65˚F to 145˚F
Firing Temperature Limits:	-40˚F to 125˚F

Figure 4-8. M456A1/M456A2 HEAT-MP-T (105-mm).



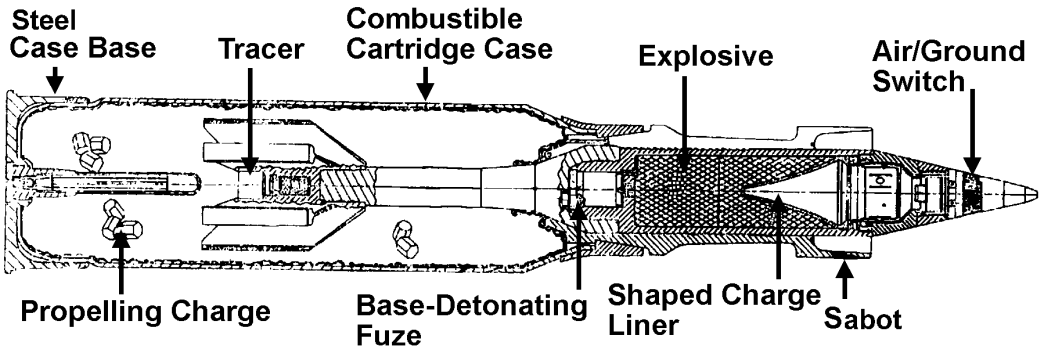
Muzzle Velocity:	1,575 m/s (M829A1). 1,680 m/s (M829A2).
Penetrator Composition:	Depleted uranium.
Announced in fire command as:	“SABOT” (pronounced SAY-BO).
Fuze:	None.
Employment:	Primary armor-defeating round against tanks or tank-like targets.
Projectile Color Code:	Black with white letters.
Weight:	46.2 lbs (M829A1). 44.9 lbs (M829A2).
Length:	38.7 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-25˚F to 125˚F
Performance Temperature Limits:	-25˚F to 125˚F

Figure 4-9. M829A1/M829A2 APFSDS-T (120-mm).



Muzzle Velocity:	1,670 m/s.
Penetrator Composition:	Depleted uranium.
Announced in fire command as:	“SABOT” (pronounced SAY-BO).
Fuze:	None.
Employment:	Primary armor-defeating round against tanks or tank-like targets.
Projectile Color Code:	Black with white letters.
Weight:	41.2 lbs.
Length:	36.8 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-50˚F to 145˚F
Performance Temperature Limits:	-25˚F to 125˚F

Figure 4-10. M829 APFSDS-T (120-mm).

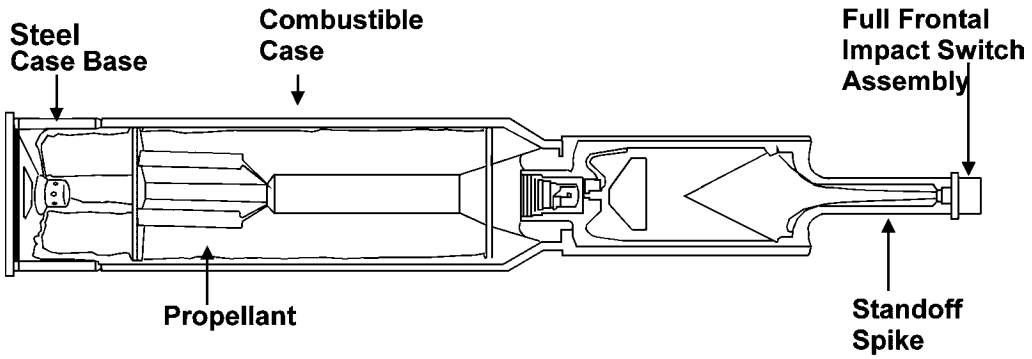


Muzzle Velocity:	1,410 m/s.
Announced in fire command as:	"MPAT" (ground mode). "MPAT AIR" (air mode).
Fuze:	Point-initiating, base-detonating (ground mode). Proximity or point-initiating, base-detonating (air mode).
Employment:	**MPAT GROUND:** Light-armored vehicles, buildings, bunkers, ATGM platforms, and personnel. Secondary round for tanks or tank-like targets. **MPAT AIR:** Helicopters.
Projectile Color Code:	Black with yellow letters.
Weight:	50.1 lbs.
Length:	38.7 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-25˚F to 120˚F
Performance Temperature Limits:	-25˚F to 120˚F

WARNING

The nose of the M830A1 contains the air/ground sensor. This sensor can be damaged if it is struck on hard surfaces inside the turret (turret strut, breech, etc.) with moderate force. Loaders must take precaution to avoid striking the nose during the loading process.

Figure 4-11. M830A1 HEAT-MP-T (120-mm).



Muzzle Velocity:	1,140 m/s.
Announced in fire command as:	"HEAT."
Fuze:	Point-initiating, base-detonating and full frontal area impact switch.
Employment:	Light-armored targets and field fortifications. Secondary round for tanks or tank-like targets.
Projectile Color Code:	Black with yellow letters.
Weight:	53.4 lbs.
Length:	38.6 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-50˚F to 145˚F
Performance Temperature Limits:	-25˚F to 125˚F

Figure 4-12. M830 HEAT-MP-T (120-mm).

TARGET-PRACTICE AMMUNITION

Target-practice ammunition is used during gunnery training in place of service ammunition. On the M1 tank, these rounds are nearly ballistically matched to service rounds out to approximately 2,000 meters. Beyond this range, as the ballistic similarities decrease, their accuracy decreases. The fire control system on the M1A1 and M1A2 tanks has the ballistics for each training round. In the fire command, target-practice rounds are announced as the round they represent. Their color code is light blue with white letters.

Note. All U.S. and German HEAT training rounds have arrows stamped on the spike. All HEAT training rounds that do not have arrows stamped on the spike should be treated as service HEAT rounds.

Target-practice rounds used in Abrams tanks are—

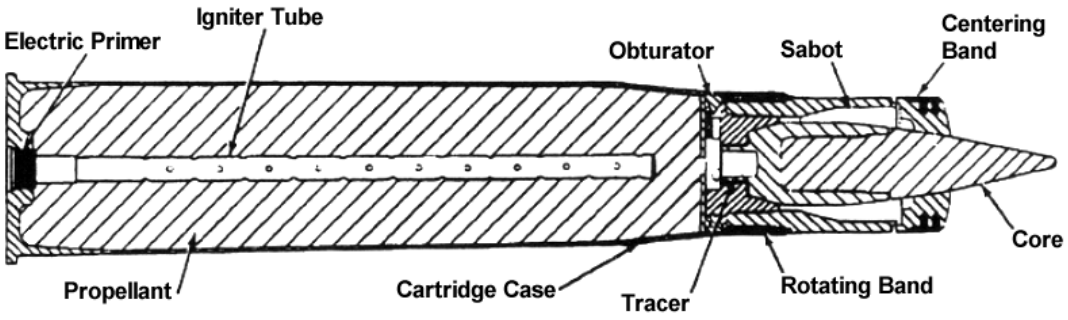
- 105-mm M490A1 TP-T.
- 105-mm M724A1 TPDS-T.
- 120-mm M831 HEAT-TP-T.
- 120-mm M831A1 HEAT-TP-T.
- 120-mm M865 TPCSDS-T.
- 120-mm M865(IP) TPCSDS-T.

Note. Since **M865** and **M865IP** use M865 as the model number, the following tips distinguish the M865IP from the M865:

- The M865(IP) sabot sections are one inch shorter.
- The M865 (IP) bourrelet is smooth, not grooved.
- The M865 (IP) lettering on sabot sections is two lines (1/4-inch high) instead of three lines (1/2-inch high).
- M865(IP) NSN: 1315-01-288-5545.
- M865 in a wooden box: NSN 1315-01-165-6488.
- M865 in a metal container: NSN 1315-01-242-4796.

Note. The way to distinguish the **M831A1** from the **M831** is—

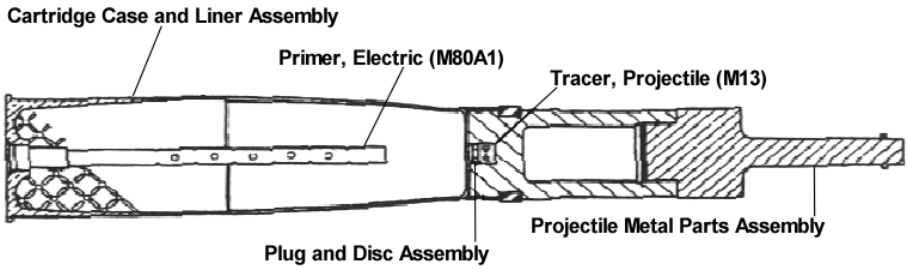
- The appropriate model number is marked on the projectile and the case base.
- The M831A1 has a nylon obturator.
- The M831A1 has an aluminum body and steel standoff spike. The body is anodized light blue with a dark blue standoff spike.
- M831A1 U.S. Army NSN: 1315-01-369-6612-C784.
- USMC NSN: 1315-01-369-1901-C784.



Muzzle Velocity:	1,539 m/s.
Announced in fire command as:	"SABOT" (pronounced SAY-BO).
Fuze:	None.
Employment:	Primary armor-defeating round against tanks or tank-like targets.
Projectile Color Code:	Light blue with white letters.
Weight:	32 lbs.
Length:	33 in.
Storage Temperature Limits:	-65˚F to 145˚F
Firing Temperature Limits:	-80˚F* to 160˚F**

* Not more than three days.
** Not more than 4 hours per day.

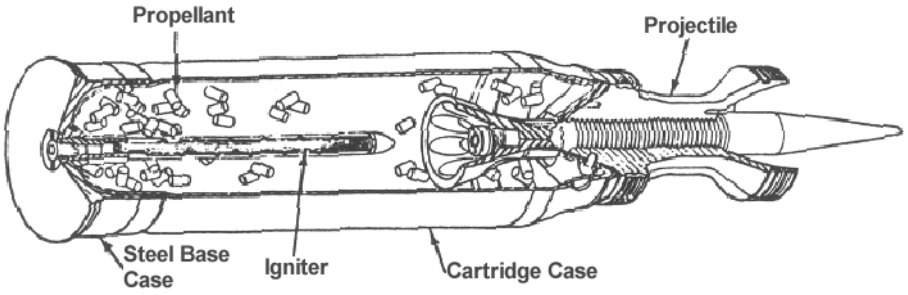
Figure 4-13. M724A1 TPDS-T (105mm)



Muzzle Velocity:	1,173 m/s.
Announced in fire command as:	"HEAT."
Fuze:	None.
Employment:	Light armored targets and field fortifications. Secondary round against tanks or tank-like targets.
Projectile Color Code:	Light blue with white letters.
Weight:	45.8 lbs.
Length:	39.3 in.
Storage Temperature Limits:	-80˚F* to 160˚F**
Firing Temperature Limits:	-40˚F to 125˚F

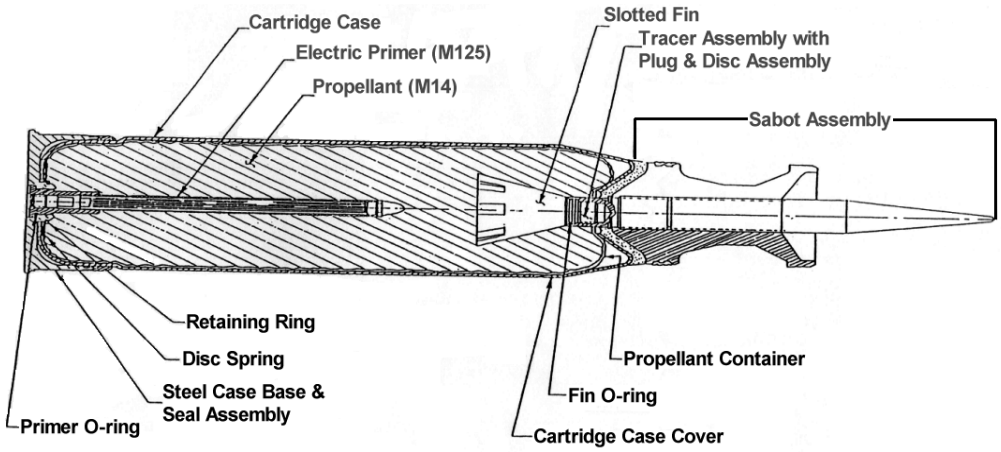
* Not more than three days.
** Not more than 4 hours per day.

Figure 4-14. M490A1 TP-T (105mm)



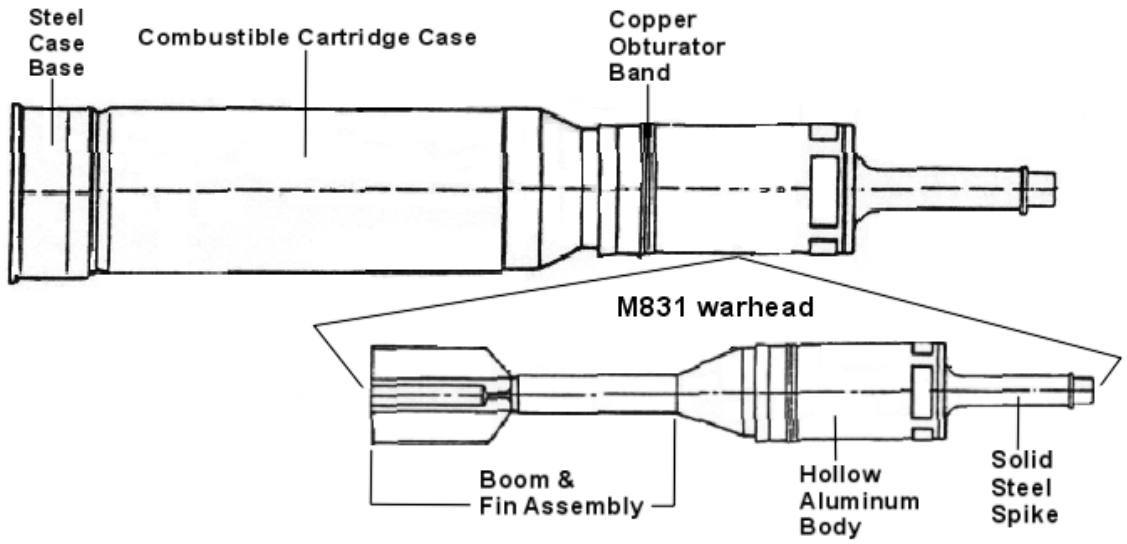
Muzzle Velocity:	1,700 m/s.
Announced in fire command as:	“SABOT” (pronounced as SAY-BO).
Fuze:	None.
Employment:	Primary armor-defeating round against tanks or tank-like targets.
Projectile Color Code:	Light blue with white letters.
Weight:	37.4 lbs.
Length:	34.7 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-50˚F to 145˚F
Performance Temperature Limits:	-25˚F to 125˚F

Figure 4-15. M865 TPCSDS-T (120mm).



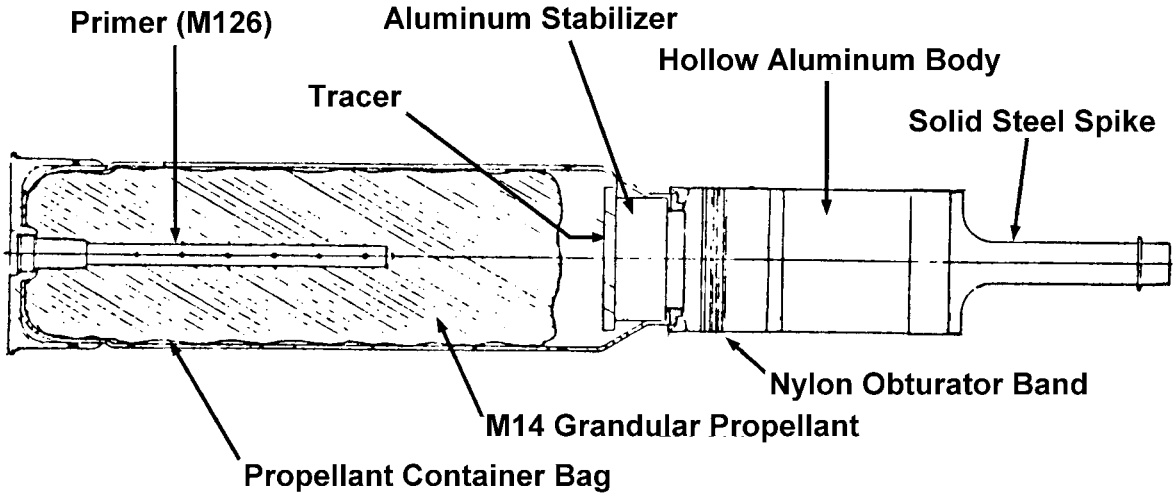
Muzzle Velocity:	1,700 m/s.
Announced in fire command as:	“SABOT” (pronounced as SAY-BO).
Fuze:	None.
Employment:	Primary armor-defeating round against tanks or tank-like targets.
Projectile Color Code:	Light blue with white letters.
Weight:	37.8 lbs.
Length:	34.7 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-50˚F to 145˚F
Performance Temperature Limits:	-25˚F to 125˚F

Figure 4-16. M865 (IP) TPCSDS-T (120mm).



Muzzle Velocity:	1,140 m/s.
Announced in fire command as:	“HEAT.”
Fuze:	None.
Employment:	Light armored targets and field fortifications. Secondary round against tanks or tank-like targets.
Projectile Color Code:	Light blue with white letters.
Weight:	53.4 lbs.
Length:	38.6 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-50˚F to 145˚F
Performance Temperature Limits:	-25˚F to 125˚F

Figure 4-17. M831 HEAT-TP-T (120mm)



Muzzle Velocity:	1,140 m/s.
Announced in fire command as:	"HEAT."
Fuze:	None.
Employment:	Light armored targets and field fortifications. Secondary round against tanks or tank-like targets.
Projectile Color Code:	Light blue with white letters.
Weight:	51.4 lbs.
Length:	38.6 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-50˚F to 145˚F
Performance Temperature Limits:	-25˚F to 125˚F

Figure 4-18. M831A1 HEAT-TP-T (120mm).

AMMUNITION STOWAGE PLAN

The ammunition stowage plan for all tanks within a battalion-size unit is part of the unit SOP. The stowage plan should include the location of all ammunition authorized for the basic load, by type and number of rounds. During darkness, when lights inside the turret will reduce the crew's night vision or give away the tank's position, a standardized stowage plan will help the loader rapidly locate the ammunition announced in the initial fire command. The stowage plan also helps the crew keep track of the number of rounds (by type) that have been fired.

When loading the Abrams tank, the loader should place sabot rounds along the sides and across the top in the turret and hull compartments. HEAT rounds should be loaded in the center racks of the compartments.

SAFETY NOTES

To decrease the chance of injury, ammunition doors must be closed at all times during main gun engagements, except to remove rounds.

M831A1 and M865 rounds will not be stored in the hull ammunition compartment due to the vulnerability of the propellant. Crews should load only enough training ammunition in the bustle compartments to achieve immediate training objectives.

Machine Gun Ammunition

LINK BELTS

Machine gun ammunition is belted in disintegrating metallic link belts. Caliber .50 M2 HB machine gun ammunition is linked with the M9 closed link. Both the 7.62-mm coax machine gun and the loader's machine gun use the M13 clip-type open link.

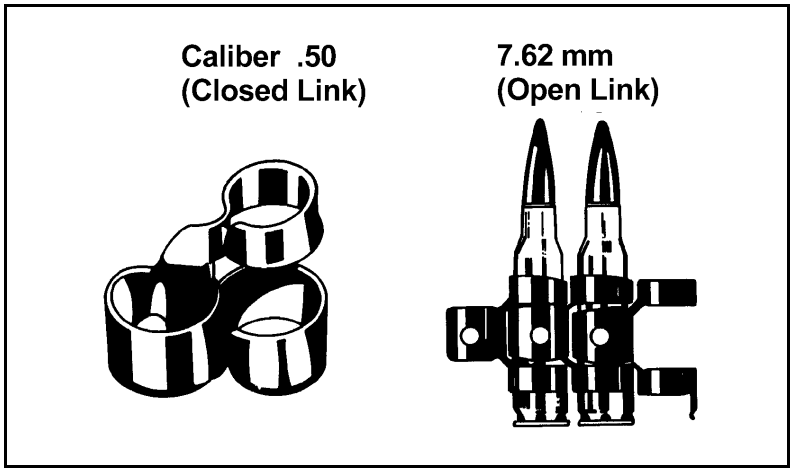


Figure 4-19. Link Belts.

IDENTIFICATION OF MACHINE GUN AMMUNITION BY COLOR CODE

Machine gun ammunition is identified by type, caliber, model, and lot number. A color code on the bullet tip or band identifies the type. Markings are also located on packing containers.

COLOR OF TIP OR BAND ON BULLET	NATO MARKING	TYPE OF CARTRIDGE
BLACK		Armor-piercing
SILVER		Armor-piercing incendiary
RED AND SILVER		Armor-piercing incendiary tracer
RED		Tracer
NOT PAINTED		Ball
GREEN AND WHITE		Frangible
BLUE		Incendiary

Notes. Dummy ammunition is identified by a corrugated, or perforated, cartridge case. It is used to train clearing, loading, and immediate action on the machine gun.

Blank ammunition is identified by a colored plug or crimped forward end in place of the projectile for caliber .50 ammunition, and an elongated case and plug for 7.62-mm ammunition.

Figure 4-20. Ammunition Color Code/NATO Marking Chart.

Smoke Grenade Ammunition

The L8A1, L8A3, and M76 infrared smoke grenades are fired from the M250 grenade launcher mounted on the Abrams tank to provide screening protection for the tank and crew. The M82 smoke grenade is designed to simulate the L8A3 and M76 smoke grenade. The M250 grenade launcher consists of two dischargers (one on either side of the turret), mounting hardware, arming and firing switches on the TC's panel, and wiring. Six smoke grenades are loaded in each discharger.

WARNING

Smoke grenades contain fire-producing chemicals and are dangerous to exposed personnel outside the vehicle.

United Kingdom (UK) L8A1 and L8A3 red phosphorus screening smoke grenades are identified by the markings at the base of the casing (see Figure 4-21). The grenade is propelled from the discharger by pressure build-up in the metal base when electrical current at the electrical firing clip ignites the squib-type electric fuze and propellant charge. The propellant charge simultaneously ignites the delay composition within the delay holder. During flight, the delay composition burns through and ignites the black powder bursting charge. The bursting charge ignites the red phosphorus and butyl rubber composition and bursts the rubber body, dispensing the burning red phosphorus and butyl rubber pellets to produce a smoke cloud.

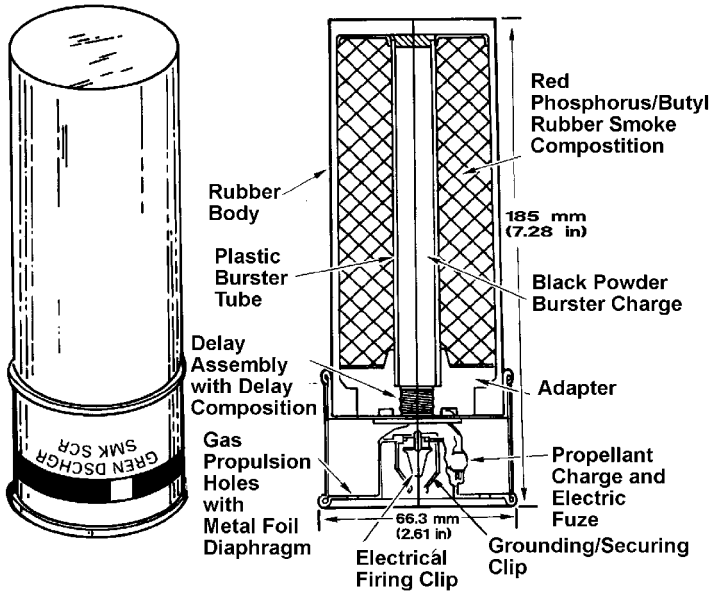


Figure 4-21. L8A1 and L8A3 Smoke Grenade.

The M76 infrared screening smoke grenade is identified by the markings at the base of the casing. The grenade is propelled from the discharger when an electrical current at the firing contact activates the electrical match. The electrical match ignites the propellant, which both launches the grenade and ignites the pyrotechnic time delay detonator. Launch acceleration causes the setback lock to displace aft, out of engagement with the safe and arm slider/bore rider. When the slider/bore rider clears the launch tube, it moves into the armed position, which aligns the transfer lead with the time delay detonator and the booster lead. When the time delay detonator ignites the transfer lead, booster lead, and central burster, the grenade bursts, creating an infrared obscuring cloud.

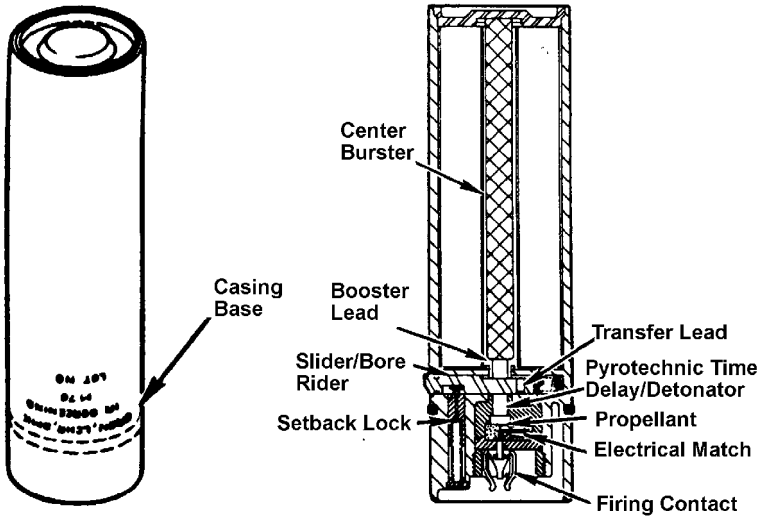


Figure 4-22. M76 Smoke Grenade.

The M82 smoke grenade is identified by the markings at the base of the casing. The M82 is an electronically initiated, propellant-launched grenade that functions to disseminate a screening cloud 30 meters forward of the firing vehicle. The environmentally acceptable smoke composition consists of 1.8 pounds of titanium dioxide. The grenade's plastic body houses the launch system, the safe and arming mechanism, the explosive booster and burster, and the smoke composition. The M82 is designed to simulate the L8A3 and M76 smoke grenade and can be used during gunnery or force-on-force training.

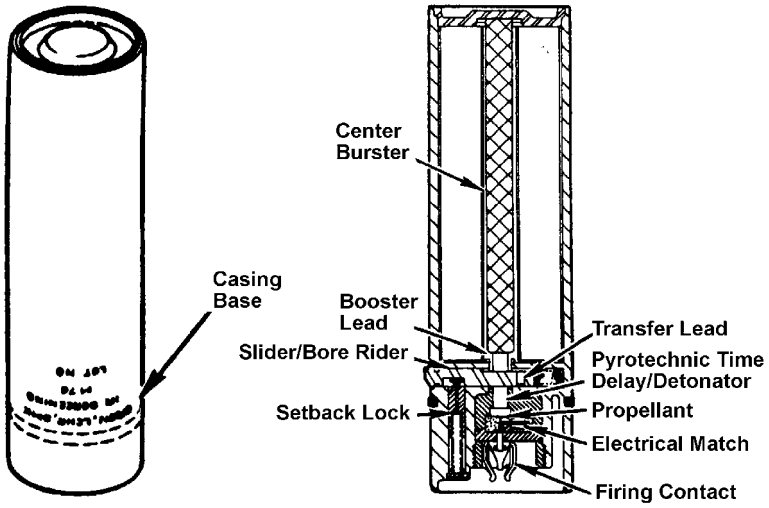


Figure 4-23. M82 Smoke Grenade.

Limited-Issue 120-mm Ammunition

DESCRIPTION

The XM908 is a highly explosive, obstacle-reducing round with tracer. It is a full-service, tactical, 120-mm round fired from the M256 cannon system. The round is similar in appearance to the M830A1 MPAT round. Major differences include:

- A steel nose cap painted yellow in place of the proximity sensor.
- Markings on the projectile.
- Markings on the case base that identify the round as the HE-OR-T XM908.

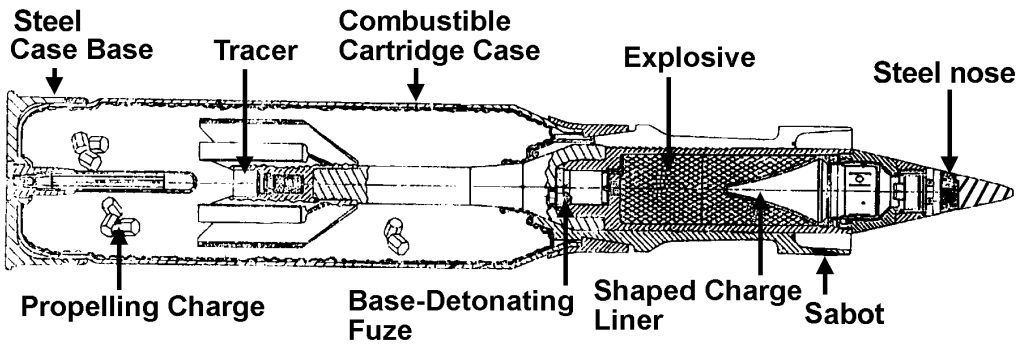
The weight of the round and center of gravity are nearly identical to the M830A1 MPAT round.

FUNCTIONING

Loading and firing procedures for the XM908 are basically the same as those used for all 120-mm tank rounds. The XM908 contains a high-explosive filler with a three-part fusing system. This fusing system consists of the M774 base element, flexible communication circuit (FCC), and frontal impact switch assembly (FISA). Upon impact, the steel nose penetrates the target, and a firing signal is sent to the M774 fuze. This initiates the firing sequence and full detonation occurs. The steel nose penetration allows the munition to explode inside the target. When firing at concrete obstacles, this penetration will reduce the obstacle more efficiently.

GENERAL USAGE

The XM908 round will primarily be used to reduce concrete obstacles into rubble small enough to be cleared by either unit organic equipment or external support. Live-fire test results have shown that this round is also effective against concrete bridge pylons. Units now have the capability to destroy bridges or damage them enough to greatly hinder their carrying capacities. This action could be used to create an obstacle that would greatly restrict or impede enemy movement.



Muzzle Velocity:	1,410 m/s.
Announced in fire command as:	“OR (Oh Are).”
Fuze:	Point-initiating, base-detonating.
Employment:	To reduce concrete structures.
Projectile Color Code:	Black with yellow letters and a yellow steel nose.
Weight:	50.1 lbs.
Length:	38.7 in.
Storage Temperature Limits:	-50˚F to 145˚F
Safe-to-Fire Temperature Limits:	-25˚F to 120˚F
Performance Temperature Limits:	-25˚F to 120˚F

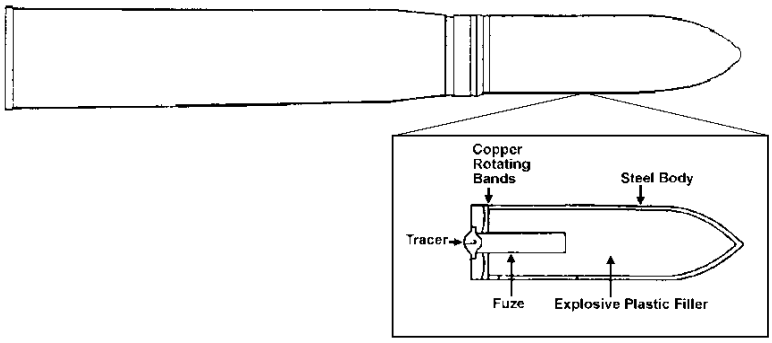
Figure 4-24. XM908 HE-OR-T (120-mm).

Limited-Issue 105-mm Ammunition

HEP, beehive, and WP 105-mm ammunition are no longer manufactured, but are still in war stocks.

HEP AMMUNITION

HEP ammunition is used primarily against bunkers and field fortifications with secondary armor-defeating capabilities. HEP-T ammunition can be used against troops when blast concussion and fragmentation are desired. It can also be used against buildings and crew-served weapon emplacements at extended ranges (beyond 2,000 meters). It is relatively easy to observe this round due to its high trajectory and slow muzzle velocity. It has greater blast, concussion, and fragmentation effect than sabot and HEAT rounds. HEP ammunition has a secondary armor-defeating capability against light armor; as a last resort, it can also be used against tanks. When a HEP round detonates against a hard surface, depending on the type and thickness of the armor hit, the opposite side will shatter into small pieces (spalling). This may kill or injure the crew and damage fire control instruments and other less rugged components. The effects on concrete (scabbing) are the same. The 105-mm HEP round can destroy reinforced concrete 6 to 8 feet thick, although it may take three or four rounds.



Muzzle Velocity:	731 m/s.
Announced in fire command as:	"HEP."
Fuze:	Base-detonating.
Employment:	Against bunkers and field fortifications with secondary armor-defeating capabilities. Can be used against troops when blast concussion and fragmentation are desired. Can also be used against buildings and crew-served weapon emplacements at extended ranges (beyond 2,000 meters).
Projectile Color Code:	Olive drab with black and yellow letters.
Weight:	45 lbs.
Length:	37 in.
Storage Temperature Limits:	-80˚F* to 160˚F**
Firing Temperature Limits:	-40˚F to 125˚F

* Not more than three days.
** Not more than 4 hours per day.

Figure 4-25. M393A2 HEP-T Projectile (105-mm).

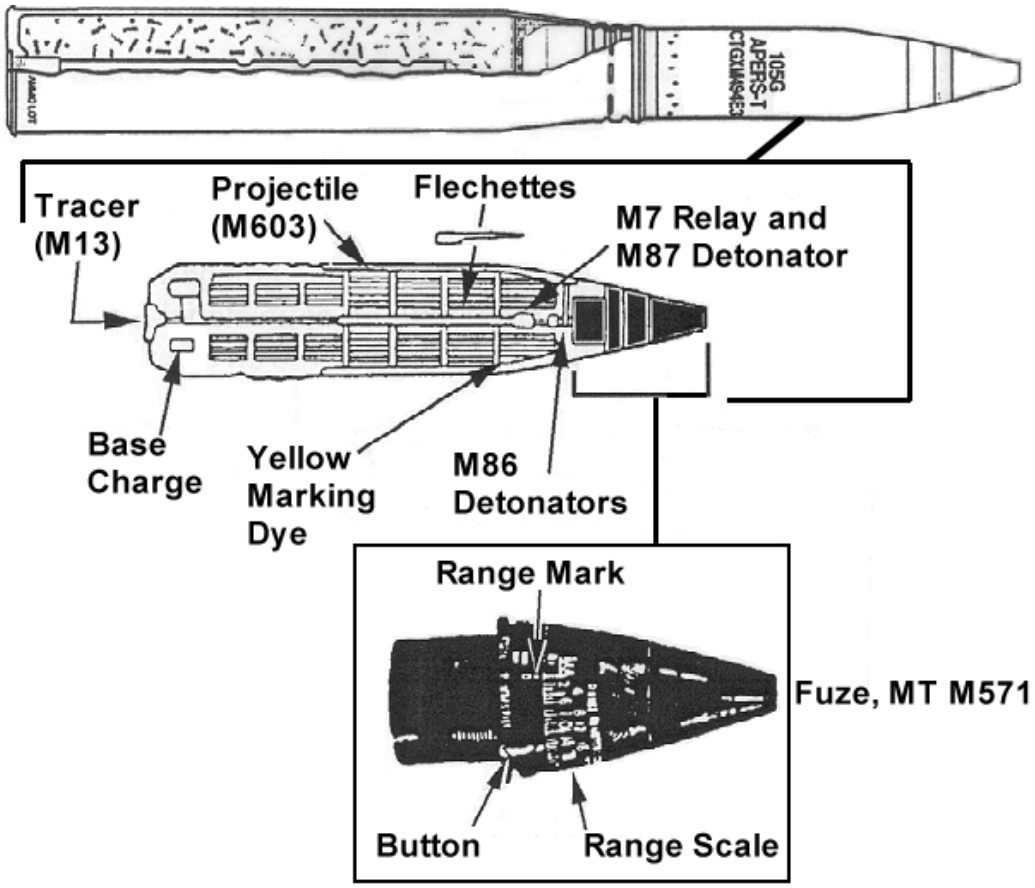
BEEHIVE AMMUNITION (M494 APERS-T)

The beehive round is used primarily against troops in the open. It is filled with 5,000 subprojectiles (flechettes) that disperse in the target area. It has a mechanical time fuze that can be set for muzzle action or to function at any range from 200 to 4,400 meters (in 100-meter increments). The range scale on the cap of the fuze is marked every 100 meters and numbered every 200 meters. To apply a range setting, the loader depresses the setter button on the side of the fuze and rotates the range scale clockwise until the index mark is aligned with the range announced in the fire command. The fuze functions 75 to 100 meters short of the indexed range to provide the best flechette dispersion before reaching the target. A puff of yellow smoke enables the crew to observe where the fuze functioned, in relation to the target, and make subsequent adjustments.

Note. If the round is not fired after indexing a range, return the fuze to the original muzzle action setting by continuing to rotate the cap clockwise.

WARNING

Never fire beehive ammunition over the heads of exposed friendly troops. When firing muzzle action, make sure that all personnel clear the dispersion cone area and take cover.



Muzzle Velocity:	823 m/s.
Announced in fire command as:	"BEEHIVE," if the target is within 300 meters. If the target is beyond 300 meters, it will be announced as "BEEHIVE TIME," with a range element in the fire command.
Fuze:	Mechanical-time (M571).
Employment:	Troops in the open.
Projectile Color Code:	Olive drab with yellow band, white letters, and white diamonds.
Weight:	55 lbs.
Length:	39.17 in
Storage Temperature Limits:	-65˚F to 145˚F
Firing Temperature Limits:	-40˚F to 125˚F

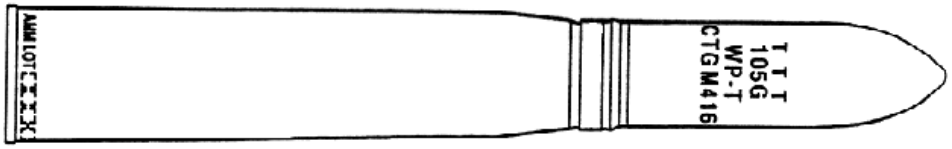
Figure 4-26. M494 APERS-T Projectile (105-mm).

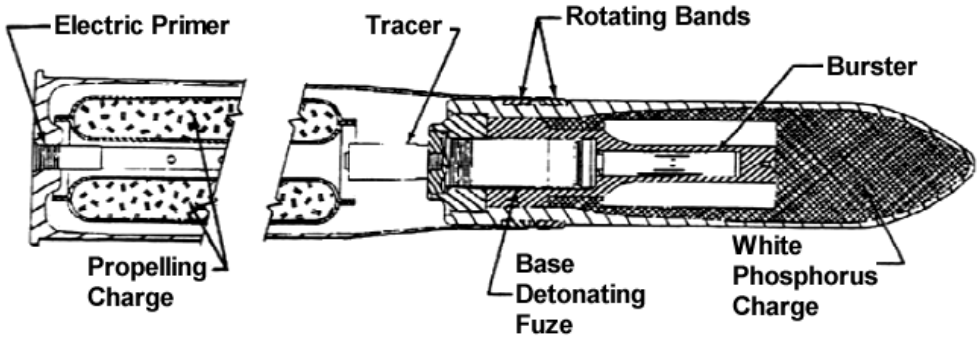
WHITE PHOSPHORUS (M416 WP-T)

The primary purpose of WP ammunition is to mark and screen targets; however, it can also be used to ignite combustible material or for psychological effect. Upon impact, the fuze in the base of the projectile detonates a burster charge, which ruptures the projectile and disperses the white phosphorus. When exposed to air, white phosphorus burns, producing thick white smoke. When white phosphorus touches combustible material or skin, it sticks and burns. For maximum damage to combustible structures, the round should be fired into an enclosure such as a bunker or the ground floor of a building. Although WP ammunition does not have the destructive capability of antimateriel rounds, it has a much greater psychological effect, and is especially effective when employed with other main gun ammunition.

Two important points should be remembered when handling and stowing WP ammunition:

- The white phosphorus in the projectile is sensitive to heat and will liquefy at 111˚F. Rounds exposed to such temperatures should not be used.
- Stowing the round on its side can cause a gas pocket to form inside the projectile causing erratic flight when fired. However, there are no ammunition racks on the Abrams tank in which WP-T can be stowed upright on its base.





Muzzle Velocity:	731.5 m/s.
Announced in fire command as:	"SMOKE."
Fuze:	Base-detonating.
Employment:	Marking, screening, or incendiary.
Projectile Color Code:	Light green with yellow band and red letters.
Weight:	45.5 lbs.
Length:	37 in.
Storage Temperature Limits:	-80˚F* to 160˚F**
Firing Temperature Limits:	-40˚F to 125˚F

* Not more than three days.
** Not more than 4 hours per day.

Figure 4-27. M416 WP-T Projectile (105-mm).

Chapter 5

Screening Test

To ensure tanks can fire accurately using the fleet zero (CCF) method of calibration, a screening test is conducted at the start of every live-fire training cycle or when a major fire control system component (such as the GPS, gun tube, recoil mechanism, and GTD) is replaced.

This chapter also discusses the use of the M1A1 gunner's quadrant end-for-end test.

CONTENTS

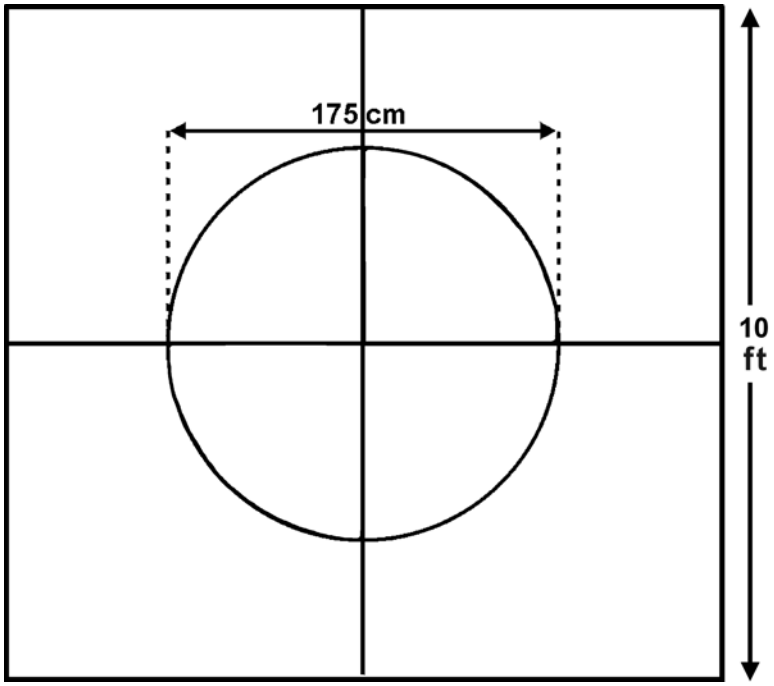
Proofing Team

The commander and master gunner must select the most technically competent TCs and gunners to act as the proofing team. At home station, the proofing team assists the master gunner with training the tank crews, as necessary (or directed by the commander). The proofing team must be on hand to help crews prepare for, and conduct, the screening test. The proofing team also assists the crew in firing the screening test, if necessary. (When available, direct support contact teams should also participate.) *Success of the screening test depends on the proofing team and crew members eliminating mechanical faults and crew errors before firing the first round of the screening test*. The following must be completed before the screening test:

- Collimation checks of the MBD (M26A1 and M27A1) (see Chapter 2, *Boresighting*).
- Preventive maintenance checks and services (see appropriate Operator's Manual).
- Armament accuracy checks (see Chapter 3, *Armament Accuracy Checks*).
- Boresighting with an MBD (see Chapter 2).
- Verify plumb and synchronization (M1A2 and M1A2 SEP) (see appropriate Operator's Manual).

Screening Procedures

The screening test consists of firing first sabot, then HEAT ammunition at a screening test target (see Figure 5-1) at 1,500 meters (M1A1, M1A2, and M1A2 SEP) or 1,200 meters (M1). (The target must be within [+ or -] 20 meters of the required range.)



Note. Units may use a fill color inside the circle to ease in round sensing.

Figure 5-1. Screening Test Target (ST-5).

The TC ensures the gunner makes a precise lay using the power control handles with the FIRE CONTROL MODE switch in the NORMAL position. The gunner lases to the target and announces the range to the target. If the correct range cannot be obtained, the known range must be indexed into the fire control system. Using the power control handles, the gunner makes a precise lay on the target aiming point, making the last movement up. When firing, the gunner keeps at least one of the palm switches on the gunner's power control handles depressed. To pass the screening test, one round for each ammunition type must hit the target fully within the circle. Targets should be checked physically or confirmed with high-power optics. There is no time limit for this screening test. The following steps outline the screening test procedures:

Notes. If the tank was given a discrete CCF during the LFAST, and no turret components have been replaced, fire the LFAST with the discrete CCF.

If the tank fires erratically during the screening test, the proofing team should inspect the tank. If more than the full width or height of the ST-5 circle separates the round strikes, the tank is firing erratically, and the problem must be fixed.

Zero the coax and M2 caliber .50 machine guns in accordance with the operator’s manual (see also page 5-24, this chapter).

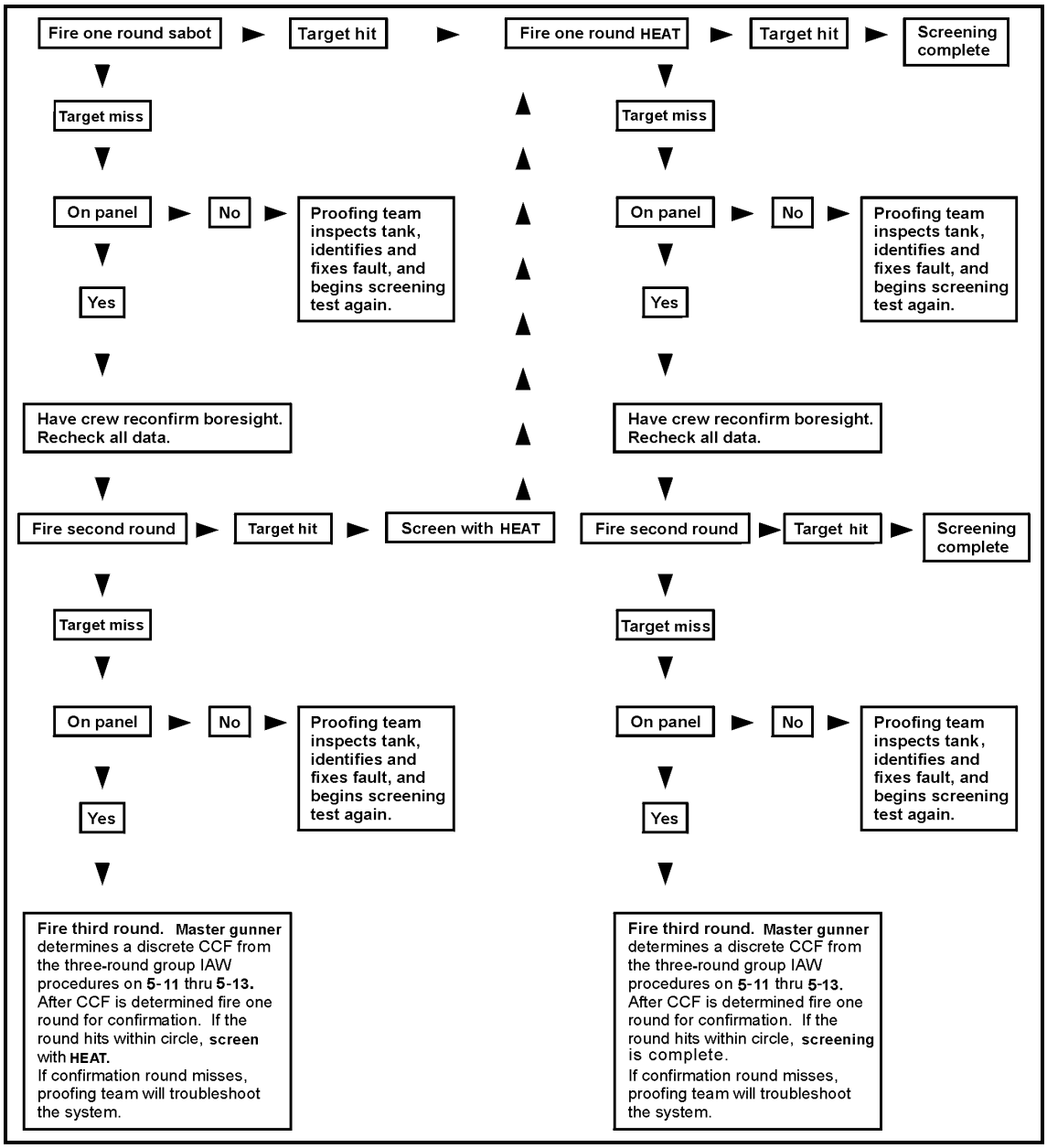


Figure 5-2. Flow Chart for Screening Test Procedures.

Screening Test Failures

The proofing team inspects tanks that fail the screening test for mechanical or crew procedural errors that might have caused the failure. (When available, direct support contact teams should also participate.) The proofing team should check the following:

- What were the failure indicators? (This basic information may help determine if there was an obvious procedural error.)

  _____ Was one round fired so far off the first target that further firing was halted?

  _____ What were the sensings from the tower?

  _____ Is the crew experienced?

  _____ Has the tank performed well (or poorly) in the past?

  _____ Have any FCS components been replaced since last live firing?

- Is the system still boresighted?

  _____ Did the crew update the MRS during the test? (They should not have.) Check this by moving the MRS lever to IN and examining the display numbers on the CCP. (They should be 0 and 0.)

  _____ Verify boresight.

- Check for possible crew error by asking the crew:

  _____ Where did the gunner aim (reticle lay)?

  _____ Did the gunner remember to depress the palm switches while firing?

- Check for possible maintenance problems:

  _____ Did the vehicle pass all checks on AACs?

  _____ Were the proper ammunition and AMMO SUBDES indexed?

  _____ Were the proper CCFs applied?

  _____ How was the target range entered in the system?

  _____ Were the manual inputs correct?

  _____ Press the CROSSWIND key. The value should be close to the estimated wind speed. Traverse the turret 180 degrees. The crosswind reading should be from the opposite direction. (Look for obvious differences only.)

  _____ Press the CANT key. For level-platform firings, the value should be within two degrees of level.

  _____ Press the LEAD key. The value for a motionless turret should be less than 1.

  _____ Was the correct ammunition fired? (Look at the bases of the expended shell casings if there is any doubt.)

  _____ Was the hydraulic system pressurized to at least 1,500 psi with the engine running?

  _____ Were any of the fire control malfunction lights illuminated?

  _____ Were any circuit breakers open?

  _____ Was there any normal/emergency mode drift in the fire control system?

  _____ Will the computer pass a self-test?

If a correctable mechanical problem or procedural error is found, it is corrected, and the crew reboresights the tank, with supervision from the proofing team. Then, the tank crew refires the portion of the screening test the tank failed. If the tank passes the screening test, the crew and tank proceed with combat operations or training. If a mechanical problem or procedural error was not found, the crew needs to complete the following checks: (for the M1): M1 Check 4 (Special Input), page 3-5 and M1 Check 5 (Ballistic Solution), page 3-11; (for the M1A1): M1A1 Check 4 (Special Input), page 3-16 and M1A1 Check 5 (Ballistic Solution), page 3-20 or M1A2 Special Input Check on page 5-5 and the M1A2 Ballistic Solution Check on page 5-8.

If the tank is sent to direct support maintenance or a line replaceable unit is changed, the tank crew must reboresight the tank and fire another screening test (when the faults are corrected) using the fleet CCF, or the tank discrete CCF if one has been established, with supervision from the proofing team.

Note. The following two procedures can be performed on the M1A2 in the event of a screening test failure, if no other cause can be determined.

M1A2 Special Input Check

PURPOSE

The M1A2 special input check verifies the proper function of manual and automatic inputs. This check ensures all individually tested component circuits are operational prior to testing full solution data. The M1A2 Special Input Check and M1A2 Ballistic Solution Check correspond closely to the special gunnery checks described in TM 9-2350-288-10-2, Appendix F.

Note. The M1A2 Special Input Check and M1A2 Ballistic Solution Check do *not* test components of the FCS; they test the ability of the TEU to compensate for the values received from these components and determine a ballistic solution for a given round.

CONDITIONS

1. The tank is on level ground with the solution board 100 meters (±3 meters) from the front edge of the tank.
2. Checks 1, 2, and 3 have been completed.
3. The horizontal reference line on the solution board is level with the gun trunnions. (Level criterion is achieved when the horizontal reference line on the solution board and the center horizontal reference line in the GPS is aligned with the gun at zero elevation. An easy way to check this is to select MRS on the GCDP and squeeze the palm switches on the power control handles [the main gun will move to zero elevation]. Press the ENT push button on the GCDP keypad. Align the reference line on the solution board with the center horizontal reference line in the primary sight reticle.) (The Abrams Combined Solution Board (Chapter 3, Figure 3-1, pages 3-8 and 3-9) is a scale drawing of the solution board to be used.)
4. An MBD is available.
5. The engine is off; the VEHICLE MASTER POWER, TURRET POWER, and AUX HYDR POWER are on; the GCDP power is on; and the FIRE CONTROL MODE switch is in the NORMAL position.

Note. The M1A2 Special Input Check and M1A2 Ballistic Solution Check must be performed with the AUX HYDR POWER on. Performing these checks at zero pressure does not test the FCS's ability to apply offsets to the gun.

PROCEDURE

WARNING

Range solutions must be entered manually with the GCDP data key during the M1A2 Special Input Check and M1A2 Ballistic Solution Check. Do *not* use the LRF; it may expose unprotected personnel to injury.

1. Record the GPS boresight, zero data, MRS update, and MRS boresight numbers before conducting the M1A2 Special Input Check.
2. Set zero data for all AMMO SUBDES, MRS update, and MRS boresight to 0.00 and 0.00 before conducting the M1A2 Special Input Check.
3. Grip one of the palm switches; then (with the palm switch pressed) press the SENSOR push button on the main menu. Press the RANGE push button on the SENSOR menu, index 1,200 meters into the GCDP, and press the ENT push button on the keypad. Hold the palm switch for five seconds, then release. (When conducting the special input check, the range value must be entered with the palm switch pressed. Failure to enter the range with the palm switch pressed will result in a failure of the M1A2 Special Input Check.)
4. Put the FCS in the BORESIGHT mode by pressing the ADJUST push button on the main menu, then pressing the BORESIGHT push button on the ADJUST menu.
5. Press the GPS push button.

Note. Do not rotate the MBD while performing the M1A2 Special Input Check and M1A2 Ballistic Solution Check.

6. Insert the MBD and direct the gunner to manually lay the main gun on the center of the target marked gun on the solution board, with last movement up.

Note. When using the M27A1 at this distance, use the GPS eyepiece parallax shield and the MBD's eyesight parallax shield (optic cover with hole) to reduce eyesight parallax.

7. When the main gun is properly laid for direction, the gunner looks through the GPS eyepiece parallax shield and, using the four-way switch on the GCDP, moves the reticle, using a *last movement up* pattern, to the center of solution board target marked GPS.
8. Store the boresight data by pressing the ENT push button on the GCDP keypad.

Note. The gunner may refer the GAS boresight cross to the gun box as a reference for gun position, as well as the MBD.

9. Check the boresight solution.
   a. Grip the palm switches for five seconds, then release.
   b. Press the BORESIGHT push button on the ADJUST menu, then press the GPS push button on the BORESIGHT menu (the MBD aiming dot should be pointing to the original aiming point of the gun target on the solution board).
   c. Press the RETURN push button to exit the BORESIGHT mode.
10. Enter the fire control inputs from Table 5-1.
    a. Enter the *basic* solution.

Note. The *basic* solution has all manual and automatic inputs set at neutral values. If the basic solution fails, do not try the other solutions; notify organizational maintenance.

   (1) Manually enter the data inputs (except for range) into the GCDP, and return to the SENSOR menu.

   (2) Press the RANGE push button, index the range, squeeze the GPCH, and press the ENT push button on the GCDP keypad. Hold the GPCH for five seconds, then release.

(3) Using a *G* pattern and the manual controls, lay the GPS aiming dot back on the aiming point, with last movement up.

(4) The crewman on the outside views through the MBD and confirms that the gun is on the correct block.

Note. Evaluate each column individually. The crewman by the MBD should make sure the aiming dot is on the appropriate block; if it is not, he should note that the MBD was not on the appropriate block. If the MBD is not on the appropriate block, possible problems are:

- Incorrect boresight.
- Not taking the same sight picture with the MBD that was taken during boresighting.
- GCDP not zeroed (for example, CCF).
- Incorrect entry of checks data into the GCDP.
- Problems with the FCS.

(5) Record the position of the MBD aiming point (in relation to the target block) on the *Sample M1A2 Data Worksheet for the M1A2 Special Input Check and M1A2 Ballistic Solution Check* on page 5-8.

Note. Repeat steps 10a (1) through (5) for each of the remaining solutions (cant, crosswind, and lead).

b. Enter the *cant* solution. (If it fails, the cant value is incorrectly set or the computer is not processing the cant function.)

c. Enter the *crosswind* solution. (If it fails, the crosswind value is incorrectly set or the computer is not processing the crosswind function.)

d. Enter the *lead* solution. (If it fails, the lead value is incorrectly set or the computer is not processing the lead function.)

11. After completing the M1A2 Special Input Check (all faults have been corrected), proceed to the M1A2 Ballistic Solution Check (page 5-8).

Table 5-1. M1A2 Ballistic Computer Inputs for the M1A2 Special Input Check.

SUBDES	Cant	Lead	Ammo Temp	Cross-wind	Baro Press	Air Temp	*Range	Solution from Board	Actual Solution		GCDP Difference Pass/Fail
									EL 88	AZ 89	
HEAT											
M831	0.00	0.100	70	0.00	29.92	59	1,030	Basic	4.82	0.0	
M831	10.4	0.000	70	0.90	29.92	59	1,855	Cant	9.87	-1.50	
M831	0.00	0.000	70	44.9	33.00	59	1,780	Crosswind	9.87	6.02	
M831	0.00	5.430	70	0.10	29.92	59	1,835	Lead	9.87	11.55	
*Range is the last input entered into the computer.											

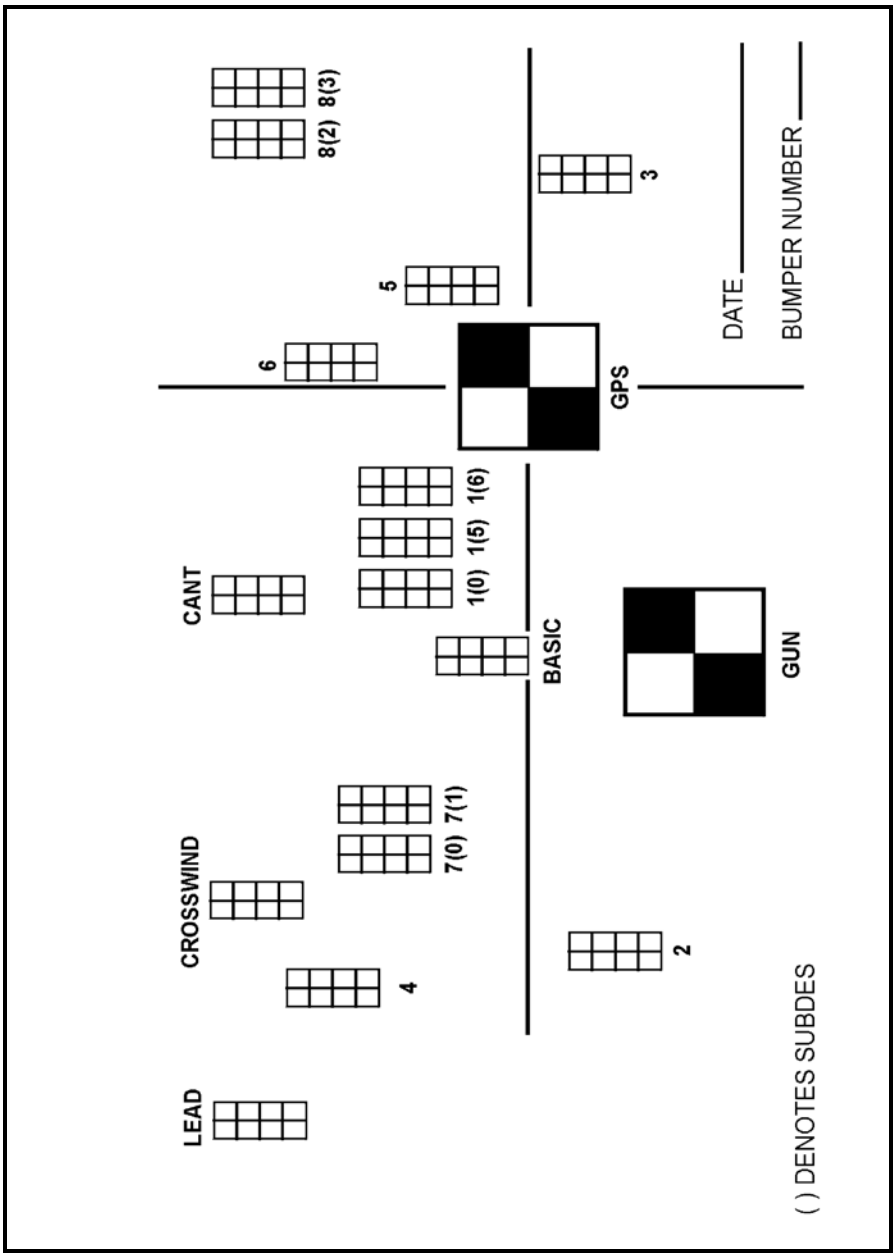


Figure 5-3. Sample M1A2 Data Worksheet for the M1A2 Special Input Check and M1A2 Ballistic Solution Check.

M1A2 Ballistic Solution Check

PURPOSE

The M1A2 ballistic solution check verifies that the FCS is correctly implementing ballistic solutions in all main gun channels.

Note. The M1A2 Special Input Check and M1A2 Ballistic Solution Check do *not* test components of the FCS; they test the ability of the TEU to compensate for values received from these components and determine a ballistic solution for a given round.

CONDITIONS

1. The ballistic solution board is shown in Chapter 3, Figure 3-1, pages 3-8 and 3-9.
2. The engine is off; the VEHICLE MASTER POWER, TURRET POWER, and AUX HYDR POWER are on; and the FIRE CONTROL MODE switch is in the NORMAL position.

Note. The M1A2 Special Input Check and M1A2 Ballistic Solution Check must be performed with the AUX HYDR POWER on. Performing these checks at zero pressure does not test the FCS's ability to apply offsets to the gun correctly.

PROCEDURE

WARNING

Range solutions must be entered manually with the GCDP data key during the M1A2 Special Input Check and M1A2 Ballistic Solution Check. Do *not* use the LRF; it may expose unprotected personnel to injury.

Note. If the tank passed the M1A2 Special Input Check and the current boresight is still valid, start at step 8. If maintenance was performed on the system or the boresight has changed, start at step 1.

1. Grip one of the palm switches; then (with the palm switch pressed) press the SENSOR push button on the main menu. Press the RANGE push button on the SENSOR menu, index 1,200 meters into the GCDP, and press the ENT push button on the keypad. Hold the palm switch for five seconds, then release. (When conducting the special input check, the range value must be entered with the palm switch pressed. Failure to enter the range with the palm switch pressed will result in a failure of the M1A2 Ballistic Solution Check.)
2. Put the FCS in the BORESIGHT mode by pressing the ADJUST push button on the main menu, then pressing the BORESIGHT push button on the ADJUST menu.
3. Press the GPS push button.

Note. Do not rotate the MBD while performing the M1A2 Special Input Check and M1A2 Ballistic Solution Check.

4. Insert the MBD and direct the gunner to lay the main gun manually on the center of the target marked gun on the solution board, with last movement up.

Note. When using the M27A1 at this distance, use the GPS eyepiece parallax shield and the MBD's eyesight parallax shield (optic cover with hole) to reduce eyesight parallax.

5. When the main gun is properly laid for direction, the gunner looks through the GPS eyepiece and, using the four-way switch on the GCDP, moves the reticle to the center of solution board target marked GPS.
6. Store the boresight data by pressing the ENT push button on the GCDP keypad.

Note. The gunner may refer the GAS boresight cross to the gun box as a reference for gun position, as well as the MBD.

7. Check boresight solution.
   a. Grip the palm switches for five seconds, then release.
   b. Press the BORESIGHT push button on the ADJUST menu, then press the GPS push button on the BORESIGHT menu (the MBD aiming dot should be pointing to the original aiming point of the gun target on the solution board).
   c. Press the RETURN push button twice to exit the BORESIGHT mode.

Note. If the tank failed the M1A2 Special Input Check and maintenance was performed, make sure the zero data (CCF) for each type AMMO SUBDES is set at 0.00 and 0.00, and the MRS update and boresight numbers are set at 0.00 and 0.00 before conducting the M1A2 Ballistic Solution Check. Failure to do so will result in a failure of the M1A2 Ballistic Solution Check.

8. Check the 13 separate main gun solutions.

   a. Manually index the data inputs (except for range) into the GCDP for a given solution as provided in Table 5-2.

   b. Grip one of the palm switches; then (with the palm switch pressed) press the SENSOR push button on the MAIN menu. Press the RANGE push button on the SENSOR menu, index 1,200 meters into the GCDP, and press the ENT push button on the keypad. Hold the palm switch for five seconds, then release. (The range value must be entered with the palm switch pressed. Failure to enter the range with the palm switch pressed will result in a failure of the M1A2 Ballistic Solution Check.)

   c. Using a G pattern and manual controls, lay the GPS aiming dot back on the aiming point, with last movement up.

   d. The crewman on the outside views through the MBD and confirms that the gun is on the correct block.

9. Record the position of the MBD aiming point (in relation to the target block) on the *Sample M1A2 Data Worksheet for the M1A2 Special Input Check and M1A2 Ballistic Solution Check* on page 5-8.

Notes. Evaluate each column individually. The crewman by the MBD should make sure the aiming dot is on the appropriate block; if it is not, he should note that the MBD was not on the appropriate block. Possible problems are—

- Incorrect boresight.
- Not taking the same sight picture with the MBD that was taken during boresighting.
- GCDP not zeroed (for example, CCF).
- Incorrect entry of checks data into the GCDP.
- Problems with the FCS.

Repeat steps 8a-d for each AMMO SUBDES to be checked.

The solution is correctly implemented if the MBD reticle is within the solution square identified in Table 5-2.

If a solution fails, the crew should rerun the check a second time, paying close attention to make sure the correct procedures are used and the correct data is put into the computer. (If a second try produces the same results, record the results on DA Form 2404 or ULLS Form 5988E, continue the check, and notify organizational maintenance.)

Be sure to reenter previously recorded data for zero (CCF), MRS boresight, and MRS update back into the GCDP upon completion of this check.

Table 5-2. M1A2 Ballistic Computer Inputs for the M1A2 Ballistic Solution Check.

SUBDES	Air Temp	Ammo Temp	Baro Press	Crosswind	Cant	Lead	Range	Solution from Board	Actual Solution		GCDP Difference Pass/Fail
									Elevation 88	Azimuth 89	
SABOT											
DM13	50	50	29.00	-3.00	0.00	-0.500	3320	1	6.57	-0.76	
DM28	100	100	28.00	38.0	0.00	15.00	0910	2	1.77	8.34	
M865 PIP	50	50	29.00	5.20	0.00	3.490	2820	4	8.09	9.62	
M865	50	50	30.00	-5.06	-10.0	1.820	2732	7	7.33	5.56	
M829A1	70	70	29.00	-10.0	0.00	-11.20	1485	3	3.03	-1087	
M829A1	60	60	28.00	1.00	-5.00	-6.300	2085	5	5.05	-8.09	
M829A2	90	90	30.00	19.0	5.00	-0.400	3720	1	6.57	-0.76	
HEAT											
DM12A1	75	75	30.00	-5.00	0.00	-3.300	1605	6	8.10	-6.06	
DM18	100	100	28.00	20.0	10.0	3.800	1361	7	7.33	5.57	
M830	50	50	29.00	-6.20	0.00	-5.000	1915	8	10.62	-11.62	
M831	80	80	28.00	-4.80	0.00	-5.000	2006	8	10.62	-11.62	
MPAT											
M830A1	65	65	30.00	-10.0	0.00	-5.580	1710	5	5.06	-8.09	
M830A1	75	75	29.00	-25.0	0.00	-2.080	2537	6	8.09	-6.07	

Determining the Mean Point of Impact and Individual Tank CCF

To ensure the most accurate measurements, the screening test target should be exactly level and at 1,500 meters (M1A1/M1A2) or 1,200 meters (M1). A vertical and horizontal line should bisect the center of the target aiming point and extend out to the edges of the screening test target. These lines are required to measure the strike of the rounds. To determine the mean point of impact for each round—

1. Measure the distance from the horizontal and vertical lines to the center of the round. The distance from the horizontal line to center of round is the elevation; the distance from the vertical line to center of the round is the azimuth. When all rounds have been measured, record the AZ and EL measurements for each round (in centimeters) with the appropriate positive (right, down) or negative (left, up) sign.
2. Find the mean (average) point of impact (MPI).

Note. When determining the mean with a calculator, make sure all left and up readings are entered as negative (-) values.

a. Add all AZ and EL measurements.

1st Round	-125 cm (Left)	-53 cm (Up)
2d Round	-150 cm (Left)	-10 cm (Up)
3d Round	-175 cm (Left)	+20 cm (Down)
Total	-450 cm (Left)	-43 cm (Up)

b. Find the MPI. Divide the AZ and EL totals by the number of rounds fired (3).

Azimuth	-450 ÷ 3 = -150 cm
Elevation	-43 ÷ 3 = -14.3333 cm

3. Convert the MPI to milliradians.
   a. Find 1/10 of the range: 1,500 ÷ 10 = 150
   b. Divide each MPI (Step 2b) by 1/10 of the range (Step 3a).

Azimuth	-150 cm ÷ 150 = -1.00
Elevation	-14.3333 cm ÷ 150 = -0.09555

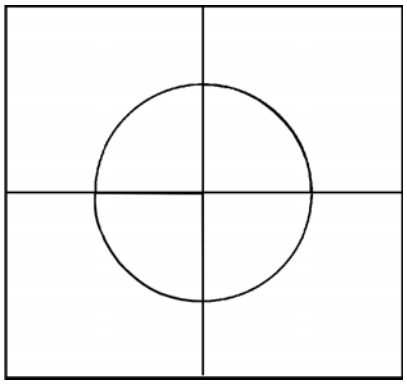
4. Convert to mils. Multiply results from step 3b by 1.02 and round to two digits. (The computer accepts two digits, regardless of the position of the decimal [for example, .15 or 1.5]. If the third number is 4 or less, the second number will remain the same. If the third number is 5 or more, the second number will increase by 1.)

Azimuth	-1.00 x 1.02 = -1.02 = -1.00
Elevation	-0.09555 x 1.02 = -0.097466 = -0.10

5. Add the AZ and EL from step 4 to the old CCF. The result is the new CCF.

Old CCF (M865-IP)	+0.15	-0.60
Result of Step 5	-1.00	-0.10
New CCF	-0.85 (Left)	-0.70 (Up)

DISCRETE CCF WORKSHEET			
Bumper Number		Unit	
Serial Number		Model	Date
Distance to Target	Air Temp	Baro Press	Ammo Temp
Cant	Crosswind	Tube Wear (M1)	Tube Serial Number
Lot Number (sabot)		Lot Number (HEAT)	



ROUND IMPACTS

	SABOT				HEAT			
	AZ		EL		AZ		EL	
Round 1								
Round 2								
Round 3								
Total								
÷ Rnds Fired								
÷ 1/10 Range								
x 1.02								
± Old CCF								
= New CCF								
Conf Rnd								

Previous gunnery: Date: _____ Sabot CCF: _____ HEAT CCF: _____

Figure 5-4. Sample Discrete CCF Worksheet.

Alternate Method—Determining Mean Point of Impact and Individual Tank CCF

You may need to determine an approximate MPI when firing on tank gunnery ranges that share a common impact area (on which you cannot go down range to get the measurements to calculate a CCF).

Using high-powered optics, such as a ground-mounted TOW sight, is essential. Use the discrete CCF worksheet above for this procedure. The following steps describe the procedures.

Note. Mark all previous impacts (holes) on the ST-5 using the sample discrete CCF worksheet above. Use a discrete CCF worksheet for each tank.

1. Mark the impact of each round fired with an S for sabot or H for HEAT (this is for later historical reference), and the sequence (1, 2, 3) in which they were fired.

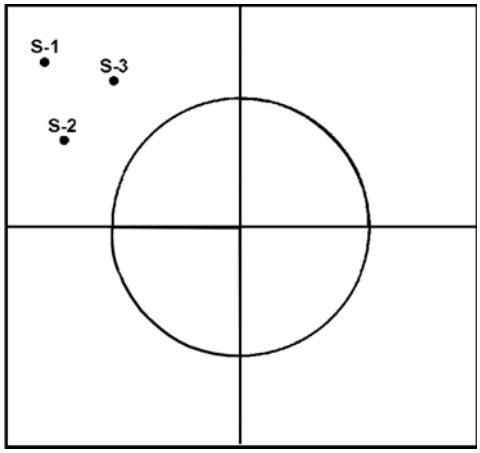


Figure 5-5. Target.

2. Draw a line connecting the center of any two round impacts on the discrete CCF worksheet. (S-1 and S-3 were used in this example.)

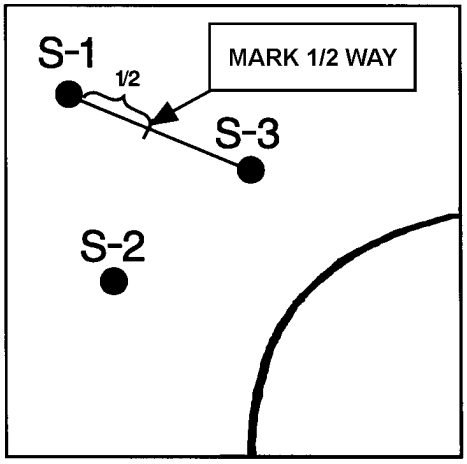


Figure 5-6. Target—Mark 1/2 Way.

3. Make a mark on this line halfway between the two impacts.

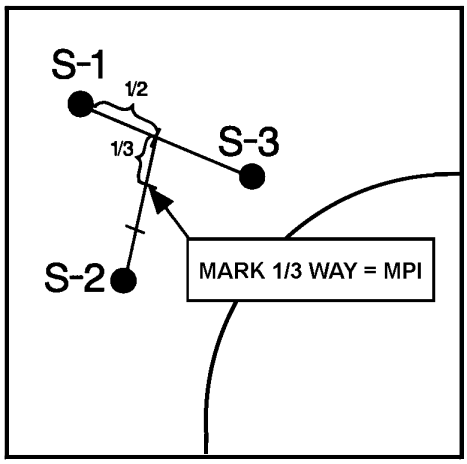


Figure 5-7. Target—Mark 1/3 Way.

4. From the halfway mark, draw a line to the center of the remaining round impact.
5. From the halfway mark, make a second mark one-third the distance to the third impact. (This mark is the MPI.)

Note. Have gunner look at the discrete CCF worksheet when completed. This will aid the gunner in recognizing the MPI.

6. Have the gunner move the FIRE CONTROL MODE switch to EMERGENCY.

M1 AND M1A1

a. Have the gunner press the ZERO push button on the CCP.
b. Manually lay the GPS reticle aiming dot on the target aiming point of ST-5, with last movement up. Using the reticle adjust toggle switch on the CCP, move the GPS reticle aiming dot to the approximate MPI, as determined on the discrete CCF worksheet, and record.
c. Make sure the appropriate ammunition is selected; press the ENTER key on the CCP keypad to store this data in the CEU.

M1A2

a. Have the gunner press the ADJUST push button on the GCDP. Press the ZERO push button on the ADJUST menu.
b. Manually lay the GPS reticle aiming dot on the target aiming point of ST-5, with last movement up. Using the four-way adjust switch on the GCDP, move the GPS reticle aiming dot to the approximate MPI, as determined on the discrete CCF worksheet, and record. (The tank discrete CCF for this round of ammunition is shown on the GCDP.)
c. Make sure the appropriate ammunition is selected; press the ENT key on GCDP keypad to store this data in the TEU.
d. Press the RETURN push button on the GCDP twice to return to the MAIN menu.

Note. The firing tank will fire a confirmation round of the same type and lot number of ammunition.

Screening Failure Data—M1, M1A1, and M1A2

Results of all proofing tests must be compiled by the firing unit and sent to the U.S. Army Armor Center (USAARMC). The data will enable USAARMC to monitor unit experience under these calibration policies.

Required data includes—

- Type of ammunition.
- CCF the tank fired and screening round impact measurements.
- Impact measurements of confirmation round.
- New CCF.
- Reason for failure, if known.
- Follow-on action.
- Unit identification.
- Location of firing and environmental conditions.
- Ammunition lot number.
- Date fired.
- Automatic and manual inputs in the computer. (When recording automatic inputs, make sure that a palm switch on the GPCH is depressed.)

Mail the data to—

Commander
USAARMC and Fort Knox
ATTN: ATZK-TDD-G
Fort Knox, KY 40121-5000

Table 5-3. Screening Test Actions Checklist (M1 and M1A1).

ACTION	ITEM
Alpha	**Complete prior to pulling forward to conduct screening test:** • Conduct PMCS IAW operator's manual. • Conduct prep-to-fire checks. • Verify that the EMERGENCY and NORMAL mode drifts were nulled out. • Make sure the boresight and CCF (zero) data is current. • Verify boresight, if condition warrants.
Bravo	**Read back the following:** • "My GPS boresight data is _____and _____." • "My MRS boresight data is _____ and _____." • "My MRS update data is 0.0 and 0.0." • "My AMMO SUBDES for sabot is _____." • "My CCF for sabot is _____ and _____." • "Crosswind is _____." • "Cant is _____." • "Air temp is _____." • "Barometric pressure is _____." • "Ammo temp is_____."
Charlie	• Make sure no lights are illuminated on the CCP. • Move the FIRE CONTROL MODE switch to NORMAL. • Move the GPS MAGNIFICATION switch to 10X. • Load one round of sabot or HEAT. • Index sabot or HEAT. • Move the GUN SELECT switch to MAIN. • Lase to appropriate ST-5. Report range to tower. • Report REDCON when complete. **CONTINUED ON NEXT PAGE**

Table 5-3. Screening Test Actions Checklist (M1 and M1A1) (cont.).

ACTION	ITEM
Delta	• Fire one round of sabot or HEAT at designated screening target. • The gunner— – Uses the power control handles. – Makes a *G* pattern. – Makes last movement up. – Announces "ON THE WAY" to alert tower. – Squeezes GPCH trigger gently; does not flinch or pull. – Takes further instructions from the tower.
Echo	• Move the GUN SELECT switch to MAIN. • Index HEAT. • Read the following back to the tower: – "My AMMO SUBDES for HEAT is _____." – "My CCF for HEAT is _____ and _____." • Lase to same ST-5. Report range to tower. • Go back to action Delta. **Note.** Use Foxtrot, Golf, And Hotel, if discreet CCF was determined.
Foxtrot	• Index sabot or HEAT. • Move the CCP PWR to ON. • Press the ZERO push button; make sure the ZERO light comes on. • Report REDCON when complete.
Golf	• Gunner uses the RETICLE ADJUST toggle switch to enter data. • Press the ENTER push button on the CCP to enter data into the CEU. • Make sure there are no lights illuminated on the CCP. • Call the tower and read back the CCF data in the computer.
Hotel	• Move the FIRE CONTROL MODE switch to NORMAL. • Load one round of sabot or HEAT. • Read back the range displayed in the GPS.

Table 5-4. Screening Test Actions Checklist (M1A2).

ACTION	ITEM
Alpha	**Complete prior to pulling forward to conduct screening test:** • Conduct PMCS IAW operator's manual. • Null out EMERGENCY and NORMAL mode drift. • Make sure the boresight and CCF (zero) data is current. • Verify boresight, if condition warrants.
Bravo	**Read back the following:** • "My GPS boresight data is _____ and _____. " • "My MRS boresight data is _____ and _____. " • "My MRS update data is _____ (or none)." (Should be 0.0 and 0.0.) • "My AMMO SUBDES for sabot is _____. " • "My CCF for sabot is _____ and _____. " • "Crosswind is _____. " • "Cant is _____. " • "Air temp is _____. " • "Barometric pressure is _____. "
Charlie	• Move the FIRE CONTROL MODE switch to NORMAL. • Move the GPS MAGNIFICATION switch to 10X. • Load one round of sabot or HEAT. • Index sabot or HEAT. • Move the GUN SELECT switch to MAIN. • Lase to appropriate ST-5. Report range to tower. • Report REDCON when complete. **CONTINUED ON NEXT PAGE**

Table 5-4. Screening Test Actions Checklist (M1A2) (cont.).

ACTION	ITEM
Delta	• Fire one round of sabot or HEAT at designated screening target. • The gunner— – Uses the power control handles. – Makes a *G* pattern. – Makes last movement up. – Announces “ON THE WAY” to alert tower. – Squeezes GPCH trigger gently; does not flinch or pull. – Takes further instructions from tower.
Echo	• Move the GUN SELECT switch to MAIN. • Index HEAT. • Read back to tower: – “My AMMO SUBDES for HEAT is _____. “ – “My CCF for HEAT is _____ and _____. “ • Lase to same ST-5. Report range to tower. • Go back to action Delta. **Note.** Use Foxtrot, Golf, and Hotel, if discreet CCF was determined.
Foxtrot	• Index sabot or HEAT. • Press the ZERO push button on the ADJUST menu. • Report REDCON when complete.
Golf	• Gunner enters data using the GCDP key pad. • Press the ENT push button to enter data into the TEU. • Call the tower and read back the CCF data in the GCDP.
Hotel	• Move the FIRE CONTROL MODE switch to NORMAL. • Load one round of sabot or HEAT. • Read back the range displayed in the GPS.

Screening Under Unusual Conditions

The target dimensions (other than 1,500 meters) shown in Table 5-5 for 105mm and Table 5-6 for 120mm are to be used only when conditions preclude use of normal screening procedures. (Such instances are excessive heat shimmer from extreme temperatures or terrain not available to place targets at 1,500 meters.) Targets must be reduced in size to correspond to the range (tank-to-target distance) being fired. If the range to the ST-5 is 1,000m or less, the tank-to-target range must be within ±10 meters.

Notes. See page 5-1 for screening procedures.

Screening panel sizes are not the same at all ranges for 105mm and 120mm. Use specific chart for the type of main gun.

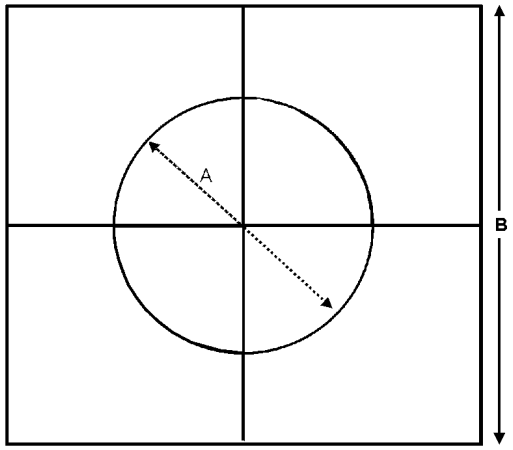


Figure 5-8. Screening Test Target (ST-5) with Dimension A.

Table 5-5. Dimensions of Screening Targets Under Unusual Conditions (105mm).

Range	A	B
1200m	175.0cm	305cm
1100m	160.4cm	279cm
1000m	145.8cm	254cm
900m	131.2cm	229cm
800m	116.6cm	203cm
700m	102.0cm	178cm
600m	87.6cm	152cm
500m	73.0cm	127cm

Table 5-6. Dimensions of Screening Targets Under Unusual Conditions (120mm).

Range	A	B
1500m	175.0cm	305cm
1400m	163.4cm	284cm
1300m	151.6cm	264cm
1200m	140.0cm	244cm
1100m	128.4cm	224cm
1000m	116.6cm	203cm
900m	105.5cm	183cm
800m	93.4cm	163cm
700m	81.6cm	142cm
600m	70.0cm	122cm
500m	58.4cm	102cm

Boresighting and Zeroing the Tank-Mounted Machine Gun

The machine gun is the tank's secondary armament. It allows the crew to engage, suppress, and destroy personnel and lightly armored vehicles. It is imperative that the machine gun is properly boresighted and zeroed.

BORESIGHTING THE CALIBER .50 MACHINE GUN (M1 AND M1A1)

The following are conducted in preparation to boresighting:

- Position the tank on as level terrain as possible, with the gun tube over the front.
- Select the boresight target with a well-defined right angle, at a range as near 500 meters as possible.
- Lase on the target using the commander's handle, if possible, to confirm the range to the boresight target.

BORESIGHTING WITHOUT THE CALIBER .50 (LENZAR) BORESIGHT DEVICE

1. Clear the machine gun.
2. Remove the rear mounting pin, and lift the rear of the machine gun above the firing roller.
3. Remove the backplate, and take the bolt group out of the caliber .50 receiver.
4. Lower the rear of the machine gun, and reinsert the rear mounting pin.
5. Look into the back of the receiver and out through the machine gun barrel. Manually traverse the CWS, and elevate or depress the machine gun to align the center of the barrel on the target's upper left corner.
6. Without moving the machine gun or CWS, look through the commander's weapon sight, and align the boresight cross of the reticle on the upper left corner of the target as follows:
   a. Loosen the setscrew with a 9/64-inch socket head key to allow the horizontal adjustment control screw to turn.
   b. Adjust the vertical line of the boresight cross on the left edge of the target, using the flat-tip screwdriver.
   c. Tighten the setscrew with a 9/64-inch socket head key to lock the horizontal adjustment control screw.
   d. Loosen the setscrew with a 9/64-inch socket head key to allow the vertical adjustment control screw to turn.
   e. Adjust the horizontal line of the boresight cross on the top edge of the target using the flat-tip screwdriver.
   f. Tighten the setscrew with a 9/64-inch socket head key to lock the vertical adjustment control screw.
7. Look through the back of the caliber .50 receiver and out the gun barrel. Elevate, and then depress the machine gun onto the upper left corner of the target, using the elevation crank.
8. Look through the CWS sight to see if the boresight cross is on the upper left corner of the target.

Notes. If the boresight cross is not on the upper left corner of the target, notify unit maintenance.
If the machine gun and boresight cross are both on the upper left corner of the target, the machine gun is properly boresighted.

9. Remove the rear mounting pin, and lift the rear of the machine gun above the firing roller.
10. Put the bolt group back into the caliber .50 receiver, and install the backplate.
11. Lower the rear of the machine gun, and reinsert the rear mounting pin.
12. Make sure the roller is over the butterfly trigger.

BORESIGHTING WITH THE CALIBER .50 (LENZAR) BORESIGHT DEVICE

1. Clear the machine gun.
2. Insert the caliber .50 boresight device.
3. Manually traverse the CWS, and elevate or depress the machine gun to align the caliber .50 boresight device on the target upper left corner.
4. Without moving the machine gun or CWS, look through the commander's weapon sight, and align the boresight cross of the reticle on the upper left corner of the target as follows:
   a. Loosen the setscrew with a 9/64-inch socket head key to allow the horizontal adjustment control screw to turn.
   b. Adjust the vertical line of the boresight cross on the left edge of the target, using the flat-tip screwdriver.
   c. Tighten the setscrew with a 9/64-inch socket head key to lock the horizontal adjustment control screw.
   d. Loosen the setscrew with a 9/64-inch socket head key to allow the vertical adjustment control screw to turn.
   e. Adjust the horizontal line of the boresight cross on the top edge of the target, using the flat-tip screwdriver.
   f. Tighten the setscrew with a 9/64-inch socket head key to lock the vertical adjustment control screw.
5. Look through the caliber .50 boresight device. Elevate, and then depress the machine gun onto the upper left corner of the target, using the elevation crank.
6. Look through the CWS sight to see if the boresight cross is on the upper left corner of the target.

Notes. If the boresight cross is not on the upper left corner of the target, notify unit maintenance.
If the machine gun and boresight cross are both on the upper left corner of the target, the machine is properly boresighted.

7. Remove the caliber .50 boresight device.

ZEROING THE CALIBER .50 MACHINE GUN

Before zeroing the caliber .50 machine gun on the M1 and M1A1, make sure the commander's weapon has been boresighted and is loaded.

1. Move the butterfly trigger safety until an *F* can be seen.

WARNING

If the butterfly trigger on the backplate is pushed, the gun will fire and could injure or kill someone.

2. Alert the crew by announcing "CALIBER .50" on the intercom.

WARNING

If the button on the CWS elevation handle is pressed down, and the ARMED light is lit, the gun will fire and could injure or kill someone.

3. Lay the 500-meter aiming point in the commander's weapon sight on the center of the target, 500 meters out, using the manual controls.
4. Move the SAFE/ARMED switch to the ARMED (right) position, then let go, and make sure the ARMED light is lit.

5. Fire a burst of 10 to 15 rounds by pressing the button on the CWS elevation handle. Release the button to cease firing.
6. Look at the beaten zone on the target in relation to the aiming point on the sight reticle.
7. Move the SAFE/ARMED switch to the SAFE (left) position, then let go, and make sure the ARMED light is not lit.
8. If the aiming point in the sight reticle is centered on the beaten zone, zeroing is complete. If the aiming point is not in the center of the beaten zone, go to step 9.
9. Without moving the machine gun or CWS sight, align the aiming point in the sight reticle to the center of the beaten zone as follows:
    a. Loosen the setscrew with a 9/64-inch socket head key to allow the horizontal adjustment control screw to turn.
    b. Adjust the vertical line of the boresight cross on the left edge of the target using the flat-tip screwdriver.
    c. Tighten the setscrew with a 9/64-inch socket head key to lock the horizontal adjustment control screw.
    d. Loosen the setscrew with a 9/64-inch socket head key to allow the vertical adjustment control screw to turn.
    e. Adjust the horizontal line of the boresight cross on the top edge of the target, using the flat-tip screwdriver.
    f. Tighten the setscrew with a 9/64-inch socket head key to lock the vertical adjustment control screw.
10. Repeat steps 3 through 8 until the aiming point on the sight reticle is centered on the beaten zone.
11. Move the butterfly trigger safety until the *S* can be seen.
12. Clear the commander's weapon.

ZEROING THE COAXIAL MACHINE GUN

Before zeroing the coaxial machine gun—

- Position the tank on as level terrain as possible with the gun tube over the front.
- Select a target with a range as near 800 meters as possible.
- Lase on the target, using the gunner's power control handle, if possible, to confirm the range to the target.

M1 AND M1A1

1. Sight through the GPS eyepiece. Using the GPCH, lay the reticle aiming point on the target.
2. Lase on the target, or manually input 800 meters range into the computer.
3. Fire a burst of 20 to 30 rounds. Mentally note the center-of-impact of the bullet strike area. Do not change the lay of the gun or reticle. Keep the GPCH centered.
4. Without disturbing the lay of the gun, release the gunner's handles.
5. Open the CCP door. Move the CCP power switch to the ON position.
6. Without disturbing the lay of the gun, press the BORESIGHT push button; the push button will illuminate.
7. Move the RETICLE ADJUST toggle switch up (U), down (D), left (L), or right (R), as needed, to center the reticle aiming point to within 3 mils of the strike area.
8. Press the ENTER push button. The BORESIGHT push button light will go out. The boresight information is stored in the computer.
9. Without disturbing the lay of the gun, press the ZERO push button; the push button will illuminate.

Note. If the reticle aiming point is not at the center of the bullet strike area, go to step 10. If the aiming point is centered in the strike area, go to step 14.

10. Move the RETICLE ADJUST toggle switch up (U), down (D), left (L), or right (R), as needed to center the reticle aiming point in the strike area.
11. Press the ENTER push button. The ZERO push button light will go out. The zero information is stored in the computer. Repeat step 1 only, then go to step 12.
12. Without disturbing the lay of the gun (keep the gunner's handles centered), fire another burst of 20 to 30 rounds.
13. If the reticle aiming point is centered in the strike area, the coax machine gun is zeroed; repeat step 9. Record the zero setting in the display, and go to step 14. If the reticle aiming point is not centered in the strike area, repeat steps 9 through 13.

Note. Record the zero setting from the computer display.

14. Press the ENTER push button. The ZERO push button light will go out. The zero information is stored in the computer.
15. Close and latch the CCP door.
16. Clear the coaxial machine gun.

M1A2

1. Sight through the GPS eyepiece. Using the gunner's handles, lay the reticle aiming point on the target.
2. Lase on the target, or manually input 800 meters range into the computer.
3. Fire a burst of 20 to 30 rounds. Do not change the lay of the gun or reticle. Keep the gunner's handle centered.
4. Without disturbing the lay of the gun, release the gunner's handles.
5. With the GCDP on the MAIN MENU, press the ADJUST push button.
6. Press the BORESIGHT push button on the ADJUST menu.
7. Move the four-way switch on the GCDP (up, down, left, or right) as needed to center the reticle aiming point to within 3 mils of the strike area.
8. Press the ENT key on the keypad. The boresight information is now stored in the computer.
9. Press the ZERO push button on the ADJUST menu.

Note. If the reticle aiming point is not at the center of the bullet strike area, go on to step 10. If the aiming point is centered in the strike area, go to step 14.

10. Move the four-way switch on the GCDP (up, down, left, or right), as needed to center the reticle aiming point in the strike area.
11. Press the ENT key on the keypad. The zero information is now stored; repeat step 1 only.
12. Without disturbing the lay of the gun (keep the gunner's handles centered), fire another burst of 20 to 30 rounds.
13. If the reticle aiming point is centered in the strike area, the coaxial machine gun is zeroed; repeat step 9. Record the ZERO setting on the ZERO menu, and go to step 14. If the reticle aiming point is not centered in the strike area, repeat steps 9 through 13.

Note. Record the ZERO setting from the ZERO menu.

14. Press the ENT key on the keypad. Press the RETURN push button on the ZERO menu two times to return to the MAIN MENU.
15. Clear the coaxial machine gun.

M1A1 Gunner's Quadrant End-for-End Test

There are occasions when crews or master gunners need to precisely measure the pointing elevation of a gun. The M1A1 gunner's quadrant is used to make measurements. Beforehand, the crew must perform an end-for-end test on the M1A1 gunner's quadrant to make sure the quadrant is in tolerance. (The quadrant is in tolerance if the end-for-end correction is between +0.4 and -0.4. The quadrant should be turned in for calibration if the end-for-end correction is ±0.5 or greater.)

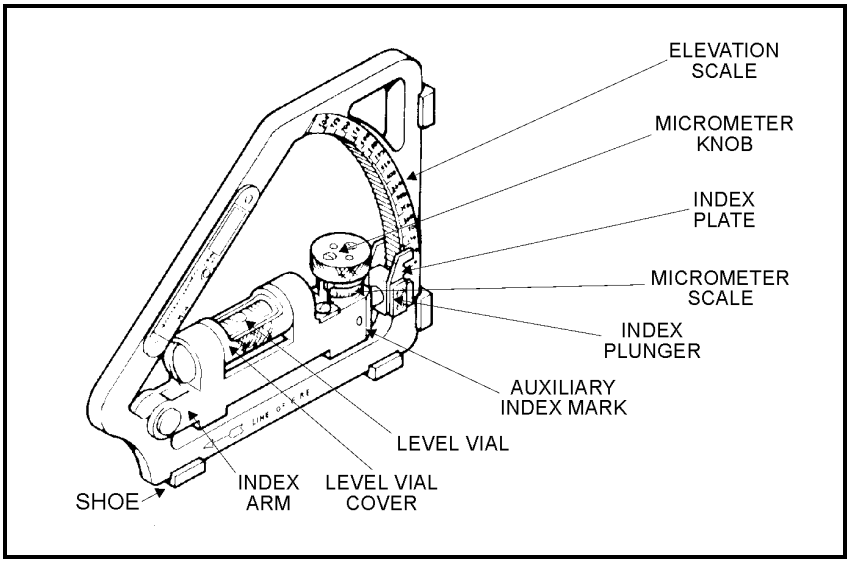


Figure 5-9. M1A1 Gunner's Quadrant.

1. Inspect the elevation quadrant seats on the weapon.
2. Inspect the quadrant shoes.
3. Zero the micrometer by turning the micrometer knob.
4. Set the index at zero mils.
5. Position the quadrant on the weapon pointing toward the muzzle end.
6. Depress or elevate the tube to center the bubble in the level vial.
7. Reverse the direction of the quadrant (the bubble should center).
   a. If the bubble centers, the test is complete.
   b. If the bubble does not center, go to step 8.
8. Center the bubble with the micrometer knob.
   a. If the bubble centers—
      (1) Divide the micrometer reading by 2 to obtain the positive correction (for example, 0.4 ÷ 2 = 0.2).
      (2) Put the result on the micrometer scale.
      (3) Point the quadrant toward the muzzle end of the weapon.

(4) Depress or elevate the tube to center the bubble.

(5) Reverse the direction of the quadrant (the bubble should center).

(6) Record the end-for-end correction on the carrying case.

b. If the bubble does not center—

(1) Set the index at -10 mils for a negative correction.

(2) Center the bubble in the level vial with the micrometer knob.

(3) Add 10 mils to the micrometer reading (for example, 9.8 + 10 = 19.8).

(4) Divide the result by 2 (for example, 19.8 ÷ 2 = 9.9)

(5) Put the result on the micrometer scale.

(6) Point the quadrant toward the muzzle end.

(7) Depress or elevate the tube to center the bubble.

(8) Reverse the direction of the quadrant (the bubble should center).

(9) Subtract 10 from the micrometer reading (for example, 9.9 - 10.0 = -0.1). (Since this is a negative correction, a minus sign must be placed in front of the correction factor.)

(10) Record the end-for-end correction on the carrying case.

Chapter 6

Target Acquisition

Speed and accuracy of engagement depend on crew proficiency in target acquisition; yet target acquisition is one of the hardest gunnery tasks to train effectively.

Target acquisition is the timely detection, location, and identification of targets in sufficient detail to permit accurate attack by either direct or supporting fire. Effective target acquisition requires the combined effort of all crewmen.

This chapter describes the target acquisition process, discusses methods for acquiring and classifying targets, and relates target acquisition confirmation to the conduct-of-fire process.

CONTENTS

Target Acquisition Process

The target acquisition process is a series of progressive and interdependent steps or actions by which a tank crew acquires enemy targets for destruction. It is a continuing requirement for all tank crew members, whether in the offense or defense, or moving or stationary. There are six steps in the target acquisition process:

- *Crew search* is the crew's collective efforts, using both the unaided eye and vehicle optics within assigned sectors of observation, to survey for enemy presence.
- *Detection* is the discovery of any phenomena (personnel, equipment, objects) that is potentially a target.
- *Location* is the determination (by direction, reference point, or grid) of where a potential military target is on the battlefield (ground or air).
- *Identification* is the friendly, hostile, or neutral character of a detected potential target, determined by its physical traits (such as size, shape, and functional characteristics).
- *Classification* is the categorizing of a potential target by the relative level of danger it represents.
- *Confirmation* is the rapid verification of a target in terms of the initial identification and classification. During the conduct-of-fire (see Chapter 8, *Direct Fire*), the TC and gunner must confirm that the target is properly identified, as enemy, and classified before engaging.

At platoon level, leaders must make sure the target acquisition process is outlined for their specific mission.

In the offense, sectors of observation vary due to terrain and weather conditions. As the platoon moves, the platoon leader or platoon sergeant must make sure all areas within the platoon's sector are covered. The platoon leader or platoon sergeant adjusts sectors using TRPs, prominent terrain features, or other graphic control measures. Platoon leaders or platoon sergeants must also decide which tanks will scan using daylight sights and which tanks will use thermal sights. Air guard and ATGM observers must also be designated. The platoon may be required to make these adjustments from a short halt (overwatch) to ensure maximum target acquisition and fire distribution.

In the defense, the same rules apply. When constructing the platoon fire plan, the platoon leader and platoon sergeant must make sure that dead space, secondary avenues of approach, and obstacles not covered by direct fire are observed continuously. Overlapping observation and fires, both within and between platoons, must also be planned in the defense.

CREW SEARCH

Crew search, or observation, is the act of carefully viewing or watching the area of operations, using search and scan techniques and sectors of observation, to acquire targets.

SECTORS OF RESPONSIBILITY (M1, M1A1, M1A2, AND M1A2 SEP)

Terrain, visibility conditions, vehicle positioning, and fire distribution planning dictate the distance (depth and width) a tank crew, section, or platoon must cover. Each tank's sector of fire and observation must overlap with the sectors of adjacent tanks. Based on these factors, the TC and gunner must coordinate how they will cover the tank's assigned sector, for both the offense and defense.

Sectors of responsibility are areas assigned to each crew member for search and target acquisition. Standard sectors of observation depend on turret orientation for all crew members except the driver. Crew members must know their assigned sectors of observation to ensure 360-degree coverage of the battlefield. When operating with the platoon, each tank's 360-degree coverage will create overlapping fields of observation.

Sectors are normally assigned as follows:

- The TC's sector of responsibility is 360 degrees. However, when the loader observes from the hatch, the TC observes from the left front of the gun mantle, clockwise, to the left rear of the turret.
- The gunner's sector is along the axis of the main gun, within the limits of the GPS in 3X magnification.
- The loader's sector is from the right front of the gun mantle, counterclockwise, to the right rear of the turret. The loader should be designated as primary air guard when he is not inside the turret.
- The driver's sector is forward, between the front fenders.

During buttoned-up operations, the tank crew's ability to acquire targets is reduced by at least 50 percent. The crew must make sure all vision blocks and sights are clear and free of obstruction. The sectors of responsibility for the *M1 and M1A1* crew must be altered as follows:

- *TC*—must observe 360 degrees using his vision blocks. When the loader is able to scan to the rear, the TC must be able to view from the back of the loader's sponson box. This should slightly overlap the loader's viewing area. Assumes duties as primary air guard.
- *Gunner*—remains the same.
- *Loader*—orients to the rear of the turret, using his periscope.
- *Driver*—remains the same.

Acquisition responsibilities for the *M1A2 and M1A2 SEP* crew must be altered as follows:

- *TC and gunner*—remains the same with changes in responsibility depending on the situation. (For example: The individual tank is allotted a sector of fire; the TC determines where most main gun engagements are likely to occur. Usually, the gunner covers this area with the GPS. Depending on the width of the sector, the TC may scan the same sector with the gunner [opposite directions], or assign the CITV its own sector. If the CITV is assigned its own sector, the CITV and GPS sectors must overlap. In some situations, the tank's sector may require the TC and gunner to scan different sectors simultaneously; the TC and gunner need to know the limits of both sectors and ensure that these sectors overlap. Depending on the size of the sector to be scanned, the crew may decide to scan the sector in different fields of view. The CITV would be set to scan in the WFOV, AUTO-SCAN. This allows the TC to monitor the CITV, ICWS, and the TACTICAL DISPLAY, simultaneously; while the gunner employs detailed search techniques with the GPS in 10X magnification.)
- *Loader*—orients to the rear of the turret, using his periscope.
- *Driver*—remains the same.

Notes. When preparing for operations, each crew must make sure that the seats, foot stands, safety guards, and hatches are checked and adjusted to support the crew in target acquisition. This is especially true for the TC when in the open-protected or buttoned-up mode. Information on correct positioning of seats and platforms for observation can be found in TM 9-2350-255-10-1 (M1), TM 9-2350-264-10-1 (M1A1), TM 9-2350-288-10-1 (M1A2), or TM 9-2350-388-10 (M1A2 SEP).

Regardless of the technique used, the crew tries to reduce its assigned sector to a manageable level to ensure that neither crew member is required to manipulate the gun and turret excessively and that the crew can rapidly acquire, identify, and engage targets.

DISMOUNTED OBSERVER

When the tank is in a hide position, a dismounted observer forward of the position, equipped with binoculars and land-line communications, can provide effective observation.

The observer must be able to provide information such as friendly and enemy vehicle movement, location, and number. He must also know if civilian or neutral vehicles are in the area. The observer is the eyes and ears of the TC.

GROUND-SEARCH TECHNIQUES

Crew members will scan their areas of observation at all times to detect targets or possible target signatures. Three ground-search techniques (rapid scan, slow scan, and detailed search) enable crew members to locate targets quickly. All crew members may use all three techniques simultaneously, using the unaided eye, binoculars, or vehicle optics.

Rapid-Scan Technique

The rapid-scan technique is used to quickly detect obvious signs of enemy activity (see Figure 6-1). It is usually the first method used, whether the tank is stationary or moving. On the *M1 or M1A1*, the TC or loader will use binoculars or the unaided eye and the gunner will use the GPS (daylight channel or TIS) or unity periscope. On the *M1A2 and M1A2 SEP*, the loader will use binoculars or the unaided eye, the gunner will use the GPS (daylight channel or TIS [M1A2] or FLIR [M1A2 SEP]) or unity periscope, and the TC will use the CITV. (In case of a CITV failure, binoculars or unaided eye would be used as an alternate method.)

- Start in the center of the sector and rapidly scan from the nearest to the farthest visible point.
- Then, orient left or right and conduct a rapid scan, near to far. This sweep must overlap the center area previously scanned.
- Once one side of center is scanned completely, scan the other side in the same way.

Slow-Scan Technique

If no obvious targets are identified during the rapid scan, crew members will scan the terrain more deliberately, using the tank's optics or binoculars and the slow-scan technique (see Figure 6-2). The slow-scan technique is best employed by the TC or gunner in a defensive position or from a short halt.

- Pausing at short intervals to give the eyes time to focus, search a strip of the target area using the height of the GPS reticle in 10X as a reference, from right to left.
- Then, search a strip farther out, from left to right, overlapping the first strip.
- Continue until the entire target area is searched.
- When a suspicious area or possible target signature is detected, stop and search the immediate area thoroughly, using the detailed-search technique.

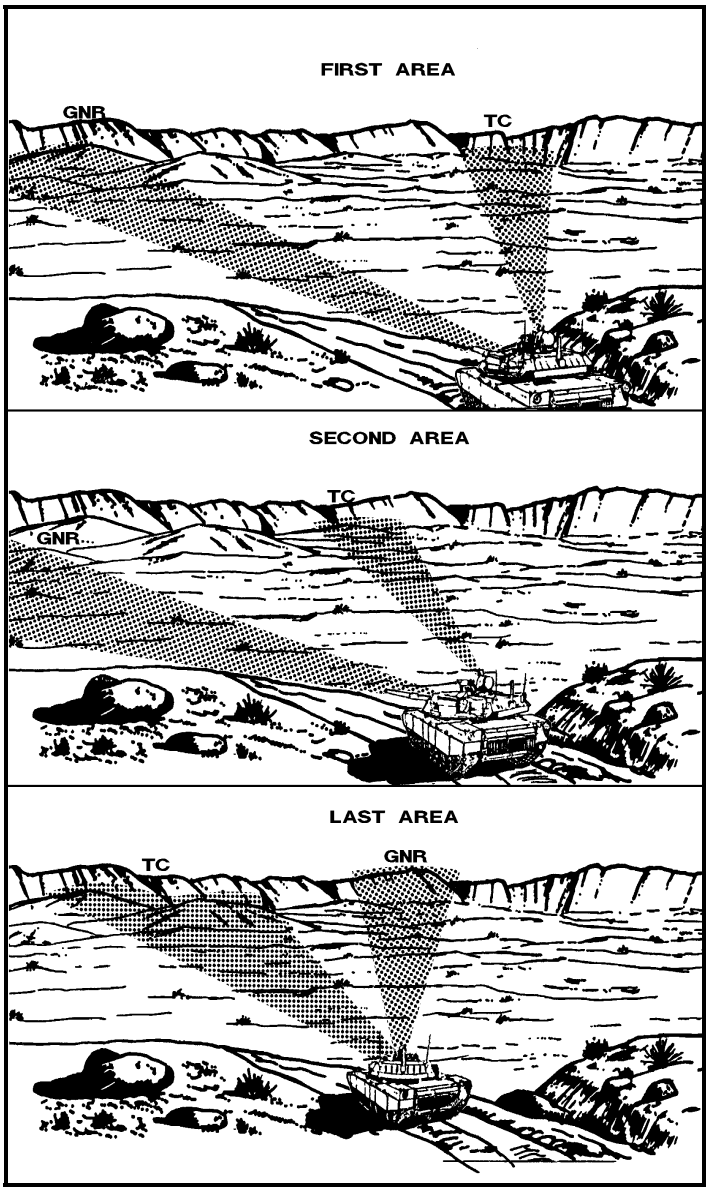


Figure 6-1. Rapid-Scan Technique.

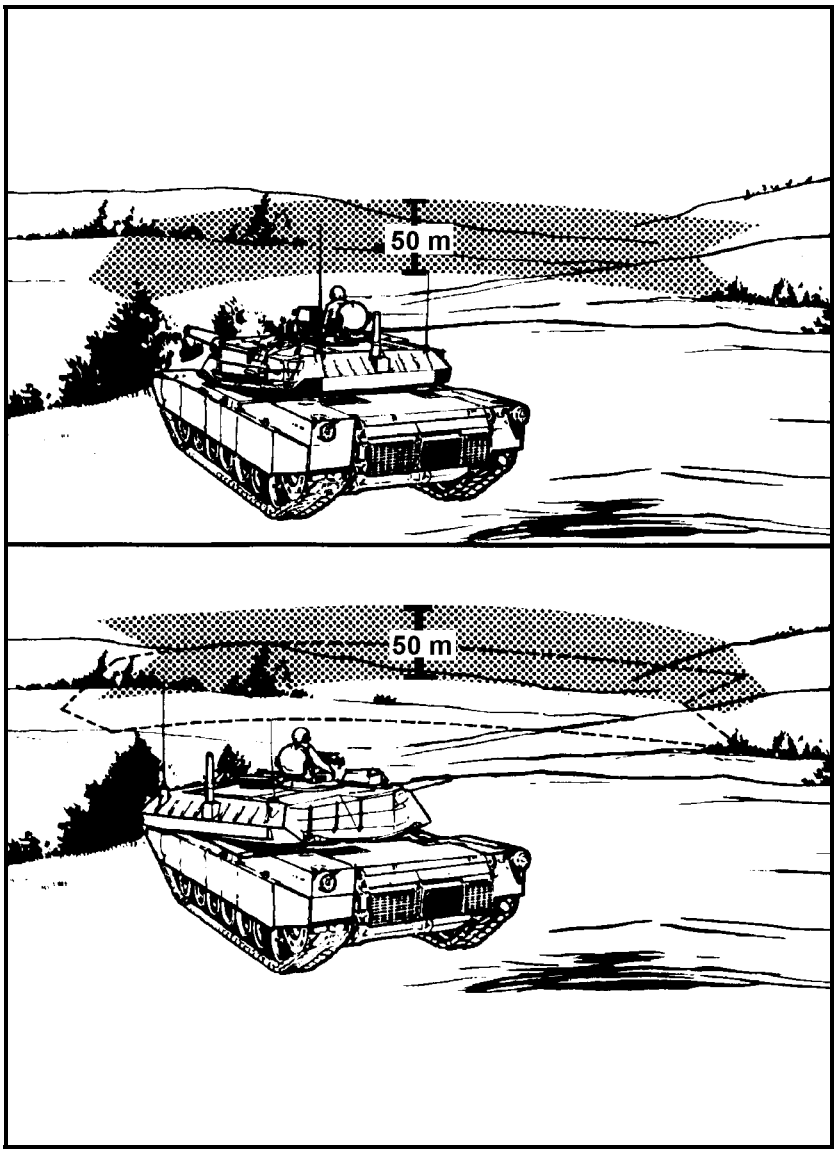


Figure 6-2. Slow-Scan Technique.

Detailed-Search Technique

If no targets are found using the rapid-scan or slow-scan techniques and time permits, crews should use their optics (day and night) to make a careful, deliberate search of specific areas in their sector (see Figure 6-3). This method is also used to search, in detail, small areas or locations with likely or suspected enemy activity.

- Concentrate on one specific area or location, and study it intensely.
- Look for direct or indirect target signatures by sweeping left and right of the focal point (terrain feature) of the area.

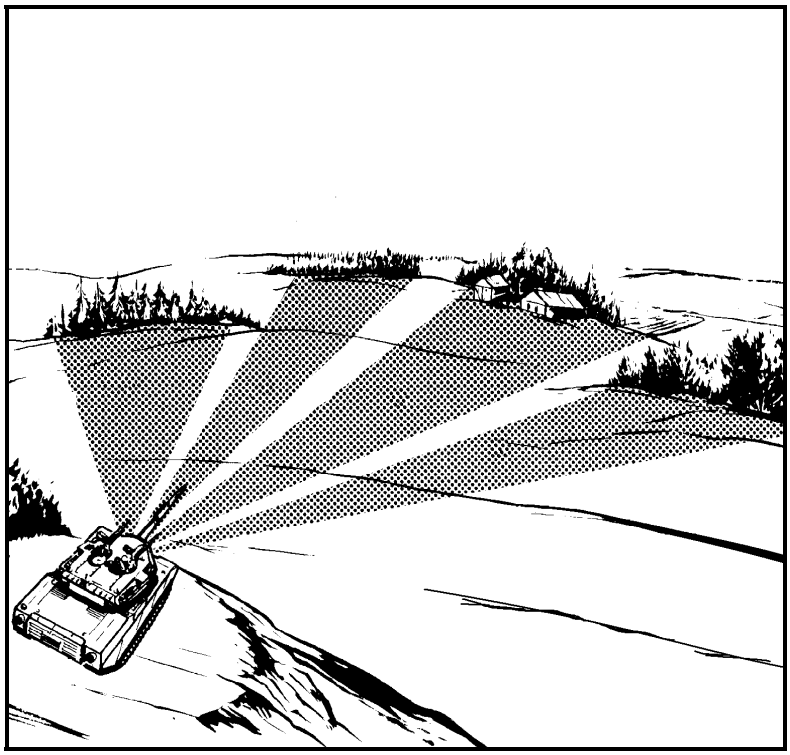


Figure 6-3. Detailed-Search Technique.

OFF-CENTER VISION

Day and night scanning techniques (rapid scan, slow scan, and detailed search) are similar, with one exception. Do not look directly at an object at night, using daylight optics or the unaided eye; look a few degrees off to the side (off-center vision). When scanning with off-center vision, move the eyes in short, abrupt, irregular movements. Pause a few seconds at each likely target area to detect any movement. If a possible target is detected, use off-center vision to observe it. Frequent eye movement is necessary to prevent object fade-out while observing the object. Cupping the hands around the eyes will also increase night vision.

AIR-SEARCH TECHNIQUES

While scanning their assigned sector for ground targets, crew members must also be aware of air targets. To aid in the detection of air targets, crews should use the horizontal search-and-scan technique or vertical search-and-scan technique. Crew members should periodically check the air space above their assigned sector using the rapid-scan technique. As each crew member completes a rapid scan across the sector and his field of view meets the horizon, he should switch to a detailed search and make a careful, deliberate search of tree lines, valleys, and possible air corridors silhouetted by distant background terrain.

Attack helicopters try to engage at extremely long ranges; therefore, target identification is difficult. Crews must make every effort to correctly identify the target. To prevent fratricide, leaders must keep tank crews informed of friendly aircraft operating in their unit's sector.

Based on METT-TC, the unit commander may establish one or more air guards. An air guard is a designated tank (or tanks) with MPAT battlecarried in AIR mode. The air guard is primarily responsible for detecting and engaging aerial targets. An air guard crew searches for aerial targets in the same manner as other crews. Gunners search their assigned sector using the search and scan techniques; however—

- Sector limits established for the gunner must cover likely helicopter locations and avenues of approach.
- Gunners must make sure ground reference points are always within their field of view.

Horizontal Search and Scan

Search up to 20 degrees above the horizon by moving the eyes in short movements across the sky, working your way up and across. Continue the scan pattern below the horizon to detect aircraft flying nap-of-the-earth.

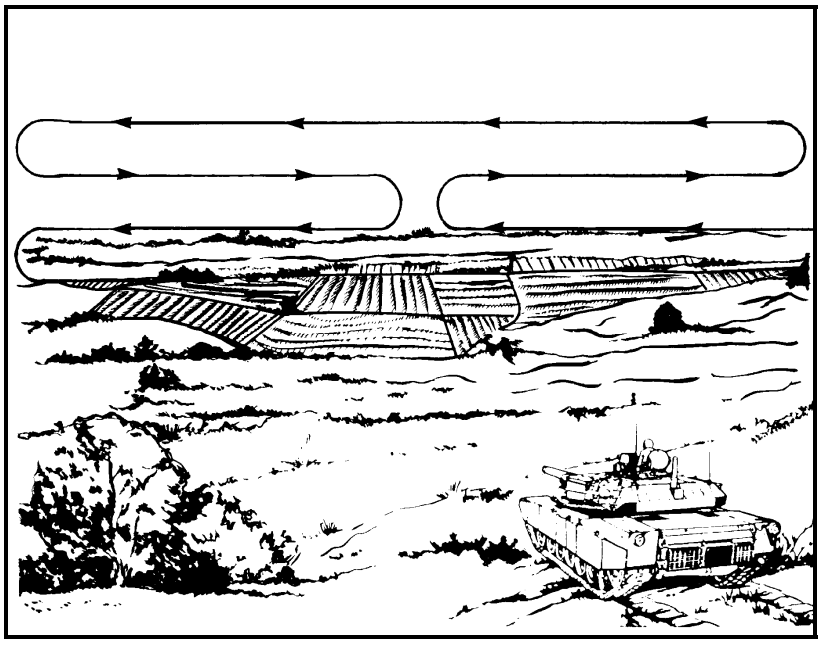


Figure 6-4. Horizontal Search and Scan.

Vertical Search and Scan

Search the sky using the horizon as a starting point and prominent terrain features as points of reference. Move the eyes in short movements into the sky, then back down, continuing this movement across the terrain. Scan in the same pattern below the horizon to detect aircraft flying nap-of-the-earth.

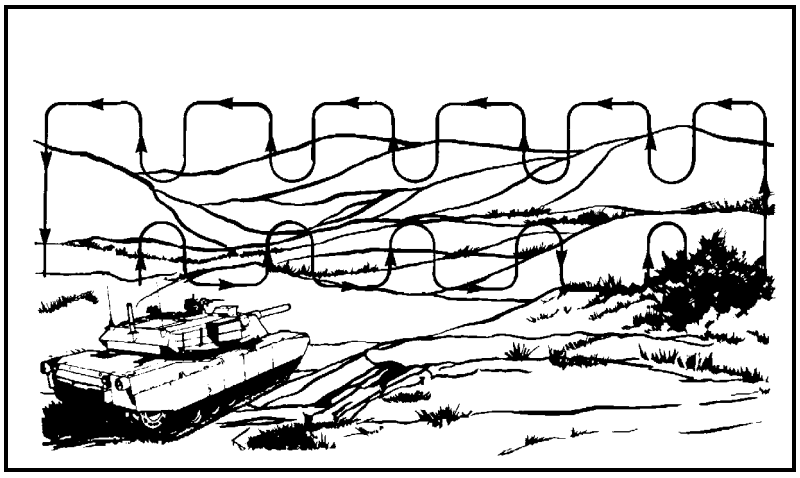


Figure 6-5. Vertical Search and Scan.

Estimation of Upper Search Limits

When scanning the sky for aircraft, crew members may miss high-flying aircraft if they limit their search too near the horizon; yet, they are likely to miss low-flying aircraft if they expand the upper limits of their search too high above the horizon. The correct upper limit of search is 20 degrees. Estimate 20 degrees using the technique illustrated. With the fingers fully spread, the tip of the thumb is the upper search limit.

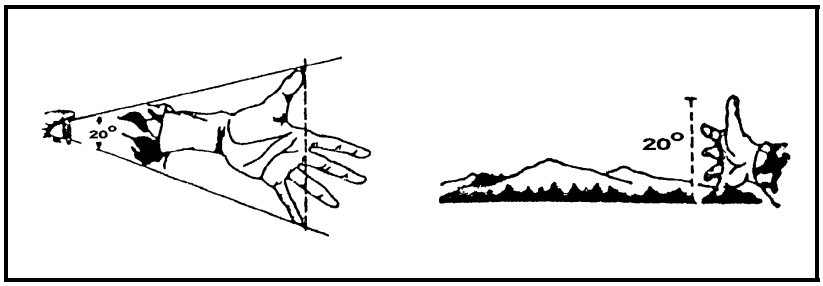


Figure 6-6. Estimating 20 Degrees.

TARGET DETECTION

Target detection is the discovery of objects on the battlefield (personnel, vehicles, or equipment) of potential military significance.

TARGET SIGNATURES

Target signatures are telltale indicators (clues) that help an observer detect potential targets on the battlefield. Most weapons and vehicles have identifiable signatures. These distinguishing characteristics may be the result of equipment design or the environment in which the equipment is used:

- Firing a tank main gun produces blast, flash, dust, smoke, and noise.
- A tank moving through a built-up area makes much more noise than one moving through an open field.
- Fixed-wing and rotary-wing aircraft produce noise such as a fast-moving jet aircraft breaking the sound barrier, and light reflected off aircraft windows, canopies, or rotating blades.
- Helicopters produce dust or excessive movement of tree tops and bushes caused by rotor wash.

Look for targets where they are most likely to be employed. Look for track vehicle signatures in open areas and rolling terrain. Enemy antitank positions will cover primary avenues of approach where tanks and PCs are likely to be used. Look for helicopters on the back side of woodlines, ridgelines, and significant folds in the terrain. These are only a few examples of signatures with which crews must be familiar. Sight, sound, and smell can all assist in detecting signatures that may lead to target location and identification.

Soldier Signatures

Some examples of soldier signatures are:

- Foxholes.
- Broken vegetation.
- Footprints.
- New and old fires.
- Thermal signatures viewed through thermal optics.
  - Exposed skin areas are more visible than clothes.
  - Hot weapons are more visible than cold weapons.
  - Hair and glasses are less visible than exposed skin.

Track-Vehicle Signatures

Some examples of track-vehicle signatures are:

- Vehicle tracks on ground.
- Engine noise.
- Exhaust smoke.
- Dust clouds from movement .
- Weapon firing reports, and smoke.
- A bright white flash at night.
- Thermal signatures viewed through thermal optics.
  - Suspension and exhaust systems are more visible than the rest of the vehicle and the surrounding area.
  - A gun tube that has just fired is more visible than one that has not.
  - Normally, vehicles are more visible than the surrounding area and are readily visible through the thermal sight, when weather conditions permit.

Antitank Signatures

Some examples of antitank signatures are:

- The *swish* noise of a missile launch.
- Long, thin wires from previously fired ATGM.
- The sharp *crack* noise of an ATGM being fired.
- A soldier dismounted with an ATGM, may be within 100 meters of a PC.
- Thermal signatures viewed through thermal optics.
  - The suspension system and engine exhaust are more visible on track vehicles.
  - The engine exhaust, wheels, and windshield are more visible on wheel vehicles.
  - A fired ATGM leaves a distinct hot spot, more visible than the surrounding area.
  - A dismounted soldier has the same characteristics as listed under soldier signatures.

Artillery Signatures

Some examples of artillery signatures are:

- A loud, dull explosive noise.
- A grayish white cloud of smoke.
- A bright orange flash with black smoke from air bursts.
- A rushing noise heard several seconds before the impact of a round.
- Thermal signatures viewed through thermal optics.
  - Self-propelled artillery has the same thermal signature as a track vehicle.
  - Towed artillery signatures vary according to the towing vehicle.

Aircraft Signatures

Some examples of aircraft signatures are:

- Aircraft noise.
- Glare of sun from canopies, wings, and fuselages of fixed-wing aircraft, as well as windows and rotor blades of helicopters.
- Vapor trails from engine exhaust and fired missiles.
- Dust and movement of foliage from hovering helicopters.

- Thermal signatures viewed through thermal optics.
  - Fixed-wing aircraft are more visible than the surrounding sky.
  - Helicopters, once they unmask, are more visible than the surrounding area.

Obstacles and Mines

Some examples of obstacle and mine signatures are:

- Loose or disturbed dirt in regular patterns.
- A previously destroyed or disabled vehicle that appears to have struck a mine.
- Troop positions and vehicles covering obstacles and mines.
- Thermal signatures viewed through thermal optics. (Loose dirt is more visible than packed dirt.)

DETECTION CHALLENGES

Some targets are more difficult to detect than others. Increased crew sustainment training and greater concentration are needed to detect and locate these targets. The tactical tables were designed to meet many of these challenges in training. Some examples of these more difficult targets and detection challenges are:

- Targets on the extreme edge of the field of view (peripheral targets).
- Targets that are camouflaged or in shadows.
- Targets that can be heard but not seen.
- Targets under less than ideal indirect-fire illumination. (If the illumination is in front of the target, the resulting shadow will be darker than the target. If the illumination is behind the target and not in position to *wash out* the crew's optics, the target should stand out distinctly from the background. Always keep one eye closed during illumination search, and never look directly into the illumination source.)
- Small, single targets such as a lone, dismounted ATGM or RPG position.
- Natural obstacles (such as weather and terrain).
- Man-made obstacles (such as smoke and battlefield clutter).
- Behavioral or physical deficiencies (such as fatigue and eye reaction to gun flashes).

DETECTION TIPS

The following tips will help detect targets:

- Scan with the unaided eye first, then with magnifying optics. All tank optical devices can be used to acquire targets at ranges beyond the extent that the unaided eye can see; however, the TIS and CITV are the preferred optics for searching and detecting targets, day or night.
- TC and gunner should not scan and search the same sector in the same manner; they should alternate sectors. (For example, when the gunner on an M1 or M1A1 is searching the left sector with the TIS, the TC should be searching the right sector with binoculars; the gunner on an M1A2 or M1A2 SEP searches with the TIS, and the TC uses the CITV. This will increase the probability of detecting a target.
- While scanning, crew members should shield their eyes from the blinding effects of the sun. Looking directly into the sun will cause them to miss targets coming from the sun's direction. Squinting changes the eyes' focal length, which helps bring distant targets into focus.
- Turn down the dome light, panel lights, and illuminated reticles in the optics to increase the ability to acquire targets during day or night observation. This will also decrease the possibility of being acquired by enemy gunners using passive sights.

- Do not overlook targets at the edge of the peripheral field of view, where they are harder to detect and locate. Protective masks narrow the field of view. When masked, crew members must compensate by moving their heads more. Concentrate search in areas where targets are more likely to appear, such as identified avenues of approach, woodlines, and reverse-slope firing positions.
- While on the move, continue to search for targets. The TC must continuously reassign sectors for scanning and searching based on visibility and changes in the terrain.
- When searching for aerial targets, especially above the horizon, frequently focus their eyes on a distant object, land feature, or even a cloud to prevent distant objects from becoming blurred. Once an aircraft is spotted, crew members should keep their eyes on it. If it is necessary to look away, remember exactly where the target was and its heading direction from a specific point, such as a cloud or terrain feature. This will help sight the target again in less time.

TARGET LOCATION

Target location is the determination of where a potential target is on the battlefield. Locating a target occurs as a result of observation and detection during crew search. The target location methods used by armor crewmen to fix or locate a target for another crew member depend on the individual's specific crew position, the unit SOP, and available time.

TC OVERRIDE METHOD

This method may be the fastest, most accurate method of target location. After acquiring the target, the TC lays the gun for deflection with his power control handle. The gun on the M1 and M1A1 is laid for deflection when the target appears between the end of the gun tube and the left corner of the GPS assembly (dog house). The M1A2 and M1A2 SEP gun is laid for deflection (by means of the target designate function) when the target appears in the TC's sector of observation.

TRAVERSE METHOD

The traverse method is a relatively quick method. It is used primarily by the TC to get the gunner on target when the TC cannot use his power control handle to guide the gunner. (Example: "TRAVERSE LEFT (RIGHT)—STEADY—ON.")

REFERENCE POINT METHOD

The reference point method is used with the vehicle optics. The TC uses his binoculars to determine the mil value from a terrain feature or known position. He then announces the mil value to the gunner. The gunner uses the mil reticle relationship to traverse onto the target. The key to this location method is TC and gunner familiarity with the mil sight relationship. (Example: "ATGM—TRP ONE THREE THREE RIGHT FIVE MILS.")

The reference point method is used by all crew members to hand over targets in the vicinity of a TRP. (Example: "TWO TANKS—TRP ONE THREE FOUR.")

CLOCK METHOD

The clock method is one of the fastest methods used to get the TC or gunner on target. The tank crew bases 12 o'clock on the direction of vehicle movement while traveling, and on hull orientation when stationary. Loaders and drivers usually use the clock or sector method to locate targets for the TC or gunner. (Example: "BMP—NINE O'CLOCK.")

SECTOR METHOD

Similar in concept to the clock method, the sector method is quick. It is best used to indicate a direction from the vehicle's direction of movement (moving) or hull orientation (stationary). Center sector is always to the direct front. (Example: "THREE TANKS—LEFT REAR.")

TANK SKETCH CARD METHOD

This method is used in defensive positions. When preparing the sketch card, the TC will have the gunner identify specific terrain features, TRPs, and platoon targets within both his sector of fire and adjacent sectors. When the TC needs to shift fires, the gunner will know exactly where to look for targets.

GRID METHOD

The grid method is the least desired technique, due to the length of time it takes to bring the gunner on target. The TC receives the location of a target by map grid (usually from a listening post or observation post). The TC then uses his map to orient the main gun into the target area.

TARGET IDENTIFICATION

Target identification is the determination that a potential military target is a particular object (such as a specific vehicle, by type). As a minimum, this identification must determine the potential target as friendly or enemy. *Tank crews must know what to engage and what not to engage*.

The tank crew's only method of positive vehicle identification is visual. As engagement ranges increase, camouflage techniques improve, and battlefield obscuration increases, the effectiveness of visual identification greatly diminishes. Being able to identify first gives a tank crew the advantage of engaging first and destroying the enemy. The crew should identify targets as friend, foe, or neutral at the maximum range, depending on visibility. Repeated crew sustainment training and evaluation on target identification is the key to proficiency.

Target identification training is an essential part of any weapon system proficiency training program. TCs must continually train their crews in target identification using all sights. The TCGST includes a station on vehicle identification (see Chapter 12, *Tank Crew Gunnery Skills Test [TCGST]*).

Tank crew vehicle and aircraft (target) identification training programs should incorporate some or all of the following references:

- STP 21-1-SMCT, Soldiers Manual of Common Tasks.
- GTA 17-2-13, Armored Vehicle Recognition (Study Cards 1-52).
- GTA 44-2-17, 18 and 19, Combat Aircraft (recognition cards).
- Recognition of Combat Vehicles (ROC-V).

See your unit S2 for more information on identifying vehicles, aircraft, and equipment likely to appear on the battlefield in your sector. Keep in mind that in many parts of the world, both our allies and the enemy employ a mix of allied and enemy-made vehicles.

TARGET ACQUISITION REPORTS

Targets acquired by a crew member are immediately reported to the TC with an acquisition report. This target hand-over procedure may take place during any of the three target acquisition phases (detection, location, or identification) and must take place before the classification step of the target acquisition process.

An acquisition report consists of three elements: alert (optional), description, and location (optional for gunner only). (Example: "LOADER REPORT—MOVING TANK—LEFT FLANK.") The acquisition report is given internally between crew members who can readily identify each other (crew position) by voice. Therefore, the description element of the report usually serves as the alert element also. (Example: "MOVING TANK—ONE O'CLOCK" [TC and gunner recognize loader by voice as initiator of the report].)

Note. An acquisition report by the loader, gunner, or driver cannot be used as the alert or target description element of a fire command.

TARGET CLASSIFICATION

Target classification is the grouping of potential targets by the relative level of danger they represent. It is the fifth step in the target acquisition process and is determined by the TC after target acquisition has been completed.

To defeat the many enemy targets that may appear on the battlefield, the TC must rapidly decide which targets present the greatest danger. Targets are classified as *most dangerous*, *dangerous*, or *least dangerous*. Estimating the enemy array, target by target, leads to a priority of engagements. The TC further analyzes the targets in terms of *hard* (armored vehicle, concrete bunker) versus *soft* (truck, troops) and *point* (tank, truck) versus *area* (troops) to determine the proper ammunition and weapon system to use in an engagement. The TC must continuously revise the classification of targets as they are destroyed.

MOST DANGEROUS

When the crew observes an enemy target with armor-defeating capabilities that appears to be preparing to engage them, the target is classified *most dangerous*. This type of target is the greatest threat and must be engaged immediately. If there is more than one, engage the closest one first. The crew should use alternate firing positions when engaging three or more *most dangerous* targets from a stationary (hull-down) position. Smoke (indirect fire or on-board generation) may also be used to split targets or keep the enemy from observing your tank. (See Chapter 8, *Direct Fire*, for more details.) Minimizing the number of rounds fired from any one position will help confuse the enemy about your tank's exact location.

DANGEROUS

When the crew sees a target with armor-defeating capabilities, but that target is not preparing to engage them, the target is classified *dangerous*. This type of target should be engaged after all *most dangerous* targets have been destroyed, unless otherwise specified by the priority of engagements. Multiple *dangerous* targets are engaged the same as *most dangerous* targets—the closest one first.

LEAST DANGEROUS

A target that does not have an armor defeating weapon system, but can report you to one that does, is classified *least dangerous*. Engage this type of target after all *most dangerous* and *dangerous* targets have been destroyed, unless certain *least dangerous* targets have a high priority of engagement, as in the case of command and control vehicles.

TARGET CONFIRMATION

Target confirmation is the rapid verification of the initial identification and classification of the target. It is the final step in the target acquisition process and is completed *during* conduct-of-fire. Confirmation takes place after the TC has issued all elements of the fire command, *except* the execution element, and as the gunner is completing his precise lay. Gunners also go through a confirmation step. For the gunner, the verification is simply that, as he makes his final precise lay, he assures himself that the target is hostile, not friendly or neutral.

The TC (examining the target through the GPS extension, if necessary) completes his evaluation of the target based on the target's appearance and his knowledge of the tactical situation. If the TC determines the target is hostile, he continues the engagement. If he determines the target is friendly or neutral, he announces "CEASE FIRE." If he cannot confirm the nature of the target, he continues to observe until he can.

If the gunner confirms that the potential target is hostile, he completes his final lay and engages the target on order. If the gunner determines the target is friendly or neutral, he announces "CONFIRMATION FRIENDLY" or "CONFIRMATION NEUTRAL" to the TC. If he cannot determine the nature of the target, he announces "CONFIRMATION DOUBTFUL." The TC will then determine whether to continue or terminate the engagement. (See Chapter 8, *Direct Fire*, for a complete list of crew duties during conduct-of-fire.)

It is vital that TCs be kept informed of the current tactical situation to assist in target confirmation, especially in movement of friendly elements within or between battle positions, forward passage of lines, withdrawal of any covering force, or the movement of civilian vehicle traffic in the area of operations.

Target Acquisition and Conduct-of-Fire Process

The target acquisition process described in this chapter and the conduct-of-fire process described in Chapter 8, *Direct Fire*, are interwoven and interdependent on the battlefield. Tank crews must be proficient in the techniques and procedures of both target acquisition and conduct-of-fire to engage the enemy successfully in combat.

Chapter 7

Range Determination

Although the LRF is the principal means of determining range in the Abrams, LRF malfunctions, environmental conditions, or target size may force the crew to use an alternate method. This chapter explains how to determine range using alternate methods. Alternate methods vary from the simple and quick recognition method to the more complex, time-consuming, but accurate mil relation formula. Additional methods include reticle relationship, ranging with the TC's machine gun, flash-bang, adjacent tanks, known range, and map. Each method is based on varying situations, conditions, and degrees of accuracy. Each of these methods should be practiced at every opportunity and individual performance checked using the LRF.

CONTENTS

Immediate Range Determination Methods

RECOGNITION METHOD

With practice, range determination by recognition is quick and accurate; however, this method will not work with passive or thermal sights. The principle of the recognition method is simple. When the TC sees a target, he can determine the range according to what he recognizes. For example, if a target can be recognized as a tank with the unaided eye, it is within 1,500 meters; if a target can be recognized as a tank through magnifying optics (GAS, binoculars, and so forth), it is within 5,000 meters.

The following table gives range estimations for targets as seen with the unaided eye and through magnifying optics (binoculars).

RANGE DETERMINATION	RECOGNITION METHOD	
Target	**Unaided Eye (meters)**	**Magnification 7 or 8 Power (meters)**
Tank crew, troops, machine gun, mortar, antitank gun, antitank missile launchers	500	2,000
Tank, personnel carrier, truck, (by model)	1,000	4,000
Tank, howitzer, personnel carrier, truck	1,500	5,000
Armor vehicle, wheel vehicle	2,000	6,000

When using the recognition method, the size and clarity of the target in relation to its background must be considered. Some light and terrain conditions make a target seem closer; other conditions make it seem farther away. The conditions outlined in the following table may cause an error in estimating range by the recognition method.

TARGET CONDITIONS	
Seems Closer	**Seems Farther**
Bright, clear day	Fog, rain, haze, twilight
Sun in front of target	Sun behind target
Targets at higher elevations	Targets at lower elevations
Large targets	Small targets
Bright colors—white, red, yellow	Dark colors
Contrast	Camouflaged targets
Looking across ravines, hollows, rivers, depressions	
Desert	
At sea	

M1A2 COMMANDER'S INDEPENDENT THERMAL VIEWER STADIA RETICLE

The stadia reticle is displayed when the NFOV is selected using the FOV button on the CCHA, the CITV is in SEARCH mode, and the range/stadia reticle switch is pressed. The stadia reticle is used to determine the approximate range to tank-height targets when the LRF is inoperable, or the TC wishes to avoid traversing the turret to align the LRF. Range is determined by matching the apparent height of the target with the stadia reticle, which can be made smaller or larger by moving the range/stadia reticle switch.

- The range/stadia reticle switch will only operate the stadia reticle when the LRF is OFF, inoperable, or the CITV is in a non-GUN LOS state.
- The stadia reticle will only appear when in NFOV.
- There are 11 different reticle sizes that provide ranges from 500 meters to 3,630 meters.
- Moving the range/stadia reticle switch backward will increase the size of the stadia reticle. Moving the range/stadia reticle switch forward will decrease the size of the stadia reticle.
- The stadia reticle will disappear from view after 10 seconds if the range/stadia reticle switch is not used. The last range input will remain displayed.
- The stadia reticle is most accurate when used with tank-height targets. Ranges to targets that are of different heights will be inaccurate.
- When the stadia reticle is used, the range will be input into the fire control system once the DESIGNATE button is pushed.

To determine the range to a full-height target, move the range/stadia reticle switch forward or backward until the bottom index line rests on the bottom of the target and the top index line rests on the top of the target. The approximate range is displayed on the CITV display.

To determine the range to a hull-down target, move the range/stadia reticle switch forward or backward until the bottom center index line rests on the bottom of the target and the top center index line rests on the top of the target. The approximate range is displayed on the CITV display.

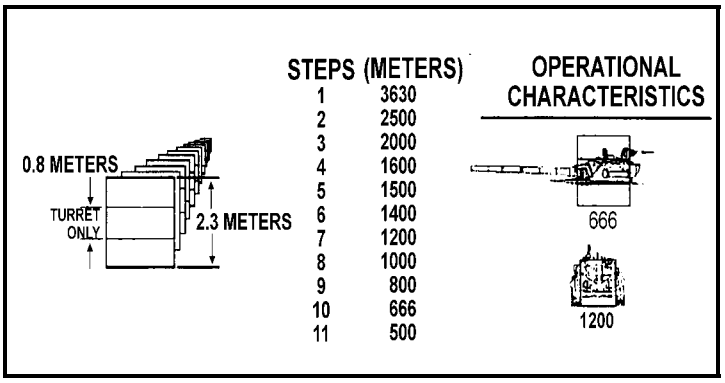


Figure 7-1. CITV Stadia Reticle.

GUNNER'S AUXILIARY SIGHT STADIA RETICLE

On the M1, M1A1, and M1A2, the stadia reticle pattern is included on both gunner's auxiliary sight reticles. If the laser range finder is inoperative, the stadia reticle may be used to determine the range to a target. The pattern has a base line and a series of range lines for full-height targets, and a series of dots for ranging at a target in hull defilade (see Figure 7-2). The GAS stadia reticle is designed to permit gunners to determine range to the target if other, more precise, ranging methods are not available. The full-size portion of the reticle is designed for a 2.30-meter-high target, while the turret portion is for a 0.90-meter-high target (see Figure 7-3). With practice, gunners using the stadia reticle can consistently determine the range to within 100 meters.

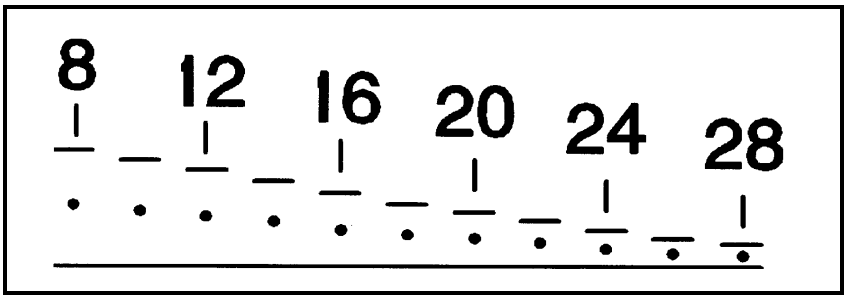


Figure 7-2. GAS Stadia Reticle.

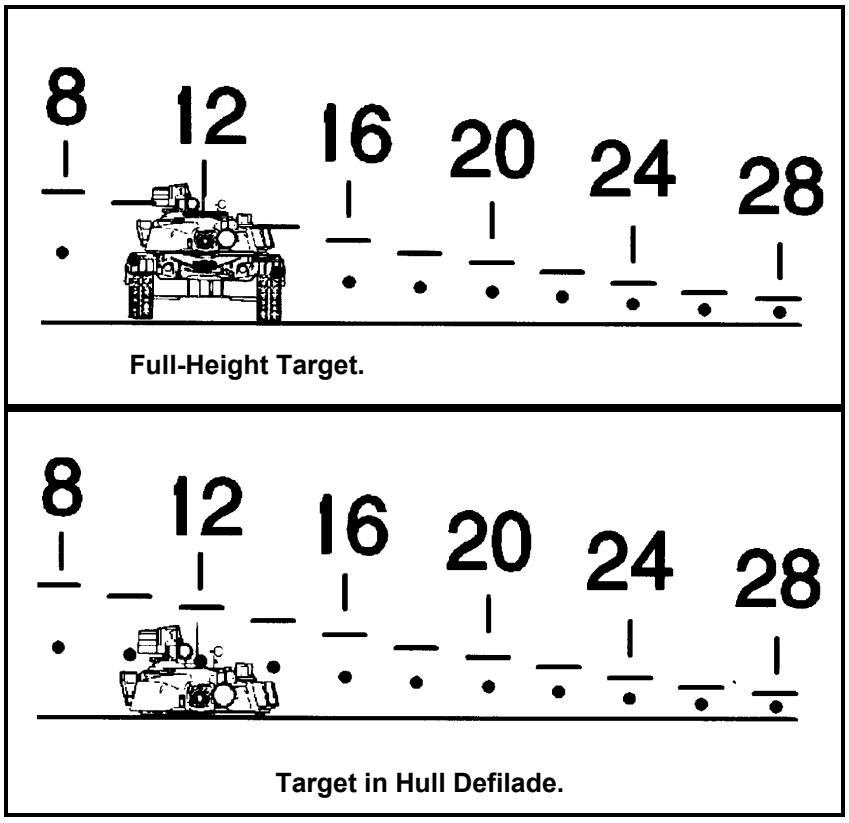


Figure 7-3. GAS Stadia Reticle, Displaying Target.

RETICLE RELATIONSHIP METHOD

This method is a combination of the range estimation and engagement technique. It provides the TC a rapid, accurate alternate method of determining range to a target and successfully engaging the target. The reticle relationship method is based on an average enemy tank with the following dimensions:

- Width 3.4 meters.
- Height 2.3 meters.
- Length 6.7 meters.

When the reticle of either the GPS or GAS is superimposed over the enemy tank, the properly trained gunner or TC can rapidly determine if the target is within a preselected battlesight range, or if further range determination is required.

Gunners should also be trained to use the SABOT/STAFF and MPAT/HEAT reticles on the M1A1 and M1A2 GAS, and the SABOT and HEAT reticles on the M1 GAS to determine range. Since there is no vertical mil value established for these reticles, using a vertical measurement is not recommended.

ESTIMATED-RANGE METHOD

To engage targets when the LRF cannot be used and the range is unknown, the TC or gunner must estimate the range to the target. Range data is announced in the fire command in even hundreds or thousands, otherwise digit by digit.

Examples: If the TC announces—

- "CHOKED—ONE EIGHT HUNDRED," the gunner uses the GPS and the range designated from the TC (*M1A2 only*).
- "ONE EIGHT HUNDRED," the gunner shifts to the GAS and uses the appropriate reticle and range line.

- "INDEX ONE EIGHT HUNDRED," the gunner uses the GPS and enters the range into the FCS using the CCP or GCDP.
- "GUNNER—SABOT—TANK—CHOKE (description)," the gunner shifts to the GAS, selects the appropriate reticle, and uses the choke sight to estimate the range, then repeats the range to the TC.

Range	GPS Announced As	GAS Announced As
900 meters	"INDEX NINE HUNDRED"	"NINE HUNDRED"
2,000 meters	"INDEX TWO THOUSAND"	"TWO THOUSAND"
1,200 meters	"INDEX ONE TWO HUNDRED"	"ONE TWO HUNDRED"
860 meters	"INDEX NINE HUNDRED"	"NINE HUNDRED"
3,040 meters	"INDEX THREE THOUSAND"	"THREE THOUSAND"

TANK COMMANDER'S MACHINE GUN METHOD

The TC's machine gun with sight reticle gradation can be used to determine range out to 1,800 meters. The TC's machine gun allows him to suppress the target and determine range at the same time. To aid the gunner in target identification and to reduce engagement time, the CWS should be aligned with the main gun. The disadvantage of this method is that the tank's position will be disclosed. (This method cannot be used on the M1A2.)

To use this method, the TC initiates the fire command (for example, "GUNNER—HEAT— ANTITANK," "CALIBER FIFTY—RANGING"). The TC places his sight reticle aiming point on the target, and fires. He then observes the tracers and adjusts their impact until they strike the target. Once the tracers impact on, or near, the target, the TC reads the corresponding aiming point of the reticle and announces the range to the gunner, (for example, "ONE EIGHT HUNDRED" or "INDEX ONE EIGHT HUNDRED") followed by the execution element ("FIRE").

Note. If the tank is in a turret-down defensive position, it should move to a hull-down position; the commands "DRIVER—MOVE OUT" and "DRIVER—STOP" must be issued before the execution command.

The TC's initial aiming point should correspond with the battlesight range for the ammunition announced in the fire command. By applying the battlesight range to the TC's sight, if the initial burst is observed over the target, the TC can engage immediately by announcing the battlesight range.

Deliberate Range Determination Methods

MIL RELATIONSHIP METHOD

The mil relation may be used in deliberate range determination. One mil equals a width (or height) of 1 meter at a range of 1,000 meters. The relationship of the angle, the length of the sides of the angle (range), and the width (height) between the sides remains constant. Figure 7-4 shows the constant relationship as the angle increases from 1 to 2 mils and the range increases from 1,000 to 2,000 meters.

Note. Tank fire control systems use mils (~~m~~) to apply deflection and elevation corrections and measure angular velocity. One mil is equal to 1/6400 of a circle; there are approximately 17.8 mils in one degree.

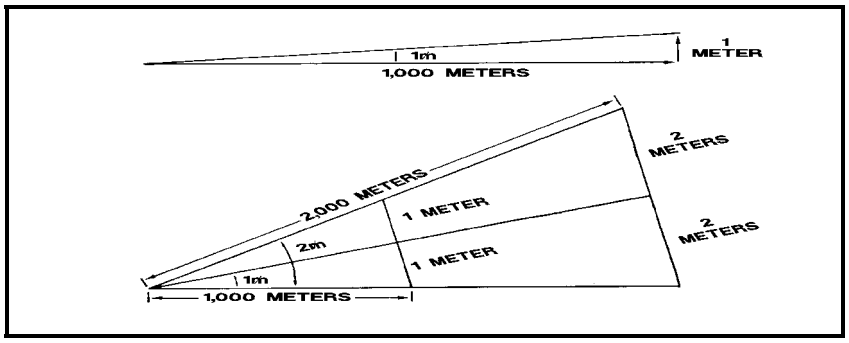


Figure 7-4. Constant Mil-Angle Relationship.

To determine range using the mil relation, the width, length, or height of the target must be known. (Accuracy depends on knowledge of target dimensions and the ability of the individual to make precise measurements with the binoculars.) Measure the width, length, or height with the binocular mil scale or a nonballistic reticle, substitute the mil relation, and compute the range. The relationship of the angle in mils (~~m~~), the length of the sides (or range) in thousands of meters (R), and the width between the ends of the sides in meters (W) is expressed as the mil relation. As a memory aid, the word WORM may be used, meaning width over range X mil or—

$$\frac{W}{R \times \text{~~m~~}}$$

The mil relation may be converted into a formula by removing the factor that is to be determined.

Thus: $W = R \times \text{~~m~~} \div 1{,}000$
or $R = W \div \text{~~m~~} \times 1{,}000$
or $\text{~~m~~} = W \div R \times 1{,}000$

The mil relation holds true whether the W factor is in a horizontal or vertical plane, if the mil angle is measured in the same plane. Because the mil relation is constant, other units of measurement such as yards, feet, or inches may be substituted for meters in expressing width or range; however, the relation holds true only if both W and R are expressed in the same unit. For example, if the sides of a 1-mil angle are extended to 1,000 yards, the width between the ends of the sides is 1 yard.

The following formula should be used when looking at the tank from the side view. **Example:** A T-72 is approximately 6.7 meters long (W). Using binoculars, the TC determines that the tank he sees is 5 mils (~~m~~) in length (W). Remove the R factor from the mil relation: W ÷ ~~m~~ x 1,000. Substitute the two known values for W and ~~m~~ and solve for R: R = 6.7 ÷ 5 = 1.34. Since R is in thousands of meters, multiply the answer 1.34 x 1,000 = 1,340 meters. This will be the range to the enemy tank.

The following should be used when looking at the tank from a frontal view. **Example:** A T-72 is approximately 3.3 meters wide (W). Using binoculars, the TC determines that the tank he sees is 2.5 mils (~~m~~) wide (W). Remove the R factor from the mil relationship: W ÷ ~~m~~ x 1,000. Substitute the two known values for W and (~~m~~) and solve for R: R = 3.3 ÷ 2.5 = 1.32. Since R is in thousands of meters, multiply the answer 1.32 x 1,000 = 1,320 meters. This will be the range to the enemy tank.

ADJACENT TANK METHOD

Range information can be obtained from an adjacent tank that has an operable LRF. If the tank providing the range data is relatively close (lateral distance) to the receiving tank, then it will be at the same range from the target. On the M1A2 tank this can be accomplished with IVIS.

MAP METHOD

A map can also be used to determine range to a target. The TC finds his tank's position and the target's position on a map, then he measures the distance between the two points on the map scale. On the M1A2 tank this can be accomplished by using the CID.

KNOWN RANGE METHOD

When time permits the tank crew to prepare a position for combat, one of the first things that should be done is to range to areas where targets are likely to appear. These known ranges are recorded on a sketch card. If the LRF is inoperative or cannot be used, recorded range data will significantly reduce engagement time and improve accuracy. The crew performs as in a normal engagement except that the gunner or TC manually indexes the announced range, or the gunner fires from the GAS using the appropriate range line. The range to a previous target engagement is also classified as a known range.

FLASH-BANG METHOD

Sound travels through the air at a fairly constant speed, about 330 meters (approximately 1,100 feet) per second. This makes it easy to estimate range, if you can see and hear the action. For example, when you see the flash or smoke of a weapon, or the dust it raises, immediately start counting at a rate of one count per second. When you hear the report of the weapon, stop; then multiply the number you were counting when you heard the report by the constant 330. This will be the range to the weapon in meters. If you stop on the number 3, the range is about 990 meters.

Practice timing the speed of your count. The best way to do this is to practice with pyrotechnics fired at known distances. If this is not possible, have someone time you while you count. When the count reaches a number higher than 10, start over again. Counting numbers such as 12 and 13 will throw your timing off. With practice, you can estimate range more accurately with this method than by eye alone.

Chapter 8

Direct Fire

Tank crews must be able to engage and destroy targets quickly and with a minimum expenditure of ammunition. To accomplish this, each member of the crew must know his particular job well enough that, in combat, his responses are automatic. Each crew member must be familiar with the duties of the other tank crewmen so that loss of one member will not destroy the fighting effectiveness of the tank.

This chapter discusses the fire commands, gunnery techniques, and crew duties required to effectively employ all tank-mounted weapons.

CONTENTS

Battlecarry

Battlecarry is a posture in which a tank is prepared for an engagement at all times (the main gun is loaded with a round of ammunition, the AMMUNITION SELECT switch or push button is set for the type of ammunition loaded, a specific battlesight range is applied to the computer, the proper GAS reticle is selected, and the gun select switch is in the TRIGGER SAFE position).

The crew will place their tank in a battlecarry posture before moving into a tactical situation or upon command from an approving authority. All engagements begin from this posture. This allows the crew to keep the fire control system prepared for an engagement at all times.

Table 8-1 shows the crew duties involved with placing a tank in a battlecarry posture.

Table 8-1. Standard Procedure for Battlecarry (M1, M1A1, and M1A2).

TC	GUNNER	LOADER	DRIVER
Announces "BATTLECARRY SABOT (HEAT, MPAT)."	Ensures the GUN SELECT switch is in TRIGGER SAFE and announces "MAIN GUN SAFE."	Opens ready ammunition door and removes announced ammunition.	Checks driver's instrument panel for caution/warning lights.
	Sets AMMUNITION SELECT switch or push button to SABOT. Selects SABOT/STAFF reticle on GAS, applies correction determined during GAS sight alignment, and announces "SABOT INDEXED."		
WARNING			
Never remove a round of ammunition from the ready ammunition rack while the main gun is loaded. The ready ammunition door must remain closed until the round in the main gun has been fired or the main gun has been unloaded.			
	Sets GPS to 3X.	Loads the main gun with the selected ammunition.	
	Ensures LRF is set in FIRST or LAST RETURN logic, based on the tactical situation.	Announces "SABOT (HEAT/ MPAT) LOADED." The loader does not announce "UP" until a fire command is given. Ensures main gun is set to SAFE and the ready ammunition door is closed.	
Announces "CREW REPORT."			
Ensures main gun SAFE/ARMED lever is in SAFE, and white SAFE light is illuminated; scans assigned sector.	Ensures proper battlecarry ammunition is indexed and GUN SELECT switch is in TRIGGER SAFE. Announces "GUNNER READY;" scans assigned sector.	Ensures path of recoil is clear, white SAFE light is illuminated, SAFE/ARMED lever is on SAFE, and correct battlecarry ammunition is loaded. Announces "LOADER READY," scans assigned sector.	Announces "DRIVER READY." Scans assigned sector, monitors controls, and follows TC's commands.

Fire Commands

All direct-fire engagements begin with a fire command. The fire command coordinates the crew's effort, reduces confusion, and helps the crew engage targets faster.

This section discusses the fire command elements, reduced fire commands, crew duties in response to fire commands, target engagements, and direct-fire adjustment techniques.

FIRE COMMAND ELEMENTS

The TC issues a fire command to his crew for each target engagement. Standard terminology and logical sequence are used to achieve effectiveness and speed of engagement. Only those elements necessary to load, aim, and fire the tank's weapons are given. There may be as few as two or as many as six elements, depending on the situation. The following examples show the sequence and terminology used in a fire command:

M1 and M1A1	
Element	**Example**
Alert	"GUNNER"
Ammunition or Weapon	"SABOT"
Description	"TANK"
Direction (optional)	"TRAVERSE RIGHT—STEADY—ON"
Range (optional)	"ONE TWO HUNDRED"
Execution	"FIRE"

M1A2	
Element	**Example**
Alert	"GUNNER"
Ammunition or Weapon	"SABOT"
Description	"TANK"
Direction (optional)	As necessary.
Range (optional)	"CHOKED ONE TWO HUNDRED"
Execution	"FIRE"

Note. Designating is not considered part of the fire command. However, when using the DESIGNATE button, the TC *must* announce "DESIGNATING" for safety purposes on the M1A2.

ALERT

The first element of the fire command alerts the crew to an impending engagement. The alert element for engagements in which the gunner fires the main gun or coax is "GUNNER." The TC announces "LOADER" as the alert element in which the loader will be firing the M240 machine gun. When firing the main gun as part of a three-man crew, the TC announces "LOAD" to alert the crew. When firing the commander's machine gun, the TC announces the weapon element only (for example, "CALIBER FIFTY" OR "TWO FORTY," as appropriate, alerts the crew that the TC will engage a target with his machine gun).

AMMUNITION OR WEAPON

The second element of the fire command tells the crew what type of ammunition or which weapon will be used. The ammunition element of the fire command is the loader's cue to perform one of the following actions:

- If battlecarried, he clears the path of recoil, arms the gun, and announces "UP."
- If not battlecarried, he loads the type of round announced, clears the path of recoil, arms the gun, and announces "(ammunition type) UP."

Note. The loader should announce "UP" as a response to a fire command only. When loading the main gun as part of battlecarry, he will announce "SABOT (HEAT) LOADED."

If the TC decides to engage a target with the main gun, he will announce the ammunition by one of the following terms:

M1, M1A1, and M1A2	
Ammunition or Weapon	**Announced As**
All KE rounds	"SABOT" (pronounced SAY-BO)
All CE rounds (except M830A1)	"HEAT"
M830A1 (ground mode)	"MPAT"
M830A1 (air mode)	"MPAT AIR"
XM908	"OH-ARE"
M494	"BEEHIVE"
M494 (with range setting on fuze)	"BEEHIVE TIME"
M393A2	"HEP"
M416	"SMOKE"
Gunner's coaxially mounted 7.62mm	"COAX"
Externally-mounted M240	"TWO-FORTY"

Notes. If there is a mix of rounds available, the unit SOP or tactical situation should determine the employment in which the rounds will be used.

When using battlesight gunnery techniques, the command "BATTLESIGHT" is used as the *ammunition or weapon* element. Announcing "BATTLESIGHT" alerts the crew that a predetermined range and ammunition will be used.

When designating which machine gun to use, the TC will announce "COAX" for the coaxially-mounted M240 or "TWO FORTY" for an externally-mounted M240.

DESCRIPTION

The third element of the fire command identifies the target to the gunner or loader. If there are several similar targets, it tells the gunner or loader which target to engage first. Most targets can be designated by one of the following terms:

Target	Announced As
Tank or tank-like target	"TANK"
Unarmored vehicle	"TRUCK"
Personnel carrier	"PC"
Helicopter	"CHOPPER"
Fixed-wing aircraft	"PLANE"
Personnel	"TROOPS"
Machine gun	"MACHINE GUN"
Antitank gun, antitank missile, or towed artillery	"ANTITANK"
Other targets	Use the briefest term possible to clearly describe the target.

Combining terms ("ANTITANK TRUCK") can identify combination targets, such as truck-mounted antitank guided missile systems. The gunner announces "IDENTIFIED" as soon as he identifies the target. If the gunner cannot identify the target, he announces "CANNOT IDENTIFY;" the TC may have to give an elevation or deflection direction, designate or lay the main gun in the target area, or engage the target himself.

If there are multiple targets, the TC identifies the targets he acquires (for example, "GUNNER—SABOT—TWO TANKS"). The TC then designates which target to engage first ["RIGHT (LEFT, NEAR, FAR, STATIONARY, MOVING) TANK"] or ("DESIGNATING RIGHT TANK").

Note. An acquisition report from the gunner, loader, or driver, cannot substitute for the description element of the fire command. However, the gunner does not have to announce "IDENTIFIED" if he gave the acquisition report.

DIRECTION

The TC omits the direction element if he can lay the main gun for direction and elevation. If he cannot lay the main gun for direction, one of the following methods can be used.

Notes. For safety purposes on the M1A2, the TC *must* announce "DESIGNATING" when designating from target to target. However, "DESIGNATING" is not part of the fire command. When the TC announces “DESIGNATING,” the gunner should center the GPCH until he has identified the target.

During a loader's engagement with the M240, the TC must give the direction element; for example, "LOADER—TWO FORTY—TROOPS—LEFT FRONT."

TCs should practice these methods to improve skills.

Traverse Method

The TC tells the gunner "TRAVERSE LEFT (RIGHT)." The gunner rapidly traverses in the direction announced. As the gun tube nears the target, the TC announces "STEADY," and the gunner slows his traverse. When the TC thinks the target is in the gunner's field of view, the TC announces "ON." When the gunner sees the target(s), he announces "IDENTIFIED." (The gunner should use the 3X magnification on the GPS when using this method.)

Reference Point and Deflection

The reference point must be one that the gunner can see and recognize easily. For example, the TC's command might be "REFERENCE POINT—BRIDGE—TRAVERSE RIGHT." The gunner identifies the reference point and traverses right, looking for the target. The TC may have to further define the target description and location.

Marking Targets with Tracers (Caliber .50)

Using the caliber .50 to mark targets is the least desirable method of laying the gun for direction. It should be used only when immediate target suppression is necessary and the gunner cannot identify the target. The main gun and machine gun must be in the same target area so the gunner can see the tracers. The TC will announce the first three elements of the fire command followed by "WATCH MY TRACERS" (for example, "GUNNER— HEAT—PC—WATCH MY TRACERS—CALIBER FIFTY").

RANGE

The TC may omit the fifth element if the LRF is operational. With an operational LRF, the gunner will lase to every target. With the M1A2's CITV, the TC can determine the range to a target independently from the gunner using the CITV stadia reticle.

When both the CITV and the LRF are functional, the gunner should lase to each target that the TC designates. If the CITV and LRF are not operational, or environmental conditions prevent their use, determine range using either the known-range method or the estimated-range method depicted below, or other method, as deemed necessary (see Chapter 7, *Range Determination*). When the TC wants the gunner to determine the range to the target using the stadia reticle, he will announce “CHOKE” as the range element.

Known-Range Method

By knowing the range to probable target areas, the crew can reduce engagement time and improve accuracy by indexing the known tank-to-target range into the CCP or GCDP. The known range from a previous target engagement may also be used.

Estimated-Range Method

To engage targets when the LRF cannot be used and the range is unknown, the TC or gunner must estimate the range to the target. Range data is announced in the fire command in even hundreds or thousands, otherwise digit by digit.

Examples: If the TC announces—

- "CHOKED—ONE SIX HUNDRED," the gunner uses the GPS and the range designated from the TC (*M1A2 only*).
- "ONE EIGHT HUNDRED," the gunner shifts to the GAS and uses the appropriate reticle and range line.
- "INDEX ONE EIGHT HUNDRED," the gunner uses the GPS and enters the range into the FCS using the CCP or GCDP.
- "GUNNER—SABOT—TANK—CHOKE," the gunner shifts to the GAS, selects the appropriate reticle, and uses the choke sight to estimate the range, then repeats the range to the TC.

Range	**GPS** Announced As	**GAS** Announced As
900 meters	"INDEX NINE HUNDRED"	"NINE HUNDRED"
2,000 meters	"INDEX TWO THOUSAND"	"TWO THOUSAND"
1,200 meters	"INDEX ONE TWO HUNDRED"	"ONE TWO HUNDRED"
860 meters	"INDEX NINE HUNDRED"	"NINE HUNDRED"
3,040 meters	"INDEX THREE THOUSAND"	"THREE THOUSAND"

EXECUTION

Once the crew responds to the first elements of the fire command, the TC will announce the execution. Before announcing the execution command, the TC will mentally run through the confirmation procedures described in Chapter 6, *Target Acquisition*. As a minimum, he will *reconfirm the target as hostile before firing;* if there are multiple targets within the TC's sector, he designates to the *most dangerous* target first. Three execution commands may be given:

Note. The TC must make sure the path of recoil is clear before giving the command of execution.

- "FIRE." The command "FIRE" tells the gunner to fire the gun. If the TC designates the gunner to a single target and is able to assist the gunner, he issues the command, "FIRE." If the TC wants to delay firing, he will announce "AT MY COMMAND," then announce "FIRE" when he is ready to engage.
- "FIRE AND ADJUST." If the TC cannot assist the gunner or loader in adjustment, he announces "FIRE AND ADJUST." This tells the gunner or loader that he will not receive a subsequent fire command and must conduct the engagement on his own. If the TC continues to designate the gunner to each target, then continues to scan his sector, he issues the command "FIRE AND ADJUST."
- "FROM MY POSITION." Normally, the gunner will engage all main gun targets; however, if he is unable to identify the desired target, the TC will engage the target using the trigger on his power control handle or CCHA. If the gunner can identify the target while the TC is engaging from his position, the gunner

announces "IDENTIFIED." The TC can return control to the gunner or complete the engagement from his position. To maintain overall control and ensure continuous target acquisition, the TC should return control to the gunner immediately after the gunner identifies the target. To return control to the gunner, the TC announces "FIRE."

Notes. "ON THE WAY" is the last verbal response announced by whoever is firing. Whoever is firing will squeeze the trigger on the "Y" of "WAY." Additionally, when the gunner or loader are firing machine guns and release the triggers, even momentarily, they must announce “ON THE WAY” prior to resuming firing.

If the TC wants to change the type of ammunition being fired, he announces, "FIRE, FIRE HEAT (SABOT)." The loader must respond with "HEAT (SABOT) UP," and the gunner must respond "HEAT (SABOT) INDEXED," to inform the TC that the proper ammunition is loaded and indexed.

When the TC is firing either the caliber .50 or the M240 mounted in the CWS, he announces "CALIBER FIFTY" or "TWO-FORTY" to notify the crew.

When firing the main gun as part of a three-man crew engagement, there is no command of execution for the TC.

TERMINATION OF ENGAGEMENT

Although this is not an element of a fire command, every engagement must be terminated. The TC announces "CEASE FIRE" to end a main gun, loader, or coax engagement. Once the command of “CEASE FIRE” is given, the loader moves the main gun SAFE/ARM lever to the SAFE position. When the gunner completes his part of a multiple weapon systems engagement, he announces "GUNNER COMPLETE." The gunner then moves the GUN SELECT switch to TRIGGER SAFE, the MAGNIFICATION switch to 3X, and continues to scan his sector.

To terminate the loader's engagement, the TC announces "CEASE FIRE" or "LOADER—CEASE FIRE" during multiple weapon systems engagements. If the loader completes his part of a multiple weapon systems engagement, he announces "LOADER COMPLETE."

When the TC finishes an engagement with the commander's weapon, he announces "TC COMPLETE." The TC has overall responsibility of the turret and is still responsible for terminating the engagement.

Note. (M1A2) When the TC is going to use the CITV to search for more targets, the fire-and-adjust command of execution is given to the gunner. If the gunner has destroyed all identified targets, he announces "GUNNER COMPLETE," to inform the TC that all identified targets have been destroyed, and awaits further instructions from the TC.

REPEATING COMMANDS

When a crew member fails to understand an element of a fire command, he announces the element in question and the TC repeats that element only. For example, if the gunner or loader announces "AMMO," the TC repeats "SABOT."

CORRECTING ERRORS

To correct an error in a fire command, the TC announces "CORRECTION" and corrects the fire command, starting with the incorrect element and repeating all elements that follow. If the description element was wrong, the TC announces "CORRECTION," gives the correct target description, and continues with the fire command (for example, "GUNNER—SABOT—PC—CORRECTION—TANK— FIRE").

If an error has been made in the fire command, and the execution command has been given, the TC must cease fire and issue a complete, new fire command.

To correct an error in a subsequent fire command, the TC announces "CORRECTION" and repeats the entire subsequent fire command.

REDUCED FIRE COMMANDS

The TC, at his discretion, may choose to omit certain parts of the fire command (IAW unit SOP). The reduced fire command must not confuse the crew and must include sufficient information to allow the crew to react properly to the situation. A reduced fire command must contain (as a minimum) the target description and

command of execution (for example, "TANKS, FIRE"). (If time permits, a full fire command should always be used.) *The TC is responsible for confirming all targets as hostile before announcing "FIRE."*

The following are examples of situations in which reduced fire commands may be used:

- When a crew member acquires a target(s) that is an immediate threat, he gives an acquisition report (TANK(S)—DIRECT FRONT"). The TC or gunner lays the gun and the gunner announces "IDENTIFIED;" the TC confirms the target as hostile, announces "TANK(S)," waits for the loader to announce "UP," and announces "FIRE."

Note. An acquisition report, by the gunner, loader, or driver, cannot substitute for the description element of the fire command.

- During continuing contact, after a fire command has been issued, the TC elects to omit the alert and ammunition elements of the fire command. In a target-rich environment, the fire command becomes "TANK." The TC lays the gun for direction, as needed, and the gunner announces "IDENTIFIED." The loader's response of "UP" must be given to assure the gunner and TC that he has armed the main gun and is clear of the path of recoil. After the TC confirms the target as hostile and evaluates the range, he announces "FIRE." Other than the omission of the alert and ammunition elements, the fire command remains standard.

Strict compliance with crew drills is critical to ensure the crew responds correctly to reduced fire commands.

CREW DUTIES IN RESPONSE TO A FIRE COMMAND

Each crew member has specific duties to perform in response to each element of a fire command. The TC and gunner will apply the *rules of lay* for every round fired. The rules of lay are:

- End lay in elevation.
- Always aim at the center of visible mass.
- Remember the sight picture at trigger squeeze.

A crew's ability to accomplish any mission depends on the ability of its crew members to perform individual tasks and, at the same time, operate effectively as a crew. Consequently, unit trainers must emphasize both individual and collective training. These crew duties are designed to provide tank crews an outline to be used when conducting training. The following pages show examples of various duties performed by individual crew members while performing the collective tasks associated with main gun engagements. Each crew should periodically practice these procedures to enhance effectiveness and crew performance.

With the enhancements of digital capabilities for information gathering and reporting, and the CITV for increased observation, the M1A2 can cover a larger sector of fire than previous tanks. This larger sector could have multiple avenues of approach. The gunner could be required to engage multiple targets on his own, while the TC continues to scan and designate with the CITV, which places increased responsibilities on the gunner to make his own decisions when given the command, "FIRE AND ADJUST." Also, this requires the TC and gunner to maintain a constant communication flow.

Normally, the LRF is kept in the ARM LAST RTN logic position. When the target is extremely small or at an extended range (the entire target appears within the aiming circle), ARM 1ST RTN logic is the preferred position, as the laser beam may project beyond the target and cause multiple returns. Before firing, the gunner checks through the GAS to ensure the main gun is clear of mask.

Setting the AMMUNITION SELECT switch (or push button on the M1A2) to the new ammunition with the palm switches pressed updates the ballistic solution for the new ammunition. If, when changing ammunition during a degraded-mode engagement, the gunner indexes the correct ammunition type, but does not release his palm switches, the TC does not have to press the BATTLE SGT button again (the range in the fire control system remains the same). However, if the gunner releases the palm switches during the engagement, he must regrasp the palm switches and track the target smoothly. The TC presses the BATTLESIGHT button and uses the ADD/DROP toggle switch (or the four-way switch on the M1A2) to update the complete ballistic solution (±10 meters) for the new ammunition.

To make sure the main gun can be loaded safely across all types of terrain, the GUN/TURRET drive switch in the loader's position must remain in the EL UNCPL position.

The TC or gunner will squeeze the trigger as soon as he announces "ON THE WAY" (on the "Y" of "WAY").

Tables 8-2 and 8-3 do not cover all crew duties, but are intended to illustrate the main responses to a fire command for a given situation.

Table 8-2. Crew Duties in Response to a Fire Command (M1 and M1A1 Main Gun Precision Engagement Battlecarry Posture—Sabot 1,200 Meters).

ELEMENT	TC	GUNNER	LOADER	DRIVER
Pre-conditions.	Scans sector of responsibility. Checks battlesight range through GPSE.	Scans assigned sector in 3X. Ensures FIRE CONTROL MODE switch is in the NORMAL mode, LRF RANGE switch is in the appropriate position, and the AMMUNITION SELECT switch is in the appropriate position for battlecarry ammunition.	Checks the turret ring. Ensures the GUN/TURRET DRIVE switch is in the EL UNCPL position. Ensures ammunition door is closed. Scans sector of responsibility.	Scans sector. Continues to maneuver vehicle according to the TC's directions.
Alert.	Announces "GUNNER." Lays gun for direction, if necessary. **Note.** Attempts to confirm the target as hostile.	Continues to scan sector, trying to acquire targets.		
Ammunition.	Announces "SABOT."	Moves GUN SELECT switch to MAIN.	Clears path of recoil, moves main gun SAFE/ ARMED lever to ARMED position, ensures yellow MAIN GUN STATUS ARMED light is lit, and announces "UP."	
Description.	Announces "TANK." Releases override, if depressed, when gunner identifies target.	Using 3X, attempts to acquire target. (If the target is acquired, announces "IDENTIFIED," and switches to 10X.)		
Direction.	If necessary, talks gunner into target area by announcing "TRAVERSE LEFT (RIGHT)." Announces "STEADY" when gun is in general target area. Announces "ON" when gun is on target.	If unable to identify target, announces "CANNOT IDENTIFY," and TC must take further action. Traverses in the direction of target as fast as possible. On hearing "STEADY," slows traversing rate and continues to search for target. On hearing "ON," stops traversing and searches for the target. When target is acquired, announces "IDENTIFIED."		
				continued next page

Table 8-2. Crew Duties in Response to a Fire Command (M1 and M1A1 Main Gun Precision Engagement Battlecarry Posture—Sabot 1,200 Meters) (cont.).

ELEMENT	TC	GUNNER	LOADER	DRIVER
Range.	**Note.** This portion of the fire command is used only when an accurate tank-to-target range cannot be determined using the LRF.			
Note. If range is announced as "ONE FOUR HUNDRED," it indicates to the gunner that he should use his GAS. If announced as "INDEX ONE FOUR HUNDRED," the gunner enters the range into the CCP and uses the GPS.				
Execution.	Verifies that target is hostile, evaluates the range, ensures the path of recoil is clear, and announces "FIRE." Braces and attempts to sense round. Terminates engagement or issues subsequent fire command.	Lases and confirms range. Makes a final lay on target center of mass. Mentally confirms the target as hostile, announces "ON THE WAY," and fires. Attempts to sense round. Announces sensing and intended correction. Continues to fire until "CEASE FIRE" is announced.	After main gun fires, moves main gun SAFE/ARMED lever to SAFE position, and opens ready ammunition door with knee switch. Loads ammunition announced in fire command, clears path of recoil, ensures bustle ammunition door is closed, moves main gun SAFE/ARMED lever to ARMED position, and makes sure yellow MAIN GUN STATUS ARMED light is lit, and announces "UP." Continues to load that type ammunition until the TC changes ammunition or announces "CEASE FIRE."	Attempts to sense round. Maneuvers vehicle, as directed by the TC.
Post-conditions.	Announces "CEASE FIRE." Presses the BATTLE SGT button and places the tank back in battlecarry posture. Returns to sector of responsibility and continues to scan.	Returns GUN SELECT switch to TRIGGER SAFE. Switches to 3X magnification. Continues to scan assigned sector. Indexes battlecarry ammunition.	After "CEASE FIRE" is announced, loads battlecarry ammunition, if not already loaded, checks turret bustle ammunition stowage, and repositions ammunition, if necessary. Removes base stubs or canisters, if possible. Assists scanning sector.	Takes commands from TC. Continues to scan sector.
Note. Normally, the LRF is kept in ARM LAST RTN logic position. When the target is extremely small or at an extended range (the entire target appears within the aiming circle), ARM 1ST RTN logic is the preferred position, as the laser beam may *spill over* past the target and cause multiple returns. Before firing, the gunner checks through the GAS to ensure the main gun is clear.				

Table 8-3. Crew Duties in Response to a Fire Command (M1A2 Main Gun Precision Engagement Battlecarry Posture—Sabot).

ELEMENT	TC	GUNNER	LOADER	DRIVER
Pre-conditions.	Scans sector with CITV in WFOV. Checks battlesight range in the CITV.	Scans assigned sector in 3X. Ensures FIRE CONTROL MODE switch is in the NORMAL mode, LRF RANGE switch is in the appropriate position, and the correct AMMUNITION SELECT push button is selected for battlecarry ammunition.	Checks the turret ring. Ensures the GUN/TURRET DRIVE switch is in the EL UNCPL position. Ensures ammunition door is closed.	Scans sector. Continues to maneuver vehicle according to the TC's directions.
Alert.	Switches to NFOV, attempts to confirm target as hostile and, if time is available, chokes target with stadia reticle. Announces "GUNNER."	Continues to scan sector, trying to acquire targets.		
Ammunition.	Announces "SABOT."	Moves GUN SELECT switch to MAIN.	Clears path of recoil, moves main gun SAFE/ ARMED lever to ARMED position, ensures yellow MAIN GUN STATUS ARMED light is lit, and announces "UP."	
Description.	Announces "TANK."	Using 3X, attempts to acquire target. (If the target is acquired, announces "IDENTIFIED," and switches to 10X.) (On the M1A2 SEP, use 13X, 25X, or 50X in the TIS, as the tactical situation dictates.)		
Direction.	If necessary, uses the CITV to designate main gun for direction. Announces "DESIGNATING." (Not necessarily given at this point.)	If unable to identify target, announces "CANNOT IDENTIFY."		
Range.	**Note.** This portion of the fire command is used only when an accurate tank-to-target range cannot be determined using the LRF.			

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Table 8-3. Crew Duties in Response to a Fire Command (M1A2 Main Gun Precision Engagement Battlecarry Posture—Sabot) (cont.).

ELEMENT	TC	GUNNER	LOADER	DRIVER
Execution.	Verifies that target is hostile, evaluates the range, ensures path of recoil is clear, and announces "FIRE," or "FIRE AND ADJUST." Braces and attempts to sense round. Regrasps CCHA and prepares to designate subsequent target, if necessary. Issues subsequent fire command, if necessary.	Lases and confirms range. Makes final lay on target center of mass. Mentally confirms target as hostile, announces "ON THE WAY," and fires. Attempts to sense round. Announces sensing and intended correction. Continues to fire until "CEASE FIRE" is announced.	After main gun fires, moves main gun SAFE/ ARMED lever to SAFE position and opens bustle door with knee switch. Loads ammunition announced in fire command, clears path of recoil, ensures bustle ammunition door is closed, moves main gun SAFE/ARMED lever to ARMED position, makes sure yellow MAIN GUN STATUS ARMED light is lit, and announces "UP." Continues to load that ammunition and announce "UP" until TC announces change of ammunition or "CEASE FIRE."	Attempts to sense round. Maneuvers vehicle as directed by TC.
Post-conditions.	Announces "CEASE FIRE." Presses the BATTLE SIGHT button and places the tank back in the battlecarry posture. Returns to sector of responsibility, and continues to scan sector in WFOV.	Returns GUN SELECT switch to TRIGGER SAFE. Indexes battlecarry ammunition. Switches to 3X magnification. Continues to scan assigned sector.	After "CEASE FIRE" is announced, loads battlecarry ammunition, if not already loaded, checks turret bustle ammunition stowage, and repositions ammunition, if necessary. Removes base stubs, if possible. Assists scanning sector.	Takes commands from TC. Continues to scan sector.

TARGET ENGAGEMENTS

In combat, tank crews may engage targets using multiple engagement techniques. These engagements require speed and accuracy to suppress or destroy all targets.

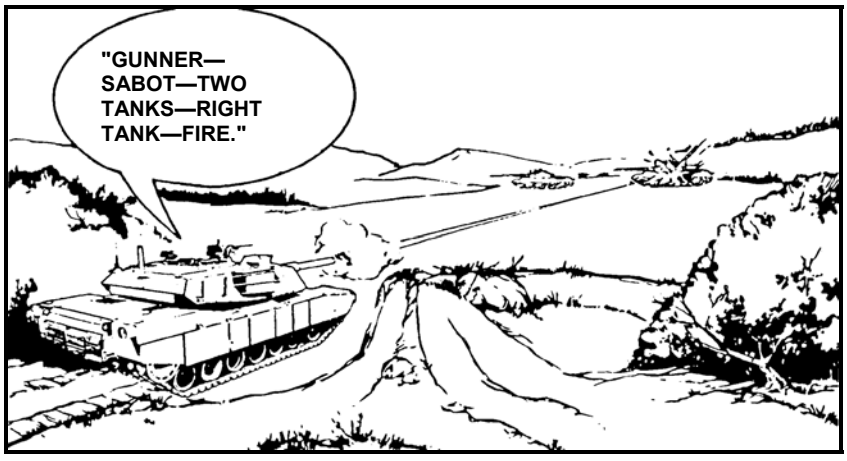


Figure 8-1. Multiple Target Engagement (M1 and M1A1).

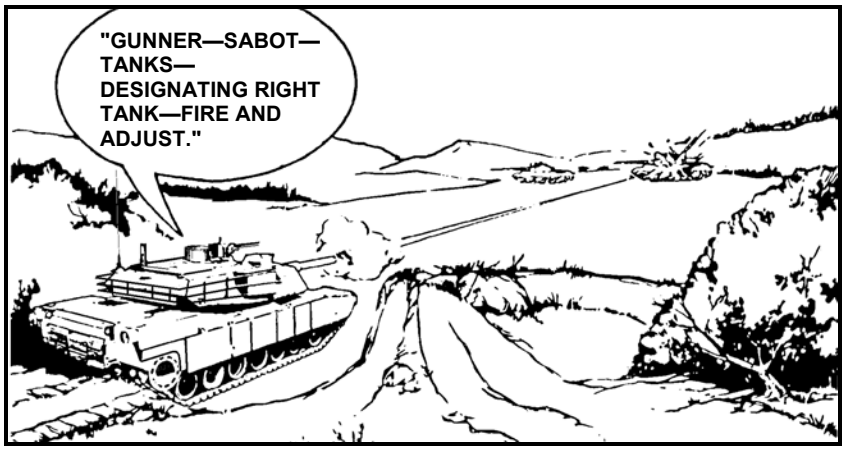


Figure 8-2. Multiple Target Engagement (M1A2).

MULTIPLE MAIN GUN OR COAX MACHINE GUN ENGAGEMENTS

A multiple main gun or coax machine gun engagement is more than one target engaged with the same weapon. These engagements, especially multiple tank engagements, require rapid and accurate fire, target destruction, and quick shifts to new targets. The TC determines which target presents the greatest threat (*most dangerous*) and issues a fire command to engage that target first. The TC determines the next *most dangerous* target, directs fires to the second target and continues this process until all targets are destroyed. In the M1 and M1A1, when moving from one target to another, the gunner must make sure he releases the palm switches momentarily (dumps lead solution), then squeezes the palm switches again. This eliminates the floating reticle and makes laying on the next target much faster. The gunner must now re-lase to the new target to establish an accurate ballistic solution.

The TC must decide whether or not a target has been destroyed. Indications that a target has been sufficiently damaged include secondary explosions or crew members abandoning the vehicle. Multiple engagements require the TC to shift fires quickly from one target to the next as the classification of *most dangerous* changes from moment to moment.

Multiple coax machine gun engagements are performed in the same manner. The *most dangerous* target is engaged first; fires are then shifted to the next *most dangerous* or *dangerous* target.

MULTIPLE WEAPON SYSTEMS ENGAGEMENT

A multiple weapon systems engagement is engaging one or more targets with more than one weapon system, whether independently or simultaneously. A sample fire command and the TC's and gunner's responses to a multiple weapon systems engagement are outlined as follows: (see Figure 8-3) The TC announces "GUNNER—SABOT—TWO TANKS—LEFT TANK." The gunner announces "IDENTIFIED" and takes up the correct sight picture. The TC evaluates the fire control solution, then announces "FIRE AND ADJUST—CALIBER FIFTY." The gunner announces "ON THE WAY" and engages his first target. He then announces his sensing and intended correction and continues to engage the target. If a target destructive hit is sensed, the gunner announces "TARGET—RIGHT TANK—IDENTIFIED" and shifts fire to the next target. This enables the TC to adjust for the deflection shift and lets the TC and loader know how the engagement is going. The gunner continues the engagement until all targets are destroyed, then he announces "TARGET—GUNNER COMPLETE." When the TC finishes his engagements, he announces "TC COMPLETE." The TC resumes control of the engagement at this time, senses, adjusts fire as needed, or announces "CEASE FIRE."

During some multiple weapon systems engagements, the TC may need to temporarily stop firing his caliber .50 engagement, to assist the gunner. The two most common situations are—

- When the gunner cannot identify the target, the TC will lay the main gun on target.
- When the gunner cannot sense the effect of the round, the TC will help sense rounds.

Note. If the TC is engaging targets using the CWS and is going to issue a fire command, he needs to announce "TC COMPLETE," issue the fire command, and use the "FIRE AND ADJUST" command of execution if he needs to finish engaging targets from the CWS.

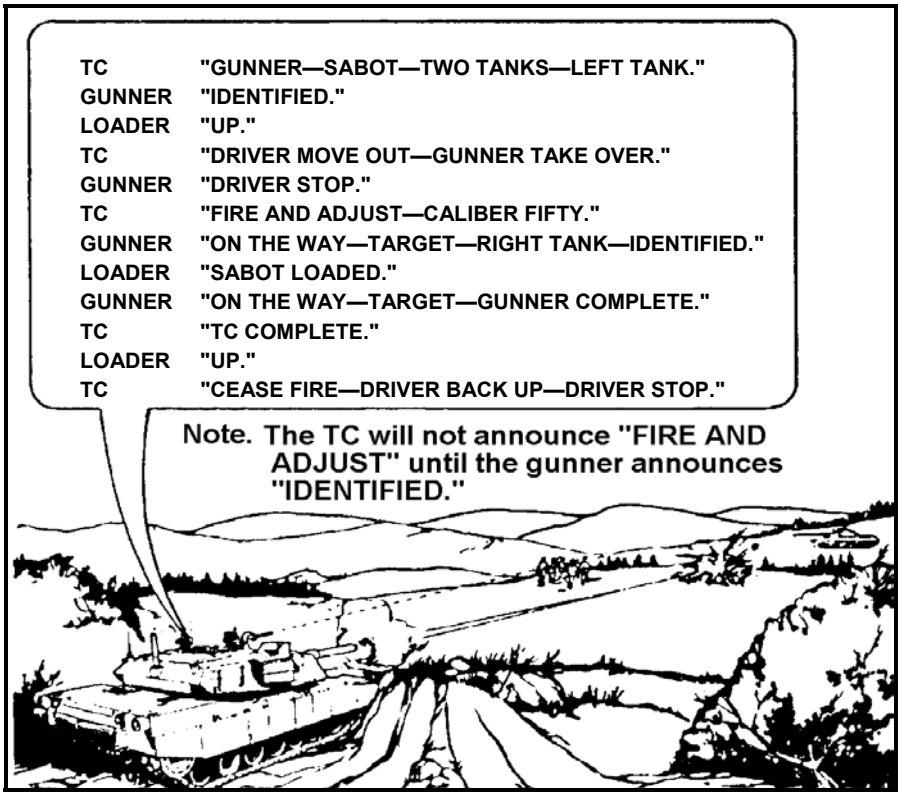


Figure 8-3. Multiple Weapon Systems Engagement (M1 and M1A1).

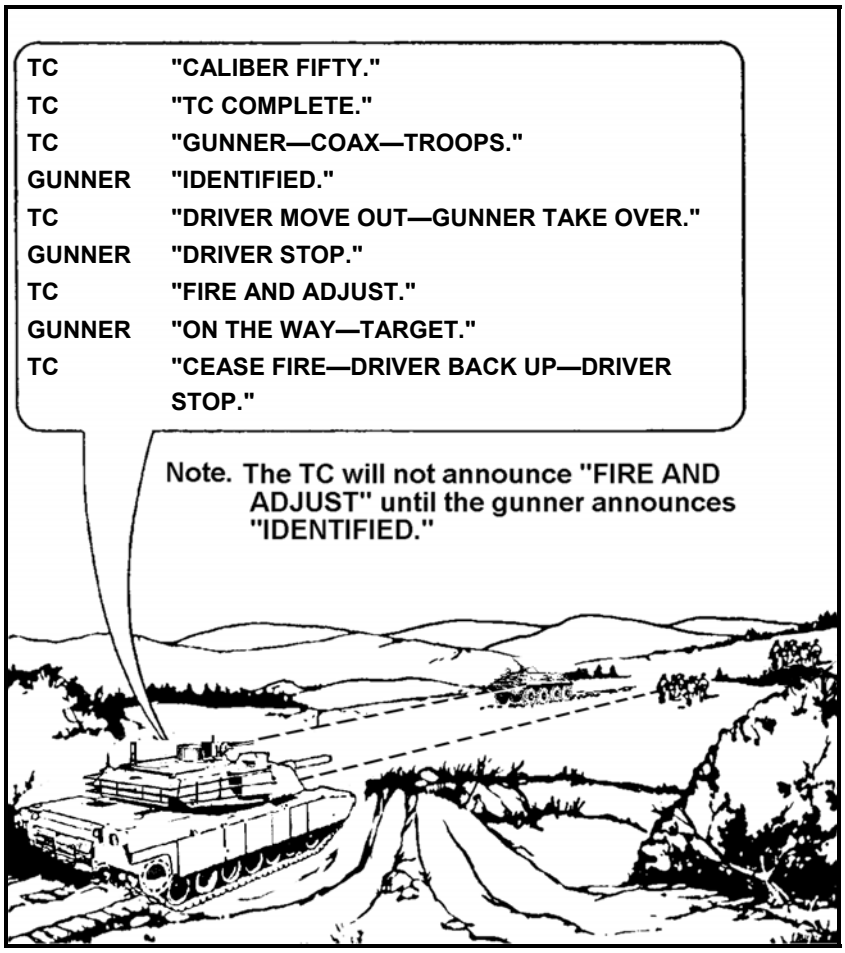


Figure 8-4. Multiple Weapon Systems Engagement (M1A2).

Note. (M1A2) The fire and adjust command of execution used when the TC is going to use the CITV to search for more targets does not take the responsibility for cease firing the weapon system in use from the TC.

DIRECT-FIRE ADJUSTMENT TECHNIQUES

Closely following the before-operation checks, prep-to-fire checks, and the direct-fire techniques already discussed will increase the chances of achieving a first-round, target destructive hit. However, in some situations, direct-fire adjustment will be necessary. When a gunner or TC fires a round and misses the target, the crew must take actions to obtain a rapid target hit with a subsequent round.

FACTORS IN TARGET MISSES

Many factors can cause a target miss. These factors depend on the direct-fire technique used and the ammunition fired. The following factors could contribute to target misses:

- Incorrect boresight.
- Battle damage.
- Failure of the crew to perform correct before-operation checks or armament accuracy checks of the fire control system.
- Error in crew drill during the engagement, such as an incorrect lay of the sight reticle on the target aiming point (poor sight picture).
- Loss of boresight.

- Round-to-round dispersion.
- Incorrect range.
- Excessive cant (trunnion tilt).
- Refraction (optical path bending).

SENSINGS

A sensing is a mental notation by the gunner or TC of where the round strikes or passes the target in relation to the target aiming point. A sensing will be given for every main gun round fired. If the first round fails to destroy the target, sensings may enable the gunner or TC to adjust subsequent rounds. The ability to sense a fired round will depend on obscuration and flight time—

- *Obscuration.* The flash, muzzle blast, heat shimmer, debris, and movement of the firing tank (platform rock) may prevent the crew from sensing their fire.
- *Flight time.* When firing main gun ammunition, flight time is so short that the projectile may reach the target before the tank has settled and obscuration has cleared.

Because of obscuration and time of flight, it is almost impossible to sense sabot rounds at ranges less than 2,000 meters. Even at extreme ranges (3,000 to 4,000 meters), determining an accurate sensing is extremely difficult, unless the target is hit.

When possible, all crew members should attempt to sense every round fired. When firing service ammunition, a bright flash or explosion will be visible if the target is hit. When firing MPAT ammunition in the AIR mode, a black cloud of smoke is produced when the round functions on a target. If the point at which the tracer strikes short, passes, or hits the target cannot be sensed, the gunner announces "LOST." When the gunner senses the strike of the round in relation to the target, he announces one of the following sensings:

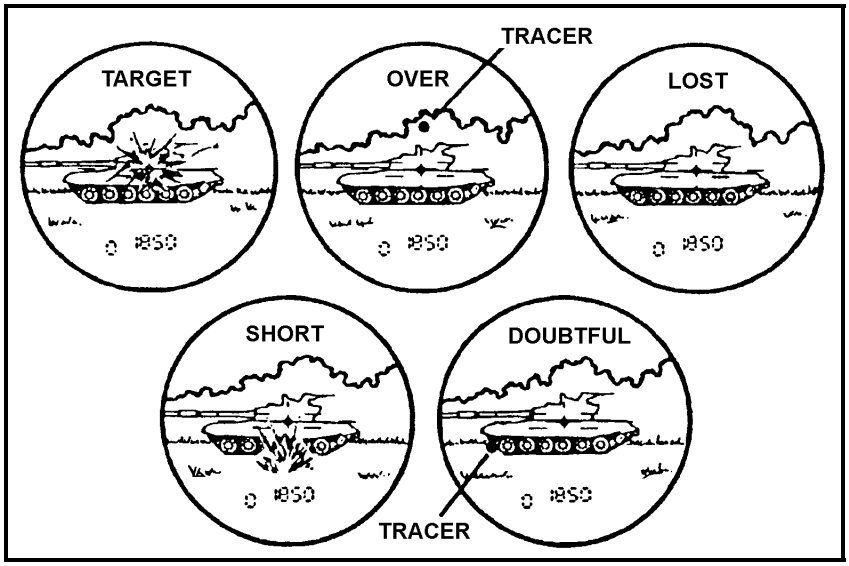


Figure 8-5. Sensings.

- "TARGET"—Any part of the target is hit by direct fire.
- "OVER"—The round, tracer, or its effects are sensed over the target.
- "SHORT"—The round, tracer, or its effects fall between the firing tank and the target.
- "DOUBTFUL"—The round, or its effects, are seen as passing to the left or right of the target, but appear correct for range. With this sensing, it is *doubtful* that range correction is required, but a deflection shift is necessary.
- "LOST"—Neither the round nor its effects are sensed, in relation to the target.

SUBSEQUENT FIRE COMMANDS

A subsequent fire command may contain up to four elements: alert, deflection correction, range correction, and execution. The alert and execution elements are always given. A deflection or range correction should be given when a full-up fire control system is not available. Otherwise, the reengage method should be used. A sensing of "LOST," "OVER," "SHORT," or "DOUBTFUL" will cue the crew that a subsequent fire command will be given.

- Alert. The sensing for the round fired alerts the gunner that a subsequent fire command is being issued.
- Deflection Correction (only if necessary). A deflection correction is based on the TC's or gunner's sensing of where the round strikes in relation to the target. Because of the accuracy of the fire control system, deflection errors should not exceed one target form. A deflection error in excess of one target form indicates a fire control malfunction, optical path bending, or an error in the gunner's lay. Deflection corrections will not be less than half target form or more than one target form. For deflection errors in excess of one form, reengage.
- Range Correction (only if necessary). A range correction is based on the TC's or gunner's sensing of where the round strikes in relation to the target. Range corrections will not be less than half target form or more than one form. For range corrections in excess of one target form, reengage.

Note. When adjusting by target form using the GPS or TIS reticle, do not release palm switches or re-lase to target. This will cause the ballistic solution to change.

- Execution. The TC completes the subsequent fire command by announcing "FIRE."

REENGAGE METHOD

If the fire control system is fully operational, the reengage method is the preferred method for subsequent rounds after a first-round miss. Reengage is a rapid technique in which a new ballistic solution is entered in the fire control system. The reengage method can only be used with a full-up fire control system. Example:

Driver: "OVER."

TC: "OVER—REENGAGE."

Gunner: Dumps the lead solution in the fire control system by quickly releasing and regrasping the palm grips, then re-lays, re-lases to the target, and announces "IDENTIFIED."

Loader: "UP."

TC: "FIRE."

Gunner: "ON THE WAY."

Note. If the gunner has been given the "FIRE AND ADJUST" command, he announces his sensing and "REENGAGING," dumps the lead solution in the fire control system by quickly releasing and regrasping the palm grips, then re-lases to the target, waits for an "UP," and announces, "ON THE WAY."

If the crew has a sensing of "TARGET," but the target has not been completely destroyed (for example, it cannot move but can still fire), the gunner or TC will re-lay using the same sight picture, announce "TARGET—REENGAGE ("REENGAGING")," and fire the second round.

STANDARD ADJUSTMENT METHOD USING GPS OR GAS

When firing and unable to hit the target using the reengage method (or when using degraded-mode gunnery techniques using the GPS), the TC or gunner (if given the "FIRE AND ADJUST" command) may choose to use the standard adjustment method. The standard adjustment for both elevation and deflection will not be *less* than a half-target form or *more* than one target form. When the crew observes a round missing the target in both range and deflection, the deflection correction is given before the range correction. If the crew observes over,

short, lost, or doubtful, the TC (gunner) will announce his sensing and the intended correction in one of the following ways:

Note. The TC has the option of increasing the gunner's adjustment to one target form based on the situation.

- Deflection correction: "DOUBTFUL—RIGHT (LEFT) HALF FORM."
- Range correction: "SHORT (OVER)—ADD (DROP) HALF FORM."
- Combination of deflection and range correction: "OVER (SHORT) —RIGHT (LEFT) HALF FORM—DROP (ADD) HALF FORM."
- Lost: "LOST—DROP HALF FORM."

After making his sight correction, the gunner awaits an *"UP"* from the loader and command of execution from the TC (unless given the fire-and-adjust command), announces "ON THE WAY," and fires.

If, after firing two rounds with the GPS using degraded gunnery techniques, the gunner or the TC has not sensed some target effect, the decision should be made to use the GAS to complete the engagement. As soon as the tactical situation permits, the crew should perform a boresight check, and reboresight if necessary. During combat, the TC may have to make larger corrections than the standard in order to get target effect.

Gunnery Techniques

There are three types of gunnery techniques—precision, degraded, and battlesight.

- Precision gunnery is defined as: using the full capability of the fire control system to engage targets.
- Degraded-mode gunnery techniques are used when the crew cannot use the full capability of the fire control system.
- Battlesight gunnery is used when an accurate tank-to-target range cannot be determined, when the computer is inoperative, or in most surprise situations.

PRECISION GUNNERY

Precision gunnery is the most accurate technique of direct-fire engagement and is used when the tank has a fully operational fire control system. *The preferred method is to use the thermal channels as the primary sight (day or night)*. The TIS and CITV are very effective for target acquisition, sensing, firing through obscurants, and minimizing the effects of directed-energy weapons such as laser washout. In some instances (such as desert environment), the GPS daylight channel may work better.

Normally, when using precision gunnery techniques, only four (alert, ammunition or weapon, description, and execution) of the six elements will be needed in the fire command ("GUNNER—SABOT—TANK—FIRE"). The direction is normally omitted if the TC lays the gun for direction (for safety purposes, when using the designate function on the M1A2, the TC will announce "DESIGNATING".). The range is determined by the LRF and evaluated by the gunner and TC prior to firing.

Examples of the crew duties associated with the employment of precision-mode gunnery techniques are located on pages 8-9 through 8-12.

Note. (M1A2 SEP) When engaging targets in higher magnifications (25X or 50X), the gunner and TC must realize that the tank cannon is no more accurate than when using 13X. The target only *appears* closer. Gunners and TCs must be more conscious of their final lay before squeezing the trigger. Also, if moving over rough terrain, keeping the target within the field of view may be more of a challenge. If the target is lost, go to a lower magnification to reacquire.

GUNNERY TECHNIQUES FOR MPAT

MPAT gunnery techniques, although part of precision gunnery, may require certain aim-off techniques.

Engagement Techniques

Gunnery techniques for engaging either ground targets or helicopter targets in the open with MPAT is the same as for any other main gun round. Gunners place the AMMUNITION SELECT switch to MPAT, lay on

the visible center-of-mass, lase and, when given the command by the TC, fire. The loader either checks that the AIR/GROUND switch is on GROUND (ground mode) or moves the switch to AIR and announces "AIR" (air mode) before chambering the round and announcing "UP."

In AIR mode, after the proximity fuze is fully enabled, the round will function on almost any object it detects, whether it is a target or not. Therefore, in a cluttered environment, it may be necessary to use an alternate aiming point to help make sure the round does not explode before it is in the vicinity of the target. For example, if the target helicopter is hovering or flying close to a group of trees, the round may function on the near edge of the tree line; if the target helicopter is using the top or side of a building for cover, the round may function on the building. In either case, using an alternate aiming point increases the standoff between the clutter and the trajectory of the round (whether in deflection [2-1/2 mils] or elevation [2 mils]) and, therefore, increases the chance of the round functioning on the desired target. Figure 8-6 displays a deflection offset, and Figure 8-7 displays an elevation offset.

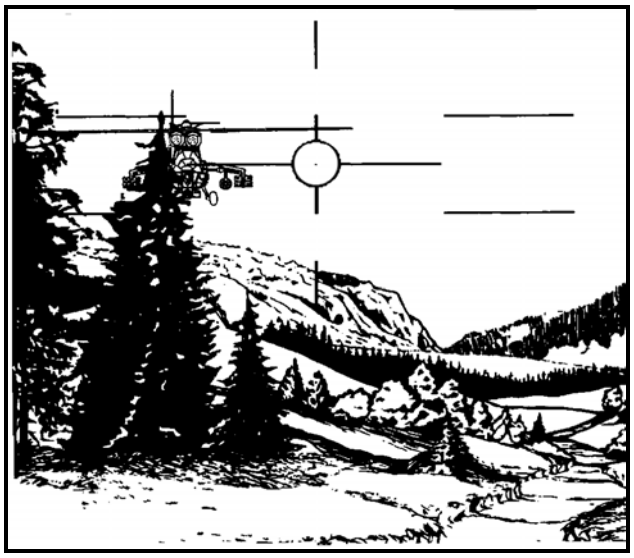


Figure 8-6. Deflection Offset.

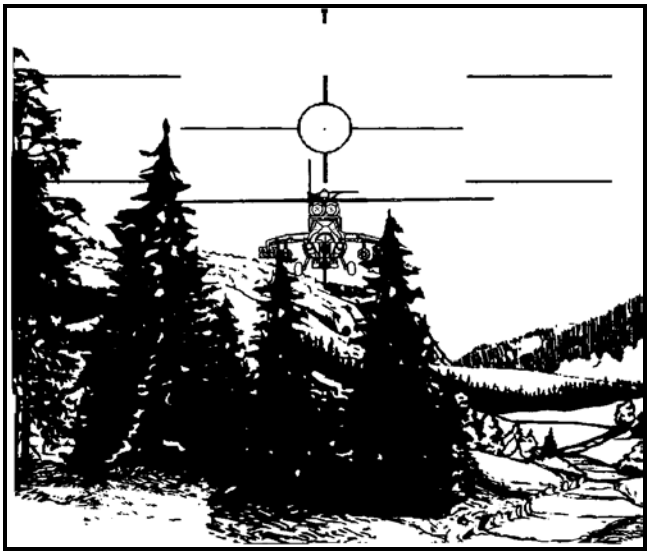


Figure 8-7. Elevation Offset.

Sensing

In AIR mode, a black cloud of smoke is produced when the round functions on a target. This smoke allows the firing tank or wingman to sense MPAT rounds employed against helicopters.

DEGRADED-MODE GUNNERY

Sometimes it may be necessary to fight with less than a fully operational system (use degraded-mode gunnery procedures). (See Chapter 11, *Survivability and Fight-Back Capability*, for procedures that will allow crews to continue to fight after the tank is hit by direct or indirect fire.)

The TC may decide to fire degraded mode before the engagement starts (battlesight or fire control malfunction) or when a malfunction of the fire control system or an environmental condition during a precision engagement requires a change in the engagement. When a precision engagement has started, but due to fire control malfunction, cannot be completed, the TC may have to issue further instructions to the gunner; this depends on the urgency of the engagement and the time available. The situation may require completing the engagement using the GAS.

The degraded-mode technique used will depend on which fire control component is inoperative. The following situations may occur during an engagement. The corrective actions, including the appropriate fire command, are indicated. These actions allow the tank crew to engage targets effectively until repairs return the tank to a fully operational status, or until environmental conditions change.

LRF INEFFECTIVE

Effective use of the LRF may be lost due to any of the following:

- Internal LRF or vehicle malfunction.
- Environmental conditions (fog, falling snow, or heavy rain).
- Man-made or battlefield smoke and obscurants.
- Multiple returns from a target smaller than the LRF beam width, with interference both in front of, and behind, the target.

Note. Battlesight gunnery is the quickest method that can be used when the LRF is ineffective. It is the preferred method when targets are within battlesight range. If the situation allows, the gunner should use the stadia reticle in the GAS to determine a range to the target. On an M1A2, the TC and gunner can use stadia reticles to determine range.

Manually Indexing Range

When the gunner cannot determine range effectively using the LRF, the TC or gunner can enter the estimated range into the system manually. This allows the gunner to use the GPS and a full ballistic solution for the estimated range.

(M1 and M1A1.) If the TC enters the range, he will not announce the range in the fire command. Instead, after the gunner announces "IDENTIFIED," the TC will press the MANUAL RANGE BATTLE SGT button on the TC's panel; then, he will use the ADD/DROP toggle switch to enter the estimated range while viewing the range readout in his GPSE. The range readout will change in 10-meter increments at 50 meters per second for the first four seconds, then in 100-meter increments at 500 meters per second. Once the correct range is displayed and the loader announces "UP," the TC will give the command of execution.

If firing at a stationary target, the gunner should dump the palm switches to dump lead solution. If firing at a moving target, the TC must press the BATTLE SGT push button (*after* the gunner establishes a smooth track) to induce a lead solution, *then* use the ADD/DROP toggle switch to enter the estimated range.

(M1A2.) If the TC enters the range, he will not announce the range in the fire command. Instead, after the gunner announces "IDENTIFIED," the TC will press the MANUAL RANGE BATTLESIGHT push button on

the CID; then, he will use the four-way switch to enter the estimated range while viewing the range readout in his GPSE and CITV. For small adjustments, move the four-way switch up to add range or down to drop range at a speed of 10 meters per second. For large adjustments, hold the four-way switch up or down for four to eight seconds to add or drop range at a speed of 50 meters per second. If the four-way switch is held up or down more than eight seconds the range will add or drop at a speed of 100 meters per second. Once the correct range is displayed and the loader announces "UP," the TC will give the execution command. If firing at a moving target, the TC must press the BATTLESIGHT push button (*after* the gunner establishes a smooth track) to induce a lead solution, *then* use the four-way switch to enter the estimated range.

Note. The TC must press the BATTLESIGHT push button twice; otherwise, the CID will remain in the BATTLESIGHT mode.

If the TC wants the gunner to enter the range manually, he will announce "INDEX" and the estimated range in the fire command.

- (M1 and M1A1): The gunner will open the CCP door, turn the CCP on, press the RANGE push button, enter the range, press the palm switch, and press the ENTER push button.
- (M1A2): The gunner will go to the GCDP and press the ADJUST push button on the main menu, then press the RANGE push button on the ADJUST menu, enter the range, press the palm switch, and press the ENT push button on the GCDP keypad.

Example fire command: "GUNNER—SABOT—TANK—INDEX ONE SIX HUNDRED—FIRE."

Note. The gunner uses the GPS, opens the CCP for M1 and M1A1 or GCDP for M1A2 and M1A2 SEP, and indexes the range announced in the fire command.

To induce and maintain lead, the gunner must keep the palm switch on the GPCH pressed. If the gunner *dumps* his lead, the TC can press the BATTLESIGHT push button after the gunner has established a steady track to induce the lead again.

- (M1 and M1A1): The range will change to the preindexed battlesight range. If the range to the target is different, the TC must press the ADD/DROP toggle switch to correct the range before giving the execution command.
- (M1A2): The range will change to the preindexed battlesight range. If the range to the target is different, the TC must press the MANUAL RANGE BATTLESIGHT push button on the CID, then use the four-way switch to enter the estimated range before giving the execution command.

Note. Announcing "INDEX," and having the gunner manually index the range is the least preferred method of applying a range—it is time-consuming and requires the gunner to take his eye from the sight.

Manually Applying Range Using the GAS

If the GPS is inoperative or the TC elects to fire from the GAS, he can still conduct an engagement by having the gunner determine the range using the stadia reticle or announcing the range in the fire command. The gunner will lay the appropriate range line on the target center of mass (or offset if lead or cant must be applied), and fire when directed. Example:

Example fire command: "GUNNER—SABOT—TANK—ONE SIX HUNDRED—FIRE."

Note. The gunner automatically shifts to the GAS and uses the appropriate reticle line.

Example fire command: "GUNNER—SABOT—TANK—CHOKE—FIRE."

Note. The word "CHOKE" is used when the tank-to-target range is unknown and the TC wants the gunner to estimate the range. The gunner uses the GAS stadia reticle to estimate the range and announces the choked range to the TC, then the TC determines if the range appears correct and announces "FIRE."

Manually Applying Range Using the CITV Stadia Reticle

To determine the range to a full-height target, move the range/stadia reticle switch forward or backward until the outer-most index lines rest on the top and bottom of the target. The approximate range is displayed on the CITV display.

To determine the range to a hull-down target, move the range/stadia reticle switch forward or backward until the inner-most index lines rest on the top and bottom of the target. The approximate range is displayed on the CITV display.

Example fire command: "GUNNER—SABOT—TANK—CHOKED ONE SIX HUNDRED—FIRE."

Notes. This method is used when the TC uses the CITV stadia reticle to estimate the range to the target.

The TC may also elect to have the gunner use the GAS stadia reticle to confirm the range to the target.

Loss of Symbology. Although loss of symbology due to failure in the image control unit or electronics unit does not affect the function of the LRF, it does prevent the gunner or TC from evaluating range returns. The accuracy of the LRF and the ability to select first or last return logic should provide enough confidence to fire, although range may not be displayed. If the crew is uncertain and time permits, the TC may have the gunner check the range using the RANGE push button on the CCP or the GCDP.

Computer Lockup. Damage to the CEU (TEU or HEU on the M1A2) may occur as a result of the impact of enemy direct fire. If this occurs, the gunner should move to the GAS immediately.

A computer lockup prevents ballistic solutions from being induced; the electrical triggers may also malfunction. If computer lockup is suspected and immediate return fire is required, the gunner uses the GAS and the manual firing device. At the first opportunity, move the tank to a position where the crew can troubleshoot the system. Replace damaged components as soon as possible.

CANT SENSOR FAILURE (M1 AND M1A1)

If a cant sensor failure occurs during a computer self-test, a numeral *2* will appear on the CCP display window and the CANT push button will flash. To cancel this input, the gunner should press the CANT push button, then the 0 and ENTER push buttons on the CCP keypad (the CANT push button will remain illuminated).

When the turret cants to the right or left, the gun trunnions are not horizontal. This creates a deflection and range error, causing rounds to impact low and toward the downside of the cant. As the degree of cant increases, the strike point of the round moves farther from the aiming point in the direction of the cant. Corrections for cant cannot be made while firing on the move. When engaging a target during a cant sensor failure, the crew uses the following techniques to compensate for cant:

- The gunner presses the CANT push button on the CCP to cancel the input, then presses the 0 and ENTER push buttons on the CCP keypad (the CANT push button will remain illuminated).
- The gunner lays the gun on target and lases.
- The driver attempts to locate a level firing position. (If not able to locate a level firing position, the gunner does not apply any AZ or EL corrections for KE rounds. For HEAT rounds, the gunner aims one-half target form in the opposite direction of cant in AZ, but makes no EL correction.)

CANT SENSOR FAILURE (M1A2)

If a cant sensor failure occurs during a computer self-test, a fault message will appear in *Cautions/Warnings* on the GCDP. To cancel this message, the gunner should press the SENSORS push button on the main menu, the ATTD push button on the SENSORS menu, the CANT push button on the ATTD menu, the MANUAL push button on the CANT menu, and the 0 and ENT push buttons on the GCDP keypad.

When the turret cants to the right or left, the gun trunnions are not horizontal. This creates a deflection and range error, causing rounds to impact low and toward the downside of the cant. As the degree of cant increases, the strike point of the round moves farther from the aiming point in the direction of the cant. Corrections for

cant cannot be made while firing on the move. When engaging a target during a cant sensor failure, the crew uses the following techniques to compensate for cant:

- The gunner presses the SENSORS push button on the main menu, the ATTD push button on the SENSORS menu, the CANT push button on the ATTD menu, the MANUAL push button on the CANT menu, and the 0 and ENT push buttons on the GCDP keypad.
- The gunner lays the gun on target and lases.
- The driver attempts to locate a level firing position. (If not able to locate a level firing position, the gunner does not apply any AZ or EL corrections for KE rounds. For HEAT rounds, the gunner aims one-half target form in the opposite direction of cant in AZ, but makes no EL correction.)

CROSSWIND SENSOR FAILURE (M1 AND M1A1)

If a crosswind sensor failure occurs during a computer self-test, a numeral *3* will appear on the CCP display window, and the CROSSWIND push button will flash. To cancel this input, the gunner should press the CROSSWIND push button on the CCP, then press the 0 and ENTER push buttons on the CCP keypad (the CROSSWIND push button will remain illuminated). The TC should not try to estimate wind speed.

CROSSWIND SENSOR FAILURE (M1A2)

If a crosswind sensor failure occurs during a fire control system test, a fault message will appear in *Cautions/Warnings* on the GCDP. To cancel this message, the gunner should press the METRL DATA push button on the main menu, then the CROSSWIND and MANUAL push buttons, and the 0 and ENT push buttons on the GCDP keypad. The TC should not try to estimate wind speed.

GPS AZIMUTH DRIVE SYSTEM FAILURE (M1 AND M1A1)

If the GPS azimuth drive system fails during a computer self-test, the numeral *4* will appear in the CCP display window, and the LEAD push button will flash. To cancel this input, the gunner should press the LEAD push button, then the 0 and ENTER push buttons on the CCP keypad (the LEAD push button will remain illuminated). The gunner will know that lead is not automatically induced by the computer because the reticle does not move toward the side of the GPS field of view when following a moving target or slewing from target to target. To engage a target under these conditions, the gunner must remember the following:

- A GPS azimuth drive system failure does not affect firing at stationary targets from a stationary tank.
- Since lead is not automatically applied, the gunner must apply lead using the lead lines on the reticles.
- When engaging a moving target or firing from a moving tank, the gunner must apply lead from the target center of visible mass in the direction the target is moving.
- The amount of lead is based on the type of round fired, the tracking rate of the turret, and the range to the target. The speed of a distant target is hard to estimate. The standard lead is 2½ mils for sabot or MPAT, and 5 mils for HEAT. (The recommended standard leads are based on a standard target size and speed, and may be revised.)

LEAD SYSTEM FAILURE (M1A2)

A lead system failure is indicated by an FCEU fault message displayed in the GCDP. The gunner will not notice whether lead is or is not automatically induced because the DAHA in the GPS is keeping the reticle in the center of the sight. The gunner can detect lead failure by observing lack-of-sight movement (not reticle) and turret effects with a full ballistic solution while tracking a moving target or slewing from target to target. If the gunner finds a lead system failure, he should press the SENSORS push button on the main menu, the ATTD push button on the SENSORS menu, the LEAD push button on the ATTD menu, the MANUAL push button on the LEAD menu, and the 0 and ENT push buttons on the GCDP keypad. To engage a target under these conditions, the gunner must remember the following:

- A lead system failure does not affect firing at stationary targets from a stationary tank.
- Since lead is not automatically applied, the gunner must apply lead using the lead lines on the reticles.
- When engaging a moving target or firing from a moving tank, the gunner must apply lead from the target center of visible mass in the direction the turret is moving.

- The amount of lead is based on the type of round fired, the tracking rate of the turret, and the range to the target. The speed of a distant target is hard to estimate. The suggested initial lead is 2½ mils for sabot or MPAT, and 5 mils for HEAT. (The recommended standard leads are based on a standard target size and speed, and may be revised.)

GPS FAILURE (DAY CHANNEL)

If the GPS daylight channel fails, the TIS can be used. If both daylight and thermal channels are inoperative, the gunner uses the GAS. If the GPS fails, the LRF will probably also be inoperative.

LOSS OF BORESIGHT

Boresight may be lost in the GPS due to the impact of enemy direct fire. If this occurs, or is suspected, the gunner should immediately move to the GAS. Detailed procedures are in Chapter 11, *Survivability and Fight-Back Capability*.

NORMAL-MODE FAILURE

When the NORMAL mode fails, the tank can still operate in EMERGENCY mode. The gunner moves the FIRE CONTROL MODE switch to the EMERGENCY mode position. This automatically slaves the sights to the gun. If all other components of the fire control system work, the TC issues a fire command and, if moving, before firing, orders the driver to stop. (For greater accuracy, EMERGENCY mode engagements should be fired from a short halt.) If the target is moving, the gunner applies manual lead; otherwise, his duties remain the same.

TURRET POWER FAILURE

When the turret power fails, the TC tells the driver to orient the front slope toward the target and come to a short halt, and issues a fire command using the GAS degraded-mode gunnery technique. The gunner uses the manual control handles to traverse and elevate, and fires using the manual firing device. (The TC's fire command must include the *direction* element to get the gunner on target.)

WARNING

Traversing the turret using the manual traversing handle while on the move could cause personal injury to the gunner.

LOSS OF REPLENISHER

If the replenisher is damaged or destroyed and immediate return fire is required, it is likely that at least one round can be fired without seriously damaging the gun and recoil mechanism.

Each subsequent round increases the chance of serious damage to the gun and recoil mechanism; continued firing may result in the gun coming out of battery and into the crew compartment.

MISFIRE

The misfire procedures in the operator's manual will correct a misfire (cause the gun to fire), but they are not combat effective. In combat, the gun must fire as quickly as possible when the trigger is squeezed. The following misfire procedures are designed to get the gun fired as quickly as possible.

Table 8-4. Abrams Standardized Misfire Procedures.

TC	GUNNER	LOADER	DRIVER
Ensures path of recoil is clear, and announces "FIRE."	Announces "ON THE WAY," and squeezes trigger on GPCH. Announces "MISFIRE."		
(TC on M1A2 and M1A2 SEP) Checks the circuit breakers. Resets any circuit breakers that are off and announces “CIRCUIT BREAKER RESET.”	Keeps main gun aimed at target. Announces "ON THE WAY," and vigorously turns the EMERGENCY MANUAL FIRING DEVICE (blasting machine) handle clockwise two to four times. If the round does not fire, announces "MISFIRE."	(Loader on M1 and M1A1) Checks the circuit breakers. Resets any circuit breakers that are off and announces “CIRCUIT BREAKER RESET.”	Follows instructions from TC.
Note. If the round fires using the EMERGENCY MANUAL FIRING DEVICE, the TC must decide, based on the tactical situation, whether to continue to fire using the EMERGENCY MANUAL FIRING DEVICE or immediately perform *main gun failure to fire* troubleshooting steps.			
Observes loader’s actions and guides, if necessary. Directs driver as the tactical situation dictates.		Checks ARMED light on loader’s panel. (If light is not illuminated, clears path of recoil, rearms gun, and announces "UP.") Ensures breechblock is flush with or above breech ring. (If it is not, announces "BREECH," moves main gun SAFE/ARMED lever to SAFE position, ensures GUN/TURRET DRIVE switch is in EL UNCPL position, pushes up on breech [without placing body in the path of recoil], clears the path of recoil, moves main gun SAFE/ARMED lever to ARMED position, ensures yellow MAIN GUN STATUS ARMED light is lit, and announces "UP.")	
	Keeps main gun aimed at target. If a fault was identified during the loader’s checks, waits for loader to announce "UP," then announces "ON THE WAY," and attempts to fire the main gun using the GPCH. If the round does not fire, announces "MISFIRE" and immediately attempts to fire using the EMERGENCY MANUAL FIRING DEVICE (blasting machine). If gun fails to fire, announces "MISFIRE" and moves GUN SELECT switch to TRIGGER SAFE. If no faults were found during the loader’s checks, moves GUN SELECT switch to TRIGGER SAFE.		

continued on next page

Table 8-4. Abrams Standardized Misfire Procedures (cont.).

TC	GUNNER	LOADER	DRIVER
Tells loader when to move the main gun SAFE/ ARMED lever to SAFE positions and open breech.		Follows TC's directions. Moves main gun SAFE/ ARMED lever to SAFE position, opens breech half way (M1: rotates round one-half turn) closes breech, clears path of recoil, moves SAFE/ ARMED lever to ARMED position, ensures yellow MAIN GUN STATUS ARMED light is lit, and announces "UP."	
Ensures path of recoil is clear, and announces "FIRE."	Moves GUN SELECT switch to MAIN position, announces "ON THE WAY," and attempts to fire using the GPCH. If the gun does not fire, announces "MISFIRE," and immediately attempts to fire using the EMERGENCY MANUAL FIRING DEVICE (blasting machine). If the gun fails to fire, announces "MISFIRE."		
SAFETY CAUTION In training, the crew waits 2 minutes (M1) or 15 minutes (M1A1 and M1A2) for the round to *cook off*. **Note.** In combat, the TC determines (depending on the tactical situation) how long to wait, whether to discard the round, and if the tank needs to move to a turret-down position.			
Directs loader to place gun on SAFE.	Moves GUN SELECT switch to TRIGGER SAFE.	Moves main gun SAFE/ARMED lever to SAFE (down) position.	
Directs loader to remove round and place it in the ready ammunition compartment.		Removes round and places it in the ready ammunition compartment.	
Directs crew in performing a firing circuit check and troubleshooting accordingly.			

LOSS OF A CREW MEMBER

Casualties will occur in battle, and a tank crew may find itself fighting with only three men. Regardless of which crew member is out of action, the remaining crew members must reorganize to perform the duties of the three key positions of TC, loader, and driver. Although some familiarization and orientation may be necessary in repositioning the crew, a cross-trained crew can adapt quickly in an emergency.

Fire Control Preparation for Three-Man Crew Operations

After the crew has reorganized, the following actions must be taken:

Fully Operational System. With a fully operational system, the TC will use precision techniques. Coax targets can be engaged in an emergency with the loader's machine gun or the TC's machine gun. If time permits, the

TC may select COAX with the GUN SELECT switch and fire the coax using the GPSE or CITV. To prepare his position to engage targets using the GPSE or CITV, the TC—

- Moves the MAGNIFICATION lever on the GPS (or TIS) to the 10X position. (On the M1A2 SEP, uses 3X, 6X, 13X, 25X, or 50X in the TIS, as the tactical situation dictates.)
- (M1A2 only)—Powers up the CITV and makes sure it is in the WFOV position.
- Moves the FIRE CONTROL MODE switch to the NORMAL mode position.
- Moves the TIS to STBY (or ON).
- Moves the FLTR/CLEAR/SHTR switch to the correct position.
- Moves the LRF RANGE switch to the ARM LAST RTN position.
- Moves the GUN SELECT switch to the MAIN position.
- Moves the AMMUNITION SELECT switch to the type of round loaded.
- Checks the reticle brightness to make sure it is visible in the GPSE.

Degraded System. There are no hard and fast rules in a degraded-mode situation with a three-man crew. The TC must know how to identify malfunctions and take corrective actions. If the LRF is not operational, the TC uses battlesight techniques from the GPSE. If the target is beyond battlesight range, the TC presses the BATTLE SGT push button, then adjusts the range using the ADD/DROP toggle switch. (M1A2) If in the defense and time permits, the TC determines the range using the CITV stadia reticle. If the TC is firing from the TC's position and the gun misfires, he will have to move to the gunner's seat.

Modification of Crew Duties

Crew duties must be modified to compensate for the loss of the gunner. The driver's and loader's duties will remain relatively the same as when fighting with a full crew; however, everyone, especially the driver, must become more aware of target acquisition before, during, and between engagements. The TC will assume the gunner's duties, becoming the principal user of the tank's fire control and sighting systems.

LOSS OF TIS ON THE M1 AND M1A1 OR TIS AND CITV ON THE M1A2

The TIS (M1 and M1A1) or TIS and CITV (M1A2) on the Abrams make night engagements similar to day engagements. If these systems malfunction in combat, the following techniques may help the crew during night or limited visibility engagements.

Night Vision

To preserve night vision and prevent detection by the enemy, the tank crew should use only the blue or red lights inside the turret during night operations. Interior lights should be kept at the lowest level possible for the crew to function efficiently. Lights should only be used when necessary.

Searchlight Illumination

Although the Abrams is not equipped with a searchlight, it is possible it will be fighting with other combat vehicles that are equipped with mounted searchlights. The GPS or the GAS on the Abrams can be used with searchlights from other vehicles providing illumination.

Indirect Illumination

Mortar or artillery illumination or pre-positioned pyrotechnics can help a crew acquire and engage targets at night. Since the Abrams is not equipped with passive or infrared sights, indirect illumination must be planned.

BATTLESIGHT GUNNERY

Battlesight gunnery is used when an accurate tank-to-target range cannot be determined, when the computer is inoperative, or in most surprise situations. This method takes advantage of the relatively flat trajectories of armor-defeating ammunition to ensure a high probability of first-round hits. It is normally used when the fire

control system is not fully operational, or when weather conditions (fog, rain) or enemy actions (use of smoke) prevent the gunner or TC from using the LRF. Battlesight gunnery is quick, but not as accurate as precision gunnery. Point of aim will continue to be center of visible mass, as the gunner applies the rules of lay.

Example fire command: "GUNNER—BATTLESIGHT—TANK—FIRE."

Note. Only use the battlesight fire command when the target is within the predetermined battlesight range.

The battlesight fire command format is standard. The system is already indexed with ammunition and range; as determined by the commander using METT-TC, the ammunition or weapon element is changed to BATTLESIGHT in the fire command (for example, "GUNNER—BATTLESIGHT—TANK—FIRE"). This informs the gunner that there will be no attempt to determine range; therefore, the range element will be omitted from the fire command. If the target is beyond battlesight range, the range will need to be estimated, changing the fire command where the appropriate ammunition is announced as well as the range element of the fire command.

The gunner will fire using the GPS or TIS and the predetermined battlesight range for the ammunition selected or the appropriate range line on the GAS. If all fire control systems except the LRF are operational, a full ballistic solution except for *lead* is provided for the GPS or TIS for the previously indexed range. To provide a *lead* solution, the TC presses the BATTLE SGT push button on the TC's panel on the M1 and M1A1 or the BATTLESIGHT push button on the CID on the M1A2, *after* the gunner has established a smooth track on the target. When using the GAS, the gunner *must* apply manual lead using the reticle lead lines. The loader continues to load the battlesight ammunition until the engagement is over, or the TC changes ammunition.

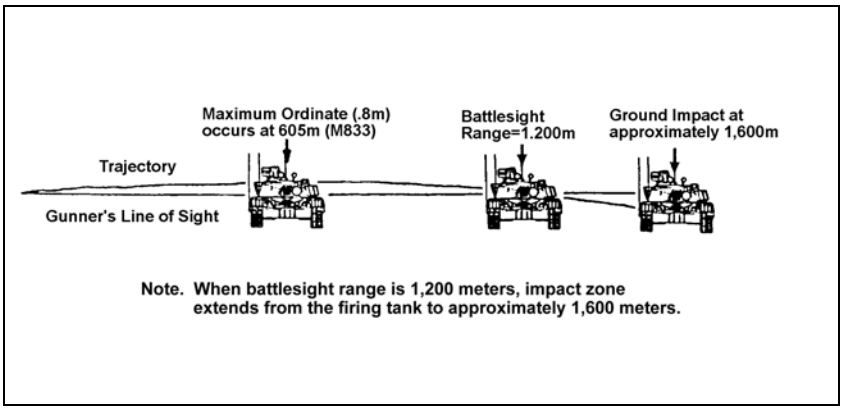


Figure 8-8. Concept of Battlesight.

DETERMINING BATTLESIGHT RANGE

The unit commander may choose (based on METT-TC) from a variety of range and ammunition combinations for his unit's battlesight.

If the primary threat (most likely target to be engaged) is tanks, sabot is the most appropriate ammunition; otherwise, use HEAT.

The typical range setting (1,200 meters for sabot, 1,000 meters for MPAT, and 900 meters for HEAT) is used, unless the commander gives guidance otherwise. (Selecting a range in excess of 1,200 meters for sabot, 1,000 meters for MPAT, or 900 meters for HEAT-T can, at certain ranges, cause the trajectory of the round to exceed the height of the target.) Factors for selecting another battlesight setting include weather, smoke, range, or other conditions that reduce visibility. The battlesight range should be based on the commander's analysis of METT-TC.

If the size of the *most likely target to be engaged* is 1.5 meters or larger, the standard battlesight range listed will give you a very good chance of a hit. Using FT 105-A-4 or FT 120-D-2, look at the maximum ordinate listed for the round you are using to determine the range to use.

Use the following method to determine battlesight range:

1. Divide the expected known height of the target by two.
2. Determine the ammunition to be fired.
3. Refer to FT 120-D-2 and use the maximum ordinate (column 7) of the ammunition to be fired.
4. Locate the answer to step 1 in the maximum ordinate column. The battlesight range will be listed in column 1 or 11 (range).

Note. If the exact number cannot be found in the maximum ordinate column, round down to ensure the projectile does not go over the target at the range to the maximum ordinate.

FIRING THROUGH SMOKE

During battlesight engagements, the TIS allows firing of the main gun and the coax machine gun through most types of smoke and other battlefield obscurants. When obscurants are present and acquisition is limited to the TIS, the gunner must make wide sweeps of the sector of fire with the sight set to 3X magnification to prevent targets from going unnoticed. The TC (M1A2) will also continually scan for targets using the CITV SEARCH mode.

Error Sources

The greater the range, the lower the probability of hit. This means that, as the range to the target increases, expectations of first-round hits decrease. Many other factors affect firing accuracy. The system and environmental and human factors involved in any target engagement comprise what is called the tank gun error budget—fixed biases, variable biases, and random errors. Each error source has varying effects on firing accuracy. The effect of these errors may be significant when a number of error sources act on the fire control system at the same time. Also, the effect of these error sources is magnified when engaging targets at long ranges. The error sources listed below are not all inclusive; several additional sources of error exist.

FIXED BIASES

Fixed biases are error sources induced by ammunition, weapon, and fire control system design and manufacture. Because they are fixed, or built-in, these error sources can be compensated for.

SYSTEM PARALLAX

System parallax is the vertical and horizontal distance between the center line of the main gun and the optical axis of the sights. When the gun and sights are boresighted, all lines of sight converge at the boresight range. At ranges less than or greater than the boresight range, the lines of sight differ. Normally, the ballistic computer compensates for system parallax in the GPS and CITV; a correction is determined and incorporated into the solution sent to the GPS (daylight or thermal channel) and the CITV.

BALLISTIC DRIFT

Drift, the lateral departure of spin-stabilized ammunition from the gun-target line, is the product of air resistance and projectile spin. Projectiles will drift in the same direction as the spin caused by the rifling of the main gun. The M68 gun rifling has a uniform right-hand twist; therefore, all spin-stabilized ammunition fired from it will drift to the right. The computer offsets drift in the ballistic solution. When firing from the GAS, the ballistic reticles compensate for drift. The current combat sabot, HEAT-T, and MPAT rounds (for the M1, M1A1, and M1A2 tanks) are fin-stabilized and not affected by drift. The computer takes this into account when the correct ammunition subdesignation is entered into the computer.

Note. The ballistic drift mentioned above is not to be confused with emergency or normal mode drift.

MEAN JUMP

Mean jump is the average difference between the actual impact of a group of rounds fired over many occasions and the intended strike of those rounds, given that all inputs to the FCS are correct or within tolerance. As a fixed bias, mean jump error is corrected by entering a CCF or SCF as either a fleet zero or a discreet correction factor.

VARIABLE BIASES

Variable biases are error sources that remain fairly constant when firing one type of ammunition at a particular target and a given range, but can change considerably from one engagement to the next.

BORESIGHT/BORESIGHT RETENTION

Initial boresight errors can occur due to tolerances in the muzzle boresight device, round-off errors in splitting means, or if the MBD operator and gunner are not sighting on exactly the same target aiming point. Once an initial boresight is established, errors can occur when the spatial relationship between the end of the tube and the GPS changes. Two primary causes are gun tube droop or turret deformation (due to the sun or wind, the turret heats up unevenly and changes the initial alignment). Boresight retention can also be affected by inaccuracies in performing an MRS update.

Although initial boresight/boresight retention errors are some of the largest error sources, they are more easily controlled or corrected by the crew.

CANT (TRUNNION TILT)

Cant occurs when the tank is on uneven ground and one gun trunnion is higher than the other. When superelevation is applied to the gun, it is applied vertically to an imaginary perpendicular line drawn between the gun trunnions. When cant is present, superelevation is applied at an angle to the vertical plane, inducing range and deflection errors. When firing from a stationary tank, cant data is supplied to the computer from the cant unit, and the ballistic solution includes a reticle adjustment to compensate for cant.

CROSSWIND

Air turbulence (wind) moving laterally to the gun-target line will cause the projectile to deviate from the gun-target line. The effect of crosswind on any round other than APFSDS-T and APDS-T is significant, regardless of engagement range. The crosswind sensor on the tank measures crosswind at the rear of the turret and feeds this data to the computer. The computer calculates a correction based on the assumption that this crosswind is constant all the way to the target. This correction is incorporated into the ballistic solution sent to the reticle azimuth drive, and is updated continuously.

FIRE CONTROL

Errors can be induced by certain stresses placed on the fire control system. The fire control system cannot compensate for most of these stresses, such as design tolerances, metal fatigue, and vehicle vibrations. However, it can compensate for the following factors:

- Muzzle displacement, or *thermal bending* is caused by uneven heat distribution along the gun tube. *Gun tube droop* is caused by gravity acting on the gun, and can disturb the gun-sight relationship established through boresighting. The thermal shroud reduces muzzle displacement caused by uneven heat distribution, but does nothing about the gravitational effect. Frequent boresighting will reduce the effect of muzzle displacement by reestablishing the gun-sight relationship.
- Air density and temperature affect the ballistics of the projectile. Air density varies with temperature and altitude. Since the computer accepts data on barometric pressure and temperature, it compensates for air density.

BALLISTIC SOLUTION

An incorrect ballistic solution may be computed for various reasons: incorrect ammunition selected, incorrect range determined, an unknown failure in the computer, or an unknown failure in one of the input devices. To ensure the computer receives the correct information, the gunner should double check the ammunition selected on the AMMUNITION SELECT switch or push button after the loader announces "UP." The TC must evaluate the range before firing. If an *F* appears in the symbology, and a manual self-test (or FCS test on the M1A2) reveals no primary direct-fire control failure, a manual self-test (or FCS test on the M1A2) should be performed after every engagement until turret mechanics can resolve the problem. The crew can detect incorrect ballistic solutions by conducting special gunnery checks (see operator's manual, Appendix F), or by performing the armament accuracy checks using a solution board. (Conducting the special gunnery checks requires an M1A1 gunner's quadrant. To check the tolerance of the M1A1 gunner's quadrant, see Chapter 5, *Screening Test*.)

MUZZLE VELOCITY VARIATION

Changes in the muzzle velocity of the projectile are due to the ammunition or weapon. The following factors will cause a vertical deviation in the strike of a round:

- Damaged rifling (105mm only).
- Tube wear.
- Temperature of the propellant.
- Change of loading density.
- Tube length.

Gun tube wear results in lowered muzzle velocity and increased dispersion. When firing from the GPS on the M1, the computer accepts data on gun tube wear and compensates for it; when firing from the GAS, there is no way to compensate for gun tube wear. Gun tube wear is not determined, nor is data input for the M1A1 or the M1A2.

RANGE ESTIMATION

Errors associated with range determination are primarily a training problem (see Chapter 7, *Range Determination*).

OPTICAL PATH BENDING

The apparent illusion of target displacement is commonly called refraction. Under certain light and environmental conditions, the path of light (line of sight) may not travel in a straight line. Refraction may cause problems for tank crews attempting engagements at ranges beyond 1,500 meters. Refraction may occur under the following conditions:

- Day—clear sky, flat terrain, winds less than 10 miles per hour.
- Night—clear sky, flat terrain, winds less than 4 miles per hour.

Note. Any time heat shimmer is present, refraction may also be present.

Refraction makes the target appear lower during the day; the sight picture, though it appears center of visible mass to the gunner, is actually below the target. The result of this may be a short round. At night, the effects are opposite and may result in an over round.

Note. The laser beam will refract with other light rays and still hit the desired target.

The most effective measure available to the crew to minimize refraction is an elevated firing position. A position at least ten meters above intervening terrain will generally negate any effects. When a crew operating

under conditions favorable to refraction misses short during daylight and over during night with their first round (an elevated position is not available), they should apply the following adjustment:

- Day—adjust the sight picture up one-half target form (top of target).
- Night—adjust the sight picture down one-half target form (bottom of target).

Note. Under normal conditions, crews do not need to make a correction for refraction at ranges less than 1,500 meters.

Boresight does not correct refraction, but crews must make sure that all before-operation checks and boresighting procedures are done correctly. When a crew is missing targets under these conditions, the cause may be refraction and not crew error or loss of boresight due to improper procedures.

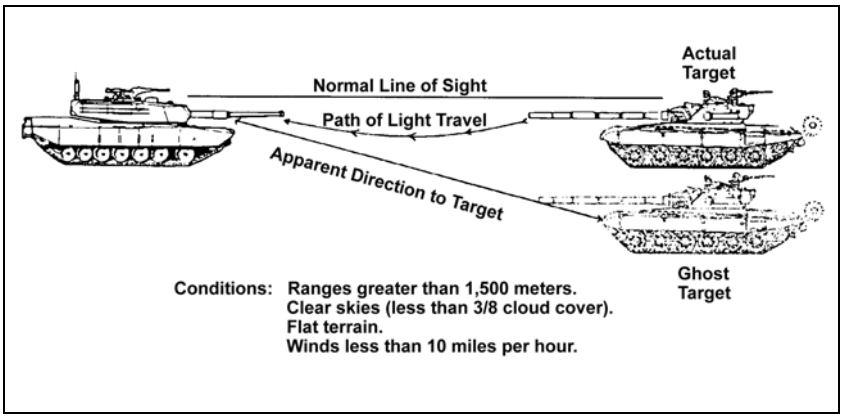


Figure 8-9. Day Refraction (Exaggerated View).

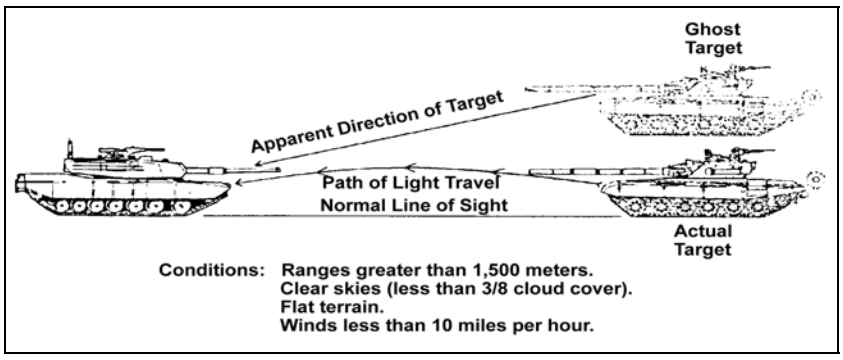


Figure 8-10. Night Refraction (Exaggerated View).

VARIABLE JUMP

Variable jump is the average difference between actual impacts for a particular occasion and the intended strike of those rounds, given all inputs to the FCS are correct or within tolerance. Variable jump may be corrected using standard sight adjustments after subsequent round misses.

RANDOM ERRORS

Random error sources are those that vary for each round fired. They cannot be predicted from one round to the next, nor can the crew compensate for them. The TC and gunner must be aware of random errors and not be unduly influenced by them when they occur.

ROUND-TO-ROUND DISPERSION

With a perfect gun and ammunition firing under ideal conditions, all rounds would hit the same spot. In reality, there is a spread of shots around a central point. The area into which these shots fall is called the dispersion zone. There is no way the crew can compensate for dispersion, but they should be aware of its effects. As the range to the target increases, so does the size of the dispersion zone. If the round misses by only a slight amount, a re-lay and reengage technique may achieve a target hit.

GUNNER LAY ERROR

Gunner lay error is caused when the gunner fails to make a correct lay to the target aiming point while either boresighting or engaging targets. It is a significant error source and primarily a training problem. To reduce this error, each gunner must be trained to make his final lay to the correct aiming point, ending his lay in elevation. This will minimize the effects of gunner lay error.

Chapter 9

Machine Guns

Tank crews must be able to effectively engage dismounted infantry, crew-served weapons, ATGM teams, RPG teams, trucks, thin-skinned armored vehicles, lightly-constructed covered positions, and aircraft. This chapter discusses how tank machine guns are used and their role in direct-fire engagements.

CONTENTS

Employing Tank-Mounted Machine Guns

COAX MACHINE GUN

The coax machine gun can effectively engage area or point targets out to 900 meters, its maximum effective range (tracer burnout). When using the coax, the TC or gunner should set the LRF RANGE switch based on the operational environment.

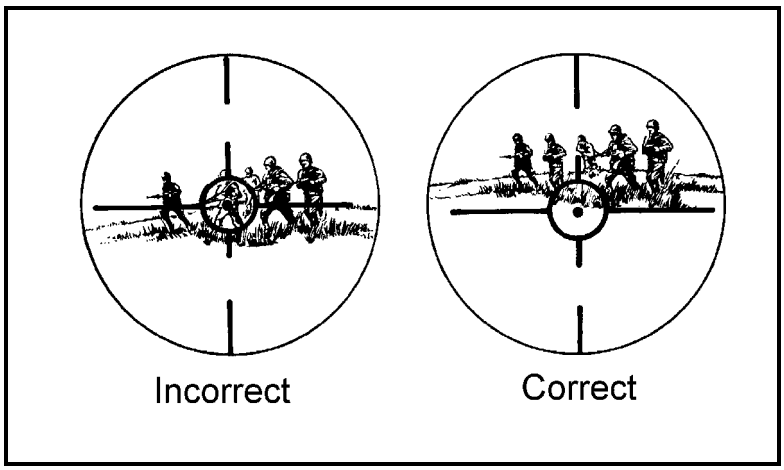


Figure 9-1. Sight Picture for Lasing on Troops Using Last Return Logic.

ENGAGEMENT TECHNIQUE FOR AREA TARGETS

Immediately after lasing, the gunner should *dump* lead by quickly releasing then reengaging the palm switches. This rationale is based on the slow ballistic characteristics of the 7.62-mm round that cause the ballistic computer to induce a large lead angle. With the sweeping firing pattern (back and forth) used in these engagements, lead makes it difficult to place effective fire on the target.

After having lased and dumped lead, the gunner brings the reticle up to the center of the target area and fires an initial burst. An initial burst is a continuous burst fired through the target area, designed to kill as many troops as possible before they hit the ground or find cover.

After an initial burst has been fired, if pockets of resistance remain visible, use the machine gun area engagement technique, but shift to a 20- to 30-round burst using the Z-pattern technique.

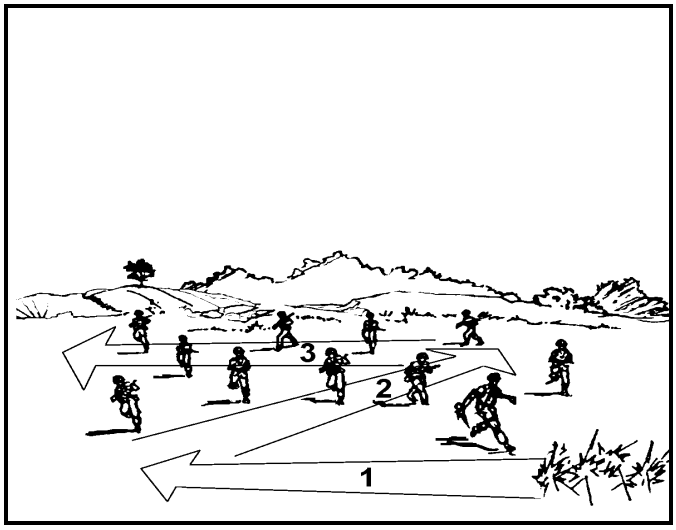


Figure 9-2. Z-Pattern Technique for Area Targets.

In the offense, continue to move when engaging targets in the normal mode. Movement of the turret and vehicle carries the burst through the target when a narrow frontal area target is presented (see Figure 9-3). Round dispersion will cover target width.

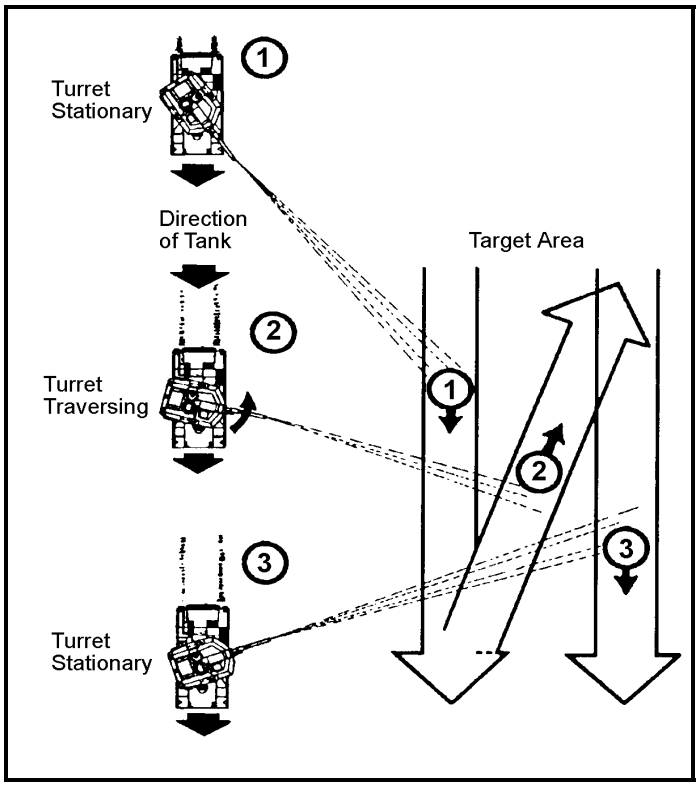


Figure 9-3. Z-Pattern from Moving Tank.

Notes. Due to the rapid decrease in range to the target during offensive coax engagements, it may be necessary to re-lase to the target during the engagement.

The gunner must not forget to dump lead after re-lasing.

If the TIS or GPS is inoperative, use the HEAT reticle in the GAS. The range must be doubled, due to the ballistic mismatch of HEAT ammunition and the 7.62mm coax round. (If the target is at 800 meters, use the 1,600-meter range line.) The gunner may need to make an immediate correction to get a killing burst into the target area.

ENGAGEMENT TECHNIQUE FOR POINT TARGETS

When engaging point targets with the coax machine gun, follow the same manipulative procedures as with main gun engagements.

In normal mode, point targets can be engaged with the coax while the tank is on the move. Stabilization allows the gunner to use the GPS or TIS to acquire, identify, and fire on targets effectively without stopping the tank.

If the LRF is inoperative, use the GPS with the coax, battlesight range previously indexed. (Recommended coax battlesight range is 500 meters, unless specified otherwise by unit SOP.) The minimum battlesight range the Abrams will accept for coax is 25 meters.

If the GPS or TIS is inoperative, use the HEAT reticle in the GAS. Due to the ballistic mismatch of HEAT ammunition and the 7.62-mm coax round, the range must be doubled. (If the target is at 800 meters, use the 1,600-meter range line.) Also, if lead is to be applied, use 7½ mils initially, and correct as necessary.

LOADER'S MACHINE GUN

The loader's M240 machine gun is used to engage targets designated by the TC. When using the M240 machine gun, the loader should—

- Lay the weapon for deflection.
- Fire bursts of 20 to 30 rounds (4 to 6 tracers) to engage all targets except aircraft. Engage aircraft using a continuous burst.
- Use tracer impact to adjust rounds on target.

When the loader is directed to engage targets with the M240, both the TC and loader must remember—

- The loader's main duty is to load the main gun.
- The loader's machine gun does not have any sights; therefore, it should be used only for area or aerial targets.
- The TC's weapon and loader's machine gun can be fired simultaneously; however, caution must be used to prevent injury to the loader or TC.
- To avoid damaging the CITV, thermal shrouds, the bore evacuator, or the muzzle reference system collimator, the loader's machine gun should be fired only at targets to the left of the main gun.

The loader's stand should be adjusted so the chest-hold technique can be used to steady the M240 while firing. The loader grasps the handles of the loader's M240 mount, holds them closely against his chest for steadiness and control, and fires the weapon.

The loader fires a burst of 20 to 30 rounds, adjusting tracer impact onto the target or target area. If the gunner or TC sees the tracers, he assists the loader in adjusting his fire. These adjustments are given as "UP/DOWN/RIGHT/LEFT." To terminate a loader's machine gun engagement, the TC announces "CEASE FIRE," or "LOADER—CEASE FIRE," after a multiple weapons system engagement. If the target is destroyed during a multiple weapons system engagement, the loader announces “LOADER COMPLETE.”

During road marches, the loader acts as an air guard with his machine gun and covers his sector of responsibility. When engaging targets, the TC and loader do not cross each other's fire (this could injure crew members and damage equipment).

TANK COMMANDER'S WEAPON

The M2 HB caliber .50 machine gun is mounted in the CWS on the M1 and M1A1 Abrams tanks. The M2 HB flex caliber .50 machine gun is mounted in the ICWS on the M1A2 Abrams tank. (The M240 7.62-mm machine gun can be mounted in the CWS and the ICWS). The M2 machine gun can engage area and point targets out to 1,800 meters, its maximum effective range. If the M240 7.62-mm machine gun is mounted, it should only be used out to 900 meters (tracer burnout). When using the commander's weapon—

- Lay the weapon for deflection and estimate the range. If the situation permits, the TC should have the gunner lase to the target and announce range; then, the TC should place the appropriate range line on target (M1 and M1A1 only).
- Fire bursts of 10 to 15 rounds (2 to 3 tracers) for the M2 or 20 to 30 rounds (4 to 6 tracers) for the M240 to adjust on target.
- Use the short-halt technique to engage targets while on the move.

On identification of an appropriate caliber .50 target, the TC announces "CALIBER FIFTY" and, on the M1 and M1A1, lays the appropriate range line on the target center of mass. On hearing the TC announce "CALIBER FIFTY," the loader positions himself in the loader's hatch (if not buttoned up), assumes the TC's responsibilities for primary target acquisition (ground and air), and will assist in adjusting the TC's machine gun fire. If the gunner is engaging targets with the main gun, the loader must remain inside the turret. In all other situations, the loader should be out of the hatch, helping to sense rounds and acquire targets.

If the gunner or loader can see the caliber .50 tracers, he assists the TC in adjusting fire. These adjustments are given as "UP/ DOWN/RIGHT/LEFT." On completion of the caliber .50 engagement, the TC announces "TC COMPLETE."

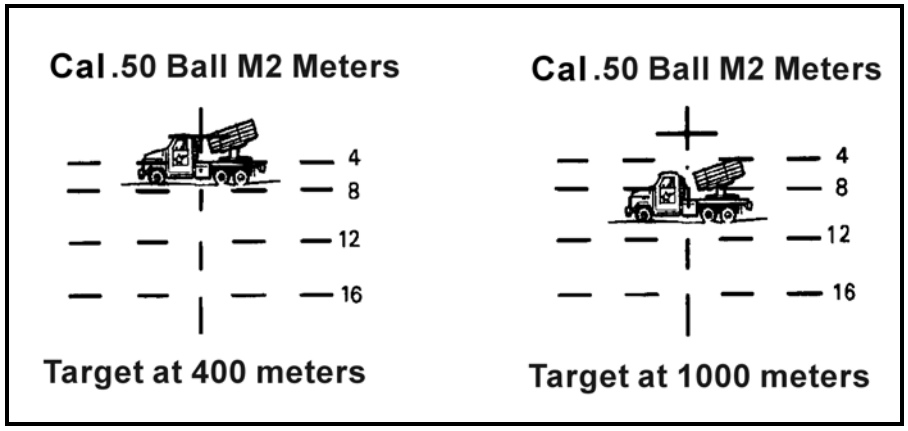


Figure 9-4. M1 and M1A1 Caliber .50 Aiming Points.

Special Use of Machine Guns

Machine guns are effective weapons, but they also serve the tank crew in different ways. The crew is limited only by their ingenuity in using these weapons. The following are special uses of machine guns.

SUPPRESSIVE FIRE ENGAGEMENTS

Tank suppressive fire is direct fire placed on known or likely enemy locations to degrade one or more of the enemy's basic combat functions—moving, shooting, observing, or communicating. Whenever possible, use machine guns for suppressive-fire engagements to conserve main gun ammunition. Suppressive fire is most effective when fired at a sustained rate of 20- to 30-round bursts (4 to 6 tracers) every 10 seconds for the M240, and 10- to 15-round bursts (2 to 3 tracers) every 10 seconds for the caliber .50. No specific pattern or engagement technique is prescribed; however, each burst should strike within 10 meters of the suspected target area. In dense terrain or areas of high enemy troop activity, overwatching tanks can cover maneuvering tanks with suppressive machine gun fire. To conserve caliber .50 ammunition, use the loader's machine gun along

with the coax on targets within 900 meters. Use the caliber .50 machine gun to suppress targets from 900 to 1,800 meters. Due to the relatively small amount of caliber .50 ammunition available, suppressive fire engagements with this weapon should be limited.

RECONNAISSANCE BY FIRE

To conserve main gun ammunition, use tank-mounted machine guns in reconnaissance by fire to cause a hidden enemy to react. Fire a single burst (20 to 30 rounds with the M240 or 10 to 15 rounds with the caliber .50) while constantly observing for enemy movement, return fire, or the flash of rounds striking metal.

Reconnaissance by fire is used when other means of enemy detection have been unsuccessful or are not available. It is best employed with another tank within the same section. One tank can fire on a suspected enemy position or suspicious area to cause the enemy to react and compromise his position at the time of our choosing, not his. The second tank can then engage and destroy the enemy from a different location.

RANGING

(M1 and M1A1 only.) When the GAS and LRF are inoperative, the caliber .50 machine gun may be used as a ranging gun out to 1,800 meters. The M240 (either coax or mounted in the CWS) may be used as a ranging gun out to 900 meters. Limited use of this technique is recommended, because it reveals your position.

DESIGNATING TARGETS

Section and platoon leaders can use machine gun fire effectively to designate targets for other tanks, artillery forward observers, or aerial fire support. Limited use of this technique is recommended, because it reveals your position.

FIRING THROUGH COVER

Tank-mounted machine guns can be used effectively to penetrate most cover used by dismounted personnel, such as small trees, hasty barricades, or lightly constructed buildings.

INCENDIARY EFFECTS

Machine gun tracers or incendiary ammunition, particularly API-T, can be used to set fire to any readily combustible material such as dry grass, grain, dried brush, or wood. Fire will deny a particular area to enemy use, and smoke from a burning field can be used to screen movement.

RICOCHET FIRE

Use ricochet fire when fighting in built-up areas. Machine gun fire can be directed around corners by bouncing rounds off buildings, walls, or streets. Ricochet fire can also suppress sniper fire. (**Note.** No proven technique has been defined for ricochet fire. It should be used on structures that are solid and provide a ricochet effect. Caution should be exercised when using ricochet fire to prevent rounds from ricocheting back into friendly forces.) Although not particularly accurate, ricochet fire can produce a desired psychological effect.

AIRCRAFT ENGAGEMENT TECHNIQUES

The caliber .50 and loader's machine guns can be used to engage aircraft and helicopters; this is more effective when several tanks are firing at the aircraft at the same time. It is difficult to track and hit aerial targets; therefore, a volume of fire should be established in front of the aircraft, forcing it to fly through the rounds.

ENGAGING HIGH-PERFORMANCE AIRCRAFT

The decision to engage high-performance aircraft should be made if the aircraft is a direct threat to the crew or unit (actually making an attack run) or mission guidance includes active engagement of high-performance aircraft.

ENGAGING HELICOPTERS

Criteria for engaging high-performance aircraft also apply to helicopters; however, helicopters exposed on the ground, and slow-moving or hovering helicopters, are targets of opportunity that should be engaged if within effective machine gun range. Heavily armored attack helicopters (such as the HIND-D) should be engaged with the main gun (M1—sabot; M1A1 and M1A2—MPAT).

METHOD OF ENGAGEMENT

Engage aircraft using a continuous burst. The following are aiming points for aircraft engagements.

Type of Aircraft	Aiming Point
Jet aircraft, **flank** target	Two football fields to front
Jet aircraft, **frontal** target	Slightly above fuselage
Helicopter, **flank** target	One-half football field to front
Helicopter, **frontal** target	Slightly above fuselage

HELIBORNE INFANTRY AND PARATROOPERS

Infantry rappelling from a hovering helicopter should be destroyed by engaging the helicopter first, using volume fire. Airborne troops are more difficult to engage because of their rapid descent (approximately 10 feet per second). When using machine guns, lead the descending troops; the standard lead is two body lengths below their feet.

Note. The Geneva Convention of 1949 and our *Rules of War* prohibit engaging crewmen parachuting from a *disabled* aircraft.

Chapter 10

Employing the Abrams Tank

This chapter is designed to provide a source of information on a variety of topics concerned with employing the Abrams series of tanks. This is not designed as a complete guide to employing the tank, rather, it is a compilation of items found in other manuals, old versions of this manual, and items that may be of use to the armor crewman in the field. This chapter discusses the functional capabilities, sights, fighting position construction and proofing, weapons planning ranges and considerations, sketch cards, and smoke employment techniques.

CONTENTS

Functional Capabilities

Unlike previous editions of this manual, the purpose of the functional capabilities in this edition is to provide a broad overview of the capabilities of the various Abrams tanks. For more in-depth information about a specific Abrams tank, refer to the appropriate TM.

ABRAMS FLEET SPECIFIC

The Abrams tank is a full-tracked, low profile, land-combat weapon system. It possesses exceptional armor protection with highly lethal shoot-on-the-move firepower and excellent maneuverability and tactical agility.

The primary armament of the M1A1, M1A2, and M1A2 SEP is the 120-mm M256A1 smoothbore cannon. The primary armament of the M1 is the 105-mm M68 cannon. The main gun can be elevated between +20 and -10 degrees from zero.

The secondary armaments are two 7.62-mm M240 machine guns and one caliber .50 M2 HB machine gun. One of the M240s is coaxially mounted to the main gun on a factory-boresighted mount in the gunner's station. The other M240 is externally mounted at the loader's station. The M2 HB machine gun is externally mounted at the TC's weapon station. The TC's weapon station mount can facilitate one of the M240s in the event of damage to or malfunction of the M2. The elevation limits of the machine gun, by position are:

- The CWS is from +65 to -10 degrees (M1 and M1A1) and +65 to -35 degrees (M1A2).
- The coax is from +20 degrees to -10 degrees (same as the main gun).
- The loader's weapon is from +65 degrees to -35 degrees.

Using these point and area fire weapons, the crew can engage the full spectrum of enemy ground targets and selected air targets on the battlefield.

M1, M1A1, AND M1A1D

The M1 is the oldest of the Abrams fleet. It is the baseline model from which all of the other Abrams tanks were developed and is no longer fielded with the active Armor Force.

The M1A1 improvements include—

- The 120-mm smoothbore cannon that provides greater lethality than the M1.
- Increased armor protection.
- An NBC overpressurization system.

The M1A1D includes the Force XXI command and control hardware, which is the main upgrade from the M1A1.

M1A2 AND M1A2 SEP

The M1A2 tank system is designed to accommodate new and upgraded components required for the continually expanding performance requirements and to facilitate ease of maintenance. This is accomplished within the same space as the M1A1 tank. Improvements to the M1A2 include:

- The M1A2 TC can acquire targets more rapidly using the CITV. The CITV decreases target hand-off time by integrating the target designate function incorporated in the CCHA. This allows the TC to acquire targets independently from the gunner and then designate the gunner to those targets.
- Increasing the accepted range parameters for ballistic solution calculation to 200 to 5,000 meters has enhanced engagement ranges. Ballistic solutions for the coax are calculated between ranges of 25 and 2,000 meters.
- Integration of the intervehicular information system (IVIS), single-channel ground/airborne radio system (SINCGARS), and radio interface unit (RIU) have greatly enhanced tactical communications and reporting. It allows the commander to transmit and receive tactical messages digitally.
- The technological advancement of the position/navigation (POS/NAV) system allows crews to navigate from one location to another with a higher level of accuracy.
- The built-in fault management system allows crews and maintenance teams to identify and isolate malfunctions, in many cases with no external diagnostic test equipment. In a fraction of a second, tripped circuit breakers are automatically reset by the fault management software. This nonintrusive test leaves the crew unaware that this is even happening.
- With redundancy designed into the system, backups for combat critical functions are distributed throughout the crew stations.

The M1A2 SEP is further improved with the addition of—

- The Second Generation Forward-Looking Infrared (2d Gen FLIR) radar thermal sighting system, which gives the TC and gunner the ability to detect, identify, and engage targets more accurately at a greater range. The 2d Gen FLIR has 3X, 6X, 13X, 25X, and 50X magnification. The 25X and 50X are digital magnifications of the 13X picture.
- Improved navigational capabilities with the global positioning system (GPS) built into the tank, which provides a more accurate positional update than the initial navigation system of the M1A2.
- Force XXI command and control software built into the system in place of the IVIS on the M1A2. This software allows the M1A2 SEP crew to communicate digitally with a wider spectrum of Army vehicles.
- An under-armor auxiliary power unit (UAAPU), which provides hydraulic and electrical power with the main engine off. This allows the crew to maintain a higher state of readiness and eliminates additional fuel consumption from running the main engine and the noise of an external auxiliary power unit.
- A thermal management system (air cooling unit) that cools the inside of the tank to protect the electronics and provide crew comfort. The system will maintain a turret temperature of 88 degrees Fahreinheit.

Sighting Systems

GUNNER'S PRIMARY SIGHT (GPS)

The GPS (day/thermal channels) and gunner’s primary sight extension (GPSE) are the primary optics for the main gun and the coax machine gun.

GPS (DAY CHANNEL)

The GPS daylight optics provide a wide range of vision alternatives. The unity power vision block can be used for close-in surveillance. The unity window field of view is 6-degrees vertically and 18-degrees (30-degrees with head movement) horizontally. The GPS has a dual power capability: a wide-angle mode (3X magnification with a 16.5-degree field of view) for acquisition and a high magnification mode (10X magnification with a 6.5-degree field of view) for target identification and engagements. This reticle may also be used to assist in range determination. The following illustration shows the mil values of the GPS reticle for range (vertical line) and lead (horizontal line).

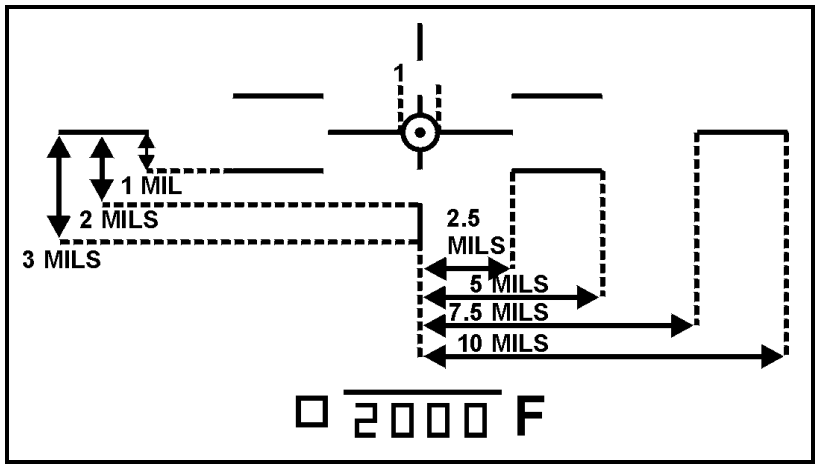


Figure 10-1. Gunner's Primary Sight (Daylight Reticle).

GPS (THERMAL CHANNEL)

The TIS is the primary channel used for main gun and coax engagements. The TIS operates on emitted thermal radiation rather than visible light. The field of view through the TIS is slightly less than the field of view through the daylight optical subsystems. The electronics unit provides reticle and display symbols similar to those of daylight optics. The gunner can select the polarity of the TIS image to help interpret thermal images. *Hot* areas in the field of view can be displayed as either *white hot* or *black hot*.

Crew members familiar with daylight ranging techniques for the Abrams may be confused by incorrect range readouts even though the target is clearly visible using the TIS. Incorrect readouts may occur because the spectrum of particle sizes that can obscure or block the TIS differs from that which affects LRF or daylight optics. The TIS may be able to see through screening smoke, dust, or camouflage; however, these same factors can degrade LRF accuracy. Therefore, the tank crew should train on visual range estimation using the TIS image alone and on manually indexing the range in the computer.

FORWARD-LOOKING INFRARED (FLIR) (THERMAL CHANNEL)

The 2d Gen FLIR (thermal channel) on the M1A2 SEP provides the crew the ability to detect, recognize, and identify targets at greater ranges. The 2d Gen FLIR has 3X, 6X, 13X, 25X, and 50X magnification. The 25X and 50X are digital enhancements of the 13X picture. The 2d Gen FLIR allows the crew to use both the GPS daylight and thermal channels simultaneously, although they may choose to have the thermal scene projected into the GPS sight to engage targets. This is totally crew choice, and crews that train to engage targets using the biocular sight should be able to do so. Crews should be able to detect both hot and cold targets by using the thermal biocular sight and the GPS daylight channel simultaneously during daylight operations.

GPS EXTENSION

The GPSE provides the TC the same sight picture and symbology display the gunner receives. However, on an M1A2 SEP, if the gunner is using the GPS daylight channel and the biocular thermal sight simultaneously, the TC will only be able to see the GPS daylight in his extension.

GUNNER'S AUXILIARY SIGHT

The GAS is an articulated telescope, coaxially mounted to the main gun. The M1 includes illuminated ballistic reticles for HEAT and sabot ammunition. The M1A1, M1A2, and M1A2 SEP include illuminated ballistic reticles for KE/STAFF and MPAT/HEAT ammunition. The GAS offers 8X magnification with an 8-degree field of view. It is filtered to protect the gunner's vision from laser reflections.

The GAS was designed for minimal exposure to battle damage. It is mounted partially through a small opening in the gun mantle and is protected by the frontal armor. This enhances its survivability when the turret sustains a nonperforating hit. It may be used for a quick check of the primary sight solution. (For further discussion on this procedure, refer to Chapter 2, *Boresighting*.)

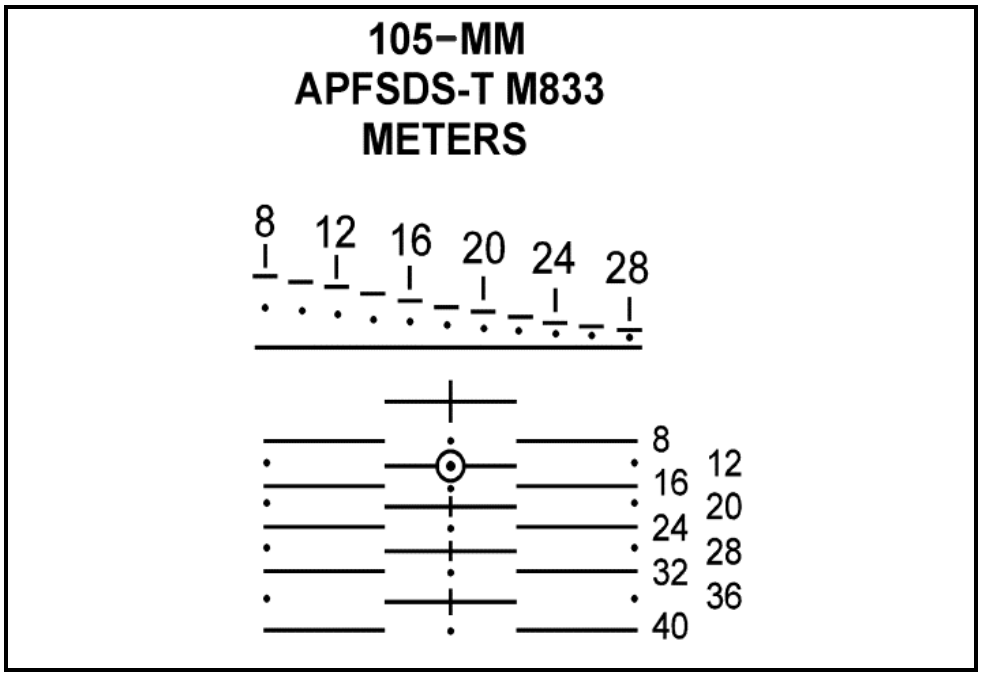


Figure 10-2A. M1 Gunner's Auxiliary Sight Reticle (Sabot) as Viewed from the Gunner's Station.

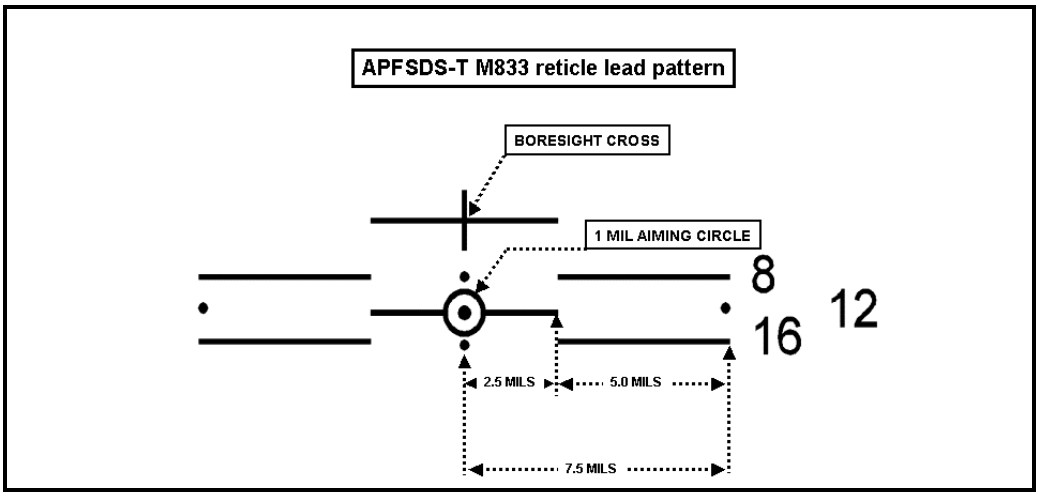


Figure 10-2B. M1 Gunner's Auxiliary Sight Reticles (Sabot) Reticle Lead Pattern.

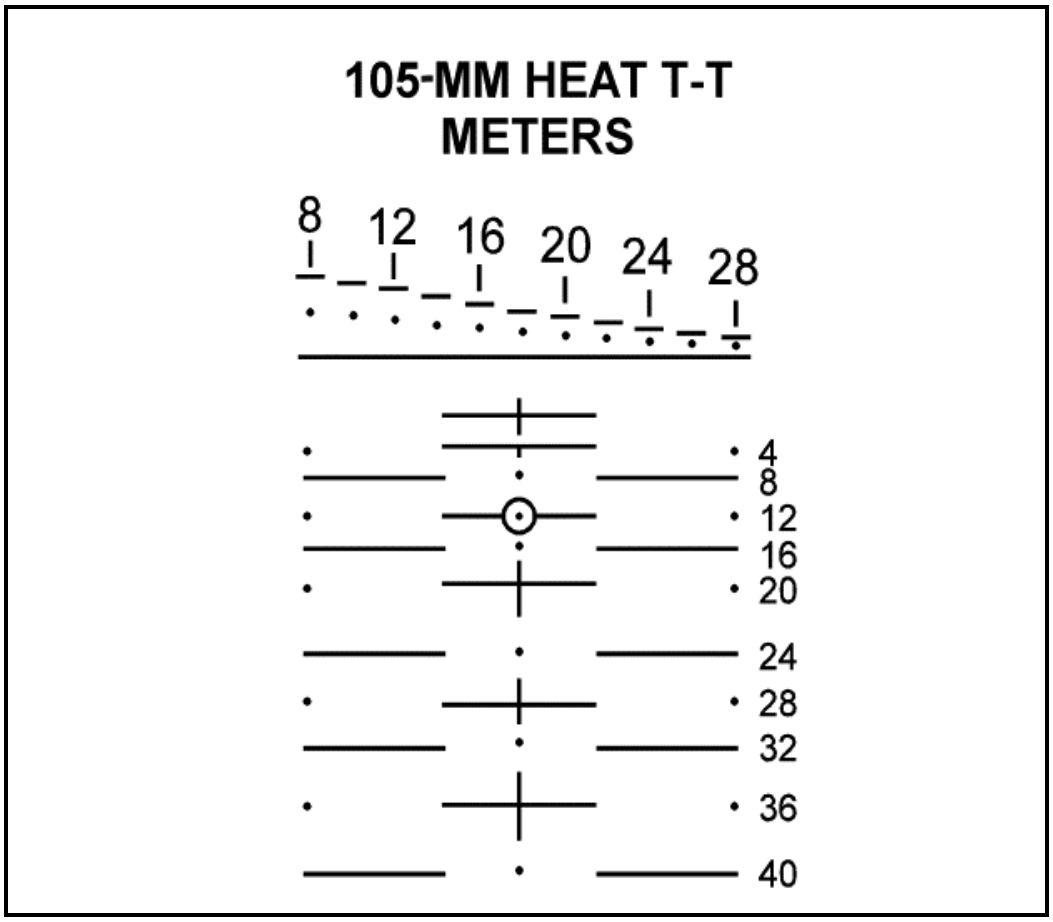


Figure 10-3A. M1 Gunner's Auxiliary Sight Reticles (HEAT) as Viewed from the Gunner's Station.

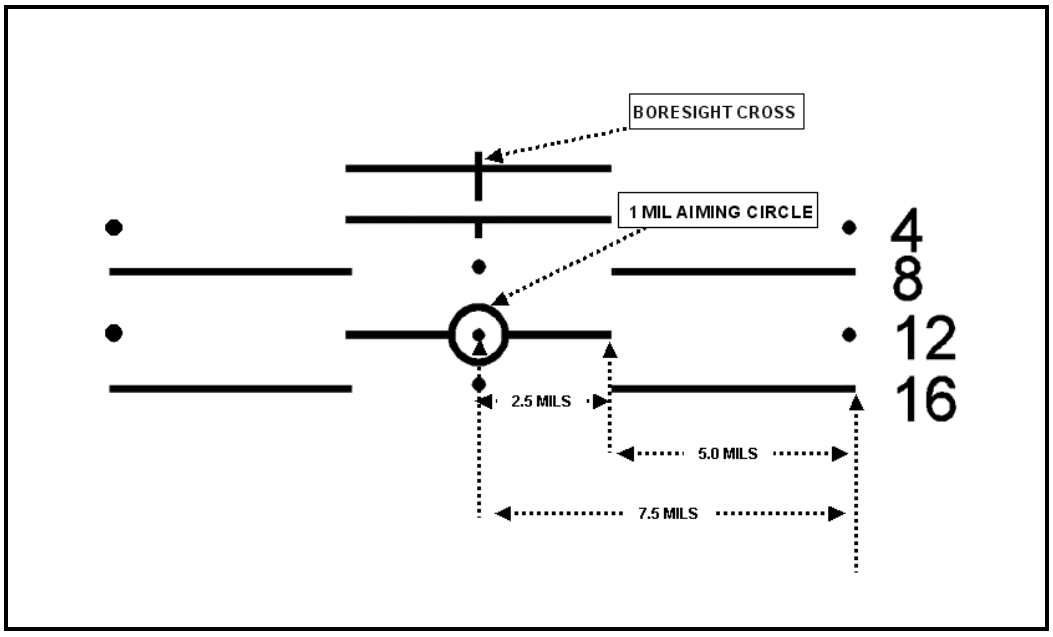


Figure 10-3B. M1 Gunner's Auxiliary Sight Reticles (HEAT) Lead Pattern.

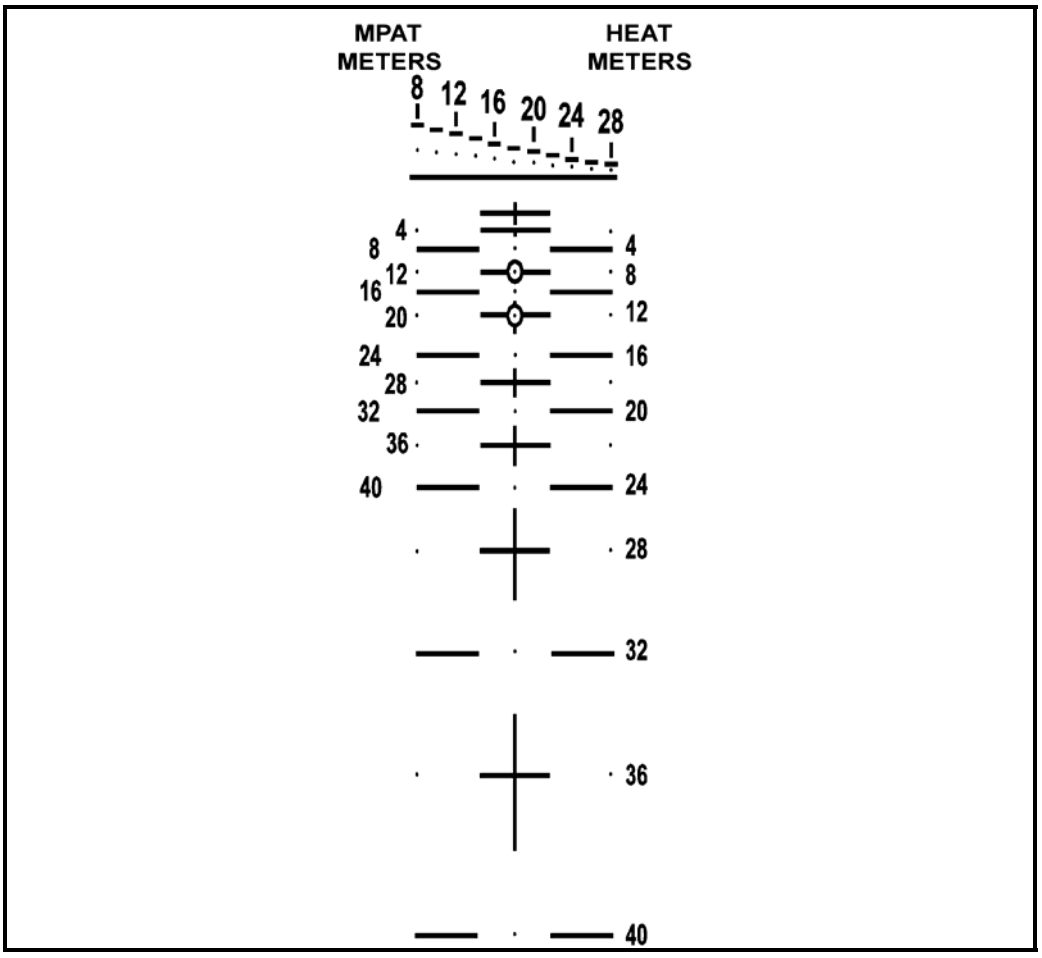


Figure 10-4A. M1A1 Gunner's Auxiliary Sight Reticles (MPAT/HEAT).

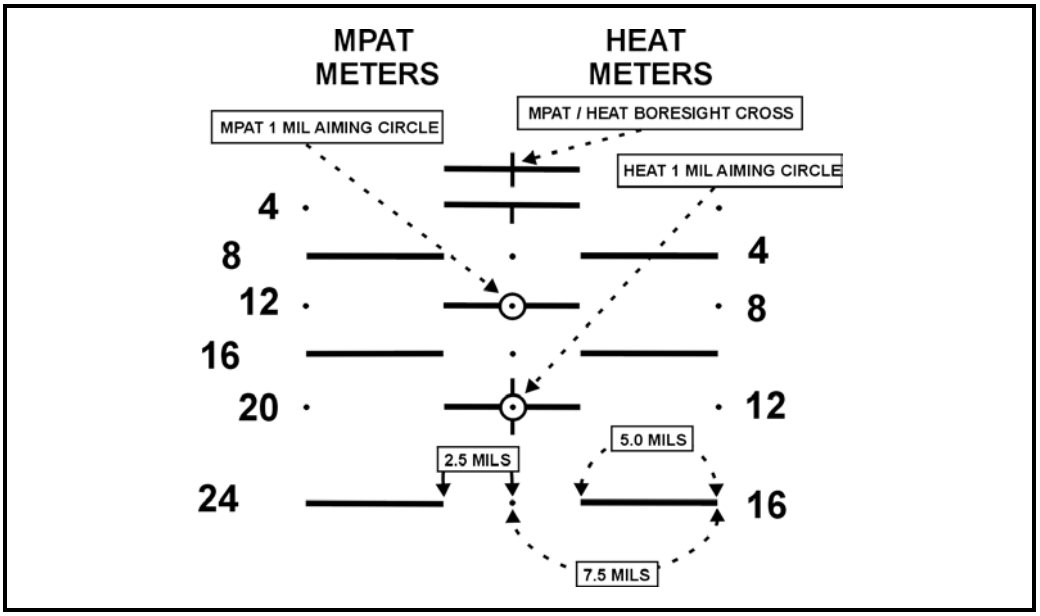


Figure 10-4B. M1A1 Gunner's Auxiliary Sight Reticles (MPAT/HEAT) Lead Pattern.

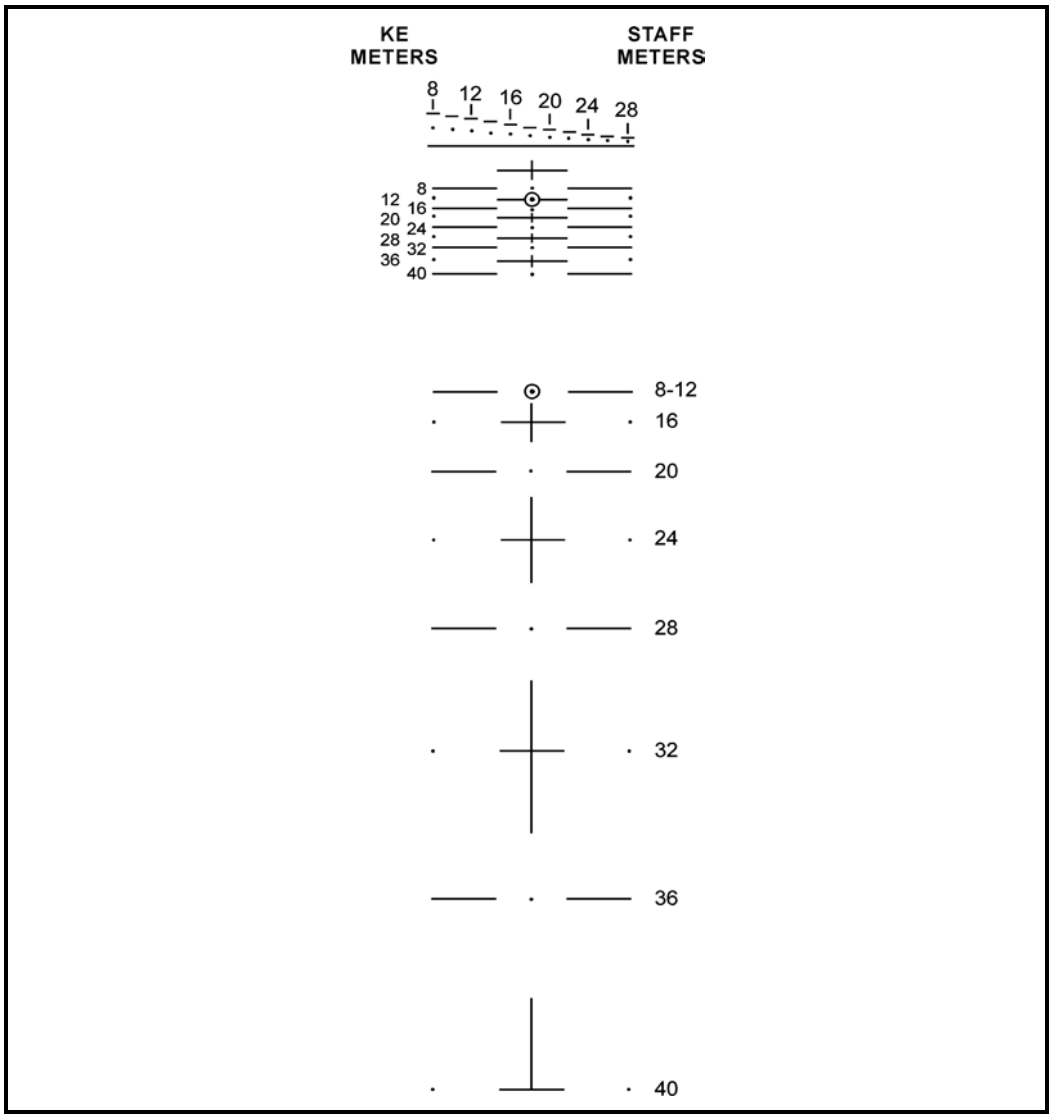


Figure 10-5A. M1A1, M1A2, and M1A2 SEP Gunner's Auxiliary Sight Reticles (KE/STAFF).

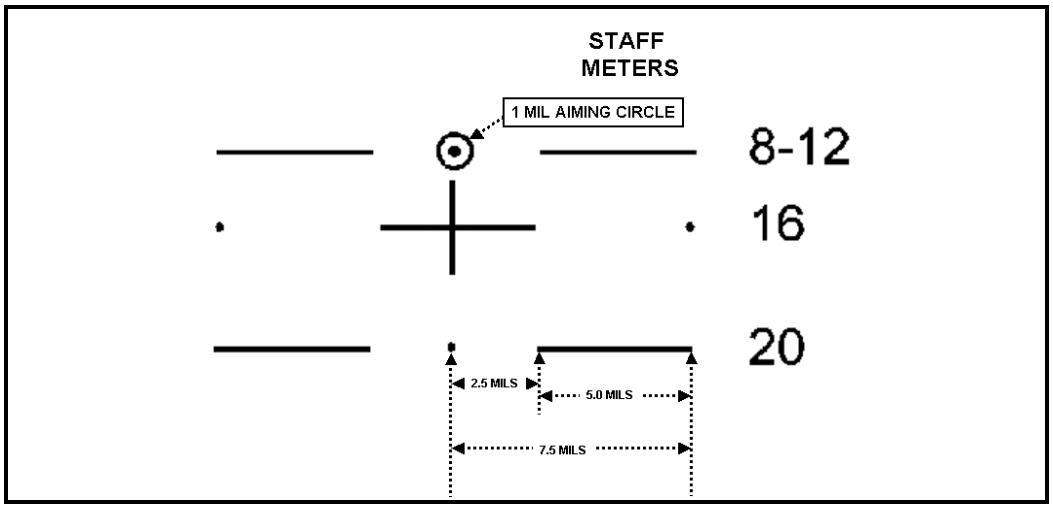


Figure 10-5B. M1A1, M1A2, and M1A2 SEP Gunner's Auxiliary Sight Reticles (KE/STAFF).

COMMANDER'S WEAPON STATION

The CWS includes a 3X, fixed-focus periscope. This periscope contains a ballistic reticle graduated for caliber .50 ammunition out to a range of 1,800 meters. The sight can be oriented independently of the turret by power or manual rotation of the CWS and by elevating or depressing the TC's machine gun. If the M240 machine gun is mounted in the CWS, there is an aiming data chart for the TC on the side of the periscope.

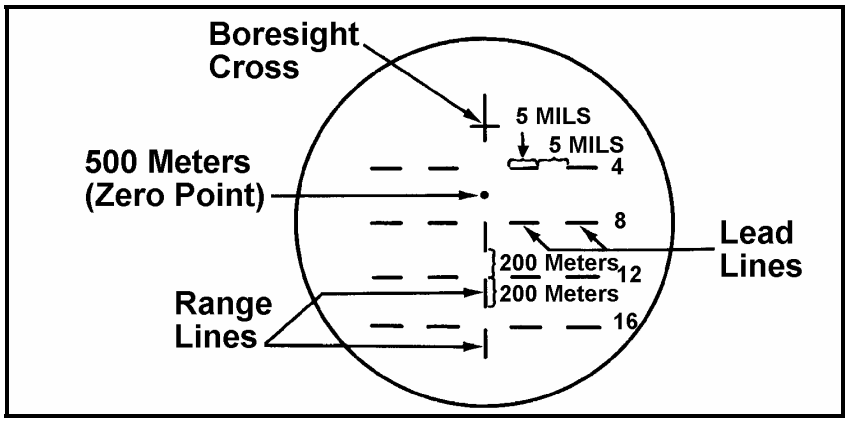


Figure 10-6. Commander's Weapon Station Sight Reticle.

Fighting Position Construction and Proofing

A fighting position is a place from which a tank crew can engage enemy targets using all of the tank's weapon systems and sights. The position must provide fields of fire for the crew, frontal and flank protection, and access to maneuver without exposing the tank to the enemy. (**Note.** The following information on tank fighting positions is designed for combat. Fighting positions constructed on multi-use ranges are designed to facilitate the firing of many different vehicle platforms and cannot be designed in the same manner as tank combat positions.)

TYPES OF FIGHTING POSITIONS

There are three types of fighting positions: hasty, two-tiered, and three-tiered. A hasty fighting position, known as a "scrape," provides minimal protection for the tank and crew (see Figure 10-7). It is the least desirable fighting position. Kinetic-energy rounds can penetrate the forward spoil and possibly the tank. The two-tiered fighting position, preferred over the hasty, is used most commonly (see Figure 10-8). It provides increased protection to the crew allowing them to identify and prepare to engage targets before pulling forward. The three-tiered fighting position is the most desirable to build, but also the most time-consuming (see Figure 10-9). This position allows the TC to observe the battlefield while remaining completely hidden from enemy ground observation. (**Note.** In the lowest level of the three-tier position, the TC should be able to view the engagement area from the turret with binoculars. If he cannot view the area, he may place an LP/OP. For more detailed information on vehicle fighting positions, refer to FM 5-34.)

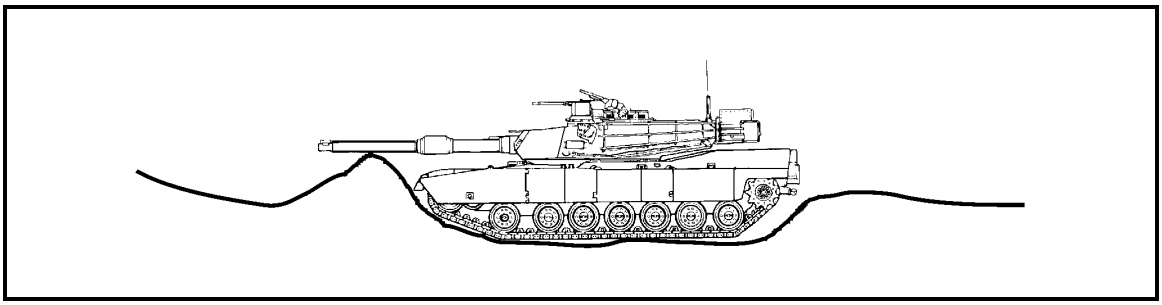


Figure 10-7. Hasty Fighting Position (Hull Down).

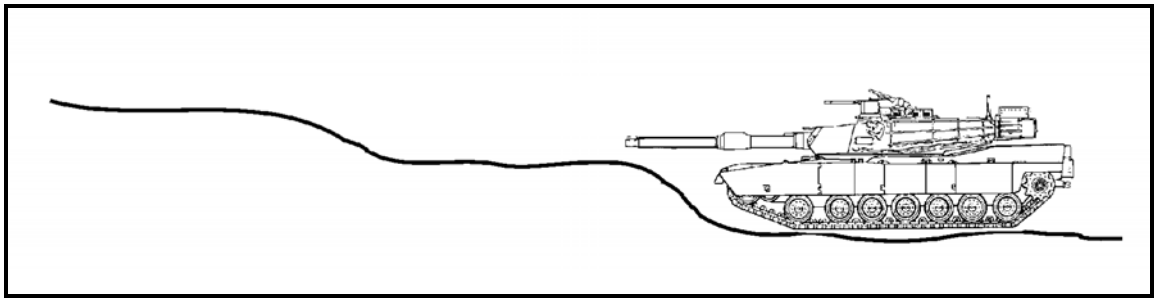


Figure 10-8. Two-Tiered Fighting Position (Turret Down).

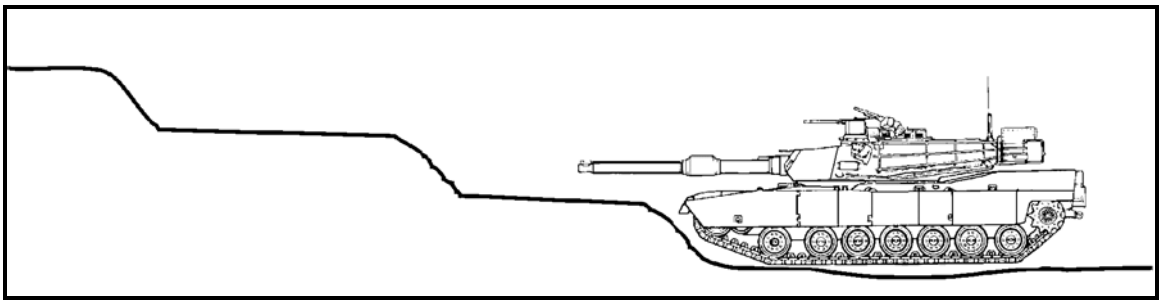


Figure 10-9. Three-Tiered Fighting Position (Hide).

FIGHTING POSITION CONSTRUCTION

Fighting position construction is one of the most critical aspects of the defense, but is often not accomplished to standard. To be successful, a prepared defensive position should meet the following criteria:

- Vehicle will not be skylined while firing.
- Completely hidden from enemy view, to include all of the spoil.
- Allows full 360-degree turret movement in the hull-down position (terrain dependent).
- Allows full 360-degree ability to engage using the GAS (terrain dependent).
- Provides routes of escape to the rear of the position.
- Allows crew to scan using GPS and CITV in the turret-down position.
- Provides covered and concealed routes to alternate and subsequent fighting positions.

Although not all-inclusive, the above is a guide for things to consider when developing a fighting position. When the TC is first assigned an area, he should lie on his stomach on the ground and sight through his binoculars to make sure that, once the hole is dug, the gunner will be able to use the GAS to cover his assigned sector. The TC should then supervise the engineer's movement to the spot and subsequent digging.

FIGHTING POSITION PROOFING

Once the hole is nearly complete, the TC should pull his tank into the position, check his fields of fire, and direct modifications until the position is complete. Once the vehicle is in the position, the gunner should begin to make a sketch card of the assigned sector. The loader should tie down all antennas, cover all reflective material, and gather material to break up the outline of the top of the tank to avoid detection by enemy aircraft. Once the gunner and loader are complete, the TC and driver should rehearse pulling into the position.

Weapons Planning Ranges and Considerations

The weapons planning range for a tank is the range at which the unit commander intends to begin engaging enemy targets. Although the commander determines the weapons planning range, it is important that the TC understand the capabilities of the rounds on his vehicle. When developing the platoon fire plan, the TC must use the various types of ammunition appropriately to destroy targets without overkill. In the offense, where platoon fire commands may not be practical, the TC must be able to decide which type of round to fire without hesitation.

With limited rounds on board, the TC must weigh the alternatives and try to make every round count. The weapons planning range for a tank cannot be separated from the number of rounds the TC is prepared to expend. While it is possible to hit an enemy tank at 3,000 meters, the probability of doing so on the first round is low. Further, given a hit, the P_K will be very low against turret frontal armor.

To counter these factors, engage from closer ranges, especially if engaging frontally. Several factors combine to make frontal engagements of enemy tanks beyond 2,500 meters only marginally effective. Enemy armor is difficult to penetrate from the front. The sides, top, and rear have relatively thin armor; therefore, flank and rear engagements give greater P_K at extended ranges.

Obviously, there is a balance. Although engaging at a close range frontally will increase P_H and P_K, it will also reduce the number of targets that can be destroyed before that attacker is too close. Further, the attacker may close with more systems and combat power. If mission considerations take priority (as in a delay mission), the engagement ranges may be extended at the cost of the number of kills possible before resupply is required.

Several additional planning factors must be considered when engaging targets at longer ranges. By engaging at longer ranges, the TC compromises his position and loses the element of surprise. While long-range engagements have a lower P_H and P_K, they can disrupt enemy command and control (by causing tanks to button up) and achieve mobility kills. Long-range engagements require sensing tanks using observed fire techniques and should be attempted from an elevated firing position. Only the best firing crews and most accurate tanks should be chosen as the long-range gunnery crews.

Note. Chapter 13, *Gunnery Training Program*, addresses the training issues of preparing crews for long-range engagements.

If the tactical situation permits, the optimum planning range against tanks in the frontal 60-degree arc is 1,500 meters. This can be extended with recognition of degraded P_H, degraded P_K against turret frontal armor, and reduced kills per on-tank load of ammunition. The weapons planning range can also be reduced based on terrain, weather, and obscuration. Engagement of IFVs can begin at longer ranges based on P_K; however, due to their smaller size, P_H of IFVs will normally be lower than that of tanks.

Tank Sketch Cards

CREATING A SKETCH CARD (M1 AND M1A1)

The crew will make a tank sketch card showing their sector for their deliberate or hasty defensive fighting position. A sketch card is a rough topographical sketch of the tank's assigned sector. The sketch card will aid the crew in target acquisition, and enable the platoon leader to develop his platoon fire plan.

The platoon leader will designate the primary, alternate, and supplementary positions for his tanks. After the positions have been designated and reconnoitered (time permitting), the platoon leader will designate the sector limits of fire for the tank and the TRPs within the sector. The platoon leader must give the TC the number designators for the TRPs.

As the positions are prepared, the TC and gunner will prepare the sketch cards for each position. When the cards are completed, one copy will be sent to the platoon leader and the other copy will be kept with the tank (normally within 20 minutes).

When the tank is moved into position, and before engineer assets are released from the position, the crew will make sure the target areas and obstacles within the sector can be fired upon, and determine if assigned TRPs can be engaged. A TRP that could be engaged before the position was prepared may be masked when the tank is dug in. The platoon leader must be informed of any inability to engage assigned TRPs and may direct a change in position. (See FM 17-15, Chapter 2, *Command and Control*.)

If time permits, the TC will make physical contact with his wing or flanking elements to determine overlapping fire within the sectors and the position of friendly OPs.

As a minimum, the sketch card will depict the following:

- *All key terrain* features.
- *TRPs*. TRPs should be marked with a cross and their assigned number in the upper right quadrant of the cross. Mark all TRPs that are visible, whether they are in your sector or not.
- *High speed avenues of approach*.
- *Symbol indicating North.*
- *Preplanned fires (direct and indirect).* These may be added after the platoon leader receives this information from the fire support team (FIST) officer and constructs a platoon fire plan. These should be marked with a cross, with the letter designation in the top left block and numeric designation in the top right.
- *Range bands*. These will help when the LRF fails. The number of bands will be determined by the terrain or mission. (If terrain permits, range bands of 1,200, 1,800, and 2,400 meters will be used.) A minimum of three range bands should be used.
- *Right and left limits of assigned sector*. These limits are marked by double lines beginning at the tank's position and extending through the terrain feature that designates the boundary limit.
- *A reference point* near the center of the sector and, ideally, at or beyond your maximum engagement range. The reference point should be a prominent, immovable, and readily identifiable feature; it should not be a target and should not be easily destroyed. The reference point should be depicted using a military map symbol, sketch of feature, or brief word description, and marked with the letters *Ref Pt* inside a circle.
- *Obstacles and dead space*. Obstacles should be marked on the sketch card using approved military symbols. Dead space should be marked using diagonal lines with the words "DEAD SPACE."
- *The position of elements left and right, and friendly OPs/LPs*. These positions should be marked with standard symbols. (This information will be omitted if the tactical situation does not allow enough time to make contact with wing and flank elements, or otherwise determine their exact location).
- *Identification data*, which consists of the *vehicle bumper number* placed directly below the tank symbol, and the *firing position* (primary, alternate, or supplementary) marked with a capital P, A, or S, placed below the vehicle bumper number.
- *Marginal information* placed in the bottom left third of the sketch card, to indicate the following:
  - List of TRPs.
  - Range to TRPs.
  - Reference points.
  - Description of TRPs.
  - Description of obstacles and other likely target areas visible to your position.
  - Range to obstacles and other likely targets.
- *Legend*, placed in the bottom right third of the sketch card, to indicate the following:
  - Explanation of symbols used on the card.
  - Other control measures and pertinent information, as required.

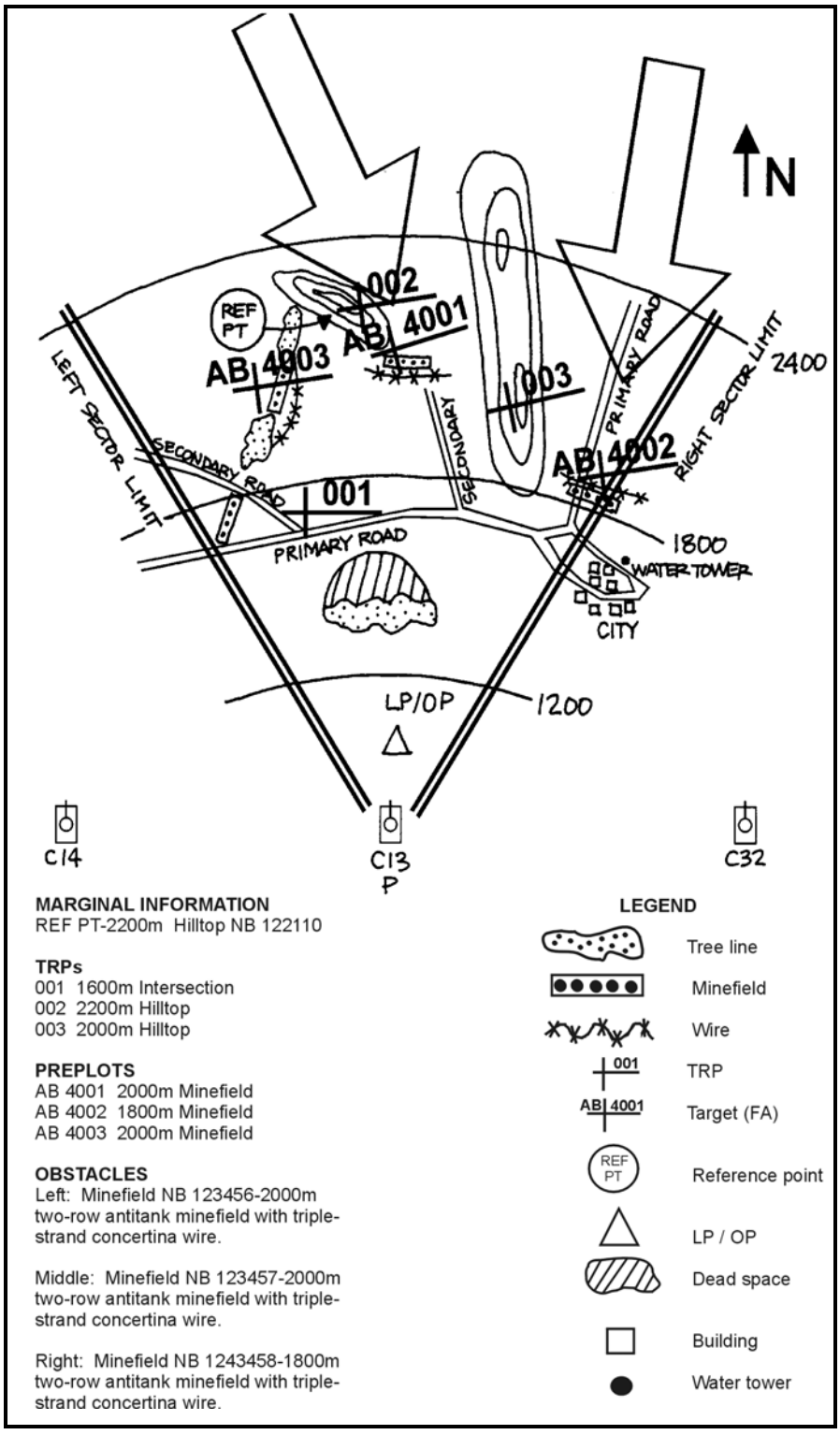


Figure 10-10. Tank Sketch Card for M1/M1A1.

CREATING A SKETCH CARD USING IVIS (M1A2)

In the defense, IVIS can be used for basic sector sketch functions. The tank crew can create a sketch card using the ENEMY OVERLAY selection in the MISSION PLANNING menu.

Before creating the sketch card, the TC directs the vehicle into the designated firing position.

With the platoon leader's guidance, the TC and gunner will make a detailed search and analysis of the tank sector with the GPS and CITV. Based on this search, they will establish intertank sectors of observation. As the crew determines limit markers, reference points, range bands, and other unique features within their sector, the gunner lases to each point. As the gunner lases to each point, the TC does one of the following:

- Records the grid location of the enemy icon, the range, and what that location is to be labeled. (Later, he will use this information to create the sketch card in the MISSION PLANNING menu.)
- Marks each point on the tactical screen with a yellow grease pencil. Later, he can go to the MISSION PLANNING menu, select the ENEMY overlay, and simply retrace the sketch card with the thumb controller and the GRAPHICS menu.

After the TC has searched his sector and either recorded or marked his range card data on the tactical screen, he can begin to prepare his tank sketch card using IVIS. First, he selects the MISSION PLANNING menu, the ENEMY overlay, and the FREE DRAW function. Then, using the first entry of the LABEL function, he marks the left and right sector limits (LL and RL). These limits should extend out past the tank's visibility limits. This will allow the TC or platoon leader to monitor movement in his sector through updated reports (enemy icon) on enemy locations.

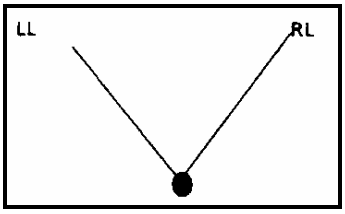


Figure 10-11. Line Limit Graphic.

Using the FREE DRAW function, the TC marks the remaining sketch card graphics:

- Trigger line. Use the first entry of the LABEL function to mark the TL.

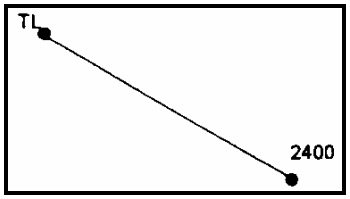


Figure 10-12. Trigger Line Graphic.

- Dead space. Outline the dead space areas. Place an *X* inside the dead space, and use the first entry of the LABEL function to label the *X* DS.

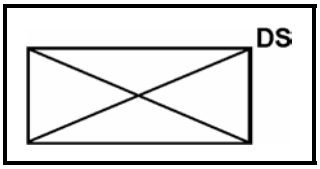


Figure 10-13. Dead Space Graphic.

- Target references. Use the TARGET REFERENCE POINT function and its numeric points to mark TRPs in your sector (platoon targets and prominent features). Use the CONTACT POINT function to mark platoon targets and other prominent features in the sector. Use the first entry of the LABEL function and mark the CONTACT POINT with an abbreviation (for example, intersection [INT], building [BLDG], infantry [INF], hill [HILL]). Use the second entry of the LABEL function to mark the range. These contact points may be used to mass fires and index range to targets during degraded operations.

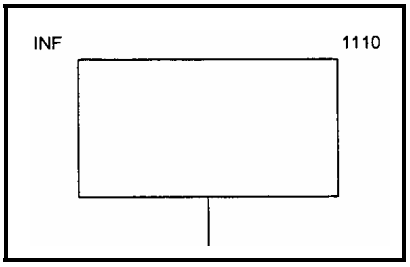


Figure 10-14. Targets Graphic.

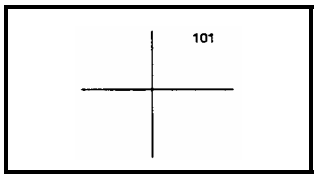


Figure 10-15. Target Reference Points Graphic.

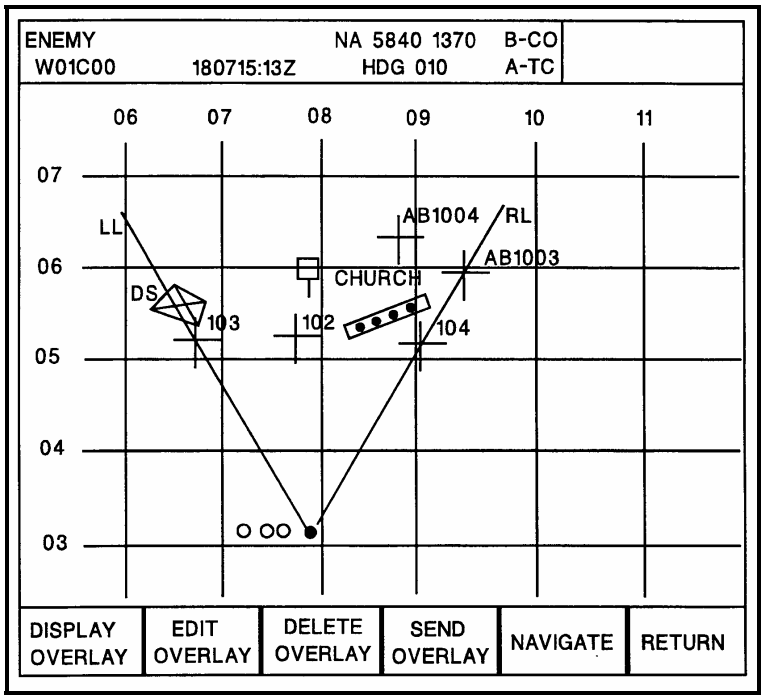


Figure 10-16. Completed Sketch Card Graphic for M1A2.

IVIS helps orient the weapon systems to the direction of an enemy (icon), as received in an incoming report. When the TC displays an incoming report, he sees how the enemy (icons) is moving toward his sector. This early warning may help the TC determine which avenue of approach the enemy will take. This is especially beneficial during hours of darkness or reduced visibility.

On command, each tank sends the ENEMY overlay to the platoon leader. As the platoon leader receives the ENEMY overlays, he uses the POST function to combine the "sketch cards." When the sketch cards are combined and displayed, the platoon leader can see whether the platoon's sector is covered and the dead space within the sector. The platoon leader then unclutters the combined ENEMY overlay to display only limit markers and dead space. Then, he sends the dead space uncluttered ENEMY overlay to the company commander. (The commander consolidates all platoon sketch cards to make sure the company's sector is covered.) This procedure helps when establishing a hasty defense or occupying defensive positions at night. This also allows each tank crew to create a sketch card for each battle position. When the need arises to displace to the different battle positions, the tactical display automatically scrolls as the tank moves. As the tank reaches and occupies its alternate battle position, that sketch card is displayed.

IVIS message protocol determines who can send, receive, and update various reports and overlays. (TM 9-2350-288-10-2, Appendix J, explains IVIS protocol, based on assigned duty positions.) To update some overlays, the crew may need to change the vehicle USER ID. Internal SOPs and command guidance determine when this may be done.

During the battle, tanks fight from their sketch cards. Using the DISPLAY overlay function, the TC switches between the unit OPERATIONS overlay and the sketch card. Depending on the size of the OPERATIONS overlay, the TC may leave the sketch card data superimposed over the OPERATIONS overlay.

CREATING A SKETCH CARD USING FBCB2 (M1A1D AND M1A2 SEP)

While FBCB2 currently does not have the capability to produce a tank sketch card, crews can use the overlay tool to produce a rough, nondoctrinal sketch card. Upon receipt of these tank sketch cards, the platoon leader must redraw them onto the platoon fire plan before forwarding it to the commander. Future software upgrades of the FBCB2 will include this function.

On-Board Smoke Employment Techniques

The Abrams tank is equipped with an M250 or M257 smoke grenade launcher system and a vehicle engine exhaust smoke system (VEESS). These smoke systems help cover movement, reduce the enemy's ability to acquire and engage the tank, and reduce enemy hit probability. The M250 or M257 smoke grenade launcher system and the VEESS can be employed effectively only when the proper preventive maintenance checks and services (as outlined in the operator's manual) are followed.

Techniques for using vehicular smoke systems on the battlefield, and employment considerations are discussed in this chapter. These systems can be used with other smoke sources (artillery, mortars, smokepots, and 105-mm smoke rounds; see FM 3-50).

CAUTION

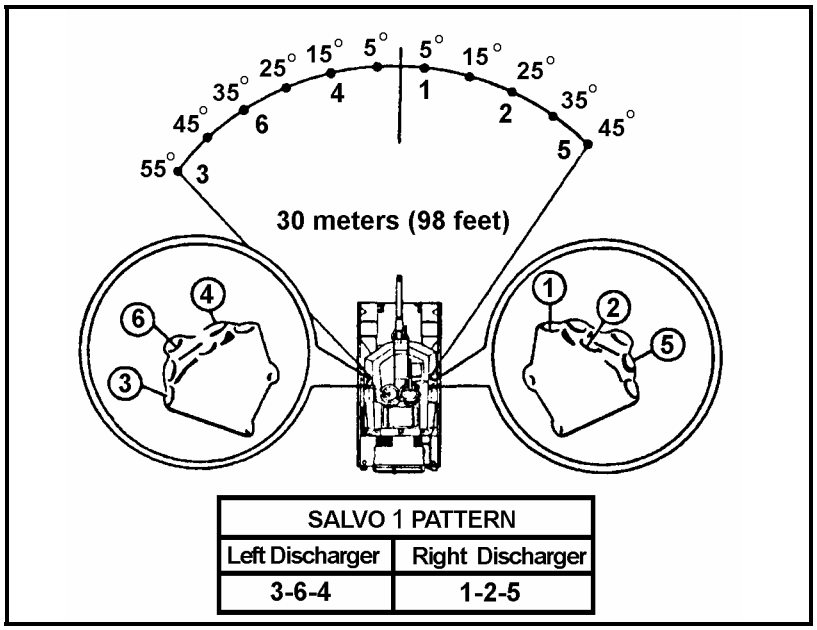
Do *not* use the VEESS when using MOGAS or JP4 fuel on an Abrams tank. Using the VEESS when using MOGAS or JP4 fuel could cause a fire.

Note. If JP8 is used for fuel, the smoke generator will not produce smoke.

To use the smoke grenade launcher system effectively, tank crews must know the grenade dispersal patterns: Salvo 1, Salvo 2, and Salvo.

M250 SMOKE GRENADE LAUNCHER SYSTEM

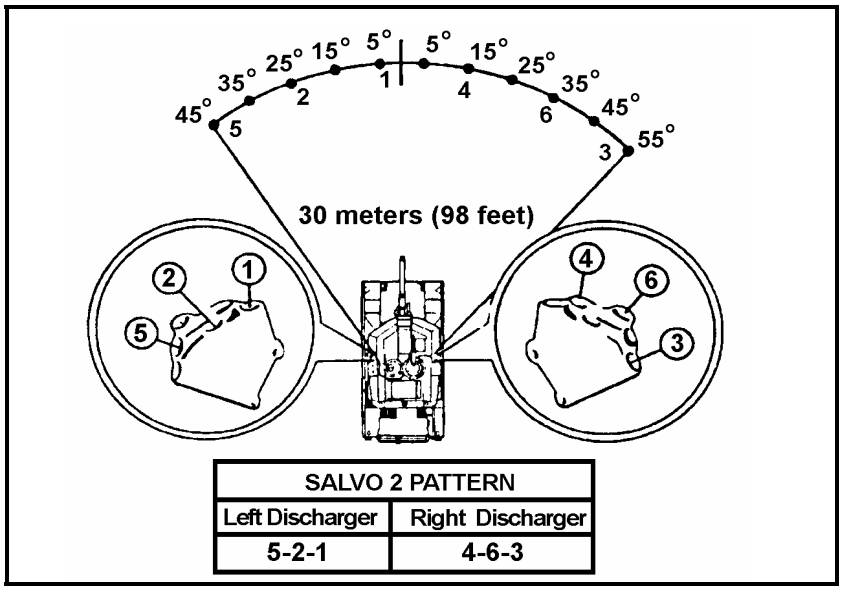
The Salvo 1 pattern should be used when engaged from the left by enemy fire. The TC moves and holds the GRENADES READY/SAFE switch to READY (M1 and M1A1), or presses the READY push button (M1A2) and the SALVO 1 (left) push button; three grenades are launched from each discharger. This provides a smoke screen from 55 degrees left to 45 degrees right of the gun tube, more to the left of the turret, approximately 30 meters from the tank (see Figure 10-17).



SALVO 1 PATTERN	
Left Discharger	Right Discharger
3-6-4	1-2-5

Figure 10-17. Salvo 1 Pattern for the M250 Smoke Grenade Launcher System.

The Salvo 2 pattern should be used when engaged from the right by enemy fire. The TC moves and holds the GRENADES READY/SAFE switch to READY (M1 and M1A1), or presses the READY push button (M1A2) and the SALVO 2 (right) push button; three grenades are launched from each discharger. This provides a smoke screen from 45 degrees left to 55 degrees right of the gun tube; more to the right of the turret, approximately 30 meters from the tank (see Figure 10-18).



SALVO 2 PATTERN	
Left Discharger	Right Discharger
5-2-1	4-6-3

Figure 10-18. Salvo 2 Pattern for the M250 Smoke Grenade Launcher System.

Normally, six grenades are adequate (the smoke will disperse more quickly if only six grenades are launched). During heavy rain, high wind, or very low humidity, the TC may press both push buttons (SALVO 1 and SALVO 2) to launch all 12 grenades. This provides a smoke screen from 55 degrees left to 55 degrees right of the gun tube, approximately 30 meters from the tank (see Figure 10-19).

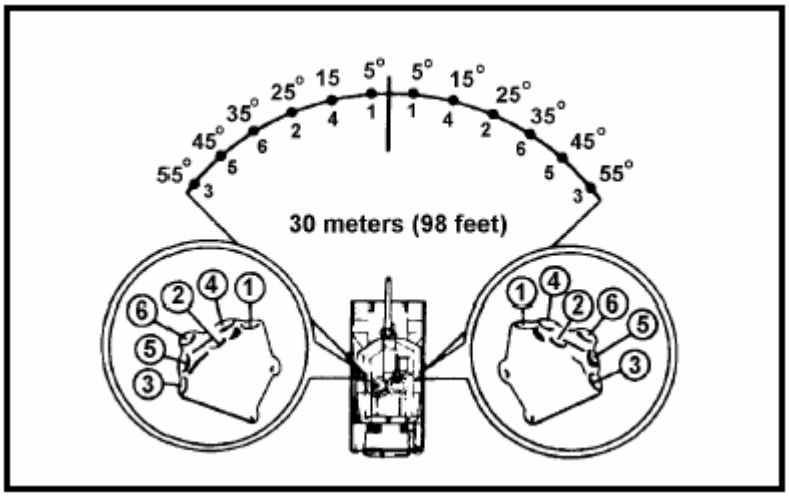


Figure 10-19. Salvo Pattern for the M250 Smoke Grenade Launcher System.

M257 SMOKE GRENADE LAUNCHER SYSTEM

The Salvo 1 pattern should be used when engaged from the left by enemy fire. The TC moves and holds the GRENADES READY/SAFE switch to READY (M1 and M1A1), or presses the READY push button (M1A2) and the SALVO 1 (left) push button; four grenades are launched from each discharger. This provides a smoke screen from 52 degrees left to 52 degrees right of the gun tube, approximately 30 meters from the tank (see Figure 10-20).

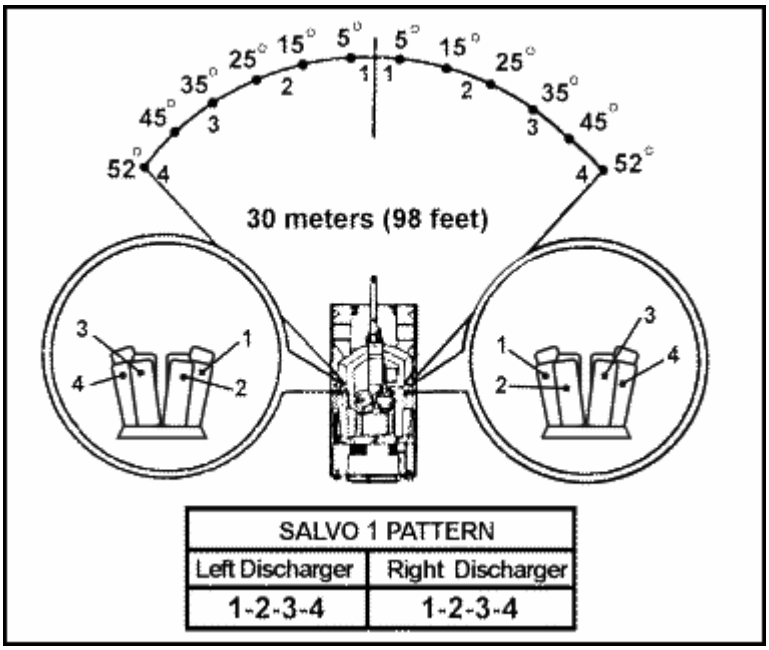


Figure 10-20. Salvo 1 Pattern for the M257 Smoke Grenade Launcher System.

The Salvo 2 pattern should be used when engaged from the right by enemy fire. The TC moves and holds the GRENADES READY/SAFE switch to READY (M1 and M1A1), or presses the READY push button (M1A2) and the SALVO 2 (right) push button; four grenades are launched from each discharger. This provides a smoke screen from 52 degrees left to 52 degrees right of the gun tube, approximately 30 meters from the tank (see Figure 10-21).

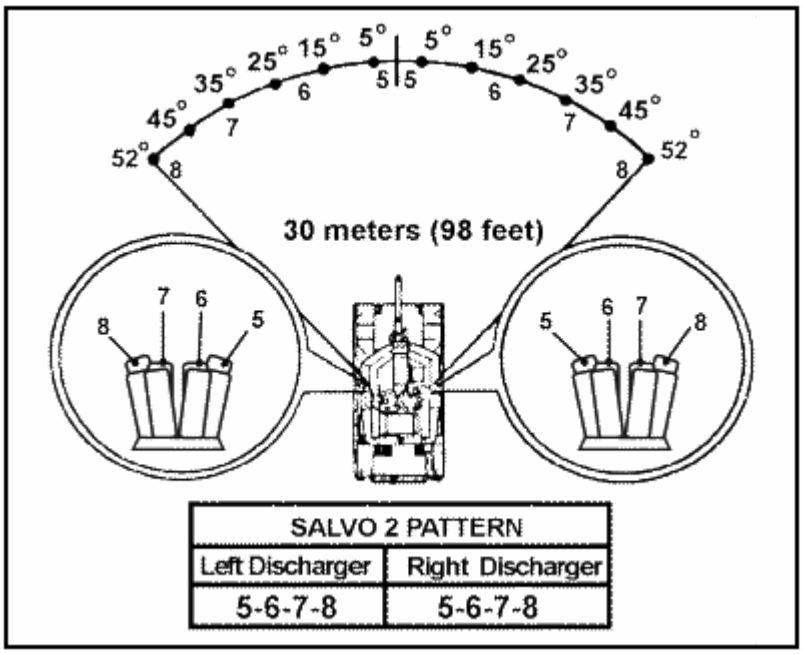


Figure 10-21. Salvo 2 Pattern for the M257 Smoke Grenade Launcher System.

Normally, eight grenades are adequate (the smoke will disperse more quickly if only eight grenades are launched). During heavy rain, high wind, or very low humidity, the TC may press both push buttons (SALVO 1 and SALVO 2) to launch all 16 grenades. This provides a smoke screen from 52 degrees left to 52 degrees right of the gun tube, approximately 30 meters from the tank (see Figure 10-22).

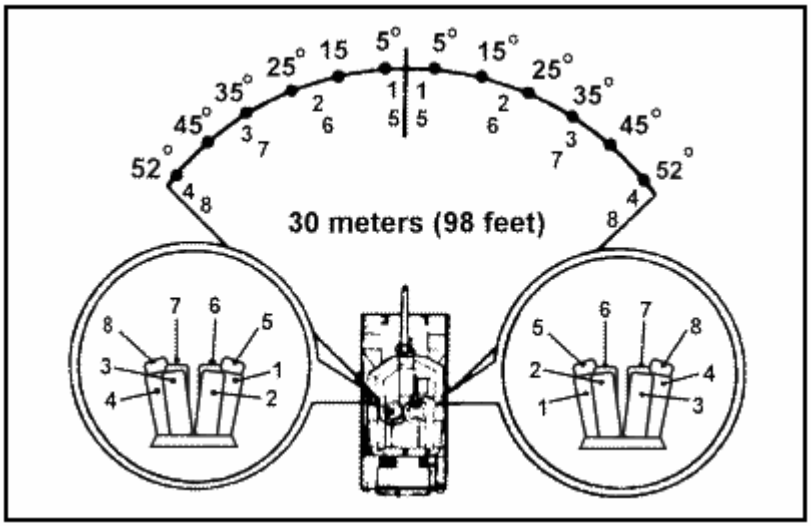


Figure 10-22. Salvo Pattern for the M257 Smoke Grenade Launcher System.

FIRE COMMAND FOR M250 OR M257 SMOKE GRENADE LAUNCHER

CAUTION

The hatches should be closed when firing the smoke grenade launchers.

The following procedure coordinates crew actions when firing the M250 or M257 smoke grenade launcher:

- To alert the crew, the TC announces "GRENADE LAUNCHER" while traversing the turret toward the area where the smoke screen is desired.
- Upon hearing "GRENADE LAUNCHER," the loader drops inside the tank and closes his hatch.
- The TC moves and holds the GRENADES READY/SAFE switch to READY (M1 and M1A1), or presses the READY push button (M1A2 and M1A2 SEP), then fires the grenades. He then issues driving commands appropriate to the tactical situation.
- When the situation permits, the TC and loader should check the grenade dischargers to make sure all grenades have been launched; then reload. For misfires, follow the procedures in TM 9-2350-255-10-1, TM 9-2350-264-10-1, TM 9-2350-288-10-1, or TM 9-2350-388-10.

This procedure stresses safety. In combat situations, it would be conducted much more rapidly; the crew might not take the time to button up.

VEHICLE ENGINE EXHAUST SMOKE SYSTEM

CAUTION

Do *not* use the VEESS when using MOGAS or JP4 fuel on an Abrams tank. Using the VEESS when using MOGAS or JP4 fuel could cause a fire.

Note. If JP8 is used for fuel, the smoke generator will not produce smoke.

The VEESS is another means of providing on-board smoke for Abrams tanks. To generate smoke, the engine sprays fuel into the exhaust duct where it vaporizes. As the vaporized fuel is expelled through the exhaust into the air, it condenses and forms a smoke cloud.

The driver, at the TC's command, controls the VEESS with the SMOKE GENERATOR switch on his master panel (M1 and M1A1), or the SMOKE GEN OFF/ON push button (M1A2 and M1A2 SEP). The TC makes the decision to use the VEESS based on the tactical situation. The vehicle may be silhouetted against the smoke if the VEESS is used incorrectly (for example, in a woodline, against similarly dark backgrounds, or moving across open terrain).

The VEESS is limited in its use by the type of fuel on board the tank. The tank crew must always know what fuel is carried before making the decision to generate smoke.

Note. Always abide by warnings in the vehicle operator's manual when using the smoke generator system.

CONDITIONS THAT AFFECT ON-BOARD SMOKE EMPLOYMENT

Tank crews must understand the conditions that affect smoke employment, and use them to their advantage on the battlefield. The tactical situation (enemy location, wind direction, wind speed, humidity, rain, width and depth of desired coverage, and desired time of obscuration) dictates how effective smoke employment will be.

WIND SPEED AND DIRECTION

Wind speed and direction are the most important factors to consider when determining whether or not to use a smoke system. If the wind is too strong or blowing in the wrong direction, it may be impossible to establish an effective smoke screen.

Wind speed is a significant factor in determining smoke dissipation time. The crosswind sensor is designed to compensate for the effects of crosswind and is not effective in determining wind speed when employing smoke. TCs must determine (by experience) how much wind will make smoke ineffective on the battlefield.

The following terms are used to describe wind direction:

- Head wind—wind blowing from the front slope of the tank, across the turret, and over the grille doors.
- Tail wind—wind blowing from the grille doors, across the turret, and over the front slope of the tank.
- Crosswind—wind blowing across the tank from right to left or left to right.
- Neutral wind—not enough wind to affect smoke.

Wind direction can be determined by watching—

- Small strips of cloth tied to the antenna.
- Dust from other moving vehicles or the wind.
- Smoke from shell explosions or burning debris on the battlefield.
- Movement of vegetation.

OTHER FACTORS

Tank crews must be aware of the limitations, benefits, and consequences of using on-board smoke. Factors to be considered when employing smoke are—

- Mission of the unit.
- Terrain in the unit's sector.
- Effect on adjacent friendly units and vehicles.
- Availability of indirect fire and smoke.
- Type of weapons and sighting systems the enemy has. (If the enemy has thermal sights, the value of smoke cover is decreased, but the smoke still degrades the enemy's target acquisition abilities.)
- Status of the tank's fire control system.
- Fuel availability; fuel consumption increases drastically using the VEESS, which consumes a gallon of fuel per minute.

The Abrams' smoke capabilities can be an effective combat multiplier. The M250 or M257 grenade launcher can be used to mask movement out of firing positions or to provide a screen to maneuver behind if being engaged. Properly used, the VEESS from a single tank can create a screen that will mask the movement of the entire platoon. (For example, the last tank in a column employs its VEESS while the remainder of the column continues to move, either through a defile or after having broken through enemy lines.) The VEESS is particularly effective for masking vehicular movement when the wind is coming from the rear toward the front of the tank.

The employment of smoke can be hazardous unless the TC understands the capabilities and limitations of the system. If the smoke grenade launcher is fired at the wrong time or the VEESS is not shut off at the proper time, smoke may silhouette the tank against a woodline or ridge, or pinpoint the tank's location.

The decision to employ smoke is based on METT-TC. Wind speed and direction are the primary considerations for VEESS employment. High humidity, low winds, and wet conditions are best for smoke employment; hot, dry, windy conditions are not as good. TCs must use smoke whenever possible so they can gain proficiency in the employment of the VEESS. A TC learns and understands the best conditions for effective smoke employment only through practice and experience. Units should train to use smoke whenever training facilities permit. There should be unlimited opportunities to train in the use of the VEESS when maneuvering.

GUNNERY TECHNIQUES WHEN EMPLOYING SMOKE OR IN A SMOKE ENVIRONMENT

When smoke is employed, basic gunnery principles and techniques may have to be altered. The obscuring and screening properties of smoke dictate what alterations (if any) are needed. The following guidance is provided for engaging targets when smoke has been employed.

THERMAL IMAGING SYSTEM ENGAGEMENT

The TC and gunner will view the area through the thermal sighting system.

Normal Mode TIS and CITV (Stationary)

The TIS is oriented on the primary enemy avenue of approach assigned to the tank. The TC and gunner acquire targets using the GPSE and CITV. Once the TC or gunner acquires a target, the TC issues an initial fire command. Range estimation or battlesight is used, since the LRF will not operate through dense smoke. On the M1A2 and M1A2 SEP, the TC can use the CITV range stadia reticle.

Normal Mode TIS and CITV (Moving)

The same precision gunnery techniques used to engage targets while moving are employed while firing through smoke (see Chapter 8, *Direct Fire*), except that the TC and gunner acquire targets and lay the gun for direction using the TIS or M1A2 CITV.

GUNNER'S PRIMARY SIGHT DAYLIGHT CHANNEL ENGAGEMENT

Use the GPS daylight channel if the TIS is inoperative.

Normal Mode GPS (Stationary)

Using daylight optics with smoke requires special techniques to engage targets effectively.

- The GPS is oriented on the tank's primary sector of fire.
- The tank is moved forward slowly until the optics clear the smoke screen. When the crew acquires a target, the TC issues a fire command. The crew uses standard precision gunnery techniques and engages the target using the GPS (see Chapter 8, *Direct Fire*).
- If a target is not acquired within 8 to 10 seconds, the crew does not leave the tank exposed, but backs up into the smoke and quickly moves to an alternate firing position (see Figure 10-23).
- When the engagement is complete, the tank moves to an alternate position behind the smoke screen. A crosswind is ideal for this technique (see Figure 10-24).

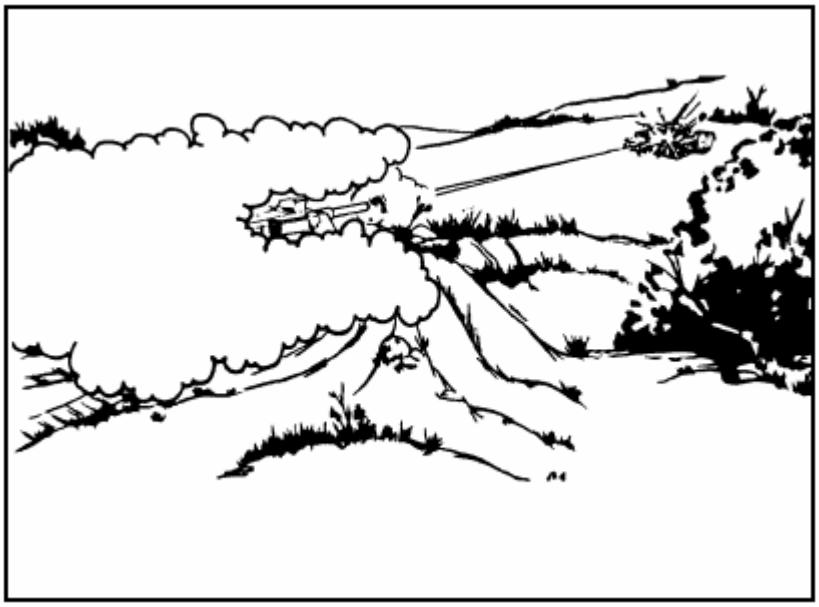


Figure 10-23. Using Smoke to Provide Concealment.

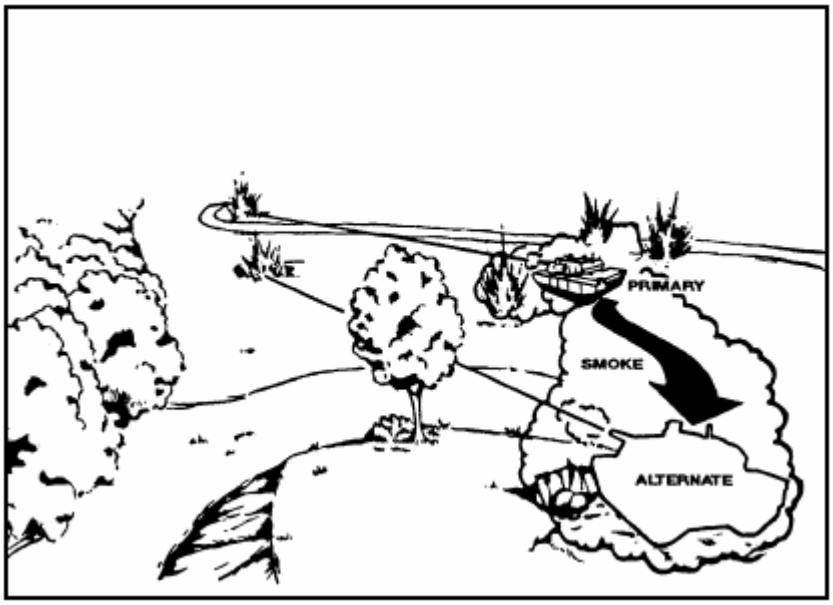


Figure 10-24. Using Smoke to Move from Primary to Alternate Firing Position.

Degraded Mode LRF

The LRF will operate through some smoke, but is ineffective in most dense smoke. Therefore, the TC must use range estimation and have the gunner manually index the estimated range into the computer, or fire using battlesight techniques, if the target is within battlesight range. On the M1A2 and M1A2 SEP, the TC can use the CITV range stadia reticle with a degraded fire control system.

SMOKE EMPLOYMENT AGAINST ENEMY ATGM GUNNERS AND HELICOPTERS

The smoke grenade launchers and the VEESS can be valuable assets against hostile ATGM and helicopter attacks. With proper maneuvering, both systems together can provide almost immediate and continuous smoke cover, preventing attack helicopters and ATGM gunners from maintaining an accurate aim.

The smoke grenade launcher can provide an almost immediate smoke screen in most situations. Since the turret is used to lay the smoke grenades for direction, it is possible to take advantage of wind speed and direction. If wind conditions allow, the VEESS can supplement the immediate smoke provided by the smoke grenade launcher.

ON-BOARD SMOKE EMPLOYMENT AGAINST ENEMY OBSERVERS

M250 or M257 grenade launchers can temporarily screen a tank from enemy observers during movement from primary to alternate or supplementary positions (defense) or from one hull-down position to another along the axis of advance (offense). The VEESS may also be used for this purpose, depending on wind conditions.

Chapter 11

Survivability and Fight-Back Capability

Various components of the Abrams fire control system may become damaged if an enemy round hits the tank; however, that need not render the tank or its crew powerless. The emergency procedures in this chapter identify actions the crew can take to survive a direct hit and continue to fight.

Notes. When the operational status of the tank changes significantly, the TC should report to the platoon leader or platoon sergeant. The TC should *always* report to the platoon leader or platoon sergeant before abandoning the tank.

The phrase "immediate return fire is required" in this chapter refers to a situation in which failure to fire will result in a subsequent hit on your tank.

CONTENTS

Ammunition Compartment Hit

The Abrams tank was designed with crew survivability as a primary consideration. Part of this design is the compartmentalization of the ammunition away from the crew. Numerous tests of fully loaded bustle and hull ammunition compartments show the crew can survive when the tank is hit in an ammunition compartment. The ammunition compartment doors protect the crew from the fire and blast of the exploding propellant and the MPAT or HEAT warheads. The safest place for the crew during an ammunition compartment fire is inside the tank. If crewmen attempt to evacuate the tank while the propellant is still burning, they could be injured by the extreme heat and flame outside the turret.

BUSTLE AMMUNITION COMPARTMENT FIRES

When an incoming round ignites ammunition stored in the bustle compartment, the explosion will cause the turret blow-off panels to fly off. The force of the explosion, therefore, is vented away from the crew compartment. The 120-mm combustible case cartridges and the 105-mm propellant will be consumed in about one minute; some unburned primers may *pop off* within the next minute.

CAUTION

Do not stow or strap equipment on blow-off panels. This could prevent proper functioning of panels during bustle compartment fire.

Following the initial explosions, there will be a two-minute period of haze or light dust around the turret. This will be followed by a lull of about 5 minutes, then some of the MPAT or HEAT warheads may *cook off*. Although a *cook off* is unlikely, it is possible that MPAT or HEAT warheads will *cook off* for nearly an hour after the fire. After that hour, the turret will have cooled sufficiently to preclude further *cook off*.

If ammunition in the bustle compartment ignites, crewmen must react quickly to ensure their safety and the continued operation of the tank. M1 crewmen should don their protective masks and use the tank's gas particulate filter system to protect themselves from any toxic fumes or smoke that may have leaked into the tank. M1A1 and M1A2 crews should also mask, but they should use the tank's overpressure system rather than the gas particulate filter system to help clean the turret of toxic fumes and smoke. The M1A1's and M1A2's gas particulate filter system draws air from outside the vehicle in the vicinity of the turret bustle and may pump

flame or toxic fumes into the turret. If the overpressure system is inoperative on the M1A1 and M1A2 tank, the crew should use their protective masks only.

The turret should be rotated to get the gun tube over the side of the tank, if possible. This action protects the engine and limits the amount of flame and hot air being pulled into the engine air cleaner and overpressure system.

If the tank automotive system is operational, the crew should seek a turret-down protected position and wait inside the tank for at least 60 minutes. (After 60 minutes, the possibility of secondary explosions will have passed.) The tank should then be driven, with the hatches open to ventilate the turret, to a maintenance collection point. While the crew is in the rear area, they should replace their protective mask filters and tank filters.

If the tank is inoperative and the TC determines it should be evacuated, the crew should evacuate between two and five minutes after the initial explosion. Evacuating during this time window reduces the possibility of the crew being hurt from secondary warhead detonations. The crew should wear gloves as they exit, to protect their hands from hot metal and sharp edges.

Note. Because the crew may have been exposed to smoke and toxic fumes before they masked, they should avoid strenuous exercise after a bustle fire. Strenuous exercise may worsen injury from toxic gases; therefore, for the next 24 hours, the crew should be as physically inactive as possible. Problems with severe coughing, difficulty in breathing, and chest pain are most likely to start within a few hours of exposure. Anyone having such symptoms should be promptly evacuated for medical attention, by stretcher if possible. If no such problems arise within 24 hours, the local commander may return soldiers to full duty with little risk of residual harmful effect.

HULL AMMUNITION COMPARTMENT FIRES

When an incoming round ignites the ammunition propellant in the rounds stored in the hull, the hull blow-off panels will fly off. Only trace amounts of toxic fumes will enter the crew compartment. The propellant fire will last for about 15 seconds. Because the fire is short-lived, there is no danger of HEAT warheads exploding.

In the heat of battle, the crew may not notice an explosion. The proper crew action is to continue the mission.

Crew Compartment Ammunition Fires

The fire suppression system is designed to suppress hull and crew compartment fires (fuel, hydraulic fluid); the system will not suppress ammunition propellant fires. The propellant contains its own oxygenating agent and will continue to burn, even under water. To minimize the chance of an ammunition fire in the crew compartment, it is important that the loading procedures described in this manual and in the operator's manual be followed.

Note. Ammunition doors must remain closed, except when the loader is removing a round to load immediately into the empty chamber, or returning a round to the compartment after it has been removed from the chamber. All guards and safety devices must be in place before firing.

EXIT AN M1A1 OR M1A2 TANK DURING AN AMMUNITION FIRE

The following procedures are used to evacuate an M1A1 and M1A2 tank during an ammunition fire in the crew compartment. Assume the tank has just completed an engagement, and the main gun is loaded with HEAT and considered *hot*. The TC has issued the command "BATTLECARRY SABOT." As the loader removes the HEAT round, the alert "AMMO FIRE" is given. (The removed round is smoldering or burning.)

The following conditions are assumed for these procedures:

- Vehicle.
  - A fully equipped, operational M1A1 or M1A2 tank in a hull-down position or on the move.
  - All safety guards are in position.
  - The main gun is loaded and considered a *hot* gun.

Note. A *hot* gun is defined as one or more rounds fired in the previous minute.

- Crew. All crewmen are in the prescribed uniform with CVC cords hooked up.

Note. Prescribed uniform is complete Nomex, if available. If not, it is coveralls with gloves. If coveralls are not available, it is BDU (with collar up and buttoned, sleeves down and buttoned) and gloves.

- TC's station.
  - The command has been given for a change of ammunition.
  - The TC's stand is adjusted for standing position.
  - Seats and platforms are adjusted in accordance with the operator's manual.
  - The TC's hatch is in open-protected or closed position.
- Loader's station.
  - The loader's hatch is in the locked position (closed).
  - The GUN/TURRET DRIVE switch is in the POWERED position.
  - The main gun is loaded and the ARM/SAFE lever is in the SAFE position; make sure the MAIN GUN STATUS white SAFE light is lit.
- Gunner's station. The gunner's seat is adjusted.
- Driver's station.
  - The driver's hatch is in the closed position.
  - The T-bar is fully extended.
  - The night vision viewer and power cable are installed (at night).
  - The engine is running.

Note. A proficient crew should be able to execute these procedures within 15 seconds (25 seconds if the night-vision viewer is installed).

Table 11-1. M1A1/M1A2 Ammunition Fire Exit Procedures.

TC	Gunner	Loader	Driver
Stops breathing.	Stops breathing.	Announces “AMMO FIRE,” and stops breathing.	Stops breathing.
If moving, commands “DRIVER, STOP.”	Disconnects CVC cord.	If round is only partially out of chamber when fire is noticed, attempts to rechamber once; if unsuccessful, leaves it alone.	If moving, stops tank, pushes T-bar to stowed position, loosens AN/VVS-2 mounting wing nuts, and drops sight to left side of driver’s seat.
	Elevates the main gun.		
Opens TC’s hatch and disconnects CVC cord.	Moves FIRE CONTROL MODE switch to MANUAL mode.	Disconnects CVC cord and opens loader’s hatch.	Opens hatch and disconnects CVC cord.
Exits the tank.		Exits the tank.	Exits the tank.
Helps the gunner exit the tank.	Exits the tank through the TC’s hatch.	Helps the gunner exit the tank.	Moves to cover behind the vehicle.
Moves to cover behind the vehicle.	Moves to cover behind the vehicle.	Moves to cover behind the vehicle.	

Notes. The gunner escapes his position by grabbing the TC's sight extension, turret handhold and pulls himself up and out while facing forward. He does not have to turn around and face the TC's position.

The TC must be able to open the hatch while sitting (closed-hatch mode) or standing (open-protected mode).

In the closed-hatch mode, the TC is sitting. The seat must be adjusted in accordance with the operator's manual; *seat adjustment is critical so the right arm is not over-extended*. The TC unlocks the hatch with his left hand, then moves his left hand to the locking lever and places his right hand, palm up, on the under side of the hatch. In one motion, he should unlock the hatch with his left hand and push it to the full-open position with his right hand, then exit the tank.

When in the open-protected mode, the TC should always be standing. The upper and lower platforms must be adjusted in accordance with the operator's manual; *it is critical that his platforms are adjusted so his arm is not over-extended*. He follows the same procedures (as in closed-hatch mode) for opening the hatch (it should not lock in the open-protected position).

Make sure the CVC cord going to the commander's weapon station fire control handle is out of the way so the gunner does not become entangled in it.

The CVC cords should never be tied, taped, or looped together; this may prevent escape.

Loss of Communications

A malfunction or the impact from an enemy round may cause one or more members of the tank crew to lose communications. Within the turret, a loss of communication is easily handled. However, a loss of communication between the TC and the driver presents a serious problem with increasing severity under combat conditions.

If the TC senses something is wrong with the intercom system, he initiates a crew report. If all stations hear the command, they will report their status, and the crew will continue the mission.

If the problem is in the TC's intercom, he tries to locate the problem and fix it. If he cannot, he takes the gunner's CVC helmet and gives his helmet to the gunner. The crew continues the mission with the TC operating off the gunner's intercom box.

If the gunner or loader loses communication, the TC shouts his instructions, ensuring they are understood.

If the driver does not report that he is ready, the TC must relay instructions to him through the gunner or loader. After ensuring that the driver is clear of the turret ring, the TC directs the gunner to traverse the turret so the gunner or loader can get the driver's attention. The gunner or loader then relays the TC's instructions to the driver.

If the driver notices a loss of communications with the turret, he should—

- *In training*, stop the tank, tell the TC that he has no communication, and get it fixed.
- *In combat*, attempt to locate the problem by checking the following items:
  - Mike connection at helmet.
  - CVC cord connections.
  - Driver's control box.
- *In combat*, if the driver cannot locate the problem, he must follow the crew SOP established by the TC and decide whether to—
  - Continue under the TC's last instructions.
  - Seek a hide position.

Abandon Tank

If the tank sustains a hit making it impossible to move and remaining in the tank will jeopardize the safety of the crew, the TC should consider abandoning the tank. The procedures in Table 11-2 are used to abandon and disable a crippled tank.

Table 11-2. Abandon Tank Procedures.

TC	Gunner	Loader	Driver
Reports crew status.			
Commands “ABANDON TANK— ASSEMBLE RIGHT (LEFT) REAR.”			Announces “CLEAR” so the TC knows he is clear and can traverse the turret.
Traverses turret to 3 o’clock position.		Sets radio to unused frequency.	
Ensures main gun is level.		Opens breech and removes main gun round. Stows round (leaves ammunition door open).	
Removes caliber .50 machine gun backplate and places it in breech.	Removes coax machine gun backplate and places it in breech.		
Secures protective mask, individual weapon, rations, and SOI.	Secures protective mask, individual weapon, rations, and all grenades, to include four thermite grenades.	Secures protective mask, individual weapon, M4 rifle, ammunition, rations, and loader’s mittens.	Secures protective mask, individual weapon, ammunition, and rations.
Places SOI in breech and receives two thermite grenades from gunner.	Passes two thermite grenades to TC and two thermite grenades to loader.	Places one thermite grenade in breech and stands by.	Ruptures heater fuel line, turns on heater, and dismounts tank.
Secures M4 rifle, exits through TC’s hatch, and moves to back deck.	Exits through TC’s hatch, secures loader’s machine gun and two boxes of ammunition, and dismounts tank.		
Opens right top grille doors to expose fuel cell.	Moves to area announced by TC and establishes security watch.		Moves to area announced by TC and establishes security watch.
Commands “PULL PIN.”		On command, pulls pin on remaining thermite grenade, places it in the breech, and closes breech.	
Pulls pin on one thermite grenade (as loader exits tank) and places both grenades on top of fuel cell.		Exits through loader’s hatch and dismounts tank.	
Dismounts tank and conducts personnel accountability.		Moves to location announced by TC and provides security watch.	

WARNING

Crews should take additional safety measures because of the use of DU if they are—

- **In, on, or near (within 50 meters) a vehicle at the time of impact by DU ammunitions or a DU armored vehicle at the time of impact by munitions.**
- **Near (within 50 meters) actively burning fires involving DU.**
- **Routinely entering vehicles with penetrated DU armor or that have been struck by DU munitions.**

Good safety procedures to take in the event of the occurrences listed above are:

- **Wear a protective mask as long as it does not degrade your ability to fight or protect yourself.**
- **Cover exposed skin; an increase in MOPP is not required.**
- **Dust off your uniform after you leave the vehicle or area. Observe standard field hygiene, including washing your hands before eating.**

Crews should follow the three basic principles of hazard avoidance, which are:

- **Minimize the time near the radioactive source.**
- **Maximize the distance between crew members and the radioactive source.**
- **Improve the shielding (use cardboard, tape, and so forth).**

TB 9-1300-278, *Guidelines for Safe Response to Handling, Storage, and Transportation Accidents Involving Army Tank Munitions or Armor Which Contain Depleted Uranium*, currently provides operational guidance for incidents involving DU munitions, armor, and battlefield damage.

DISABLING TANK PROCEDURES

If time permits, discharge fixed and portable fire extinguishers prior to disabling the vehicle.

If thermite grenades are not available to disable the tank, a sledge hammer and other heavy instruments should be used to destroy sensitive equipment (computer, optical instruments, communication equipment, and gauges). The main gun firing pin and machine gun backplates should be taken from the tank and destroyed. Pour fuel, engine oil, and other combustible liquid over the TA-50 inside the turret and ignite it by lighting it or using hand grenades.

If enemy contact or capture is imminent, the TC will destroy the SOI.

Note. For training purposes, use practice grenades and simulate rupturing heater fuel lines.

Crew Evacuation

If one of the turret crewmen is wounded and immediate return fire is required, you must adjust controls and crew positions, and fire. When the situation permits, move to a covered position, report the crew's status, request medical evacuation (if required), evaluate wounded crewman, and begin first aid.

If the wounded crewman is the driver and immediate return fire is required, return fire. When the situation permits, report the crew's status, request medical evacuation (if required), traverse the turret to gain access to the driver from the turret, evaluate the driver's wounds, and begin first aid.

Note. If under hostile fire, when the situation permits, traverse the turret and evacuate the driver through the turret; move to a covered position as soon as possible.

WARNING

Before traversing the turret, make sure the driver's body is clear of the turret, or you could kill him.

If immediate return fire is not required, report the crew's status, request medical evacuation (if required), traverse the turret, evaluate the driver's wounds, and begin first aid.

Tank Rollover

During fast-paced combat operations, the tank may roll over. The procedures in Table 11-3 allow the crew to exit the overturned tank safely and prevent a subsequent fire. The TC must decide, based on METT-TC, whether to remain with the vehicle and await recovery or to abandon the vehicle.

If the external fire extinguisher does not shut off the engine, once the danger of a fire has passed or the fire has been extinguished, the crew should secure personal weapons and protective masks. If the TC decides to abandon the tank, the crew will follow the *Abandon Tank* procedures in Table 11-2 on page 11-5.

Note. The crew member who first notices that the tank is beginning to roll over announces "ROLLOVER."

Table 11-3. Tank Rollover Procedures.

TC	Gunner	Loader	Driver
Drops inside the turret and braces for impact.	Braces for impact.	Drops inside the turret and braces for impact.	Braces for impact.
Note. Tank is turned over on its side.			
Once the tank has stabilized, directs the driver to shut down the engine. If a turret fire exists, uses a portable fire extinguisher to fight the fire.	Once the tank has stabilized, moves the main gun select switch to the TRIGGER SAFE position.	Once the tank has stabilized, moves the SAFE/ARM handle to the SAFE position.	Once the tank has stabilized, on TC's order, shuts down the engine. If a fire exists and the first shot bottle has not extinguished the fire, activates the second shot switch.
Checks the crew for injuries, administers first aid if critical condition exists, and radios for assistance.	Checks self and crew for injuries.	Checks self and crew for injuries.	Checks self and crew for injuries.
If evacuation is possible, orders the crew to evacuate the tank. If the driver cannot exit through the driver's hatch, and a life threatening situation exists, the TC orders the gunner to traverse the turret, first manually then with power, to allow the driver to exit through the driver's hatch. Ensures turret traverse lock is locked before the driver or crew exit.	On order from the TC, clears the turret of obstructions and traverses the turret, first manually then with power, to gain access to the driver's compartment. (One or more screens may need to be removed to access the driver's compartment.) Orders the loader to lock the turret traverse lock and assist the driver into the turret.	Assists the gunner clearing obstructions, locks the turret traverse lock when ordered from the gunner, and assists the driver into the turret.	Opens hatch, if possible, and tells the TC whether he can exit through the hatch.
Orders the crew to evacuate the tank through the hatch closest to the ground, and designates an assembly area 30 meters behind the tank.	Exits the tank through the hatch closest to the ground.	Exits the tank through the hatch closest to the ground.	Exits the tank through the driver's hatch or, if directed by the TC, moves into the turret and exits through the hatch closest to the ground.
Reports to the assembly area.	Reports to the assembly area.	Reports to the assembly area.	Reports to the assembly area.

Chapter 12

Tank Crew Gunnery Skills Test (TCGST)

The TCGST evaluates the crew member's ability to execute selected tank gunnery-related skills. (The TCGST is identical to the Tank Commander Certification Test—Level I [TCCT-I].) The tasks listed in this chapter provide the unit commander a means to certify the tank crewman's basic gunnery proficiency prior to live-fire exercises. The TCGST can also be used as a guide for identifying crew gunnery strengths and weaknesses. TCGST results should be used by the commander and master gunner when structuring the unit's annual gunnery training program.

CONTENTS

Requirements

All MOS 19K personnel and any personnel assigned to an Abrams tank crew (regardless of MOS) will be administered the TCGST. Tank crewmen are required to pass the TCGST prior to main gun firing IAW Chapter 14*, Crew Level Gunnery*. (An FSO assigned as a loader on a company commander's tank is also required to pass the TCGST. The FSO will load the company commander's tank during all tank tables.) To pass the TCGST, a tank crewman must receive a GO on all stations. Due to soldiers being cross-trained in all positions, all crew members will be tested on all TCGST tasks.

- M1 and M1A1—Stations 1 through 11.
- M1A1D—Stations 1 through 12.
- M1A2 and M1A2 SEP—Stations 1 through 10 and Station 12.

If a crew member fails a task, he must be retrained and retested on that station until he receives a GO. Appropriate manuals and other references listed for each station must be used to prepare, administer, and evaluate the TCGST.

Notes. Evaluators must have passed the TCGST within six months prior to testing.

An *A, B, or C* designation denotes an alternate station for M1A1, M1A2, or M1A2 SEP tank crew tasks.

Safety Precautions

The unit will conduct a safety briefing for each station in accordance with the unit SOP.

Evaluation Procedures

ADMINISTRATIVE PROCESS

Before the crewmen arrive, the evaluator sets up the equipment and materials needed at each test station. When the crewmen arrive, the evaluator logs the crewmen in on a roster at each station and provides each crewman with all materials and equipment displayed, as outlined on this page and in the test administrative guide for that station. The evaluator reads the instructions to the crewmen, exactly as written in the guide for each station. The evaluator must use the criterion scoring checklist provided for each task to evaluate each crewman's performance. As each crewman finishes or the time limit is up, whichever occurs first, the evaluator checks the crewman's performance as either GO or NO-GO, informs him of his performance on that task, and directs him either to the next station or to further training.

ADMINISTRATIVE PROCEDURES FOR CREWMAN RECEIVING A NO-GO

If a crewman does not meet the standard indicated on the criterion scoring checklist, he receives a NO-GO. He must then be critiqued on that task, to include an explanation of his mistakes and what he must do to correct them. Crewmen will be retested in accordance with the local SOP.

Evaluation Criteria

See attached criterion scoring checklist for each task.

Personnel, Equipment, and Material Required

The personnel, equipment, and material listed below are required for all stations. Additional items, if required, are listed in the test administrative guide for each particular station.

- Primary evaluator (SSG or above) in charge of administering the test (he may also occupy a test station).
- Station evaluator, SGT or above (one per test station).
- Classroom or training area.

- Stopwatch (one per evaluator).
- Criterion scoring checklist (one per crewman).
- Desk and chair or clipboard (one per crewman).
- Pencils (one per crewman).
- FM 3-20.12 (one per station).

Planning Considerations

The NCOIC tasked to conduct the TCGST should consider the following elements during his planning:

- ***Identify the type of TCGST.*** The NCOIC must determine whether the TCGST will be a diagnostic test or record test.
  - A *diagnostic* TCGST identifies the unit's strengths and weaknesses, provides information for the gunnery program, and assesses newly assigned personnel. Although DA Pam 350-38 only requires record testing of TCGST twice yearly, diagnostic evaluations should be scheduled quarterly.
  - A *record* TCGST allows commanders to certify proficiency of crew members to meet tank table prerequisites.
- ***Determine the test site.*** Establish a test site that will support the testing of all stations (for example, Station 6, *Boresight*, requires a clear view of a target at 1,200 meters). Refer to the station conditions for each station to determine what is needed for that station.
- ***Construct a test station diagram (flow chart).*** Before the test is rehearsed, a test station diagram or flow chart should be designed. This diagram will facilitate management and control of the test. It will also aid in briefing soldiers and evaluators. The diagram should include—
  - Test stations.
  - Control station.
  - Direction of rotation.
  - Movement schedule.
  - Aid station/warm-up tent, if available.
- ***Determine resources.*** The NCOIC must determine the resources necessary to support the TCGST. He must consider the support of the test site, as well as the training aids required to conduct the test to standard. The NCOIC can determine training aids, such as dummy rounds, machine guns, tanks, and muzzle boresight devices by referring to the individual station in this chapter. To support the test site, the NCOIC must determine the amount of support needed to conduct the test, for example:
  - Tanks with drivers.
  - Transportation to and from the test site.
  - Tents for warm-up briefings.
  - Stopwatches.
  - Tables for scoring.
  - Chairs.
  - Medical support, if needed.
  - Class I support, if needed.

  Once the NCOIC has determined the resources needed, he must coordinate the use of personnel and equipment. This coordinate will usually be made through the company 1SG or battalion S3 and S4.
- ***Select evaluators.*** Evaluators should be selected as far in advance as possible. This gives the NCOIC time to select the most qualified personnel available and time to coordinate with other units, if necessary and, in turn, allows the evaluator time to prepare. If the NCOIC must draw on resources from outside his unit, he should request assistance from his 1SG to make this coordination. After the evaluators have been selected, the NCOIC will brief them on their duties and responsibilities, the test schedule and location, and the station they will be testing.

- ***Test evaluators.*** Evaluators must be technically proficient in performing all tasks to standard. Each evaluator is tested on all test stations.
- ***Conduct a rehearsal.*** Because of the size and scope of this test, it must be rehearsed before it is administered. This rehearsal will be conducted at the test site with all evaluators present. The NCOIC should check each station to make sure the evaluator is aware of his duties and responsibilities, the stations are set up correctly with all training aids and test materials on hand, and that each station is conducted IAW the test administrative guides.
- ***Conduct of the TCGST.*** Prior to testing, the NCOIC must make sure the stations are set up and all equipment and training aids are available. He must also make sure the crew members are briefed on safety and location of the stations and assigned to the test stations. During testing, the NCOIC will spot-check each station to make sure the task standards are being maintained and that the evaluators are maintaining a roster of personnel evaluated and annotating the score cards correctly.
- ***Conduct of the AAR for the TCGST.*** An AAR should be conducted by the battalion/brigade master gunner or CSM to help the NCOIC understand his actions and interactions during the conduct of the TCGST. The AAR should be conducted prior to the debrief to the unit commander and should consist of a discussion of the strengths and weaknesses of the training event. This will allow the NCOIC to better prepare the debrief to the commander as well as will prepare him for the next TCGST.
- ***Prepare debrief.*** Once the test is complete, the NCOIC will prepare a brief for the commander to inform him of the TCGST results. This information is also retained for training records. Collect the crew member's scorecards as soon as they complete testing, before anyone leaves the test site. The evaluators can provide additional information about a crew member's test performance. After all data is collected, prepare a summarization of the results. Information from test results must be interpreted to determine the strengths and weaknesses of the unit. This report will at least contain the following data:
  - A roster, by duty position, of each crew member tested.
  - The scores of each crew member tested.
  - The percentage of crew members passing the TCGST.
  - A percentage of GOs per station.
  - A percentage of NO-GOs per station.
  - Recommendations of corrective action.

Test Stations

Each station consists of a test administrative guide and criterion scoring checklist. Stations 3, 4, and 4A also contain a procedures guide. Three sample roll-up scoresheets (individual, platoon, and company) are provided at Figures 12-1 through 12-3 on pages 12-70 through 12-72.

TEST ADMINISTRATIVE GUIDE
Station 1 (M1, M1A1, and M1A2)

TASK: Identify vehicles and helicopters.

CONDITIONS: Given slides, mock-ups, drawings, or models of vehicles and helicopters visible for 10 seconds each (a minimum of four of these slides must be thermal signatures).

STANDARDS: Without references, the crewman must identify (by nomenclature) 18 of 20 vehicles and helicopters.

Note. All U.S. equipment must be identified correctly to receive a GO rating.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- Twenty slides, mock-ups, drawings, or models of vehicles and helicopters.

Note. A *minimum* of five U.S. vehicles and helicopters (mixed) (no more than three helicopters per test) will be selected from U.S. *armored* vehicles and *combat* helicopters *currently in use*. A minimum of four slides must be of thermal views.

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	6 minutes 40 seconds
Total time (per crewman):	11 minutes 40 seconds

OTHER INFORMATION:

Before the crewman arrives, the evaluator will review the slides, mock-ups, drawings, or models to determine the sequence.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to identify vehicles and helicopters. You must correctly identify 18 of 20 vehicles and helicopters, by nomenclature. You must correctly identify all of the U.S. vehicles to receive a GO rating. You will have ten seconds per vehicle exposure, with ten seconds between exposures to write your answer on your checklist. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Show the first slide, mock-up, drawing, or model, and start the time.)

CRITERION SCORING CHECKLIST FOR STATION 1
Identify Vehicles and Helicopters

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

1. _____ 11. _____
2. _____ 12. _____
3. _____ 13. _____
4. _____ 14. _____
5. _____ 15. _____
6. _____ 16. _____
7. _____ 17. _____
8. _____ 18. _____
9. _____ 19. _____
10. _____ 20. _____

	GO	NO-GO	INITIALS
Crewman correctly identified 18 of 20 vehicles by nomenclature.	_____	_____	_____
Crewman correctly identified all U.S. vehicles and aircraft by nomenclature.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 2 (M1)

TASK: Identify 105-mm main gun ammunition using the shell case marking and projectile end, and explain its use.

CONDITIONS: Given shell case base and projectile mock-ups, slides, or photos visible for 10 seconds each.

STANDARDS: Without references, the crewman will—

- Identify the rounds of ammunition as announced in the fire command (sabot, HEAT, HEP, beehive, beehive time, smoke) using the lettering on the shell case base.
- Identify the rounds of ammunition as announced in the fire command (sabot, HEAT, HEP, beehive, beehive time, smoke) using the projectile end.
- Explain the primary use of each round.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- Five shell case base mock-ups, slides, or photos, numbered 1 through 5 (one each of sabot, HEAT, HEP, beehive, and WP).
- Five projectile end mock-ups, slides, or photos, numbered 1 through 5 (one each of sabot, HEAT, HEP, beehive, and WP).
- Slide projector with screen (if required).

TEST PLANNING TIME:

Administrative time:	5 minutes	
Test time:	3 minutes	20 seconds
Total time (per crewman):	8 minutes	20 seconds

OTHER INFORMATION:

Before the crewman arrives, the evaluator will review the mock-ups, slides, or photos to determine the ammunition sequence.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to identify 105-mm main gun ammunition and explain its use. This is a two-part test. The first part of the test is to evaluate your ability to identify rounds using the markings on the shell case base. The second part is to evaluate your ability to identify rounds using the projectile end. On your checklist, write how the round is announced in the fire command, and the primary use of the round. The rounds are numbered one through five for each part of the test. You will have ten seconds per round exposure, with ten seconds between exposures to write your answer on your checklist. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Show the first shell case base mock-up, slide, or photo, and start the time.)

CRITERION SCORING CHECKLIST FOR STATION 2
Identify 105-mm Main Gun Ammunition Using the Shell Case Marking and Projectile End, and Explain Its Use

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION:_____

TYPE OF AMMUNITION USING SHELL CASE BASE (AS ANNOUNCED IN FIRE COMMAND)	USED FOR	GO	NO-GO
1. _____	_____	_____	_____
2. _____	_____	_____	_____
3. _____	_____	_____	_____
4. _____	_____	_____	_____
5. _____	_____	_____	_____

TYPE OF AMMUNITION USING PROJECTILE END (AS ANNOUNCED IN FIRE COMMAND)	GO	NO-GO
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____

	GO	NO-GO	INITIALS
Crewman identified all main gun rounds and explained their use within the time allotted.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 2A (M1A1 and M1A2)

TASK: Identify 120-mm main gun ammunition using the stub base marking and projectile end, and explain its use.

CONDITIONS: Given stub base and projectile end mock-ups, slides, or photos visible for ten seconds each.

STANDARDS: Without references, the crewman will—
- Identify the rounds of ammunition as announced in the fire command (sabot, HEAT, MPAT) using the lettering on the stub base.
- Identify the rounds of ammunition as announced in the fire command (sabot, HEAT, MPAT) using the projectile end.
- Explain the primary use of each round.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- Five stub base mock-ups, slides, or photos, numbered 1 through 5 (M829A2 APFSDS-T [sabot], M830 [HEAT], M830A1 [MPAT], and any two rounds that do not have quick-reference markings). (If dummy rounds are not available, slides or photos may be used.)
- Five projectile end mock-ups, slides, or photos, numbered 1 through 5 (M829A1/A2 APFSDS-T [sabot], M830 [HEAT], M830A1 [MPAT GROUND mode] [MPAT AIR mode]). (If dummy rounds are not available, slides or photos may be used.)
- Slide projector with screen (if required).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	3 minutes
Total time (per crewman):	8 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will review the mock-ups, slides, or photos to determine the ammunition sequence.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to identify 120-mm ammunition and explain its use. This is a two-part test. The first part of the test is to evaluate your ability to identify rounds using the markings on the stub base. The second part is to evaluate your ability to identify rounds using the projectile end. On your checklist, write how the round is announced in the fire command, and the primary use of the round. The rounds are numbered one through five for each part of the test. You will have 10 seconds per round exposure, with 10 seconds between exposures to write your answer on your checklist. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Show the first stub base mock-up, slide, or photo, and start the time.)

CRITERION SCORING CHECKLIST FOR STATION 2A
Identify 120-mm Main Gun Ammunition Using the Stub Base Markings and Projectile End, and Explain Its Use

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION:_____

	TYPE OF AMMUNITION USING SHELL CASE BASE (AS ANNOUNCED IN FIRE COMMAND)	USED FOR	GO	NO-GO
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____
5.	_____	_____	_____	_____

	TYPE OF AMMUNITION USING PROJECTILE END (AS ANNOUNCED IN FIRE COMMAND)	GO	NO-GO
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

	GO	NO-GO	INITIALS
Crewman identified all main gun rounds and explained their use within the time allotted.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 3 (M1, M1A1, and M1A2)

TASK: Clear, disassemble, assemble, perform a function check, load, and perform immediate action on the M240 7.62-mm machine gun.

CONDITIONS: Given a fully operational, dismounted M240 machine gun loaded with dummy ammunition.

STANDARDS: Without references and within seven minutes, the crewman will (IAW TM 9-1005-313-10)—

- Clear (in sequence) the M240 machine gun.
- Disassemble the M240 machine gun.
- Assemble the M240 machine gun.
- Perform a function check (in sequence) on the M240 machine gun.
- Load (in sequence) the M240 machine gun.
- Perform immediate action on the M240 machine gun.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M240 machine guns (two per evaluator).
- Dummy, linked, 7.62-mm ammunition (five rounds per machine gun).
- Table (one per machine gun).
- TM 9-1005-313-10.
- Procedures guide (see pages 12-15 and 12-16).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	7 minutes
Total time (per crewman):	12 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Check the machine gun and equipment for defects.
- Make sure the dummy rounds are loaded and the safety is off.

INSTRUCTIONS TO THE CREWMAN:

"In front of you is an M240 7.62-mm machine gun. You must clear, disassemble, assemble, perform a function check, load, and perform immediate action on the machine gun within 7 minutes. Disassembly and assembly do not have to be done in sequence; however, clearing, performing the function check, loading, and performing immediate action must be done in sequence and without references. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 3
Clear, Disassemble, Assemble, Perform a Function Check, Load, and Perform Immediate Action on the M240 7.62-mm Machine Gun

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION:_____

		GO	NO-GO
1.	Cleared (in sequence) the M240 machine gun.		
	a. Moved the safety switch to the F (fire) position.	_____	_____
	b. Charged the machine gun.	_____	_____
	c. Moved the safety switch to the S (safe) position.	_____	_____
	d. Opened the cover.	_____	_____
	e. Removed the source of ammunition.	_____	_____
	f. Raised the feedtray.	_____	_____
	g. Looked into the chamber for ammunition.	_____	_____
	h. Lowered the feedtray.	_____	_____
	i. Moved the safety switch to the F (fire) position.	_____	_____
	j. Eased the recoiling parts forward.	_____	_____
	k. Closed the cover.	_____	_____
2.	Disassembled the M240 machine gun.		
	a. Cleared the weapon (if not previously cleared).	_____	_____
	b. Removed the barrel.	_____	_____
	c. Removed the trigger housing assembly.	_____	_____
	d. Removed the buffer assembly.	_____	_____
	e. Removed the bolt and operating rod assembly.	_____	_____
	f. Removed the cover assembly.	_____	_____
	g. Removed the feedtray.	_____	_____
3.	Assembled the M240 machine gun.		
	a. Installed the feedtray.	_____	_____
	b. Installed the cover assembly.	_____	_____
	c. Installed the bolt and operating rod assembly.	_____	_____
	d. Installed the buffer assembly.	_____	_____

		GO	NO-GO
e.	Installed the trigger housing assembly.	_____	_____
f.	Installed the barrel assembly.	_____	_____
4.	Performed a function check (in sequence) on the M240 machine gun.		
a.	Moved the safety switch to the F (fire) position.	_____	_____
b.	Charged the weapon.	_____	_____
c.	Moved the safety switch to the S (safe) position.	_____	_____
d.	Attempted to fire the weapon. (The weapon should not have fired.)	_____	_____
e.	Moved the safety switch to the F (fire) position.	_____	_____
f.	Pulled the trigger and eased the recoiling parts forward.	_____	_____
5.	Loaded (in sequence) the M240 machine gun.		
a.	Moved the safety switch to the F (fire) position.	_____	_____
b.	Charged the machine gun.	_____	_____
c.	Moved the safety switch to the S (safe) position.	_____	_____
d.	Opened the cover.	_____	_____
e.	Removed the source of ammunition, if present.	_____	_____
f.	Raised the feedtray.	_____	_____
g.	Looked into the chamber for ammunition.	_____	_____
h.	Lowered the feedtray.	_____	_____
i.	Moved the safety switch to the F (fire) position.	_____	_____
j.	Eased the recoiling parts forward.	_____	_____
k.	Placed the link belt in the feedtray over the belt holding paws, open link down.	_____	_____
l.	Closed the cover.	_____	_____
6.	Performed immediate action (in sequence) on the M240 machine gun (cold gun).		
a.	Announced “STOPPAGE.”	_____	_____
b.	Charged the machine gun.	_____	_____
c.	Attempted to fire.	_____	_____
d.	If the gun did not fire, cleared the weapon.	_____	_____

		GO	NO-GO
7.	Performed immediate action (in sequence) on the M240 machine gun (hot gun).		
	a. Announced "STOPPAGE."	_____	_____
	b. Charged the machine gun.	_____	_____
	c. Attempted to fire.	_____	_____
	d. Waited 15 minutes and cleared the weapon.	_____	_____
8.	Completed all steps within 7 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

PROCEDURES GUIDE FOR STATION 3

Clear, Disassemble, Assemble, Perform a Function Check, Load, and Perform Immediate Action on the M240 7.62-mm Machine Gun

These procedures have been agreed on by the U.S. Army Armor School and U.S. Army Armament Readiness Command. Trainers and evaluators will note that the procedures differ slightly from the operator's manual.

CLEAR

1. Move the safety switch to the F (fire) position.
2. Charge the weapon.
3. Move the safety switch to the S (safe) position.
4. Open the cover.
5. Remove the ammunition.
6. Raise the feedtray.
7. Look in the chamber for ammunition.
8. Lower the feedtray.
9. Move the safety switch to the F (fire) position.
10. Ease the parts forward.
11. Close the cover.

WARNING

If, during firing, an attempt is made to clear the weapon, and the bolt and operating rod are not found in the charged position (hot weapon), do not attempt to clear. Keep the weapon pointed down range for 15 minutes to cool. After 15 minutes, clear the weapon.

DISASSEMBLE

1. Clear the weapon (if not previously cleared).
2. Remove the barrel.
3. Remove the trigger housing assembly.
4. Remove the buffer assembly.
5. Remove the bolt and operating rod assembly.
6. Remove the cover assembly.
7. Remove the feedtray.

ASSEMBLE

1. Install the feedtray.
2. Install the cover assembly.
3. Install the bolt and operating rod assembly.
4. Install the buffer assembly.
5. Install the trigger housing assembly.
6. Install the barrel assembly.

FUNCTION CHECK

1. Move the safety switch to the F (fire) position.
2. Charge the weapon.
3. Move the safety switch to the S (safe) position.
4. Press the trigger.
5. Move the safety switch to the F (fire) position.
6. Ease the bolt forward.

LOAD

1. Move the safety switch to the F (fire) position.
2. Charge the weapon.
3. Move the safety switch to the S (safe) position.
4. Open the cover.
5. Remove the ammunition.
6. Raise the feedtray.
7. Look in the chamber for ammunition.
8. Lower the feedtray.
9. Move the safety switch to the F (fire) position.
10. Ease the parts forward.
11. Place the link belt in the feedtray over the belt holding paws, open link down.
12. Close the cover.

IMMEDIATE ACTION ON THE M240 MACHINE GUN (COLD GUN)

1. Announce “STOPPAGE.”
2. Charge the machine gun and observe the round or case ejection.
3. Attempt to fire.
4. If the gun did not fire, clear the weapon.

IMMEDIATE ACTION ON THE M240 MACHINE GUN (HOT GUN)

1. Announce “STOPPAGE.”
2. Charge the machine gun and observe the round or case ejection.
3. Attempt to fire.
4. Wait 15 minutes and clear the weapon.

TEST ADMINISTRATIVE GUIDE
Station 4 (M1 and M1A1)

TASK: Clear, disassemble, assemble, set headspace and timing, perform a function check, load, and perform immediate action on the M2 HB caliber .50 machine gun with M10 charger.

CONDITIONS: Given a fully operational, dismounted M2 HB machine gun with M10 charger loaded with dummy ammunition, and a headspace and timing gauge.

STANDARDS: Without references and within 16 minutes, the crewman will—
- Clear (in sequence) the M2 HB machine gun.
- Disassemble the M2 HB machine gun.
- Assemble the M2 HB machine gun.
- Adjust the headspace (in sequence) on the M2 HB machine gun.
- Set the timing (in sequence) on the M2 HB machine gun.
- Perform a function check (in sequence) on the M2 HB machine gun.
- Load (in sequence) the M2 HB machine gun.
- Perform immediate action (in sequence) on the M2 HB machine gun.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:
- Items listed on page 12-2 and 12-3.
- M2 HB machine gun with M10 charger (two per evaluator).
- Linked, caliber .50 dummy ammunition (five rounds per machine gun).

Note. When ordering dummy ammunition, make sure it has the M2 closed link.

- Table (one per machine gun).
- Headspace and timing gauge (one per machine gun).
- TM 9-1005-213-10.
- Procedures guide (see pages 12-23 and 12-24).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	16 minutes
Total time (per crewman):	21 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—
- Set up the equipment and material at the test station.
- Check the machine gun for defects.
- Make sure the dummy rounds are loaded and the safety is off.
- Make sure a headspace and timing gauge is present.
- For each evaluation, make sure the timing adjustment nut is turned at least ten notches (clicks) in either direction.

INSTRUCTIONS TO THE CREWMAN:

"In front of you is an M2 HB caliber fifty machine gun with an M10 charger. You must clear, disassemble, assemble, set the headspace and timing, perform a function check, load, and perform immediate action on the machine gun within 16 minutes. Assembly and disassembly does not have to be done in sequence; however, clearing, setting headspace and timing, performing a function check, loading, and performing immediate action must be done in sequence and without references. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 4

Clear, Disassemble, Assemble, Set Headspace and Timing, Perform a Function Check, Load, and Perform Immediate Action on the M2 HB Caliber .50 Machine Gun with M10 Charger

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION:_____

		GO	NO-GO
1.	Cleared (in sequence) the M2 HB machine gun.		
	a. Moved the safety switch to the S (safe) position.	_____	_____
	b. Opened the cover.	_____	_____
	c. Lifted the extractor and removed the ammunition belt from the feedway.	_____	_____
	d. Lowered the extractor and closed the cover.	_____	_____
	e. Moved the locking selector on the M10 charger to the rear (locked) position.	_____	_____
	f. Pulled back on the charging handle and locked the bolt to the rear.	_____	_____
	g. Opened the cover.	_____	_____
	h. Looked into both the chamber and T-slot for ammunition.	_____	_____
	i. Moved the locking selector on the M10 charger to the forward (release) position.	_____	_____
	j. Pulled back on the charging handle and eased the bolt forward.	_____	_____
	k. Closed the cover.	_____	_____
	l. Moved the safety switch to the F (fire) position.	_____	_____
	m. Pressed the trigger and attempted to fire the weapon.	_____	_____

Note. Did not close the cover with the bolt locked to the rear.

2.	Disassembled the M2 HB machine gun.		
	a. Cleared the weapon (if not previously cleared).	_____	_____
	b. Removed the barrel.	_____	_____
	c. Removed the backplate.	_____	_____
	d. Removed the driving spring and rod.	_____	_____
	e. Removed the M10 charger cover.	_____	_____
	f. Removed the bolt stud.	_____	_____
	g. Removed the barrel buffer, barrel extension, and bolt.	_____	_____
	h. Disassembled to three pieces: barrel buffer, barrel extension, and bolt.	_____	_____
	i. Disassembled the barrel buffer.	_____	_____

		GO	NO-GO
3.	Assembled the M2 HB machine gun.		
	a. Reassembled the barrel buffer.	_____	_____
	b. Reassembled the barrel buffer, barrel extension, and bolt; installed the assembled components in the receiver.	_____	_____
	c. Installed the bolt stud.	_____	_____
	d. Installed the M10 charger bolt cover.	_____	_____
	e. Installed the driving spring and rod.	_____	_____
	f. Installed the backplate.	_____	_____
	g. Installed the barrel.	_____	_____
	h. Closed the cover.	_____	_____
4.	Adjusted the headspace (in sequence) on M2 HB machine gun.		
	a. Opened the cover.	_____	_____
	b. Retracted the bolt until the locking lug on the barrel locking spring was centered in the hole of the right side plate of the receiver.	_____	_____
	c. Held the bolt in position as in step 4b and unscrewed the barrel two clicks.	_____	_____
	d. Allowed the recoiling parts to move forward.	_____	_____
Note.	Disregard steps 4a through 4d if the barrel was backed off two notches (clicks) during assembly.		
	e. Moved the locking selector on the M10 charger to the rear locked position and charged the machine gun.	_____	_____
	f. Moved the locking selector on the M10 charger forward and allowed the bolt to move forward.	_____	_____
	g. Opened the cover, and ensured firing pin was retracted.	_____	_____
	h. Retracted the recoiling parts approximately 1/16 inch.	_____	_____
	i. Raised the extractor.	_____	_____
	j. Inserted the GO end of the gauge into the T-slot between the face of the bolt and the barrel.	_____	_____
	k. If the GO end did not enter the T-slot—		
	(1) Retracted the bolt.	_____	_____
	(2) Unscrewed the barrel one notch (click).	_____	_____
	(3) Allowed the recoiling parts to move forward.	_____	_____
	(4) Checked the headspace IAW steps 4h through j.	_____	_____
	l. If the GO end entered the T-slot, attempted to place the NO-GO end of the gauge into the T-slot.	_____	_____
	m. If the NO-GO end did not enter the T-slot, went to step 5.	_____	_____
	n. If the NO-GO end entered the T-slot—		
	(1) Retracted the bolt.	_____	_____
	(2) Screwed the barrel into the extension one notch (click).	_____	_____
	(3) Allowed the recoiling parts to move forward.	_____	_____
	(4) Checked the headspace IAW steps 4h through m.	_____	_____

		GO	NO-GO
5.	Set timing (in sequence after adjusting headspace; charged weapon if necessary) on the M2 HB machine gun.		
	a. Pulled the charging handle to retract the recoiling parts about 1/4 inch.	_____	_____
	b. Raised the extractor.	_____	_____
	c. Inserted the FIRE gauge between the barrel extension and the trunnion lock.	_____	_____
	d. Made sure the FIRE gauge beveled edge rested against the barrel notches.	_____	_____
	e. Slowly released the recoiling parts, allowing them to move forward.	_____	_____
	f. Removed the backplate.	_____	_____
	g. Screwed the timing adjustment nut to the left until it rested on the trigger bar.	_____	_____
	h. Pushed up on the trigger bar and attempted to fire.	_____	_____
	i. Rotated the timing adjustment nut to the right one notch (click) and attempted to fire.	_____	_____
	j. Continued step 5i and attempted to fire after each click, until the weapon fired.	_____	_____
	k. Turned the timing adjustment nut two additional notches (clicks) to the right.	_____	_____
	l. Placed the backplate halfway on the back of the receiver to cover the drive spring rod.	_____	_____
	m. Retracted the bolt to remove the gauge.	_____	_____
	n. Installed the backplate.	_____	_____
	o. Moved the selector on the M10 charger to the rear position, charged the machine gun, placed the M10 selector to the forward position and eased the bolt forward.	_____	_____
	p. Inserted NO-FIRE gauge and attempted to fire. If weapon did not fire, inserted FIRE gauge, and attempted to fire. If weapon fired, repeated steps 5l through 5p. If weapon fired again, timing is complete; proceed to step 6.)	_____	_____
Note.	If weapon fired with NO-FIRE gauge inserted, removed gauge and went back to step 5.		
6.	Performed a function check (in sequence) on the M2 HB machine gun.		
	a. Moved the safety switch to the S (safe) position.	_____	_____
	b. Moved the locking selector on the M10 charger to the rear (locked) position.	_____	_____
	c. Pulled back on the charging handle and locked the bolt to the rear.	_____	_____

		GO	NO-GO
d.	Kept the charging handle pulled to the rear and moved the lock selector on the M10 charger to the forward (release) position.	_____	_____
e.	Pulled back on the charging handle and eased the bolt forward.	_____	_____
f.	Attempted to fire (the weapon should not fire; however, if it fired, went back to step 5 to set the timing).	_____	_____
g.	Moved the safety switch to the F (fire) position.	_____	_____
h.	Attempted to fire (the firing pin should have released; if not, went to step 5 to set the timing).	_____	_____
7.	Loaded (in sequence) the M2 HB machine gun.		
a.	Moved the safety switch to the S (safe) position.	_____	_____
b.	Opened the machine gun cover.	_____	_____
c.	Lifted the extractor and removed the ammunition belt (if present) from the feedway.	_____	_____
d.	Lowered the extractor and closed the cover.	_____	_____
e.	Moved the locking selector on the M10 charger to the rear (locked) position.	_____	_____
f.	Pulled back on charging handle and locked bolt to the rear.	_____	_____
g.	Opened the cover.	_____	_____
h.	Looked into both the chamber and T-slot for ammunition.	_____	_____
i.	Moved the locking selector on the M10 charger to the forward (release) position.	_____	_____
j.	Pulled back on the charging handle and eased the bolt forward.	_____	_____
k.	Lifted the extractor.	_____	_____
l.	Inserted the double loop of the ammunition under the extractor and pushed the extractor down between the first and second rounds.	_____	_____
m.	Closed the cover.	_____	_____

WARNING

If the caliber .50 has fired 150 rounds or more within 2 minutes, it is considered a *hot gun*. Immediate action must be applied within 10 seconds of a stoppage.

8.	Performed immediate action (in sequence) on the M2 HB machine gun (cold gun).		
a.	Announced "STOPPAGE."	_____	_____
b.	Charged the machine gun and observed the feeding and ejection.	_____	_____
c.	Attempted to fire.	_____	_____
d.	If the gun did not fire, announced "STOPPAGE," and cleared the weapon.	_____	_____

		GO	NO-GO
9.	Performed immediate action (in sequence) on the M2 HB machine gun (hot gun).		
	a. Announced "STOPPAGE."	_____	_____
	b. Charged the machine gun and observed the feeding and ejection.	_____	_____
	c. Attempted to fire.	_____	_____
	d. If the weapon did not fire, announced "STOPPAGE," and kept the weapon pointed down range.	_____	_____
	e. Waited 15 minutes and cleared the weapon.	_____	_____
10.	Completed all steps within 16 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

PROCEDURES GUIDE FOR STATION 4

Clear, Disassemble, Assemble, Set Headspace and Timing, Perform a Function Check, Load, and Perform Immediate Action on the M2 HB Caliber .50 Machine Gun with M10 Charger

These procedures have been agreed on by the U.S. Army Armor School and U.S. Army Armament Readiness Command. Trainers and evaluators will note that the procedures differ slightly from the operator's manual.

CLEAR

1. Move the safety switch to the S (safe) position.
2. Open the cover.
3. Remove the ammunition.
4. Close the cover.
5. Slide the lock to the rear.
6. Charge the weapon.
7. Open the cover.
8. Look in the chamber for ammunition.
9. Slide the lock forward.
10. Ease the bolt forward.
11. Close the cover.
12. Move the safety switch to the F (fire) position.
13. Press the trigger.

WARNING

If the bolt will not lock to the rear (the weapon is hot), do not attempt to clear the weapon. Keep the weapon pointed down range for 5 minutes (until the weapon is cool). After the weapon has cooled, clear the weapon.

DISASSEMBLE

1. Clear the weapon (if not previously cleared).
2. Remove the barrel.
3. Remove the backplate.
4. Remove the driving spring and rod.
5. Remove the Ml0 charger cover.
6. Remove the bolt stud.
7. Remove the barrel buffer, barrel extension, and bolt.
8. Disassemble to three pieces: barrel buffer, barrel extension, and bolt.
9. Disassemble the barrel buffer.

ASSEMBLE

1. Reassemble the barrel buffer.
2. Reassemble the barrel buffer, barrel extension, and bolt; install the assembled components in the receiver.
3. Install the bolt stud.
4. Install the M10 charger cover.
5. Install the driving spring and rod.
6. Install the backplate.

7. Install the barrel.
8. Set the headspace and timing IAW Criterion Scoring Checklist.

FUNCTION CHECK

1. Move the safety switch to the S (safe) position.
2. Slide the lock to the rear.
3. Charge the weapon.
4. Slide the lock forward.
5. Ease the bolt forward.
6. Press the trigger (do not release the firing pin).
7. Move the safety switch to the F (fire) position.
8. Press the trigger and release the firing pin.

LOAD

1. Move the safety switch to the S (safe) position.
2. Open the cover.
3. Remove the ammunition.
4. Close the cover.
5. Slide the lock to the rear.
6. Charge the weapon.
7. Open the cover.
8. Look in the chamber for ammunition.
9. Slide the lock forward.
10. Ease the bolt forward.
11. Place the ammunition under the extractor.
12. Close the cover.

IMMEDIATE ACTION ON THE M2 HB MACHINE GUN (COLD GUN)

1. Announce “STOPPAGE.”
2. Charge the machine gun and observe for feeding and ejection.
3. Attempt to fire.
4. If the gun did not fire, announce “STOPPAGE,” and clear the weapon.

IMMEDIATE ACTION ON THE M2 HB MACHINE GUN (HOT GUN)

1. Announce “STOPPAGE.”
2. Charge the machine gun and observe for feeding and ejection.
3. Attempt to fire.
4. If the weapon did not fire, announce ‘STOPPAGE,” and keep the weapon pointed down range.
5. Wait 15 minutes and clear the weapon.

TEST ADMINISTRATIVE GUIDE
Station 4A (M1A2)

TASK: Clear, disassemble, assemble, set headspace and timing, perform a function check, load, and perform immediate action on the M2 HB flex caliber .50 machine gun.

CONDITIONS: Given a fully operational, dismounted M2 HB flex machine gun loaded with dummy ammunition, and a headspace and timing gauge.

STANDARDS: Without references and within 16 minutes, the crewman will—
- Clear (in sequence) the M2 HB flex machine gun.
- Disassemble the M2 HB flex machine gun.
- Assemble the M2 HB flex machine gun.
- Adjust the headspace (in sequence) on the M2 HB flex machine gun.
- Set the timing (in sequence) on the M2 HB flex machine gun.
- Perform a function check (in sequence) on the M2 HB flex machine gun.
- Load (in sequence) the M2 HB flex machine gun.
- Perform immediate action (in sequence) on the M2 HB flex machine gun.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:
- Items listed on page 12-2 and 12-3.
- M2 HB flex machine gun (two per evaluator).
- Linked, caliber .50 dummy ammunition (five rounds per machine gun).

Note. When ordering dummy ammunition, make sure it has the M2 closed link.

- Table (one per machine gun).
- Headspace and timing gauge (one per machine gun).
- TM 9-1005-213-10.
- Procedures guide (see pages 12-31 through 12-33).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	16 minutes
Total time (per crewman):	21 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—
- Set up the equipment and material at the test station.
- Check the machine gun for defects.
- Make sure dummy rounds are loaded and the safety is off.
- Make sure a headspace and timing gauge is present.
- For each evaluation, make sure the timing adjustment nut is turned at least ten notches (clicks) in either direction.

INSTRUCTIONS TO THE CREWMAN:

"In front of you is an M2 HB flex caliber fifty machine gun. You must clear, disassemble, assemble, set headspace and timing, perform a function check, load, and perform immediate action on the machine gun within 16 minutes. Assembly and disassembly does not have to be done in sequence; however, clearing, setting headspace and timing, performing a function check, loading, and performing immediate action must be done in sequence and without references. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 4A

Clear, Disassemble, Assemble, Set Headspace and Timing, Perform a Function Check, Load, and Perform Immediate Action on the M2 HB Flex Caliber .50 Machine Gun

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION:_____

		GO	NO-GO
1.	Cleared (in sequence) the M2 HB flex machine gun.		
	a. Moved the safety switch to the S (safe) position.	_____	_____
	b. Moved the bolt latch release lock to the unlocked position (single shot mode).	_____	_____
	c. Opened the cover.	_____	_____
	d. Lifted the extractor and removed the ammunition belt from the feedway.	_____	_____
	e. Lowered the extractor and closed the cover.	_____	_____
	f. Pulled back on the retractor slide handle and locked the bolt to the rear.	_____	_____
	g. Opened the cover.	_____	_____
	h. Looked into both the chamber and T-slot for ammunition.	_____	_____
	i. Maintained pressure on the retractor slide handle and eased the bolt forward.	_____	_____
	j. Closed the cover.	_____	_____
	k. Moved the safety switch to the F (fire) position.	_____	_____
	l. Pressed the trigger and attempted to fire the weapon.	_____	_____
Note.	Did not close the cover with the bolt locked to the rear.		
2.	Disassembled the M2 HB flex machine gun.		
	a. Cleared the weapon (if not previously cleared).	_____	_____
	b. Removed the barrel.	_____	_____
	c. Removed the backplate.	_____	_____
	d. Removed the driving spring and rod.	_____	_____
	e. Removed the bolt stud.	_____	_____
	f. Removed the barrel buffer, barrel extension, and bolt.	_____	_____
	g. Disassembled to three pieces: barrel buffer, barrel extension, and bolt.	_____	_____
	h. Disassembled the barrel buffer.	_____	_____

		GO	NO-GO
3.	Assembled the M2 HB flex machine gun.		
	a. Reassembled the barrel buffer.	_____	_____
	b. Reassembled the barrel buffer, barrel extension, and bolt; installed the assembled components in the receiver.	_____	_____
	c. Installed the bolt stud.	_____	_____
	d. Installed the driving spring and rod.	_____	_____
	e. Installed the backplate.	_____	_____
	f. Installed the barrel.	_____	_____
	g. Closed the cover.	_____	_____
4.	Adjusted the headspace (in sequence) on M2 HB flex machine gun.		
	a. Opened the cover.	_____	_____
	b. Retracted the bolt until the locking lug on the barrel locking spring was centered in the hole of the right side plate of the receiver.	_____	_____
	c. Held the bolt in position as in step 4b and unscrewed the barrel two notches (clicks).	_____	_____
	d. Allowed the recoiling parts to move forward.	_____	_____
Note.	Disregard steps 4a through 4d if the barrel was backed off two notches (clicks) during assembly.		
	e. Charged the machine gun.	_____	_____
	f. Allowed the bolt to move forward.	_____	_____
	g. Opened the cover, and ensured firing pin was retracted.	_____	_____
	h. Retracted the recoiling parts approximately 1/16 inch.	_____	_____
	i. Raised the extractor.	_____	_____
	j. Inserted the GO end of the gauge into the T-slot between the face of the bolt and the barrel.	_____	_____
	k. If the GO end did not enter the T-slot—		
	(1) Retracted the bolt.	_____	_____
	(2) Unscrewed the barrel one notch (click).	_____	_____
	(3) Allowed the recoiling parts to move forward.	_____	_____
	(4) Checked the headspace IAW steps 4h through j.	_____	_____
	l. If the GO end entered the T-slot, attempted to place the NO-GO end of the gauge into the T-slot.	_____	_____
	m. If the NO-GO end did not enter the T-slot, went to step 5.	_____	_____

	GO	NO-GO
n. If the NO-GO end entered the T-slot—		
(1) Retracted the bolt.	_____	_____
(2) Screwed the barrel into the extension one notch (click).	_____	_____
(3) Allowed the recoiling parts to move forward.	_____	_____
(4) Checked the headspace IAW steps 4h through m.	_____	_____
5. Set the timing (in sequence after adjusting headspace; charged weapon if necessary) on the M2 HB flex machine gun.		
a. Pulled the retractor slide handle to retract the recoiling parts about 1/4 inch.	_____	_____
b. Raised the extractor.	_____	_____
c. Inserted the FIRE gauge between the barrel extension and the trunnion lock.	_____	_____
d. Made sure the FIRE gauge beveled edge rested against the barrel notches.	_____	_____
e. Slowly released the recoiling parts, allowing them to move forward.	_____	_____
f. Removed the backplate.	_____	_____
g. Screwed the timing adjustment nut to the left until it rested on the trigger bar.	_____	_____
h. Pushed up on the trigger bar and attempted to fire.	_____	_____
i. Rotated the timing adjustment nut to the right one notch (click) and attempted to fire.	_____	_____
j. Continued step 5i and attempted to fire after each click, until the weapon fired.	_____	_____
k. Turned the timing adjustment nut two additional notches (clicks) to the right.	_____	_____
l. Placed the backplate halfway on the back of the receiver to cover the drive spring rod.	_____	_____
m. Retracted the bolt to remove the gauge.	_____	_____
n. Installed the backplate.	_____	_____
o. Charged the weapon.	_____	_____
p. Inserted NO-FIRE gauge and attempted to fire. If weapon did not fire, inserted FIRE gauge, and attempted to fire. If weapon fired, repeated steps 5l through 5p. If weapon fired again, timing is complete; proceed to step 6.)	_____	_____
Note. If weapon fired with NO-FIRE gauge inserted, removed gauge and went back to step 5.		
6. Performed a function check (in sequence) on the M2 HB flex machine gun.		
a. Moved the safety switch to the S (safe) position.	_____	_____
b. Moved the bolt latch release lock to the unlocked position (single-shot mode).	_____	_____
c. Pulled back on the retractor slide handle and locked the bolt to the rear (the bolt should lock to the rear).	_____	_____

		GO	NO-GO
d.	Held the retractor handle, pressed the bolt latch release and rode the bolt forward.	_____	_____
e.	Pressed down on the trigger (weapon should not fire).	_____	_____
f.	Moved the safety switch to F (fire) position.	_____	_____
g.	Pressed down on the trigger; the weapon should have fired.	_____	_____
h.	Moved the bolt latch release lock to the locked position (automatic-fire mode).	_____	_____
i.	Pulled the retractor slide handle to the rear and held it (the bolt should not have locked to the rear).	_____	_____
j.	Released the pressure on the retractor slide handle and eased the bolt forward.	_____	_____
k.	Pressed the trigger and released the firing pin.	_____	_____
7.	Loaded (in sequence) the M2 HB flex machine gun.		
a.	Moved the safety switch to the S (safe) position.	_____	_____
b.	Moved the bolt latch release lock to the unlocked position (single-shot mode).	_____	_____
c.	Opened the machine gun cover.	_____	_____
d.	Lifted the extractor and removed the ammunition belt (if present) from the feedway.	_____	_____
e.	Lowered the extractor and closed the cover.	_____	_____
f.	Pulled back on the retractor slide handle and locked the bolt to the rear.	_____	_____
g.	Opened the cover.	_____	_____
h.	Looked into both the chamber and T-slot for ammunition.	_____	_____
i.	Maintained pressure on the retractor slide handle and depressed the bolt latch release to ease the bolt forward.	_____	_____
j.	Placed the bolt latch release lock in the locked position (automatic-fire mode).	_____	_____
k.	Lifted the extractor.	_____	_____
l.	Inserted the double loop of the ammunition under the extractor and pushed the extractor down between the first and second rounds.	_____	_____
m.	Closed the cover.	_____	_____

WARNING

If the caliber .50 has fired 150 rounds or more within 2 minutes, it is considered a *hot gun*. Immediate action must be applied within 10 seconds of a stoppage.

8.	Performed immediate action (in sequence) on the M2 HB machine gun (cold gun).		
a.	Announced "STOPPAGE."	_____	_____
b.	Charged the machine gun and observed the feeding and ejection.	_____	_____
c.	Attempted to fire.	_____	_____
d.	If the gun did not fire, announced "STOPPAGE," and cleared the weapon.	_____	_____

		GO	NO-GO
9.	Performed immediate action (in sequence) on the M2 HB machine gun (hot gun).		
	a. Announced "STOPPAGE."	_____	_____
	b. Charged the machine gun and observed the feeding and ejection.	_____	_____
	c. Attempted to fire.	_____	_____
	d. If the weapon did not fire, announced "STOPPAGE," and kept the weapon pointed down range.	_____	_____
	e. Waited 15 minutes and cleared the weapon.	_____	_____
10.	Completed all steps within 16 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

PROCEDURES GUIDE FOR STATION 4A

Clear, Disassemble, Assemble, Set Headspace and Timing, Perform a Function Check, and Load the M2 HB Flex Caliber .50 Machine Gun

These procedures have been agreed on by the U.S. Army Armor School and U.S. Army Armament Readiness Command. Trainers and evaluators will note that the procedures differ slightly from the operator's manual.

CLEAR

1. Move the safety switch to the S (safe) position.
2. Move the bolt latch release lock to the unlocked position (single-shot mode).
3. Open the cover.
4. Lift the extractor and remove the ammunition belt from the feedway.
5. Lower the extractor and close the cover.
6. Pull back on the retractor slide handle and lock the bolt to the rear.
7. Open the cover.
8. Look into both the chamber and T-slot for ammunition.
9. Maintain pressure on the retractor slide handle and ease the bolt forward.
10. Close the cover.
11. Move the safety switch to the F (fire) position.
12. Press the trigger and attempted to fire the weapon.

Note. Do not close the cover with the bolt locked to the rear.

WARNING

If the bolt will not lock to the rear (the weapon is hot) do not attempt to clear the weapon. Keep the weapon pointed down range for 5 minutes (until the weapon is cool). After the weapon has cooled, clear the weapon.

DISASSEMBLE

1. Clear the weapon (if not previously cleared).
2. Remove the barrel.
3. Remove the backplate.
4. Remove the driving spring and rod.
5. Remove the bolt stud.
6. Remove the barrel buffer, barrel extension, and bolt.
7. Disassemble to three pieces: barrel buffer, barrel extension, and bolt.
8. Disassemble the barrel buffer.

ASSEMBLE

1. Reassemble the barrel buffer.
2. Reassemble the barrel buffer, barrel extension, and bolt; install the assembled components in the receiver.
3. Install the bolt stud.
4. Install the driving spring and rod.
5. Install the backplate.
6. Install the barrel.
7. Set the headspace and timing IAW the Criterion Scoring Checklist.

FUNCTION CHECK

1. Move the safety switch to the S (safe) position.
2. Move the bolt latch release lock to the unlocked position (single-shot mode).
3. Pull back on the retractor slide handle and lock the bolt to the rear (the bolt should lock to the rear).
4. Hold the retractor handle, press the bolt latch release, and ease the bolt forward.
5. Press down on the trigger (weapon should not fire).
6. Move the safety switch to the F (fire) position.
7. Press down on the trigger; the weapon should fire.
8. Move the bolt latch release lock to the locked position (automatic-fire mode).
9. Pull the retractor slide handle to the rear and hold it (the bolt should not lock to the rear).
10. Release the pressure on the retractor slide handle and ease the bolt forward.
11. Press the trigger and release the firing pin.

LOAD

1. Move the safety switch to the S (safe) position.
2. Move the bolt latch release lock to the unlocked position (single-shot mode).
3. Open the machine gun cover.
4. Lift the extractor and remove the ammunition belt (if present) from the feedway.
5. Lower the extractor and close the cover.
6. Pull back on the retractor slide handle and lock the bolt to the rear.
7. Open the cover.
8. Look into both the chamber and T-slot for ammunition.
9. Maintain pressure on the retractor slide handle and depress the bolt latch release allowing the bolt to move forward.
10. Place the bolt latch release lock in the locked position (automatic-fire mode).
11. Lift the extractor.
12. Insert the double loop of the ammunition under the extractor and push the extractor down between the first and second rounds.
13. Close the cover.

IMMEDIATE ACTION ON THE M2 HB MACHINE GUN (COLD GUN)

1. Announce “STOPPAGE.”
2. Charge the machine gun and observe for feeding and ejection.
3. Attempt to fire.
4. If the gun did not fire, announce “STOPPAGE,” and clear the weapon.

IMMEDIATE ACTION ON THE M2 HB MACHINE GUN (HOT GUN)

1. Announce “STOPPAGE.”
2. Charge the machine gun and observe for feeding and ejection.
3. Attempt to fire.
4. If the weapon did not fire, announce ‘STOPPAGE,” and keep the weapon pointed down range.
5. Wait 15 minutes and clear the weapon.

TEST ADMINISTRATIVE GUIDE
Station 5 (M1)

TASK: Clear the main gun, and remove, inspect, and install the firing pin, perform a function check, and conduct a firing circuit check on the M68 gun breechblock.

CONDITIONS: Given a stationary M1 tank, with BII and the VEHICLE MASTER POWER switch turned to the ON position and TM 9-2350-255-10-1/-2.

STANDARDS: Within 10 minutes, the crewman will—
- Clear (in sequence) the 105-mm main gun.
- Remove, inspect, and install the firing pin.
- Perform a function check (in sequence) on the breechblock.
- Conduct a firing circuit check IAW TM 9-2350-255-10-1.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:
- Items listed on page 12-2 and 12-3.
- Ml tank with BII (one per evaluator).
- TM 9-2350-255-10-1/-2 (one set per tank).
- Spanner wrench (one per tank).
- Wooden block (2 feet long) (one per tank).
- Firing circuit tester (one per tank).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	10 minutes
Total time (per crewman):	15 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—
- Set up the equipment and materials at the test station.
- Thoroughly check the main gun breech assembly for defects. (The main gun breech assembly and firing circuit tester must be operational.)
- Make sure all equipment required is present and available to the crewman from inside the turret.
- Make sure the breechblock crankstop is in the rear position.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to clear the main gun, remove, inspect, and install the firing pin, perform a function check, and conduct a firing circuit check on the M68 gun breechblock. You will have 10 minutes to complete all requirements. You must clear and perform the function check in sequence. I may stop you at any time during the evaluation for failing to observe safety procedures. You must be completed within the time limit to receive a GO on this station. You may use TM 9-2350-255-10-1/-2 for reference. The firing circuit check is in TM 9-2350-255-10-1. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 5

Clear the Main Gun, and Remove, Inspect, and Install the Firing Pin, Perform a Function Check, and Conduct a Firing Circuit Check on the M68 Gun Breechblock

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Cleared (in sequence) the 105-mm main gun.		
a. Moved the GUN SELECT switch to the TRIGGER SAFE position.	_____	_____
b. Made sure the spent case ejection guard was in the forward (safe) position and the MAIN GUN STATUS SAFE light on the loader's panel was lit.	_____	_____
c. Moved the GUN/TURRET DRIVE switch to the EL UNCPL position.	_____	_____
d. Opened the breech and made sure the chamber was clear.	_____	_____
Note. The breechblock does not have to be locked in the open position.		
2. Removed the firing pin.	_____	_____
3. Inspected the firing pin.	_____	_____
4. Installed the firing pin.	_____	_____
5. Performed a function check (in sequence) on the breechblock.		
a. Opened the breechblock until locked to the fully open position.	_____	_____
b. Locked the breech operating handle in the upright position.	_____	_____
c. Tripped the extractors with a wooden block making sure the breechblock closed.	_____	_____
d. Used a spanner wrench to turn the spring tension adjuster clockwise until a click was heard (if more spring tension was needed).	_____	_____
6. Conducted a firing circuit check IAW TM 9-2350-255-10-1.	_____	_____
7. Observed all safety precautions.	_____	_____
8. Completed all steps within 10 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 5A (M1A1 M1A2, and M1A2 SEP)

TASK: Clear the main gun, and remove, inspect, and install the firing pin, perform a function check, and conduct a firing circuit check on the M256A1 breechblock.

CONDITIONS: Given a stationary M1A1, M1A2, or M1A2 SEP tank with BII, TM 9-2350-264-10-1/-2, TM 9-2350-288-10-1/-2, or TM 9-2350-388-10 and all stations prepared for operation.

STANDARDS: Within 10 minutes, the crewman will—

- Clear (in sequence) the 120-mm main gun.
- Remove, inspect, and install the firing pin.
- Perform a function check (in sequence) on the breechblock.
- **(M1A1)** Conduct a firing circuit check IAW TM 9-2350-264-10-1.
- **(M1A2)** Conduct a firing circuit check IAW TM 9-2350-288-10-1.
- **(M1A2 SEP)** Conduct a firing circuit check IAW TM 9-2350-388-10.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M1A1, M1A2, or M1A2 SEP tank with BII (one per evaluator).
- TM 9-2350-264-10-1/-2, TM 9-2350-288-10-1/-2, or TM 9-2350-388-10 (one set per tank).
- Firing circuit tester (one per tank).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	10 minutes
Total time (per crewman):	15 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Set up the equipment and materials at the test station.
- Thoroughly check the main gun breech assembly for defects. (The main gun breech assembly and firing circuit tester must be operational.)
- Make sure all equipment required is present and available to the crewman from inside the turret.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to clear the main gun, remove, inspect, and install the firing pin, perform a function check, and conduct a firing circuit check on the M256A1 breechblock. You will have ten minutes to complete all requirements. You must clear the main gun and perform the function check in sequence. I may stop you at any time during the evaluation for failing to observe safety procedures. You must be completed within the time limit to receive a GO on this station. You may use TM 9-2350-264-10-1/-2, TM 9-2350-288-10-1/-2, or TM 9-2350-388-10 for reference. The firing circuit check for the M1A1 is in TM 9-2350-264-10-1. The firing circuit check for the M1A2 is in TM 9-2350-288-10-1. The firing circuit test for the M1A2 SEP is in TM 9-2350-388-10. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 5A

Clear the Main Gun, and Remove, Inspect, and Install the Firing Pin, Perform a Function Check, and Conduct a Firing Circuit Check on the M256A1 Breechblock

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Cleared (in sequence) the 120-mm main gun.		
a. Made sure the GUN SELECT switch was in the TRIGGER SAFE position.	_____	_____
b. Made sure the SAFE/ARMED lever was in the SAFE (down) position and the MAIN GUN STATUS SAFE light on the loader's control panel was illuminated.	_____	_____
c. Moved the GUN/TURRET DRIVE switch to the EL UNCPL position and made sure the light came on.	_____	_____
d. Opened the breech slowly, and made sure the chamber was clear.	_____	_____
Note. The breechblock does not have to be locked in the open position.		
2. Removed the aftcap deflector.	_____	_____
3. Inspected the aftcap deflector by checking for cracks, damage, and serviceability.	_____	_____
4. Removed the firing pin.	_____	_____
5. Inspected the firing pin by checking the tip and ensuring it moved when the cam was pressed.	_____	_____
6. Installed the firing pin.	_____	_____
7. Installed the aftcap deflector.		
8. Performed a function check (in sequence) on the breechblock.		
a. Opened the breechblock until locked by extractors.	_____	_____
b. Pressed down on the manual breech closing lever with hand (breechblock should have closed).	_____	_____
9. (**M1A1**) Conducted a firing circuit check IAW TM 9-2350-264-10-1.	_____	_____
10. (**M1A2**) Conducted a firing circuit check IAW TM 9-2350-288-10-1.	_____	_____
11. (**M1A2 SEP**) Conducted a firing circuit check IAW TM 9-2350-388-10.	_____	_____
12. Observed all safety precautions.	_____	_____
13. Completed all steps within 10 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 6 (M1 and M1A1)

TASK: Boresight the M1 and M1A1 tank main gun.

CONDITIONS: Given a fully operational M1 or M1A1 tank; an MBD; a clearly defined target at 1,200 meters; the TIS in STANDBY mode; and muzzle boresighting procedure IAW Chapter 2, *Boresighting*.

STANDARDS: Within 22 minutes, the crewman will perform muzzle boresighting procedures IAW Chapter 2, *Boresighting.*

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- One crewman to lay the gun with the MBD.
- M1 or M1A1 tank with BII (one per evaluator).
- TM 9-2350-255-10-1/-2 or TM 9-2350-264-10-1/-2 (one set per station).
- MBD (one per tank).
- Boresight panel with 90-degree corners at 1,200 meters (one per tank).
- FM 3-20.12.

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	22 minutes
Total time (per crewman):	27 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in the test area.
- Place the TIS in STANDBY mode.
- Make sure FM 3-20.12 is available at the test station.
- Emplace the boresight panel at 1,200 meters.
- Perform muzzle boresighting procedure IAW Chapter 2, *Boresighting*.
- Make sure the correct AMMO SUBDES (M456A2 HEAT-T and M833 APFSDS-T for the Ml or M830 HEAT-MP-T and M829A1 APFSDS-T for the M1A1) are in the computer.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to boresight the main gun. You must use FM 3-20.12 for reference. You must observe all safety precautions. The appropriate data has been entered into the computer. You have 22 minutes to complete the task. Do you understand the requirements of this test? (Answer questions.) *You may begin."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 6
Boresight the M1 and M1A1 Tank Main Gun

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Boresighted the main gun IAW Chapter 2, *Boresighting*.	_____	_____
2. Observed all safety precautions.	_____	_____
3. Completed the task within 22 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 6A (M1A2)

TASK: Boresight the M1A2 tank main gun.

CONDITIONS: Given a fully operational M1A2 tank, an MBD, a clearly defined target at 1,200 meters, the CITV and TIS in STANDBY mode, GCDP data checks completed IAW TM 9-2350-288-10-1/-2, and muzzle boresighting procedure IAW Chapter 2, *Boresighting*.

STANDARDS: Within 25 minutes, the crewman will perform muzzle boresighting procedures IAW Chapter 2, *Boresighting*.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- One crewman to lay the gun with the MBD.
- M1A2 tank with BII (one per evaluator).
- TM 9-2350-288-10-1/-2 (one set per station).
- MBD (one per tank).
- Boresight panel with 90-degree corners at 1,200 meters (one per tank).
- FM 3-20.12.

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	25 minutes
Total time (per crewman):	30 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in the test area.
- Power up the CID/CITV and place the TIS in STANDBY mode.
- Make sure FM 3-20.12 is available at the test station.
- Emplace the boresight panel at 1,200 meters.
- Perform muzzle boresighting procedure IAW Chapter 2, *Boresighting*.
- Make sure the correct AMMO SUBDES (M830 HEAT-MP-T and M829A1 APFSDS-T) are in the computer.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to boresight the main gun. You must use FM 3-20.12 for reference. You must observe all safety precautions. The appropriate data has been entered into the computer. You have 25 minutes to complete the task. Do you understand the requirements of this test? (Answer questions.) You may begin." (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 6A
Boresight the M1A2 Tank Main Gun

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Boresighted the main gun IAW Chapter 2, *Boresighting*.	_____	_____
2. Observed all safety precautions.	_____	_____
3. Completed the task within 25 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 6B (M1A2 SEP)

TASK: Boresight the M1A2 SEP tank main gun.

CONDITIONS: Given a fully operational M1A2 SEP tank, an MBD, a clearly defined target at 1,200 meters, the CITV and FLIR in STANDBY mode, GCDP data checks completed IAW TM 9-2350-388-10, and muzzle boresighting procedure IAW Chapter 2, *Boresighting*.

STANDARDS: Within 25 minutes, the crewman will perform muzzle boresighting procedures IAW Chapter 2, *Boresighting*.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- One crewman to lay the gun with the MBD.
- M1A2 SEP tank with BII (one per evaluator).
- TM 9-2350-388-10 (one per station).
- MBD (one per tank).
- Boresight panel with 90-degree corners at 1,200 meters (one per tank).
- FM 3-20.12.

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	25 minutes
Total time (per crewman):	30 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in the test area.
- Power up the CDU and place the FLIR in STANDBY mode.
- Make sure FM 3-20.12 is available at the test station.
- Emplace the boresight panel at 1,200 meters.
- Perform muzzle boresighting procedure IAW Chapter 2, *Boresighting*.
- Make sure the correct AMMO SUBDES (M830 HEAT-MP-T and M829A1 APFSDS-T) are in the computer.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to boresight the main gun. You must use FM 3-20.12 for reference. You must observe all safety precautions. The appropriate data has been entered into the computer. You have 25 minutes to complete the task. Do you understand the requirements of this test? (Answer questions.) You may begin." (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 6B
Boresight the M1A2 SEP Tank Main Gun

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Boresighted the main gun IAW Chapter 2, *Boresighting*.	_____	_____
2. Observed all safety precautions.	_____	_____
3. Completed the task within 25 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 7 (M1 and M1A1)

TASK: Perform a muzzle reference system (MRS) update on the M1 or M1A1 tank.

CONDITIONS: Given a fully operational M1 or M1A1 tank that has been boresighted.

STANDARDS: Within 1 minute, the crewman will perform an MRS update to correct a boresight loss of .5 mil azimuth and .5 mil elevation within .15 tolerance.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M1 or M1A1 tank (one per evaluator).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	1 minute
Total time (per crewman):	6 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in a safe area to allow gun movement in the test area.
- Boresight the tank or enter the last recorded boresight readings.
- Press the boresight key on the CCP, and insert a loss in boresight of .5 mil azimuth and .5 mil elevation.
- Power up the gunner's station, open the ballistic doors, turn on the TIS, and move the FLTR/CLEAR/SHTR switch to SHTR.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to correct a suspected boresight loss by performing an MRS update on an M1 or M1A1 tank. You will have 1 minute to complete this action. You must correct a boresight loss to .15 mils of true boresight. The gunner's station is powered up. Do you understand the requirements for this test? (Answer questions.) *You may begin."* (Start time.)

CRITERION SCORING CHECKLIST FOR STATION 7
Perform a Muzzle Reference System (MRS) Update on the M1 or M1A1 Tank

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Made sure the FIRE CONTROL MODE switch was in the NORMAL position.	_____	_____
2. Moved the GPS MAGNIFICATION lever to 10X.	_____	_____
3. Moved the TIS to the STANDBY position.	_____	_____
4. Moved the FLTR/CLEAR/SHTR switch to the CLEAR position.	_____	_____
5. Moved the MRS lever to the IN position.	_____	_____
6. Had the TC check the area around the gun, announced "POWER," then squeezed the palm switches for 5 seconds and released.	_____	_____
7. Opened the CCP and moved the POWER switch to the ON position.	_____	_____
8. Made sure the POWER and MRS lights were illuminated.	_____	_____
9. Moved the reticle adjust toggle switch left (L), right (R), up (U), or down (D), to align the reticle aiming circle inside the opening of the MRS cross.	_____	_____
10. Moved the MRS lever to the OUT position and made sure the MRS light on the CCP was no longer illuminated.	_____	_____
11. Closed the CCP door.	_____	_____
12. Moved the FLTR/CLEAR/SHTR switch to the SHTR position.	_____	_____
13. Moved the TIS to the ON position.	_____	_____
14. Completed all steps within 1 minute.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TEST ADMINISTRATION GUIDE
Station 7A (M1A2)

TASK: Perform a muzzle reference system (MRS) update on the M1A2 tank.

CONDITIONS: Given a fully operational M1A2 tank that has been boresighted.

STANDARDS: Within 1 minute, the crewman will perform an MRS update to correct a boresight loss of .5 mil azimuth and .5 mil elevation within .15 tolerance.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M1A2 tank (one per evaluator).

TEST PLANNING TIME:

Administration time:	5 minutes
Test time:	1 minute
Total time (per crewman):	6 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in a safe area to allow gun movement in the test area.
- Boresight the tank or enter the last recorded boresight readings.
- Press the GPS push button at the BORESIGHT menu and, using the four-way switch, insert a loss in boresight of .5 mil azimuth and .5 mil elevation.
- Power up the gunner's station, open the ballistic doors, turn on the TIS, and move the FLTR/CLEAR/SHTR switch to SHTR.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to correct a suspected boresight loss by performing an MRS update on an M1A2 tank. You will have 1 minute to complete this action. You must correct a boresight loss to .15 mils of true boresight. The gunner's station is powered up. Do you understand the requirements for this test? (Answer questions.) *You may begin."* (Start time.)

CRITERION SCORING CHECKLIST FOR STATION 7A
Perform a Muzzle Reference System (MRS) Update on the M1A2 Tank

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Made sure the FIRE CONTROL MODE switch was in the NORMAL position.	_____	_____
2. Moved the GPS MAGNIFICATION lever to the 10X position.	_____	_____
3. Moved the TIS to the STANDBY position.	_____	_____
4. Moved the FLTR/CLEAR/SHTR switch to the CLEAR position.	_____	_____
5. Pressed the COMBAT push button on the GCDP.	_____	_____
6. Pressed the MRS UPDATE push button.	_____	_____
7. Had the TC check the area around the gun, announced "POWER," then squeezed the palm switches for 5 seconds and released.	_____	_____
8. Moved the four-way switch left (L), right (R), up (U), or down (D), to align the reticle aiming circle inside the opening of the MRS cross.	_____	_____
9. Pressed the ENTER push button to store the data.	_____	_____
10. Pressed the RETURN push button two times to return to the main menu.	_____	_____
11. Moved the FLTR/CLEAR/SHTR switch to SHTR.	_____	_____
12. Moved the TIS to the ON position.	_____	_____
13. Completed all steps within 1 minute.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TEST ADMINISTRATION GUIDE
Station 7B (M1A2 SEP)

TASK: Perform a muzzle reference system (MRS) update on the M1A2 SEP tank.

CONDITIONS: Given a fully operational M1A2 SEP tank that has been boresighted.

STANDARDS: Within 1 minute, the crewman will perform an MRS update to correct a boresight loss of .5 mil azimuth and .5 mil elevation within .15 tolerance.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M1A2 SEP tank (one per evaluator).

TEST PLANNING TIME:

Administration time:	5 minutes
Test time:	1 minute
Total time (per crewman):	6 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in a safe area to allow gun movement in the test area.
- Boresight the tank or enter the last recorded boresight readings.
- Press the GPS push button at the BORESIGHT menu and, using four-way switch, insert a loss in boresight of .5 mil azimuth and .5 mil elevation.
- Power up the gunner's station, open the ballistic doors, turn on the TIS, and move the FLTR/CLEAR/SHTR switch to SHTR.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to correct a suspected boresight loss by performing an MRS update on an M1A2 SEP tank. You will have 1 minute to complete this action. You must correct a boresight loss to .15 mils of true boresight. The gunner's station is powered up. Do you understand the requirements for this test? (Answer questions.) *You may begin."* (Start time.)

CRITERION SCORING CHECKLIST FOR STATION 7B
Perform a Muzzle Reference System (MRS) Update on the M1A2 SEP Tank

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Made sure the FIRE CONTROL MODE switch was in the NORMAL position.	_____	_____
2. Moved the GPS MAGNIFICATION lever to the 10X position.	_____	_____
3. Moved the TIS to the STANDBY position.	_____	_____
4. Moved the FLTR/CLEAR/SHTR switch to the CLEAR position.	_____	_____
5. Pressed the COMBAT push button on the GCDP.	_____	_____
6. Pressed the MRS UPDATE push button.	_____	_____
7. Had the TC check the area around the gun, announced "POWER," then squeezed the palm switches for 5 seconds and released.	_____	_____
8. Moved the four-way switch left (L), right (R), up (U), or down (D), to align the reticle aiming circle inside the opening of the MRS cross.	_____	_____
9. Pressed the ENTER push button to store the data.	_____	_____
10. Pressed the RETURN push button two times to return to the main menu.	_____	_____
11. Moved the FLTR/CLEAR/SHTR switch to the SHTR position.	_____	_____
12. Moved the TIS to the ON position.	_____	_____
13. Completed all steps within 1 minute.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 8 (M1)

TASK: Reload the 105-mm main gun.

CONDITIONS: Given a stationary M1 tank with BII; one sabot 105-mm dummy round and one HEAT dummy round in the ready ammunition rack with the ammunition door closed, main gun breech open, and a fire command per ammunition type; and all crew stations prepared for operation.

STANDARDS: Without references, the crewman will—

- Reload the main gun with the sabot dummy round within 5 seconds after the ammunition element of the fire command is announced.
- Reload the main gun with the HEAT dummy round within 5 seconds after the ammunition element of the fire command is announced.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M1 tank with BII (one per evaluator).
- Extracting and ramming tool (one per tank).
- TM 9-2350-255-10-1/-2 (one set per tank).
- Sabot dummy round (one per tank).
- HEAT dummy round (one per tank).

TEST PLANNING TIME:

Administrative time:	4 minutes	
Test time:		10 seconds
Total time (per crewman):	4 minutes	10 seconds

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in the test area.
- Have one dummy sabot round and one HEAT dummy round located in the ready ammunition rack with the main gun breech open.
- Move the SPENT CASE EJECTION arm to the ARMED position.
- Make sure the dummy rounds will chamber without excessive force.
- Make sure the ready ammunition door functions properly; lubricate the door, if necessary.
- Make sure all tank commander's and loader's safety guards are in place.
- Give the crewman time before the start of the test to adjust the loader's seat and position the dummy rounds in the ready ammunition rack.

INSTRUCTIONS TO THE CREWMAN:

First Requirement. *"The purpose of this test is to evaluate your ability to load a sabot round and arm the 105-mm main gun. Time will start when the ammunition element of the fire command is announced and stop when you announce 'UP.' You will have 5 seconds to complete this action. Do you understand the requirements of this test?* (Answer questions.) *GUNNER—SABOT* (Start the time) *—TANK."*

Second Requirement. *"The purpose of this test is to evaluate your ability to load a HEAT round and arm the 105-mm main gun. Time will start when the ammunition element of the fire command is announced and stop when you announce 'UP.' You will have 5 seconds to complete this action. Do you understand the requirements of this test?* (Answer questions.) *GUNNER—HEAT* (Start the time) *—PC."*

CRITERION SCORING CHECKLIST FOR STATION 8
Reload the 105-mm Main Gun

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
First Requirement. Load the main gun with the sabot dummy round within five seconds after the ammunition element of the fire command is announced.		
1. Moved the SPENT CASE EJECTION arm to the SAFE position.	_____	_____
2. Removed the sabot round.	_____	_____
3. Loaded the main gun.	_____	_____
4. Cleared the path of recoil.	_____	_____
5. Made sure the ammunition door was closed.	_____	_____
6. Moved the SPENT CASE EJECTION arm to the ARMED position and announced "UP."	_____	_____
7. Completed the requirement within 5 seconds.	_____	_____
Second Requirement. Load the main gun with the HEAT dummy round within five seconds after the ammunition element of the fire command is announced.		
1. Moved the SPENT CASE EJECTION arm to the SAFE position.	_____	_____
2. Removed the HEAT round.	_____	_____
3. Loaded the main gun.	_____	_____
4. Cleared the path of recoil.	_____	_____
5. Made sure the ammunition door was closed.	_____	_____
6. Moved the SPENT CASE EJECTION arm to the ARMED position and announced "UP."	_____	_____
7. Completed the requirement within 5 seconds.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 8A (M1A1, M1A2, and M1A2 SEP)

TASK: Reload the 120-mm main gun.

CONDITIONS: Given a stationary M1A1, M1A2, or M1A2 SEP tank with BII; one sabot 120-mm dummy round, one MPAT dummy round, and one HEAT dummy round in the ready ammunition rack with the ammunition door closed, the main gun breech open, and a fire command per ammunition type; and all crew stations prepared for operation.

STANDARDS: Without references, the crewman will—
- Reload the main gun with the sabot dummy round within 7 seconds after the ammunition element of the fire command is announced.
- Reload the main gun with the MPAT dummy round in GROUND mode within 7 seconds after the ammunition element of the fire command is announced.
- Reload the main gun with the MPAT dummy round in AIR mode within 8 seconds after the ammunition element of the fire command is announced.
- Reload the main gun with the HEAT dummy round within 7 seconds after the ammunition element of the fire command is announced.

Note. The crewman will receive a NO-GO if the nose of the MPAT round is struck on any hard surface in the tank during loading (see WARNING note on page 4-12).

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:
- Items listed on page 12-2 and 12-3.
- M1A1, M1A2, or M1A2 SEP tank with BII (one per evaluator).
- Extracting and ramming tool (one per tank).
- TM 9-2350-264-10-1/-2 or TM 9-2350-288-10-1/-2 or TM 9-2350-388-10 (one set per tank).
- Sabot dummy round (one per tank).
- MPAT dummy round (one per tank).
- HEAT dummy round (one per tank).

TEST PLANNING TIME:

Administrative time:	4 minutes	
Test time:		29 seconds
Total time (per crewman):	4 minutes	29 seconds

OTHER INFORMATION:
Before the crewman arrives, the evaluator will—
- Position the tank in the test area.
- Have one dummy sabot round, one MPAT dummy round, and one HEAT dummy round located in the ready ammunition rack with the main gun breech open.
- Make sure the dummy rounds will chamber without excessive force.
- Make sure the MPAT dummy round AIR/GROUND switch is functioning properly and set in the GROUND position.
- Make sure the tank hydraulic pressure is above 850 psi for all rounds loaded.
- Make sure the ready ammunition door functions properly; lubricate the door, if necessary.
- Make sure all tank commander's and loader's safety guards are in place.
- Give the crewman time before the start of the test to adjust the loader's seat and position the dummy rounds in the ready ammunition rack.
- Position the STUB BASE DEFLECTOR in the UP position by moving the SAFE/ARMED handle to the ARMED position. The breechblock should be in the fully open position.

INSTRUCTIONS TO THE CREWMAN:

First Requirement. *"The purpose of this test is to evaluate your ability to load a sabot round and arm the 120-mm main gun. Time will start when the ammunition element of the fire command is announced and stop when you announce 'UP.' You will have 7 seconds to complete this action. Do you understand the requirements of this test?* (Answer questions.) *GUNNER—SABOT* (Start the time) *—TANK."*

Second Requirement. *"The purpose of this test is to evaluate your ability to load an MPAT round in GROUND mode and arm the 120-mm main gun. Time will start when the ammunition element of the fire command is announced and stop when you announce 'UP.' You will have 7 seconds to complete this action. Do you understand the requirements of this test?* (Answer questions.) *GUNNER—MPAT* (Start the time) *—PC."*

Third Requirement. *"The purpose of this test is to evaluate your ability to load an MPAT round in AIR mode and arm the 120-mm main gun. Time will start when the ammunition element of the fire command is announced and stop when you announce 'UP.' You will have 8 seconds to complete this action. Do you understand the requirements of this test?* (Answer questions.) *GUNNER—MPAT—AIR* (Start the time) *—CHOPPER."*

Fourth Requirement. *"The purpose of this test is to evaluate your ability to load a HEAT round and arm the 120-mm main gun. Time will start when the ammunition element of the fire command is announced and stop when you announce 'UP.' You will have 7 seconds to complete this action. Do you understand the requirements of this test? (Answer questions.) GUNNER—HEAT (Start the time) —PC."*

CRITERION SCORING CHECKLIST FOR STATION 8A
Reload the 120-mm Main Gun

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION:_____

	GO	NO-GO
First Requirement. Load the main gun with the sabot dummy round within 7 seconds after the ammunition element of the fire command is announced.		
1. Moved the SAFE/ARMED handle to the SAFE position.	_____	_____
2. Removed the sabot round.	_____	_____
3. Loaded the main gun.	_____	_____
4. Cleared the path of recoil.	_____	_____
5. Made sure the ammunition door was closed.	_____	_____
6. Moved the SAFE/ARMED lever to the ARMED (up) position and announced "UP."	_____	_____
7. Completed the requirement within 7 seconds.	_____	_____
Second Requirement. Load the main gun with the MPAT dummy round in the GROUND mode within 7 seconds after the ammunition element of the fire command is announced.		
1. Moved the SAFE/ARMED handle to the SAFE position.	_____	_____
2. Removed the MPAT round.	_____	_____
3. Ensured switch was set at GROUND mode.	_____	_____
4. Loaded the main gun.	_____	_____
5. Cleared the path of recoil.	_____	_____
6. Made sure the ammunition door was closed.	_____	_____
7. Moved the SAFE/ARMED lever to the ARMED (up) position and announced "UP."	_____	_____
8. Completed the requirement within 7 seconds.	_____	_____
Third Requirement. Load the main gun with the MPAT dummy round in the AIR mode within 8 seconds after the ammunition element of the fire command is announced.		
1. Moved the SAFE/ARMED handle to the SAFE position.	_____	_____
2. Removed the MPAT round.	_____	_____
3. Moved the AIR/GROUND switch to the AIR position.	_____	_____
4. Loaded the main gun.	_____	_____
5. Cleared the path of recoil.	_____	_____
6. Made sure the ammunition door was closed.	_____	_____
7. Moved the SAFE/ARMED lever to the ARMED (up) position and announced "UP."	_____	_____
8. Completed the requirement within 8 seconds.	_____	_____

	GO	NO-GO
Fourth Requirement. Load the main gun with the HEAT dummy round within 7 seconds after the ammunition element of the fire command is announced.		
1. Moved the SAFE/ARMED handle to the SAFE position.	_____	_____
2. Removed the HEAT round.	_____	_____
3. Loaded the main gun.	_____	_____
4. Cleared the path of recoil.	_____	_____
5. Made sure the ammunition door was closed.	_____	_____
6. Moved the SAFE/ARMED lever to the ARMED (up) position and announced "UP."	_____	_____
7. Completed the requirement within 7 seconds.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR_____

OFFICER IN CHARGE _____

DATE TESTED_____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 9 (M1, M1A1, and M1A2)

TASK: Perform failure-to-fire (misfire) procedures on the Abrams main gun.

CONDITIONS: Given a fully operational Abrams tank with BII, a dummy round in the main gun, the command "FIRE," and all crew stations in the NORMAL mode of operation.

STANDARDS: Within four minutes, without references, the crewman will perform all misfire procedures (in sequence) from the gunner's position and explain the loader's and TC's actions IAW Chapter 8, *Direct Fire*.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M1, M1A1, or M1A2 tank with BII (one per evaluator).
- Dummy main gun round (one per tank).

TEST PLANNING TIME:

Administrative time:	5 minutes
Test time:	4 minutes
Total time (per crewman):	9 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will position the tank in the test area, load a dummy round, and arm the main gun.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to perform failure-to-fire (misfire) procedures to the main gun from the gunner's position. You will have four minutes to complete this action. You must complete the gunner's procedures in sequence. During this test, I will act as the tank commander and the loader; however, you must tell me exactly what to do. Your time will start when I give the command 'FIRE.' Do you understand the requirements of this test? (Answer questions.) *FIRE."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 9
Perform Failure-to-Fire (Misfire) Procedures on the Abrams Main Gun

NAME: _____ UNIT: _____

RANK :_____ DUTY POSITION: _____

	GO	NO-GO
1. Announced "ON THE WAY."	_____	_____
2. Attempted to fire using the electric trigger.	_____	_____
Note. Evaluator tells the gunner the gun did not fire.		
3. Announced "MISFIRE."	_____	_____
4. Announced on the way.	_____	_____
5. Attempted to fire using the manual firing device (blasting machine).	_____	_____
Note. Evaluator tells the gunner the gun did not fire.		
6. Announced "MISFIRE."	_____	_____
7. Explained/performed crew procedures, as appropriate.		
Note. These procedures do not need to be explained in sequence.		
a. Explained that if the gun is fired using the manual firing device (blasting machine), the TC, based on the tactical situation, may choose to continue to fight using the manual firing device (blasting machine), or immediately perform main gun *failure-to-fire* troubleshooting steps.	_____	_____
b. (Loader on M1 and M1A1) (TC on M1A2 and M1A2 SEP) Checks the circuit breakers. Resets any circuit breakers that are off and announces "CIRCUIT BREAKER RESET."	_____	_____
c. (Loader) Checks the ARMED light on the loader's panel. (If the light is not illuminated, rearms the gun, makes sure the MAIN GUN STATUS ARMED light illuminates, and announces "UP.")	_____	_____
d. (Loader) Ensures the breechblock is flush with or above the breech ring. (If it is not, announces "BREECH," and moves the main gun SAFE/ARMED lever to the SAFE position. Pushes up on the breech, clears the path of recoil, moves the main gun SAFE/ARMED lever to the ARMED position, ensures the yellow MAIN GUN STATUS ARMED light is illuminated, and announces "UP.")	_____	_____
8. Kept the main gun aimed at the target and the GPCH palm switch depressed.	_____	_____
9. If a fault was identified during the loader's checks, announced "ON THE WAY," after loader announced "UP," and attempted to fire using the GPCH. If the round did not fire, announced "MISFIRE" and immediately attempted to fire using the manual firing device (blasting machine). If the gun failed to fire, announced "MISFIRE," and moved the GUN SELECT switch to TRIGGER SAFE. If no faults were found during the loader's checks, moved the GUN SELECT switch to TRIGGER SAFE.	_____	_____
Note. The evaluator tells the gunner that the round did not fire.		
10. Announced "MISFIRE."	_____	_____
11. Explained that if the round still fails to fire, the loader will leave the spent case ejection guard (M1) or SAFE/ARMED lever (M1A1 and M1A2) in the ARMED position.	_____	_____

	GO	NO-GO
12. Explained/performed crew procedures, as appropriate.		
a. (TC) Tells the loader when to move the gun to the SAFE position and open the breech.	_____	_____
b. (Loader) Moves the gun to the SAFE position. The M1 crew will open the breech, partially remove the round, turn it 180 degrees, and rechamber the round. The loader on the M1A1 and M1A2 tank will open the breech approximately half way and allow the breech to close. Then, the M1, M1A1, and M1A2 crew will clear the path of recoil, arm the gun, make sure the MAIN GUN STATUS ARMED light on the loader's panel illuminates, and announce "UP."	_____	_____
c. (TC) Announces "FIRE."	_____	_____
Note. The evaluator announces "FIRE."		
13. Moved the GUN SELECT switch to the MAIN position.	_____	_____
14. Announced "ON THE WAY," and attempted to fire using any electrical trigger.	_____	_____
Note. The evaluator tells the gunner that the round did not fire.		
15. Announced "MISFIRE."	_____	_____
16. Immediately attempts to fire using the manual firing device (blasting machine).		
17. Announced "MISFIRE."	_____	_____

SPECIAL NOTICE

In training, the crew waits 2 minutes (M1) or 15 minutes (M1A1 and M1A2). In combat, the TC determines how long to wait (depending on the tactical situation), whether to rotate or discard the round, and if the tank needs to move to a turret-down position.

18. Moved the GUN SELECT switch to the TRIGGER SAFE position.	_____	_____	
19. Explained/performed the crew procedures, as appropriate.			
a. (Loader) Moves the gun to the SAFE position, removes the round, and places the round in the ready ammunition compartment.	_____	_____	
b. Crew conducts firing circuit check and troubleshoots.	_____	_____	
20. Completed all steps (in sequence, except step 3) within 4 minutes.	_____	_____	
	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 10 (M1, M1A1, and M1A2, and M1A1 SEP)

TASK: Prepare the gunner's station in an Abrams tank for operation.

CONDITIONS: Given a stationary, fully operational Abrams tank with BII and the VEHICLE MASTER POWER switch turned to ON, auxiliary hydraulic pump on, the gunner's station powered up, TIS in STANDBY (M1A2/M1A2 SEP—CITV powered up), and the engine off; and TM 9-2350-255-10-1/-2 or TM 9-2350-264-10-1/-2 or TM 9-2350-288-10-1/-2 or TM 9-2350-388-10.

STANDARDS: (M1 or M1A1) Within 17 minutes, the crewman will perform—
- Main accumulator pressure check IAW AAC 1, this FM, Chapter 3, *Armament Accuracy Checks*.
- TIS checkout IAW TM 9-2350-255-10-1 or TM 9-2350-264-10-1.
- Computer self-test IAW TM 9-2350-255-10-1 or TM 9-2350-264-10-1.
- Computer data check IAW TM 9-2350-255-10-1 or TM 9-2350-264-10-1.

STANDARDS: (M1A2/M1A2 SEP) Within 25 minutes, the crewman will perform—
- Main accumulator pressure check IAW AAC 1, this FM, Chapter 3, *Armament Accuracy Checks*.
- TIS checkout IAW TM 9-2350-288-10-1 or TM 9-2350-388-10.
- Fire control system test IAW TM 9-2350-288-10-1 or TM 9-2350-388-10.
- Gunner's control and display data check IAW TM 9-2350-288-10-1 or TM 9-2350-388-10.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:
- Items listed on page 12-2 and 12-3.
- M1, M1A1, M1A2, or M1A2 SEP tank with BII (one per evaluator).
- TM 9-2350-255-10-1/-2, TM 9-2350-264-10-1/-2, TM 9-2350-288-10-1/-2, or TM 9-2350-388-10 (one set per tank).
- Panel target at 1,000 meters (one per tank).
- FM 3-20.12 (one per tank).
- Current barometric pressure and air temperature.

TEST PLANNING TIME (M1 and M1A1):

Administrative time:	5 minutes
Test time:	17 minutes
Total time (per crewman):	22 minutes

TEST PLANNING TIME (M1A2):

Administrative time:	5 minutes
Test time:	25 minutes
Total time (per crewman):	30 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Set up the equipment and materials at the test station.
- Check the vehicle for operation.
- Position the main gun over the right front road wheel.
- Make sure the VEHICLE MASTER POWER switch is set at the ON position.
- (M1 and M1A1) Make sure AMMO SUBDES for selected round is set at 0 and the zero data for that AMMO SUBDES is set at 0.0 and 0.0.
- Make sure the auxiliary hydraulic pump is on.
- Make sure the gunner's station is powered up.
- Make sure the TIS is in the STANDBY mode.
- Make sure the vehicle engine is off.
- Make sure the panel target is set up at 1,000 meters.
- Make sure that either TM 9-2350-255-10-1/-2, TM 2350-264-10-11-1/-2, TM 9-2350-288-10-1/-2, or TM 9-2350-388-10 is available.
- Make sure DA Form 2408-4 with all required data is available.

INSTRUCTIONS TO THE CREWMAN:

***M1 and M1A1**: "The purpose of this test is to determine your ability to prepare the gunner's station for operation by performing a main accumulator pressure check, a TIS checkout, a computer self-test, and a computer data check. You will have 17 minutes to complete all steps. You must complete each step before beginning the next step. Your time will start when I announce 'BEGIN' and end when you announce 'FINISHED.' The operator's manual is available for your use. The current barometric pressure is _____ inches of mercury; the current air temperature is _____ degrees Fahrenheit. Do you understand the requirements of this test?* (Answer questions.) *You may begin."* (Start the time.)

***M1A2**: "The purpose of this test is to determine your ability to prepare the gunner's station for operation by performing a main accumulator pressure check, a TIS checkout, a fire control system test, and a gunner's control and display data check. You will have 25 minutes to complete all steps. You must complete each step before beginning the next step. Your time will start when I announce 'BEGIN' and end when you announce 'FINISHED.' The operator's manual is available for your use. The current barometric pressure is _____ inches of mercury; the current air temperature is _____ degrees Fahrenheit. Do you understand the requirements of this test?* (Answer questions.) *You may begin."* (Start the time.)

***M1A2 SEP**: "The purpose of this test is to determine your ability to prepare the gunner's station for operation by performing a main accumulator pressure check, a FLIR checkout, a fire control system test, and a gunner's control and display data check. You will have 25 minutes to complete all steps. You must complete each step before beginning the next step. Your time will start when I announce 'BEGIN' and end when you announce 'FINISHED.' The operator's manual is available for your use. The current barometric pressure is _____ inches of mercury; the current air temperature is _____ degrees Fahrenheit. Do you understand the requirements of this test?* (Answer questions.) *You may begin."* (Start the time.)

CRITERION SCORING CHECKLIST FOR STATION 10
Prepare the Gunner's Station in an Abrams Tank for Operation

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Performed a main accumulator pressure check (M1, M1A1, and M1A2).	_____	_____
2. Performed a TIS checkout (M1, M1A1, M1A2, and M1A2 SEP).	_____	_____
3. Performed a computer self-test (M1 and M1A1).	_____	_____
4. Performed a fire control system test (M1A2).	_____	_____
5. Performed a computer data check (M1 and M1A1).	_____	_____
6. Performed a gunner's control and display data check (M1A2 or M1A2 SEP).	_____	_____
7. Completed all steps within 17 minutes (M1 and M1A1).	_____	_____
8. Completed all steps within 25 minutes (M1A2 or M1A2 SEP).	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TEST ADMINISTRATIVE GUIDE
Station 11 (M1 and M1A1)

TASK: Mount the M2 HB caliber .50 machine gun, adjust the equilibrator, and boresight the M2 HB machine gun with the commander's weapon station sight.

CONDITIONS: Given a fully operational commander's weapon station with a dismounted M2 HB machine gun, a boresight panel at 500 meters, a caliber .50 boresight device (if available), a 9/64-inch socket head key, a 6-inch flat-tip screwdriver, a 12-inch adjustable wrench, and either TM 9-2350-255-10-1/-2 or TM 9-2350-264-10-1/-2.

STANDARDS: Within 18 minutes, the crewman will—
- Mount the M2 HB machine gun (including adjusting the headspace and setting the timing).
- Adjust the equilibrator.
- Boresight the M2 HB machine gun with the commander's weapon station sight.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- Abrams tank (one per evaluator).
- M2 HB machine gun with M10 charger (one per tank).
- Headspace and timing gauge (one per tank).
- Caliber .50 boresight device, if available (one per tank).
- Boresight panel at 500 meters.
- 12-inch adjustable wrench, 9/64-inch socket head key, and a 6-inch flat-tip screwdriver (one each per tank).
- TM 9-2350-255-10-1/-2 or TM 9-2350-264-10-1/-2 (one per tank).

TEST PLANNING TIME:

Administrative Time:	5 minutes
Test Time:	18 minutes*
Total time (per crewman):	23 minutes

*Increase the time to 21 minutes if a caliber .50 boresight device is not available.

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—

- Position the tank in the test area.
- Make sure the M2 HB caliber .50 machine gun with M10 charger is dismounted.
- Make sure the caliber .50 boresight device is available.
- Make sure the commander's hatch is locked in the open position.
- Make sure a 12-inch adjustable wrench, 6-inch flat-tip screwdriver, and 9/64-inch socket head key are available to the crewman.
- Adjust the equilibrator so that the elevation or depression is difficult.
- Make sure the boresight panel is positioned at 500 meters.

INSTRUCTIONS TO THE CREWMAN:

"The purpose of this test is to evaluate your ability to mount the M2 HB machine gun, adjust the equilibrator, and boresight the M2 HB caliber .50 machine gun with the commander's weapon sight. I will assist you at your request; however, you must tell me exactly what to do. You will have 18 minutes to complete the entire test. You may use TM 9-2350-255-10-2 or TM 9-2350-264-10-2."*

First Requirement. *"Your first requirement will be to mount the machine gun (including checking the headspace and setting the timing). Time will start when I announce 'BEGIN' and end when you announce 'FINISHED.' Do you understand the first requirement?* (Answer questions.) *You may begin."* (Start the time.)

After the machine gun is mounted, and the crewman announces, "FINISHED," stop the time and read the instructions for the second requirement to the crewman, exactly as written.

Second Requirement. *"Your second requirement will be to adjust the equilibrator. Use this adjustable wrench. Time will start when I announce 'BEGIN' and end when you announce 'FINISHED.' Do you understand the second requirement?* (Answer questions.) *You may begin."* (Start the time.)

After the crewman has adjusted the equilibrator and announced "FINISHED," stop the time and read the instructions for the third requirement to the crewman, exactly as written.

Third Requirement. (A caliber .50 boresight device is available.) *"Your third requirement is to boresight the machine gun to the commander's weapon station sight. You may use the socket head key, screwdriver, and caliber .50 boresight device. Your time will start when I announce 'BEGIN' and end when you announce 'FINISHED.' Do you understand the third requirement?* (Answer questions.) *You may begin."* (Start the time.)

(A caliber .50 boresight device is not available.) *"Your third requirement is to boresight the machine gun to the commander's weapon station sight. You may use the socket head key and screwdriver. You must perform the boresight using the alternate method in accordance with the operator's manual. Your time will start when I announce 'BEGIN' and end when you announce 'FINISHED.' Do you understand the third requirement?* (Answer questions.) *You may begin."* (Start the time.)

*Increase the time to 21 minutes if a caliber .50 boresight device is not available.

CRITERION SCORING CHECKLIST FOR STATION 11

Mount the M2 HB Caliber .50 Machine Gun, Adjust the Equilibrator, and Boresight the M2 HB Machine Gun with the Commander's Weapon Station Sight

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION:_____

	GO	NO-GO
First Requirement. Mount the M2 HB machine gun.		
1. Made sure the safety on the commander's weapon station was in the SAFE position.	_____	_____
2. Leveled the commander's machine gun mount.	_____	_____
3. Locked the commander's machine gun mount.	_____	_____
4. Placed the machine gun receiver in the mount.	_____	_____
5. Made sure the machine gun butterfly trigger was under the mount firing lever.	_____	_____
6. Lined up the receiver/mount holes and inserted the mounting pins.	_____	_____
7. Pulled back on the charging handle until the locking spring lug was centered in the hole on the right side of the receiver.	_____	_____
8. Screwed in the barrel, then unscrewed the barrel two notches (clicks).	_____	_____
9. Adjusted the headspace (in sequence) on the M2 HB machine gun.		
a. Opened the cover.	_____	_____
b. Retracted the bolt until the locking lug on the barrel locking spring was centered in the hole of the right side plate of the receiver.	_____	_____
c. Held the bolt in position and unscrewed the barrel two clicks.	_____	_____
d. Allowed the recoiling parts to move forward.	_____	_____
Note. Disregard steps 9a through d if the barrel was backed off two notches (clicks) during assembly.		
e. Moved the locking selector on the M10 charger to the rear locked position and charged the machine gun.	_____	_____
f. Moved the locking selector on the M10 charger forward and allowed the bolt to move forward.	_____	_____
g. Opened the cover, and ensured firing pin was retracted.	_____	_____
h. Retracted the recoiling parts approximately 1/16 inch.	_____	_____
i. Raised the extractor.	_____	_____
j. Inserted the GO end of the gauge into the T-slot, between the face of the bolt and the barrel.	_____	_____
k. If the GO end did not enter the T-slot—		
(1) Retracted the bolt.	_____	_____
(2) Unscrewed the barrel one notch (click).	_____	_____
(3) Allowed the recoiling parts to move forward.	_____	_____
(4) Checked the headspace IAW steps 9h through j.	_____	_____
l. If the GO end entered the T-slot, attempted to place the NO-GO end of the gauge into the T-slot.	_____	_____

	GO	NO-GO
m. If the NO-GO end did not enter the T-slot, went to step 10.	_____	_____
n. If the NO-GO end entered the T-slot—		
(1) Retracted the bolt.	_____	_____
(2) Screwed the barrel into the extension one notch (click).	_____	_____
(3) Allowed the recoiling parts to move forward.	_____	_____
(4) Checked the headspace IAW steps 9h through m.	_____	_____
10. Set timing (in sequence after adjusting headspace; charged weapon if necessary) on the M2 HB machine gun.		
a. Pulled the charging handle to retract the recoiling parts about 1/4 inch.	_____	_____
b. Raised the extractor.	_____	_____
c. Inserted the FIRE gauge between the barrel extension and the trunnion lock.	_____	_____
d. Made sure the FIRE gauge beveled edge rested against the barrel notches.	_____	_____
e. Slowly released the recoiling parts, allowing them to move forward.	_____	_____
f. Removed the backplate.	_____	_____
g. Screwed the timing adjustment nut to the left until it rested on the trigger bar.	_____	_____
h. Pushed up on the trigger bar and attempted to fire.	_____	_____
i. Rotated the timing adjustment nut to the right one notch (click) and attempted to fire.	_____	_____
j. Continued step 10i and attempted to fire after each click, until the weapon fired.	_____	_____
k. Turned the timing adjustment nut two additional notches (clicks) to the right.	_____	_____
l. Placed the backplate halfway on the back of the receiver to cover the drive spring rod.	_____	_____
m. Retracted the bolt to remove the gauge.	_____	_____
n. Installed the backplate.	_____	_____
o. Moved the selector on the M10 charger to the rear position, charged the machine gun, placed the M10 selector to the forward position and eased the bolt forward.	_____	_____
p. Inserted NO-FIRE gauge and attempted to fire. If weapon fired, removed gauge, recharged weapon, and went to step 10c.	_____	_____
q. If weapon did not fire, inserted FIRE gauge and attempted to fire. (If weapon did not fire, went to step 10c. If weapon fired, repeated steps 10l through 10q. If weapon fired again, timing is complete.)	_____	_____

	GO	NO-GO
Second Requirement. Adjust the equilibrator.		
1. Depressed the weapon to the maximum depression.	_____	_____
2. Made sure the locking lever was positioned for the caliber .50 operation.	_____	_____
3. Loosened the equilibrator locknut.	_____	_____
4. Adjusted the equilibrator by turning (with the adjustable wrench) the equilibrator adjusting bolt.	_____	_____
5. Checked for smooth and equal effort in depression and elevation.	_____	_____
6. Tightened the equilibrator locknut.	_____	_____
Third Requirement. Boresight the machine gun (with a caliber .50 boresight device).		
1. Made sure the bolt was forward.	_____	_____
2. Inserted the caliber .50 boresight device.	_____	_____
3. Aligned the caliber .50 boresight device reticle on the target upper left-hand corner.	_____	_____
Note. Steps 4 through 9 are performed on the commander's weapon station sight.		
4. Loosened the setscrew with the 9/64-inch socket head key to allow the horizontal adjustment control screw to turn.	_____	_____
5. Adjusted the vertical line of the boresight cross on the left edge of the target using the flat-tip screwdriver.	_____	_____
6. Tightened the setscrew with the 9/64-inch socket head key to lock the horizontal adjustment control screw.	_____	_____
7. Loosened the setscrew with the 9/64-inch socket head key to allow the vertical adjustment control screw to turn.	_____	_____
8. Adjusted the horizontal line of the boresight cross on the top edge of the target using the flat-tip screwdriver.	_____	_____
9. Tightened the setscrew with the 9/64-inch socket head key to lock the vertical adjustment control screw.	_____	_____
10. Removed the caliber .50 boresight device.	_____	_____
11. Completed all requirements within 18 minutes.	_____	_____
Third Requirement. Boresight the machine gun (without a caliber .50 boresight device).		
1. Made sure the bolt was forward.	_____	_____
2. Removed the rear mounting pin and lifted the rear of the machine gun above the firing lever.	_____	_____
3. Removed the backplate.	_____	_____
4. Removed the bolt group from the weapon.	_____	_____
5. Lowered the machine gun and reinserted the rear mounting pin.	_____	_____
6. Aligned the center of the barrel on the target upper left corner.	_____	_____

	GO	NO-GO
Note. Steps 7 through 12 are performed on the commander's weapon sight.		
7. Loosened the setscrew with the 9/64-inch socket head key to allow the horizontal adjustment control screw to turn.	_____	_____
8. Adjusted the vertical line of the boresight cross on the left edge of the target using the flat-tip screwdriver.	_____	_____
9. Tightened the setscrew with the 9/64-inch socket head key to lock the horizontal adjustment control screw.	_____	_____
10. Loosened the setscrew with the 9/64-inch socket head key to allow the vertical adjustment control screw to turn.	_____	_____
11. Adjusted the horizontal line of the boresight cross on the top edge of the target using the flat-tip screwdriver.	_____	_____
12. Tightened the setscrew with the 9/64-inch socket head key to lock the vertical adjustment control screw.	_____	_____
13. Repeated step 2.	_____	_____
14. Replaced the bolt group and backplate and repeated step 5.	_____	_____
15. Completed all requirements within 21 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR_____

OFFICER IN CHARGE _____

DATE TESTED_____

REMARKS _____

_____

_____

_____

TEST ADMINISTRATION GUIDE
Station 12 (M1A1D, M1A2, and M1A2 SEP)

TASK: Send, receive, and interpret a digital spot report.

CONDITIONS: Given a fully operational M1A1D, M1A2, M1A2 SEP tank, or appropriate digital trainer and SOI information.

STANDARDS: Within 10 minutes, the crewman will—
- Send a digital spot report.
- Receive a digital spot report.
- Interpret a digital spot report.

PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED:

- Items listed on page 12-2 and 12-3.
- M1A1D, M1A2, or M1A2 SEP tank (one per evaluator).

TEST PLANNING TIME:

Administration time:	5 minutes
Test time:	10 minutes
Total time (per crewman):	15 minutes

OTHER INFORMATION:

Before the crewman arrives, the evaluator will—
- Position the tank on a level spot in the test area.
- Lock the turret traverse lock and gun travel lock.
- Log on to the digital communication system.
- Have a sample SPOT REPORT for the crewman to use.

Note. Two tanks should be used for this station, so that the crewmen can send and receive to each other.

INSTRUCTIONS TO CREWMAN:

"The purpose of this test is to evaluate your ability to send, receive, and interpret a digital spot report. You will have 10 minutes to complete this action. You must send a spot report, receive a spot report, and interpret the spot report you received. Do you understand the requirements for this test? (Answer questions.) *You may begin."* (Start time.)

CRITERION SCORING CHECKLIST FOR STATION 12
Send, Receive, and Interpret a Digital Spot Report

NAME: _____ UNIT: _____

RANK: _____ DUTY POSITION: _____

	GO	NO-GO
1. Sent a digital spot report.	_____	_____
2. Received a digital spot report.	_____	_____
3. Interpreted the digital spot report.	_____	_____
4. Completed all requirements within 10 minutes.	_____	_____

	GO	NO-GO	INITIALS
Crewman satisfactorily completed all requirements.	_____	_____	_____

EVALUATOR _____

OFFICER IN CHARGE _____

DATE TESTED _____

REMARKS _____

_____

_____

TANK CREW GUNNERY SKILLS TEST (TCGST)									
NAME _____ **RANK** _____ **POSITION: TC** _____ **GNR** _____ **LDR** _____ **DVR** _____									
UNIT _____ **PLATOON** _____ **TANK CREW** _____									
STATION NUMBER	DATE TESTED			DATE TESTED			DATE TESTED		
TASK	Score G or N	Scorer's Initials	Remarks	Score G Or N	Scorer's Initials	Remarks	Score G Or N	Scorer's Initials	Remarks
1. AFVID									
2. AMMO ID									
3. M240									
4. M2									
5. FIRING PIN									
6. BORESIGHT									
7. MRS									
8. RELOADING									
9. MISFIRE									
10. GNR STATION									
11. CWS									
12. DIGITAL SPOTREP									

Figure 12-1. Sample Scoresheet for TCGST-Individual Roll-Up.

PLATOON TANK CREW GUNNERY SKILLS TEST RESULTS															
	____ UNIT ____ PLATOON ____ DATE		AFVID	AMMO ID	M240	M2	FIRING PIN	BORESIGHT	MRS	RELOADING	MISFIRE	GNR STATION	CWS	DIGITAL SPOTREP	# OF GOs
	TANK CREW	PSN	1	2	3	4	5	6	7	8	9	10	11	12	
TANK		TC													
# ____		GNR													
		LDR													
		DVR													
TANK		TC													
# ____		GNR													
		LDR													
		DVR													
TANK		TC													
# ____		GNR													
		LDR													
		DVR													
TANK		TC													
# ____		GNR													
		LDR													
		DVR													
	# OF IND TESTED														
	% OF 1st TIME GOs														
	% OF 1st TIME NO GOs														
A - ABSENT	**G** - GO	**N** - NO-GO	(N1) - GO 1ST RETEST	**N1** - NO-GO 1ST RETEST											

Figure 12-2. Sample Scoresheet for TCGST-Platoon Roll-Up.

COMPANY/TROOP TANK CREW GUNNERY SKILLS TEST RESULTS													
UNIT									DATE				
		AFVID	AMMO ID	M240	M2	FIRING PIN	BORESIGHT	MRS	RELOADING	MISFIRE	GNR STATION	CWS	DIGITAL SPOTREP
TCGST TASKS		1	2	3	4	5	6	7	8	9	10	11	12
1ST PLT	#TESTED												
	#GOs												
	%GOs												
	#NO-GOs												
	%NO-GOs												
2D PLT	#TESTED												
	#GOs												
	%GOs												
	#NO-GOs												
	%NO-GOs												
3D PLT	#TESTED												
	#GOs												
	%GOs												
	#NO-GOs												
	%NO-GOs												
HQs PLT	#TESTED												
	#GOs												
	%GOs												
	#NO-GOs												
	%NO-GOs												
TOTAL	#TESTED												
TOTAL	#GOs												
TOTAL	%GOs												
TOTAL	#NO-GOs												
TOTAL	%NO-GOs												

Figure 12-3. Sample Scoresheet for TCGST-Company Roll-Up.

Chapter 13

Gunnery Training Program

This chapter provides guidelines for the development of a gunnery training program that is designed to make crew members, crews, and platoons more proficient by training them to work together as a team. Further, it covers setting up training ranges and developing tank table scenarios.

Gunnery training programs should be developed to follow a logical progression of training, conducted in three phases: basic, intermediate, and advanced.

- The basic phase trains individual crewman skills and crew skills, and culminates in a Tank Crew Proficiency Course (TCPC), Table IV.
- The intermediate phase develops crew skills on Tables V, VI, and VII, and culminates in crew qualification on Table VIII.
- The advanced phase develops platoon coordination and fire distribution and control on Table XI, and culminates in platoon qualification on Table XII.

The tactical tables located in Chapter 16 parallel the gunnery tables located in Chapters 14 and 15. When possible, the tactical tables are conducted in concert with the gunnery tables.

The success or lack of success of any training program will be the direct result of the amount of time, effort, and emphasis placed into the development of the program. Keep in mind that this chapter gives commanders and trainers a guide by which to base a training program, but it does not limit the ability to create innovative variations built upon this framework.

CONTENTS

Commander's Assessment

Tank gunnery training must be well-designed and continuous for units to achieve, improve, and sustain gunnery proficiency. Each commander must assess his unit to determine its level of proficiency in gunnery. Then, he must train his unit to produce skilled crewmen, crews, and platoons. The master gunner should advise the commander and assess, plan, develop, implement, instruct, evaluate, and reassess all phases of tank gunnery training. The commander's assessment is the crucial phase of the gunnery program development and where the team effort should be demonstrated most.

The following factors must be considered during the assessment:

- Level of maintenance within the unit.
- Previous TCGST results; conduct a TCGST, if necessary.

- Crew turbulence.
- Training days available.
- Training dollars available.
- Resources available.
- The unit's specific METL.
- Past strengths and weaknesses within the unit.
- Availability of experienced and proficient crewmen, capable of peer training.
- Who will be the primary trainer for the gunnery program.

Training Goals

Training goals will vary as the local training conditions vary. Commanders must, therefore, modify their conditions statements to fit their training environments and assessments of their unit's level of proficiency. The goal is to create a training environment that is as realistic and demanding as possible with the resources available. As a norm, the following goals should be set to ensure successful training:

- Set and enforce tough, but achievable standards. Tough standards will generate effective training; loose standards will produce weak tank crews. The crews cannot be fooled; they know when they have done well. Insist on repetition to achieve mastery.
- Start early. All aspects of a training program must be thoroughly coordinated. Forecast and request resources and maintenance assistance long before they are needed.
- Be thorough. Leave nothing to chance. Avoid wasting resources and training opportunities. Give platoon leaders and TCs the guidance and assets needed to train their crews and platoons.
- Be flexible. Continually update the training program to the changing needs of the unit. If assessment and planning stop, the training program stagnates.
- Train continually. Train at every opportunity, not just during an intensified period, to get ready for qualification tables. Intensified programs should be used only to bring a unit up to a desired proficiency level; then train continually to maintain that level.

Contingency plans and alternate methods of training should be identified in case the primary plan cannot be executed. Training time is valuable and should not be lost due to unforeseen factors, whenever possible.

Training Requirements

Training must conform to Army doctrine. Doctrinal manuals provide the commander with correct procedures and principles to conduct training properly. The training requirements listed below must be trained and completed to standard to ensure the ultimate success of the gunnery training plan:

- Schedule crew skills training monthly, concurrently with PMCS, prepare-to-fire checks, AACs and tactical training.
- Schedule and conduct TCGST testing quarterly.
- Schedule gun tube recoil exercise, borescope, and pullover semi-annually. If direct support will provide it quarterly, then it should be conducted quarterly.
- Conduct COFT or AGTS training to achieve the prerequisites to live fire.
- Conduct basic gunnery Tables I, II, III, and IV semi-annually before conducting the intermediate tables.
- Conduct the intermediate gunnery Tables V, VI, VII, and VIII semi-annually. Crews must qualify on Table VIII before conducting the advanced gunnery tables.
- Conduct the advanced gunnery Tables XI and XII annually.
- Schedule and conduct platoon field training exercises (FTX) quarterly.

Training Plan

After completing his assessment and establishing the training goals and requirements, the commander can then design his gunnery training plan. This plan should follow the same flow of training as outlined in Figure

13-1 on page 13-8. The training events resourced by DA Pam 350-38 are shown in Table 13-1 on page 13-4. A notional training strategy for conduct of the training is shown in Table 13-2 on page 13-5. The commander must select an approach to training that suits his unit's needs and is structured to the average proficiency level of his unit. The commander and the primary trainers must now schedule training to coincide with the availability of training days, devices, and areas. Whenever possible, training events should be combined to maximize the available OPTEMPO and training days. An example of events that can be combined would be to structure a platoon FTX to evaluate the tasks trained on Tactical Tables D through I. The following is a list of the major components of a gunnery training program, in the recommended order of training:

- Preparatory crew member gunnery training.
- Maintenance program (PMCS, prepare-to-fire checks, AACs, gunnery checks).
- Intense training phase for new TC and gunner combinations.
- TCGST.
- UCOFT, AGTS, and AFIST, as shown in Tables 13-3 through 13-5 on pages 13-6 through 13-8. (See FM 17-12-7 for a description of these devices.)
- Basic gunnery training.
- Platoon gunnery trainers (PGT) (M1A1 units), if available.
- AGTS training in platoon mode (M1A2 units).
- Intermediate and advanced tank gunnery tables.
- Close combat tactical trainer (CCTT) to train all crew members in a simulated tactical environment.
- Intermediate and advanced tank tactical tables.

Table 13-1. Tank Gunnery Training Program (Firing Twice Annually).

	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Main gun qualification						X						X
INDIVIDUAL												
TCGST	D			R			D			R		
***CREW**												
UCOFT/AGTS	X	X	X	X	X	X	X	X	X	X	X	X
Tank Table I		X						X				
Stationary tank (Table II)		X						X				
Moving tank (Table III)			X						X			
*TCPC (Table IV)				X						X		
Table C			X						X			
Accuracy screening test						X						X
Preliminary machine gun (Table V)						X						X
*Preliminary main gun (Table VI)						X						X
Intermediate training course (Table VII)						X						X
Crew qualification (Table VIII)						X						X
***PLATOON**												
**Advanced training course (Table XI)						X						
Advanced qualification (Table XII)						X						
Platoon tactical training (Tables G and H)												X
Platoon tactical qualification (Table I)												X

D = Diagnostic **R** = Record

*Use appropriate training device(s) (such as TWGSS).

**Inbore device.

Note. UCOFT: Prior to live-fire, each crew should complete Group 2 Original Matrix, Group 1 Advanced Matrix, and qualify a gate-to-live-fire exercise. Tank Tables II and III can be replaced by firing Group 2 Regular Matrix and Group 1 Advanced Matrix. If, due to time constraints, these requirements cannot be met, the following exercises should be fired successfully: 21241, 22211, 31211, 33221, 33311, 33331, 33461, 33511, 33521, and gate-to-live-fire.

AGTS: Prior to live-fire, each crew should complete all basic pre-live-fire exercises and qualify on a gate-to-live-fire exercise. Tank Tables II and III can be replaced by firing Advanced Skill Level I Crew Training Program.

Table 13-2. Notional Annual Training Program.

Event	TRC A	TRC B	TRC C
Basic Gunnery Tables II and III (COFT and AGTS)*	2	2	2
Table IV**	2	1	1
Table V	2	1	1
Accuracy Screening Test	2	1	1
Table VI (TWGSS)	2	1	1
Table VII (Main Gun)	2	1	1
Table VIII (Main Gun)	2	1	1
Basic Tactical Tables A through C	2	1	1
Intermediate Tactical Tables D through F	2	1	1
Table XI (TWGSS)	1	0	0
Table XII (Main Gun)	1	0	0
Advanced Tactical Tables G through I	1	1	1
Platoon FTX	4	1	1
Combined Arms Live-Fire Exercise (CALFEX) (TWGSS)	1	0	0

* TRC B&C units that cannot conduct these tasks in UCOFT due to resource constraints may utilize AFIST see Chapter 14 page 14-3.

** Table IV will not be qualified in the COFT, AGTS, AFIST or any similar device.

Table 13-3. COFT Training Milestones.

Milestone	Description	Training Time (approximate)
Initial Training	Tank combat training before beginning COFT training. The following skills are trained in the initial phase: • Using fire control system. • Issuing and responding to fire commands. • Laying main gun for direction and target hand-off. • Proper engagement techniques and procedures. • Target acquisition and identification.	15 to 20 hours
Intensive Training	Concentrated training on the COFT, used to build skills to a level that can be retained with less frequent training sessions. Intensive training should be used to complete the following: • Through Group 2 (original matrix). Crews must complete Group 2 of the original matrix before entering Group 1 of the advanced matrix. • Group 1 and Gate (advanced matrix). The Gate exercise is the live-fire prerequisite. **Note.** Groups 3 through 6 of the original matrix are used for remedial training for new crews or crews who have difficulty in the advanced matrix.	Through Group 2 (original matrix)—10 to 15 hours. Group 1 and Gate (advanced matrix)—8 to 12 hours.
Intermediate Gunnery Training	Group 2 (advanced matrix).	12 to 15 hours
Advanced Gunnery Training	Group 3 (advanced matrix). Crew certifies when they successfully complete Group 3 of advanced matrix.	14 to 17 hours
Sustainment Training	Group 4 (advanced matrix, unlimited configurations of exercises).	Unlimited replications.

Table 13-4. AGST Training Milestones.

Milestone	Description	Training Time (approximate)
Initial Training	Tank gunnery training before beginning AGTS training. The following skills are trained in the initial phase: • Use of the fire control system (GCDP, CID, CITV). • Issuing and responding to fire commands. • Proper engagement techniques and procedures. • Target acquisition and identification. • Laying the main gun for direction, including target designate.	35 to 40 hours
Intensive Training	Intensive training on the AGTS is used to build gunnery skills to a level that can be retained with less frequent training sessions. Crews should attain the following level within the intensive phase: • Pass the seven basic prelive-fire exercises. • Complete a Gate to live-fire exercise with a passing score.	8 to 12 hours
Basic Gunnery Training	Advanced Skill Level 1.	10 to 15 hours
Intermediate Gunnery Training	Advanced Skill Level 2.	18 to 24 hours
Advanced Gunnery Training	Advanced Skill Level 3.	26 to 30 hours
Sustainment Training	Random exercises from the entire matrix, with combat conditions.	Unlimited replications.

Table 13-5. A-FIST Training Milestones.

Milestone	Description	Training Time (approximate)
Preparatory Training	Tank combat training, before beginning AFIST training.	15 to 20 hours
Initial Training	Initial training will include the following: • Use of the fire control system. • Issuing and responding to fire commands. • Target acquisition and identification. • Laying the main gun for direction. • Occupy defensive fighting position.	35 to 40 hours
Intensive Training	Intensive training should be used to complete the following: • Groups 1 through 4. • TT IV Qualification. • TT VIII Qualification per FM 3-20.12 standards.	8 to 12 hours
Sustainment Training	Groups 4 and 6 Evaluation.	Unlimited replications.

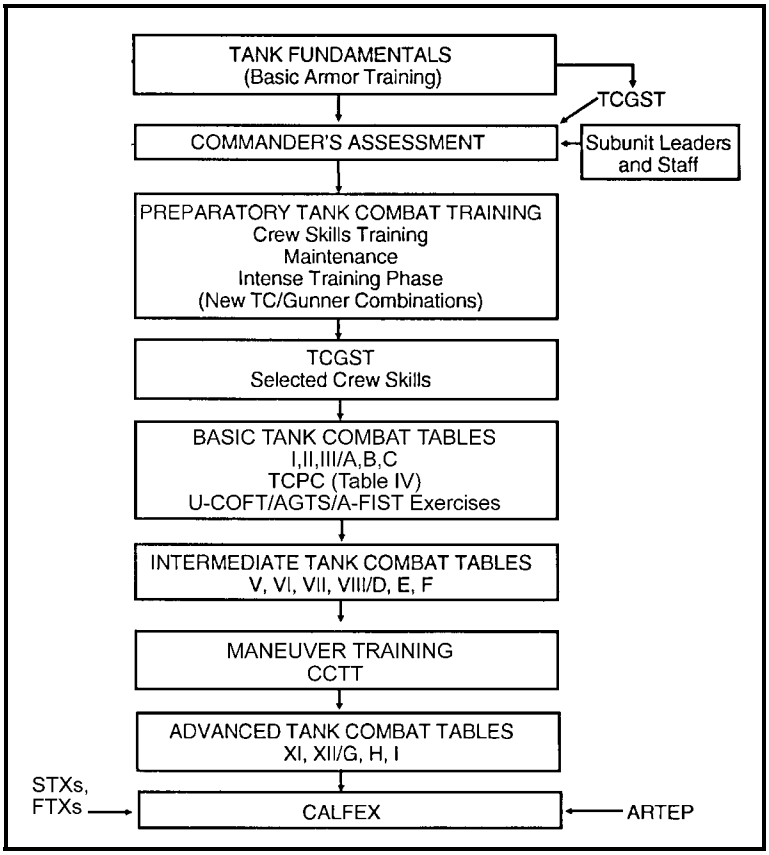


Figure 13-1. Gunnery Progression Chart.

Preparatory Tank Gunnery Training

To employ the Abrams FCS in both fully-operational and degraded modes, the tank crew needs to understand how the tank functions, how to detect malfunctions, and how to perform maintenance. To engage and destroy targets quickly, each crew member's responses must be automatic. Each crew member must be cross-trained to know the duties of the other crew members, so the loss of one does not destroy the fighting effectiveness of the tank.

The core of the tank crew is the TC and gunner combination. Careful consideration should be made when selecting personnel for these positions. Technical expertise, motivation, discipline, compatibility, and stabilization are key factors for successful TC and gunner combinations.

Armor crewmen are taught tank fundamentals during one-station unit training (OSUT) before being assigned to a unit. When previous gunnery and TCGST results show weaknesses in these fundamentals, those crew members should be retrained. Training is the TC's responsibility, but the commander must give the TC time and resources for training.

Each crew member should know the fundamentals of safety, communications, and maintenance.

- ***Safety.*** Each crew member should know how to—
  - Mount and dismount the tank.
  - Exit the tank in emergencies, which include rollover drills, fire evacuation drills (crew compartment and engine), ammunition fire (bustle and hull), and loss of power, steering, or brakes.
  - Act as a ground guide for the tank.
  - Drive at night using AN/VVS-2 and NVGs.
  - Follow safety procedures.
- ***Communications.*** Each crew member should know how to—
  - Maintain and operate the tank communication system.
  - Use visual signaling techniques.
  - Follow radiotelephone procedures.
  - Place digital enabling systems into operation.
- ***Maintenance.*** Each crew member should understand the operating limitations and know how to—
  - Perform before-operation PMCS.
  - Perform during-operation PMCS.
  - Perform prepare-to-fire checks.
  - Perform plumb and synchronization (M1A2).
  - Perform AACs and gunnery checks.
  - Perform PMCS on crew-served weapons.
  - Employ basic recovery techniques.
  - Perform after-operation PMCS.
  - Conduct starting operations.
  - Follow operator's troubleshooting procedures.

BORESIGHTING

The basis of tank accuracy is precise boresighting. Like prepare-to-fire checks, initial boresight training must be conducted to ensure the crew is capable of performing the procedure step-by-step correctly. After initial boresight training, crews should be required to boresight the tank, at least weekly. Boresighting is a combat-critical skill. Crews must be able to boresight or conduct a boresight check precisely and routinely (using Chapter 2, *Boresighting*), with no supervision. Facilities should be set up in or near the motor pool to facilitate boresighting during maintenance and the TCGST, and before and after semiannual services and gunnery training. During tactical operations, boresighting should be conducted as the tactical situation permits.

ARMAMENT ACCURACY CHECKS

When performed monthly in accordance with Chapter 3, *Armament Accuracy Checks,* AACs help ensure the operational readiness of the Abrams FCS. AACs are also a valuable training tool for initial and sustained crew skill training. AACs teach and reinforce how the FCS operates.

Note. Gunnery checks from TM 9-2350-264-10-2 (M1A1); TM 9-2350-255-10-2 (M1 and M1IP); TM 9-2350-288-10-2 (M1A2), Appendix F; or TM 9-2350-388-10 (M1A2 SEP) parallels AACs 4 and 5 and can, therefore, be used to train crews and verify the operational readiness of the FCS.

CREW SKILLS TRAINING

Crew skills training is taught in two phases. Phase I (Fire Control Training) ensures that battle-rostered crews and new TC and gunner combinations are technically proficient with the Abrams FCS. This phase should be used for initial and sustainment training.

Phase II (Manipulation Drills) is designed to train crews to a high degree of proficiency in manipulating the FCS to bring fire on the enemy with speed and accuracy. These skills are easy to train and are not resource intensive. Manipulation drills are only as effective as the quality of time spent on them and the standard that is set. Command emphasis and participation are critical to make these drills successful. Phase II can be conducted as Tables I, II, and III and can be conducted in the UCOFT, AGTS, or AFIST if resources are unavailable.

Commanders, with the master gunner's advice, must select qualified TCs and gunners to be instructors and evaluators. These personnel must display a high degree of technical and tactical proficiency with the FCS and tank gunnery. They will organize, instruct, and evaluate the training objectives to the commander's standard. Instructors and evaluators comprise the proofing team, and perform the screening test duties outlined in Chapter 5, *Screening Test.*

PHASE I—FIRE CONTROL TRAINING

Before gunnery training, tank crews must know the operating principles and capabilities of the FCS. This information can be found in the operator's manual (Chapter 1, Sections I, II, and III). Units should develop fire control lesson plans and examinations based on this information. These classes and examinations should be given periodically to established crews, and used in the selection process for new TCs and gunners.

Fire Control Technology

Switchology training (training to use the switches on the GPS, TIS, CITV, and CCP or GCDP) is recommended after successful completion of gunnery exams. Switchology training takes place on the vehicle with the crew member's position prepared for operation (hatches, guards, and weapons properly positioned; CVC uniforms worn; and protective gear ready).

The evaluator will have the crewman conduct various functions such as magnification selection, main gun selection, fire control mode selection, and reticle and TIS adjustments while observing through the CITV, GPS, or GPSE. Trainers should also evaluate the crewman's responses to situations that require other reactionary functions such as computer self-tests (M1 and M1A1), FCS tests (M1A2), MRS updates, ballistic data entries, and responses to fault indicators and messages. Crews should also train wearing CVC gloves and protective masks (in NBC posture).

Prepare-to-Fire Checks

During initial crew skills training, new TCs and gunners should be supervised on conducting prepare-to-fire checks using the operator's manual. These checks and services are critical to the success of other gunnery-related tasks. When the trainer uses the prepare-to-fire checks as a training tool, he can verify that the crewman understands the operation of the FCS and switchology.

PHASE II—MANIPULATION DRILLS

Manipulation drills consist of gun-laying exercises, tracking board exercises, and target hand-off exercises.

Gun-Laying Exercises

Gun laying requires the TC to lay the gun for direction so that the gunner can identify a target. Speed and accuracy of the gun lay are emphasized. Units with access to full-scale ranges, or areas where they can construct one, should use them. Scaled ranges are less desirable, but may be used. If pop-up targets are used, they are raised on command of the evaluator. Targets should depict flank, frontal, oblique, and hull-down views. The following exercises train laying the main gun for direction from a stationary tank and a moving tank.

STATIONARY TANK GUN-LAYING EXERCISE	
TASK:	Lay the main gun for direction.
CONDITIONS:	Given the following: • A stationary hull-down Abrams tank. • Stationary targets located to the tank's front.
Notes. M1A2 crews will use the CITV to perform this task. This training can also be conducted while practicing moving from a turret-down to a hull-down position.	
STANDARDS:	The TC must lay the main gun on target so that the gunner can identify the target through the GPS in 10X within six seconds after target designation. The TC must successfully lay the main gun for 70 percent of the targets.

MOVING TANK GUN-LAYING EXERCISE	
TASK:	Lay the main gun for direction.
CONDITIONS:	Given the following: • A moving Abrams tank. • Stationary targets located along the tank's route of travel.
Note. M1A2 crews will use the CITV to perform this task.	
STANDARDS:	The TC must lay the main gun on target so that the gunner can identify the target through the GPS in 10X within six seconds after target designation. The TC must successfully lay the main gun for 70 percent of the targets.

Tracking Board (Snake Board) Exercises

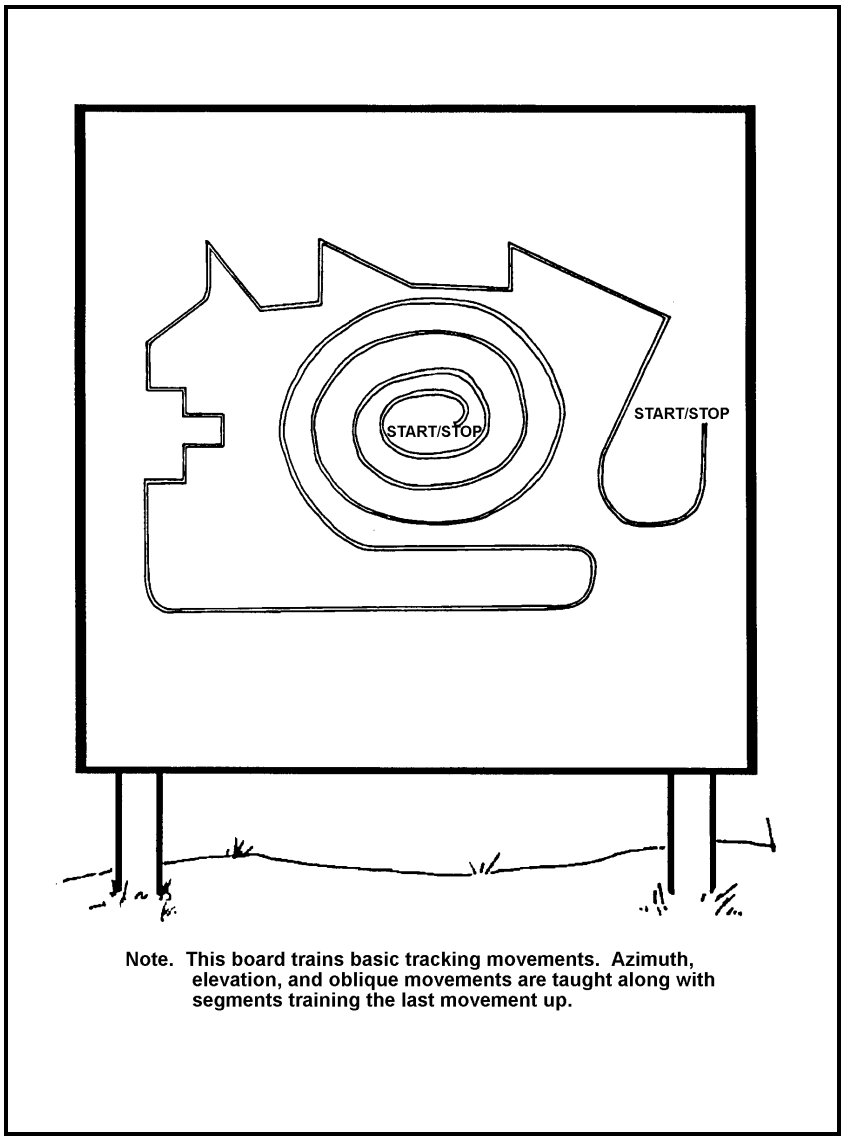
Tracking boards are extremely effective tools in training hand-and-eye coordination, turret control, speed, and accuracy. Tracking boards should have a wide variety of designs with horizontal, vertical, and oblique motion in any direction. The boards may also incorporate (along the board path) scaled targets that replicate the most effective way to lay onto, lase, and engage a target. Paths on the boards should be tracked in all fire control modes, and incorporate the use of all sights. The goal of this training is for the gunner to reach the level of familiarity with his system at which he anticipates movements of the sight and can, therefore, maintain his

point of aim while tracking. (Examples of tracking boards can be found on pages 13-13 through 13-16.) The following tracking board exercise trains the crew to manipulate the fire control system.

Note. Tracking boards can be thermalized using no-power thermal paper.

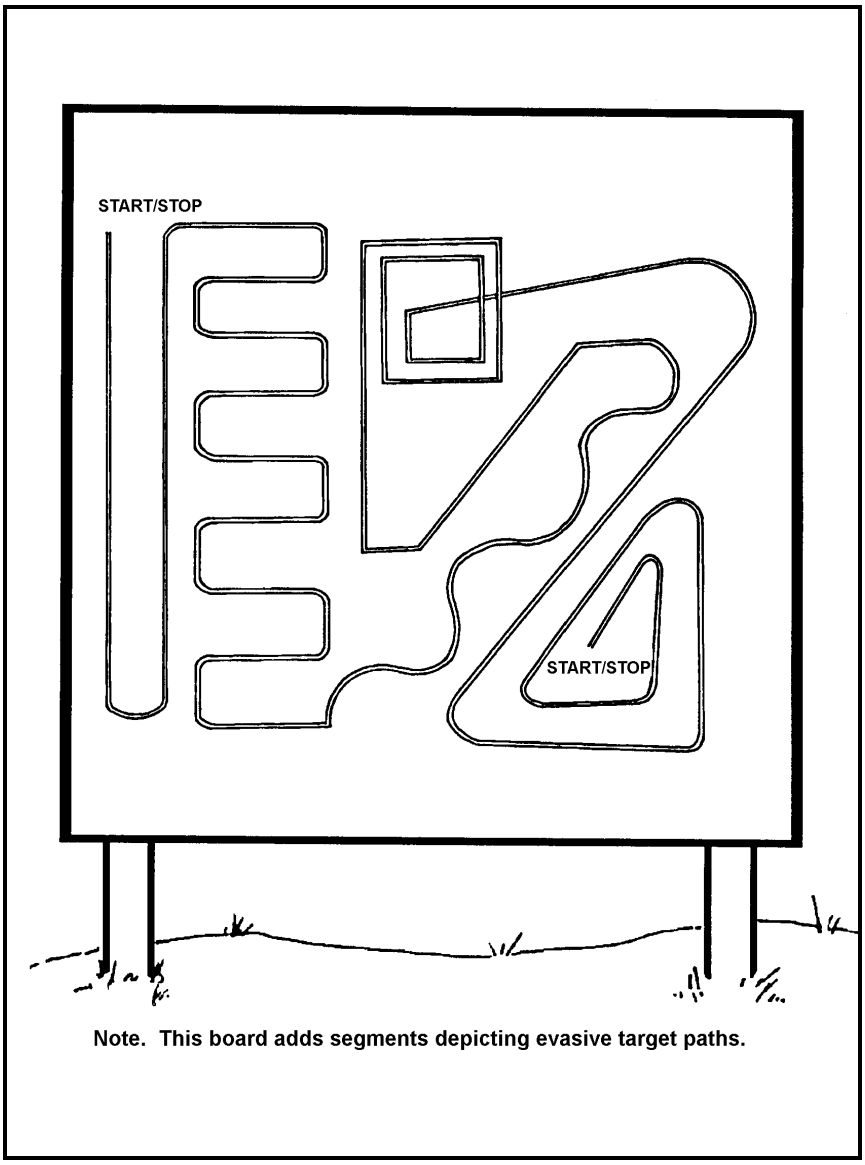
TRACKING EXERCISE	
TASK:	Negotiate a tracking board.
CONDITIONS:	Given the following: • A stationary Abrams with operational GPS, GPSE, and/or CITV. • Four tracking boards, progressing from simple to more difficult.
Notes. This training can be done in the unit motor pool. With the GPS and the CITV, M1A2 crews can perform this training simultaneously.	
STANDARDS:	The TC or gunner must— • Use the appropriate sight to track. • Track each tracking board, keeping the 1-mil aiming circle in the GPS or GPSE between the parallel tracking lines.
Note. The aiming point on the reticle should not be outside the shaded area for more than two seconds on each tracking exercise.	

TRACKING BOARD MEASUREMENTS	
Tank-to-Target Distance (meters)	**Width Between Parallel Lines (millimeters)**
5	**14**
10	**28**
15	**42**
20	**56**
25	**70**
30	**84**
35	**98**
40	**112**
45	**126**
50	**140**



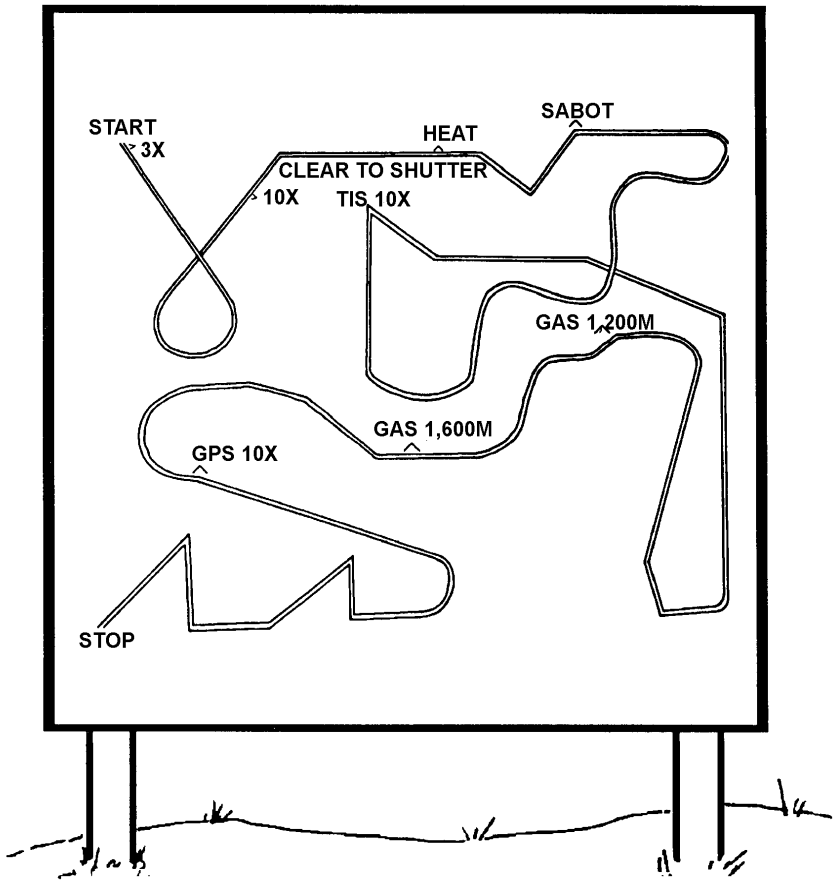
Note. This board trains basic tracking movements. Azimuth, elevation, and oblique movements are taught along with segments training the last movement up.

Figure 13-2. Tracking Board 1 Graphic.



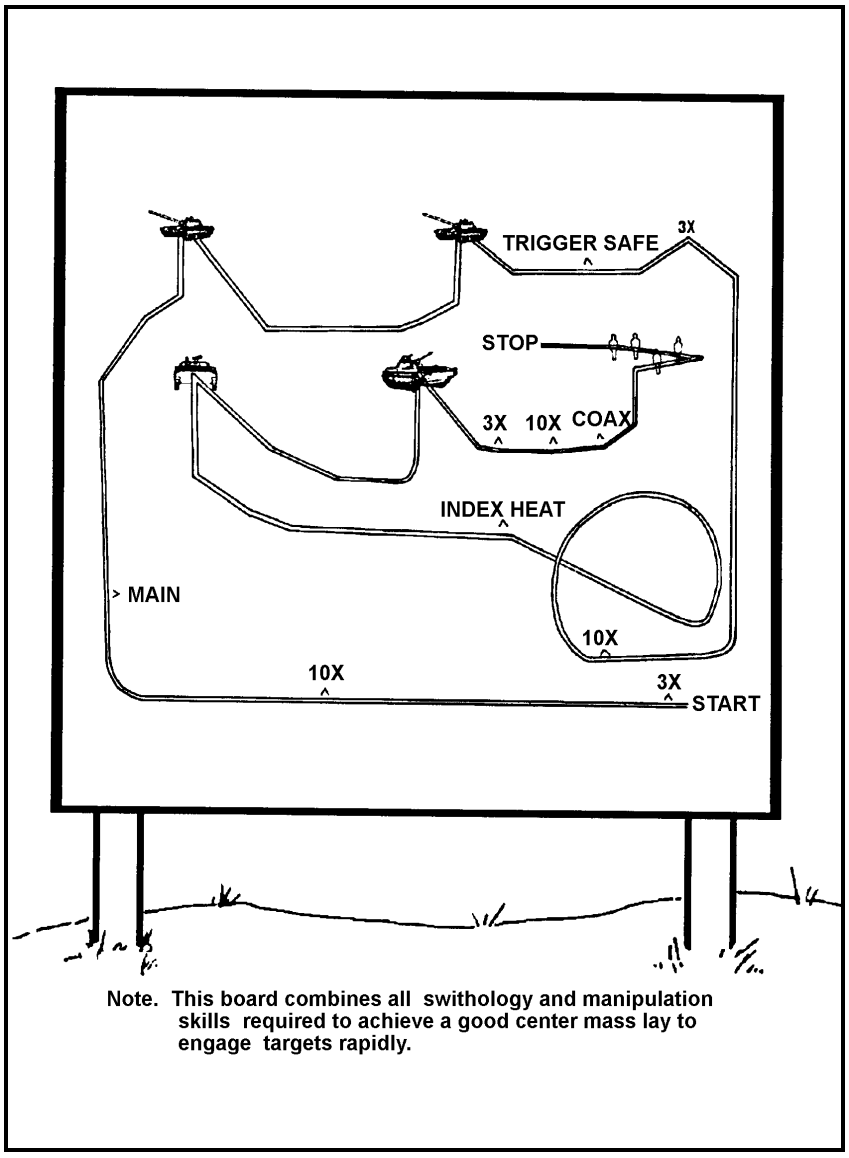
Note. This board adds segments depicting evasive target paths.

Figure 13-3. Tracking Board 2 Graphic.



Note. This board incorporates switchology into manipulation training.

Figure 13-4. Tracking Board 3 Graphic.



Note. This board combines all swithology and manipulation skills required to achieve a good center mass lay to engage targets rapidly.

Figure 13-5. Tracking Board 4 Graphic.

Target Hand-Off Exercise

Target hand-off exercises allow the evaluator to evaluate the gunner's ability to acquire, lay on, and destroy a series of targets. While the UCOFT and AGTS can be used to teach procedures for reticle lay, these procedures should be practiced intensely and evaluated on the tank during initial training, and on a regular basis for experienced crews. AGTS has eight CITV hand-off exercises designed to evaluate target designate and choking ranges using stadia reticle. The best way to conduct manipulation drills is with scaled targets. Normally, a 1/10-scale target is best suited for this type of training (see TC 25-8 for additional information on scaled targets).

Training will be enhanced by mounting targets on a lifting devices to add realism. If lifting devices are not available, number the targets as a control measure. The targets must be spread far enough apart to force the gunner to scan. With the circuit tester installed in the breech and the main gun armed, the evaluator observes through the GPSE or CITV, issues the gunner a series of targets (by number), and starts the stopwatch. The evaluator observes the gunner acquire the target, take a correct sight picture, and fire (indicated by a flash from the circuit tester). The evaluator records the time and makes comments on the log. The evaluator may have the gunner announce the range so the evaluator can place lead into the system to make sure the gunner dumps lead between engagements. Gunners are evaluated with one to five targets, presented all at once or time delayed. The evaluator may sit in the gunner's seat to evaluate the TC by having him acquire targets and lay the gun for direction. These drills are not resource intensive and can be accomplished in the motor pool.

Training Devices

A wide assortment of training devices are available that support gunnery training. Devices are used to help the crew or platoon through all three phases of the training process. Some crew duties can be trained almost as well with devices. Devices are a tool and should never be used as an alternative to main gun live firing. Before selecting a training device, the trainer must consider its training value and should—

- Analyze the task(s) he wants to train.
- Consider available devices and their suitability to teach crew or platoon task(s).
- Prepare an evaluation plan based on the duties that can be trained with available device(s).
- Consider negative vs positive training incurred when using certain devices.
- Consider the unit’s training time.
- Consider whether outside support is required.
- Determine if the training device requires specialized operators or installation.

Note. Complete descriptions of training devices, target mechanisms, and training exercises may be found in FM 17-12-7, TC 25-1, TC 25-8, DA Pam 350-9, and local Training Support Center (TSC) catalogs.

Tank Crew Gunnery Skills Test

The TCGST should be given to a crew after Phase II of crew skills training. The results will be used to determine if the crewmen are trained to a level of proficiency so they can move to sustainment training.

Throughout the training year, the TCGST may be given to crews to ensure they maintain proficiency. Many of these tasks (see Chapter 12, *Tank Crew Gunnery Skills Test [TCGST]*) may be incorporated during routine maintenance and training.

Chapter 12 contains the tasks, conditions, standards, administrative guides and criterion scoring checklists for the TCGST. The TCGST can be used as both a diagnostic tool and a semiannual test. Test all assigned MOS 19K personnel at the start of the gunnery program to assess their abilities to perform common and specialized skills. All other personnel who occupy, or will occupy, a crew slot must also take the test.

The commander uses the TCGST as a diagnostic tool for planning his gunnery training program and to ensure all personnel have a standard level of individual skills. Commanders should make sure all TCGST evaluators pass the TCGST before administering the test.

Recommend that personnel successfully complete the TCGST within six months prior to Tank Table IV live simulation. To meet this requirement, the test should be administered at least once every six months, and a diagnostic TCGST administered at least every three months for assigned personnel. A unit will probably have to conduct the diagnostic test more often to evaluate new personnel before main gun firing. The TCGST must be given to new TCs and gunners who have just completed Phases I and II of crew skills training.

THERMAL-MODE TRAINING

The TIS (M1, M1A1, and M1A2), CITV (M1A2), and FLIR (M1A2 SEP) can be used for day and night training (training should reflect both). This training can be conducted on a full-scale or scaled range; it is recommended that it be accomplished during Table III.

To conduct thermal-mode training, place full-scale thermal targets (see FM 17-12-7) at ranges from 400 meters out to the maximum range available. Units may use either local training areas or major training areas. Targets representing frontal, flank, hull-down, and oblique tanks; ATGM teams; BMPs; and troops should be used. Place at least half the targets in hull-down positions. Ideally, each target should be exposed only when needed. Use target mechanisms or manual methods to raise and lower targets. Crews should use the LRF to determine range to each target (M1A2 crews will use the CITV stadia reticle and designating capabilities to choke the estimated range to the gunner. The gunner will use the LRF to get an accurate range as long as the LRF is operational). M1A2 SEP crews should be trained using long-range targets due to the increased ranges viewable with the FLIR.

Additionally, a thermal training CD-ROM can be used to train thermal recognition of actual combat vehicles. This allows crews to see how the actual vehicle looks through the specific thermals of their particular Abrams tank (1st or 2d Gen FLIR). Crews may also be trained using actual friendly vehicles placed in a tactical array in a training area.

TARGET ACQUISITION TRAINING

Target acquisition training may vary from unit to unit. Commanders conduct target acquisition training representative of the unit's METL. Target acquisition training must be continuous; some form of target acquisition training can be found in almost all gunnery training. Commanders vary the targets, conditions, and situations to meet the needs of the unit. Timing standards may also be changed to challenge a unit's target acquisition skills. Target acquisition training can be conducted on full-scale ranges, or with scaled ranges using scaled targets.

To conduct target acquisition training, place eight stationary targets and two moving tank targets between 100 meters and the maximum range available. Targets should be in flank, frontal, hull-down, and oblique views. At least half should be in hull-down positions. Targets should be tactically arrayed and presented at different time intervals to ensure sectors of fire and observation at tank and platoon level are maintained. Some targets should be camouflaged to match the training area. Target acquisition should be trained using both daylight and thermal sights. All stationary targets should be the mechanical pop-up type, when available, and raised or exposed on command of the evaluator. Target locations must be changed to prevent memorization. Integrate target acquisition training with driver training to develop the target acquisition skills of the driver. Some of the targets should be friendly targets, identifiable by shape and color or some predetermined identifiable markings; for example, IFOR. FLIR-equipped tank crews should be trained at longer ranges.

Crews will perform this training in moving and stationary tanks. During UCOFT, AGTS, and AFIST training, the instructor/operator must ensure that each crew determines sectors of fire between the TC and gunner. As targets appear, the instructor/operator must enforce proper acquisition and identification procedures.

TARGET ACQUISITION EXERCISE—STATIONARY AND MOVING	
TASK:	Acquire various targets.
CONDITIONS:	Given the following: • An operational Abrams tank. • Eight stationary targets. • Two moving targets. • Targets located from 100 meters out to the maximum range available. • Crew members are presented only those targets within their assigned sectors.
Note. This exercise should be done in both open-hatch and closed-hatch positions.	
STANDARDS:	The crew must acquire and identify seven of ten targets within 8 seconds after target exposure.

RANGE ESTIMATION AND DETERMINATION TRAINING

The *range to a target* is one of the most important elements of the ballistic solution needed to engage the enemy successfully. Crews must be able to estimate and determine accurate range information in case of an LRF failure. Constant training is required to achieve and maintain proficiency.

For range estimation and determination training, place full-scale or half-scale stationary and moving targets at ranges from 500 meters out to the maximum range available. The targets should represent frontal, flank, oblique, and hull-down views of tanks; BMPs; and troops. Place at least half of the targets in hull-down positions. Ideally, each target should be exposed only when needed. If, on a full-scale range, the targets are not pop-up types, use at least two separate courses. The tank should use different hull-down firing positions during stationary training. Range estimation and determination can be trained in conjunction with target acquisition training as explained on page 13-17. If the training area is laser safe, obstructions (such as foliage, barbed wire, or smoke) should be placed between the tank and the target to produce multiple returns. Range estimation should be practiced using the GPS, CITV, TIS, FLIR, and the GAS. Chapter 7, *Range Determination*, explains the reticle relationship method, use of the GAS choke sight, and use of the CITV stadia reticle during range determination. These are a few of the alternate methods of determining range. These methods can easily be practiced on the UCOFT, AGTS, and AFIST.

RANGE ESTIMATION TRAINING EXERCISE	
TASK:	Estimate range to targets using the LRF, CITV, GAS, recognition, reticle relationship, mil relation, map, and known range methods.
CONDITIONS:	Given the following: • Stationary and moving Abrams tank. • Stationary and moving targets. • Sector of fire or axis of advance. • Targets located 500 meters out to maximum range. • Binoculars, GPS, CITV, TIS, and GAS.
Note. This exercise should be done in both open-hatch and closed-hatch positions.	
STANDARDS:	The TC and gunner must determine range to within ±10 meters of all targets with the LRF and 80 percent of the targets to within ±200 meters using alternate methods within 6 seconds per target.

SMOKE EMPLOYMENT TRAINING

Train to use smoke whenever training facilities permit. The M250 smoke grenade launcher system and VEESS can be used to mask movement out of firing positions or to provide a screen to maneuver behind if being engaged. Train to use the VEESS when maneuvering; commanders must stress that the crews use smoke whenever possible, so TCs can gain proficiency in the employment of the VEESS. Wind speed and direction are the primary considerations for VEESS employment. If available, smoke pots, smoke generators, or smoke grenades can be used in the maneuver areas and on ranges in the engagement area(s) to replicate a dirty battlefield. When training on the AGTS or UCOFT, instructors/operators should ensure that TCs make tactical decisions when to use the M250 smoke grenade launcher system.

CAUTION

Do *not* use the VEESS when using MOGAS or JP4 fuel on an Abrams tank. Using the VEESS when using MOGAS or JP4 fuel could cause a fire.

Tank Combat Tables

The tank combat tables consist of the tank gunnery tables (see Chapter 14, *Crew-Level Gunnery* and Chapter 15, *Collective Gunnery Training*) and the tank tactical tables (see Chapter 16, *Tank Tactical Tables*). Together, they provide a systematic way to train Abrams tank gunnery and tactical proficiency through tank platoon level. The following table shows the relationship between the tank gunnery tables and the tank tactical tables.

GUNNERY TABLES	TACTICAL TABLES
Provide: • Manipulation. • Crew duties. • Standard fire adjustment. • Use of all sights. • Use of full-up fire control. • Night firing. • Ammunition selection. • Use of degraded fire control.	**Provide:** • Realistic targets. • Tough acquisition problems. • Real target signatures. • Shoot-back targets. • Evasive targets. • Means to exercise vehicle mobility and agility. • Potential to vary vulnerability. • Full 360-degree range.
Do Not Provide: • Realistic targets. • Real target signatures. • Shoot-back targets. • Means to use system mobility. • Vulnerable areas. • Full 360-degree range.	**Do Not Provide:** • Full-crew duties. • Standard fire adjustment. • Use of all sights. • Use of full-up fire control. • Ammunition selection.

BASIC TABLES

The first phase of the tank combat tables consists of the basic tank gunnery tables (Tables I through IV) and the basic tank tactical tables (Tables A through C). These basic tables bring the crew together to develop the teamwork and coordination necessary to engage targets in a combat setting. The basic tank tactical tables should be conducted with the basic tank gunnery tables to prepare crews for the intermediate tables.

BASIC TANK GUNNERY TABLES

The concept of basic tank gunnery tables is to build gunnery skills in conjunction with the tank tactical skills. Tables II and III train crew tasks that combine skills practiced in individual basic tank combat training. Table IV (TCPC) is an evaluation table for the basic tables and must be completed successfully before a crew advances to the intermediate tables.

BASIC TANK TACTICAL TABLES

The basic tank tactical tables develop teamwork and coordination. Table A concentrates on individual skills and must be tested as a prerequisite to Tables B and C.

INTERMEDIATE TABLES

The second phase of tank combat training consists of the intermediate tank gunnery tables (Tables V through VIII) and intermediate tank tactical tables (Tables D through F).

INTERMEDIATE TANK GUNNERY TABLES

The intermediate tank gunnery tables are a logical extension of the basic tank gunnery tables. They train the crews to engage moving and stationary targets with all tank-mounted weapons during periods of daylight and limited visibility. The commander may conduct these tables employing the wingman concept, to begin the integration of tank crews into sections. The wingman cannot be an active participant, except for target observation. The ultimate goal of these tables is to qualify tank crews on the tank crew qualification course (Table VIII). Table VIII is a qualification table for the intermediate tank gunnery tables; the crew must complete Table VIII successfully before executing the advanced gunnery tables.

INTERMEDIATE TANK TACTICAL TABLES

The intermediate tank tactical tables (Tables D through F) will no longer be used by tank platoons because doctrinally, the platoon is the smallest maneuver element. However, these tables can be used to train the wingman concept within the platoon.

ADVANCED TABLES

The third phase of the tank combat tables consists of the advanced tank gunnery tables (Tables XI and XII) and the advanced tank tactical tables (Tables G through I). These advanced tables combine qualified crews to form platoons that must control and distribute fires under simulated combat conditions.

ADVANCED TANK GUNNERY TABLES

The advanced tank gunnery tables are an extension of the intermediate tank gunnery tables. The advanced tank gunnery tables train platoons to engage moving and stationary targets with all tank-mounted weapons during periods of daylight and limited visibility.

ADVANCED TANK TACTICAL TABLES

The advanced tank tactical tables train platoons to develop teamwork and coordination. They start with coordination within the platoon (Table G), move into platoon drills (Table H), and culminate in platoon reaction exercises (Table I).

Long-Range Tank Gunnery

Tank gunnery doctrine indicates that engagements at closer ranges have a better chance of success than those at farther ranges, and recommends that engagements begin at 2,000 to 2,500 meters, if the tactical situation permits. This recommendation is based on the P_H, P_K, effects of the dirty battlefield, and limited on-board ammunition. There may be situations, however, that will require crews to engage targets at extended ranges of 3,000 to 4,000 meters.

SELECTING TANKS AND CREWS

Not every tank crew can be successful at long-range gunnery. Based on the commander's assessment of crew demonstrated proficiency and tank accuracy, he may assign crews to tanks to serve as sniper crews. The following are some considerations for selecting sniper crews and tanks:

- TCs and crews should have demonstrated a high degree of accuracy in shorter range engagements.
- The crew must be able to give accurate sensings and make correct adjustments.
- The crew should have a thorough understanding of the FCS and its operation.
- The crew must have the knowledge and discipline to perform meticulous prepare-to-fire checks and frequent, precise boresighting.
- M1A2 SEP crews should be able to detect, recognize, and identify targets at longer ranges than other crews.

- The system must be fully operational, and every attempt should be made to use vehicles that have proven that they shoot accurately.
- The tank must be prepared carefully in accordance with the AACs and appropriate operator's manual.

Frequent, extremely precise boresighting is essential. Significant changes in weather conditions (day, night, overcast, or sunny) may require boresighting as often as every two to four hours (depending on the suddenness of the change) to maintain optimum boresight. When boresighting is not possible, crews may use the MRS (to perform MRS updates).

SENSINGS

There will be few instances when tank crews will be able to sense their own rounds accurately when they miss the target, even at extended ranges. Local obscuration and weather dictate how well a crew can sense its own rounds. However, in most cases (using daylight or thermal sight), a crew can sense the *splash* when the round strikes the target.

The best sensings for main gun engagements come from the wingman. With the limited amount of ammunition available in the ready rack, it is imperative for crews to inform other crews of sensings, no matter what. This allows the crew to check the operation of the vehicle and the crew's procedures.

During live-fire training on intermediate tank gunnery tables, the TC must allow the firing tank wingman to try to sense for him. Vehicle positioning, sectors of fire, and understanding the platoon fire plan allow TCs to sense for these wingmen periodically.

Scaled-Range Gunnery

Crew turbulence and the rising cost of tank main gun ammunition, fuel, and spare parts make it difficult to produce and maintain skilled tank crews. Moreover, units frequently cannot travel to major tank range complexes to fire as often as they should. To overcome these training limitations, gunnery must be trained more at home station using simulators, subcaliber training devices, and innovative training techniques.

By using scaled ranges, units can realistically simulate day and night tank main gun firing at home station by tank and platoon against single and multiple, stationary and moving targets. Actual machine gun engagements can be incorporated when a unit has enough space for the larger range safety zones they require. Targets representing friendly equipment should be placed in the target area to give the crew practice in distinguishing friend from foe. Terrain and target arrays can be set up to resemble anticipated enemy targets and actual terrain that correspond to the unit’s METL. The commander must choose the range scale that best suits his training needs and facilities. (See TC 25-8 for more information on scaled ranges.)

Training Analysis

Commanders and trainers should continually compile results from previously conducted training. This is especially important after a major training milestone has been completed. From the data collected, the effectiveness of the training used to prepare for these milestones should be evaluated for strengths and weaknesses. Data should not only be reviewed from within the unit, but results from sister units should be analyzed to determine if their program was more effective, and why. From this data, a lessons-learned list should be compiled, and the training program should be altered to concentrate on weak areas and sustain strengths. Following this procedure, the gunnery training cycle will continue and evolve as the unit’s needs change.

Range or Training Area for Tank Combat Training

A complete tank combat training program includes range firing and using training areas or dry-fire ranges to run tactical courses. It provides an opportunity to acquire targets in a realistic environment and to use the weapon systems to engage targets. Tactical training should be integrated with gunnery training, when possible, to provide a more realistic training environment. This section outlines procedures, duties, and responsibilities for establishing and operating tank gunnery ranges and tactical courses, to include developing scenarios for gunnery ranges.

ESTABLISHING A LIVE-FIRE TANK RANGE

SITE SELECTION

Before selecting a site, make a careful map study and ground reconnaissance of areas available for firing. The range must be large enough to accommodate all weapon systems, types of ammunition, and types of exercises to be fired (stationary or moving). Realistic conditions not provided by the selected terrain must be constructed; for example:

- Sufficient maneuver area and enough targets to provide several routes and target arrays.
- Targets in realistic arrays and, where possible, not marked by berms.
- Turret-down and hull-down firing positions.
- Routes that offer maximum cover and concealment but still allow acquisition and target engagements.
- Sand table layouts of the entire range area to aid *war gaming*.

Environmental Note: Whenever possible, choose gunnery training sites that minimize damage to vegetation and waterways.

Tank gunnery Tables III through XII are divided into stationary and moving portions. During the stationary portions of the tables, the tank moves from turret-down to hull-down and back during the course of each firing task.

The Abrams tank can fire accurately at speeds in excess of 48 kmph (30 mph). Most installations, however, do not have range facilities to support an Abrams moving and firing at these speeds.

SURFACE DANGER ZONE (SDZ) DIAGRAMS

When establishing ranges, tank units must submit SDZ diagrams to the installation range control facility for approval before firing. Restrictions and precautions for SDZ diagrams are found in AR 385-63 and TB MED 524. SDZ diagrams show range boundaries and safety features in overlay form, including safety limit markers for each firing position. Firing tables that provide values for range, maximum ordinates, and superelevation for each ammunition type are also required.

SDZ diagrams on established ranges should be modified, or request a waiver or deviation when these ranges do not provide realistic conditions or do not make maximum use of available terrain. Total range distance includes horizontal range corresponding to 10-degree quadrant elevation, and an allowance for the maneuver area and Area B, when required. This total range distance will be decreased only on a waiver basis. The main gun will not be fired at quadrant elevations greater than +5 degrees (+89 mils). This provides a safety factor of 5 degrees within the SDZ diagram. Firing limits for establishing ranges can be obtained from the local range control officer. Safety measures to ensure compliance will include, but are not limited to—

- Command supervision.
- Proper use of mechanical and automatic safeties.
- Placement of targets so the quadrant elevation will not exceed +5 degrees (+89 mils).

WARNING

LRFs will be used only on established laser-safe ranges. Do not fire the LRF at highly reflective surfaces at any range.

When non-eyesafe lasers (including the LRF) are used, the nominal ocular hazard distance (NOHD) (an additional buffer area) must be added to the SDZ diagram. The NOHD will vary for each type of laser device and type of terrain (backstops). (Refer to AR 385-63, Table 19-1, for the appropriate NOHD.) For the LRF, the NOHD is 7 kilometers. Every object the laser beam strikes will reflect energy. In most cases, this energy is diffused and is not hazardous. To prevent eye injury from a reflected laser beam, avoid shiny surfaces.

Remove mirrors, panes of glass or plastic, chrome-plated metal, or other flat mirror-like objects having a vertical or near-vertical surface from the target area. If it is impractical to remove some surfaces, cover them with lusterless paint. Cloth, cardboard, wood, and lusterless metal targets are acceptable for laser ranging.

Note. If you must construct an SDZ diagram, refer to AR 385-63.

RANGE OR TACTICAL COURSE RECONNAISSANCE

The OIC and NCOIC should personally conduct a reconnaissance and coordinate with range control headquarters before the unit occupies the range or training area. The reconnaissance should provide answers to the following questions:

- What route to the range or training area will be used?
- How many vehicles can run the combat course simultaneously?
- Are hull-down and turret-down positions available?
- What control facilities are available? What is their condition?
- Is the tower equipped with FM communication equipment?
- Are range safety markers visible for live fire? How will they be illuminated at night?
- How is access to the impact area controlled for live fire? What are guard requirements?
- Who furnishes targets, target supplies, or vehicle visual modification sets (VISMODS)? Where are targets stored? Are the targets the correct type, size, shape, and color? What is the condition of target mechanisms? Is there a boresight panel at the recommended range?
- What is the condition of moving targets? Are OPFOR vehicles and drivers available?
- Who furnishes TWGSS or MILES equipment for the tactical course? Is all TWGSS or MILES equipment accounted for and operational?
- Has the range or training area been cleared of unexploded ordnance?
- Who will furnish fire-fighting equipment, range flags, and range regulations?
- Does the range or training area provide adequate space for maneuvering tanks and the weapons to be used?
- Does the range provide firing positions for indirect-fire illumination?
- Does the range allow reduced tank-to-target ranges for limited visibility.
- Who will supply optics for scoring and control?
- Where are the following administrative areas:
  - Ammunition pad?
  - Misfire pit?
  - Mess area?
  - Latrine?
  - Helipad?
  - Aid station?
  - Troop break and billet areas?
  - Maintenance area?
  - Briefing and debriefing tent (AAR facility)?
  - Track vehicle parking area?
  - VIP parking area?
  - Wheel vehicle parking area?
  - Concurrent training area?

CONDUCT OF THE RANGE OR TRAINING AREA

ADMINISTRATION AND EMERGENCY DIRECTIONS

Poor administration reduces training time. Violation of established live-fire rules can result in a closed range. Administration requirements in AR 385-63, local range regulations, and unit MOIs can be used to plan personnel and equipment requirements. All current references should be placed in a notebook and kept at the training site at all times. Range control frequency, phone number, and certain emergency directions must be included. Emergency directions should include the MEDEVAC radio frequency and call sign; hospital phone numbers; and the frequency, call sign, and directions to the nearest aid station or dispensary.

REQUIRED PERSONNEL

The commander is responsible for safety during all phases of training; however, he designates an OIC for each range training area. The OIC is responsible for everything that occurs at the training site. The master gunner or other capable NCO conducts planning, preparation, coordination, and execution of the exercise. The commander also designates—

- A range safety officer (RSO) who will make sure—
  - All personnel have passed the TCGST in the last six months.
  - He conducts a safety briefing before any day or night firing.
  - All safety regulations are enforced.
  - All ammunition is handled correctly.
  - Smoking restrictions are enforced.
  - Misfires are handled as stated in AR 385-63 and the appropriate operator's manual.
  - Accidents are investigated and reported promptly in accordance with all regulations.
  - Weapons on live-fire ranges are pointed toward the impact area at all times.
  - Personnel are clear of the danger area (except as authorized in AR 385-63).
  - DA Forms 2408-4 (Weapon Record Data) are checked for accuracy and gun tube status.
  - All ammunition is checked for restricted or suspended lots, using TB 9-1300-385.
  - Barriers and guards are in place before the exercise is started.
  - Checks medics to make sure they have all required medical supplies and a vehicle for transporting casualties.
- An NCOIC who will supervise details and assist the OIC and RSO.
  - Coordinate placement of vehicles upon arrival.
- An ammunition NCO who will make sure—
  - All ammunition is delivered and properly stored at the training site.
  - The correct type and amount of ammunition is present at each training site.
  - Each tank receives the proper number of rounds, by type.
  - The training site is properly policed of brass and packaging materials.
  - All ammunition is checked to make sure no restricted or suspended lots are used in training.
- A target NCO who will make sure that—
  - Targets are the type and color specified by the OIC and placed in the correct array.
  - Moving targets are operable and trained operators are available.
  - The target detail is available when needed.
  - There are enough spare targets, target mechanisms, and batteries on hand to support the range or training area.
- Evaluators who will—
  - Act as instructors during practice exercises.
  - Act as evaluators during qualification.
  - Conduct firing, as directed by the OIC.
  - Ensure compliance with all safety procedures.

- A fire-fighting detail.
  - Know who they are.
  - Know the location of equipment.
  - Know how to use the equipment.
- Radiotelephone operators.
  - Be able to operate the radios.
  - Be able to use the SOI properly.
  - Maintain a communications log.
- A medical aidman who must—
  - Have an identification card with a red cross on it, or an MFR from the battalion commander stating that he is qualified to act as an aidman (combat lifesaver).
  - Have an aid bag.
  - Have a vehicle available that has been properly dispatched with proper fuel and oil levels.
  - Know how to get to the aid station or hospital (primary and alternate route) and have rehearsed the route.
  - Be a licensed driver (not a primary driver of his vehicle).
- Briefing NCO.
  - Knows how to conduct range operations.
  - Knows who is firing.
  - Knows the results of the crews/platoons already fired.
  - Knows the location of other key personnel.
- Concurrent training NCO.
  - Ensures proper set up and running of site.
  - Maintains control of personnel on site.
  - Gathers site information for the OIC.

Note. For moving tank ranges, personnel requirements are larger; usually more evaluators are needed.

RANGE EQUIPMENT

The OIC and NCOIC should make sure the following suggested equipment is on hand:

- For gunnery and tactical exercises:
  - MOI for the exercise.
  - Range regulations.
  - All other required regulations, SOPs, maps, and overlays.
  - Waivers, if necessary.
  - RSO and OIC certification cards.
  - TMs and operators manuals for all equipment on the range.
  - FM radio sets and antennas.
  - Evaluator communications (jump radios).
  - Targets and target operating and control mechanisms.
  - Target repair equipment.
  - Flashlights for scorers.
  - Batteries for lights and radios.
  - Clipboards.
  - Water.
  - Stop signs.
  - Engineer tape.
  - Fire extinguishers for ammunition pads.

  - No smoking signs.
  - Ammunition markers.
  - Flag sets.
  - Recovery means.
  - Briefing tent.
  - Scoresheets.
  - Stopwatches/eight-face punch clock.
  - Binoculars/spotting scope.
  - Night-vision devices.
  - Field telephones, as required.
  - Fire-fighting equipment.
  - Vehicles for target and scoring detail, fire-fighting detail, backup aid vehicle, and safety officers (moving range).
  - Generators to power light sets.
  - Equipment for concurrent training.
  - Boresight equipment, including main gun and caliber .50 muzzle boresight device.
  - Other TOE and expendable supplies.
- For gunnery exercises:
  - Range flag.
  - Range lights, chemical lights, or lanterns.
  - Compass for marking rounds out of impact area.
  - M1A1 gunner's quadrant.
- For tactical exercises:
  - TWGSS or MILES equipment.
  - OPFOR equipment (VISMODS, personal gear if available).
  - OPFOR personnel.
  - ELF.
  - Target signature devices.
  - Blank adapters.
- Environmental: Ensure that absorbent materials are available for spills.

RANGE OR TRAINING AREA LAYOUT

A well-organized gunnery range provides maximum firing time. If ranges are planned and organized in advance and all equipment is gathered before moving to the range, firing can start on time and finish in time to allow an orderly move off the range.

A good battalion-level range MOI will save both time and energy for the firing unit. The MOI should include guidelines for occupying the range and describe actions to be taken for specific tasks:

- Coordinating with maintenance contact teams.
- Replacing targets.
- Repairing target mechanisms.
- Fighting range fires.
- Breaking down ammunition.
- Moving vehicles to the ammunition point and to the ready line.
- Firing orders.
- Policing the range.
- Departing the range.

The conduct of moving tank ranges generally parallels that of stationary tank ranges. Moving tank ranges have maneuver box areas, instead of stationary firing positions, and are laid out to make sure firing is within limits. When possible, course runs will not be limited to roads or range trails, but will be designed to maneuver cross-country.

DEVELOPING SCENARIOS FOR GUNNERY TABLES

Each installation may have specific requirements for scenario development; be sure to check the local SOPs before beginning. When planning the scenarios for a qualification range, remember that a minimum of two scenarios per lane must be developed and utilized to be considered a qualification range.

The following planning guide is designed to help units develop tank table scenarios for gunnery ranges and training areas. This planning guide consists of the planning, development, and proofing processes.

Planning the Scenario

Include the following when planning the range scenario:

- Identify which tables and tasks are going to be fired.
- Coordinate with the range facility manager to gather information about the facility. Determine if the SDZ diagram is current; construct one, if necessary. As a minimum, you will need to obtain the following information about your facility:
  - A scaled range diagram (preferably in 100-meter increments) that identifies target pits (by type), battle positions, and firing points or map of the training area.
  - A fire/no-fire matrix (if available), which is the authorized list of targets allowed to be fired within the SDZ diagram from each firing point/battle position.
- Conduct a reconnaissance of the facility to better prepare yourself for the lay of the land. Also—
  - Identify any restrictions for the facility.
  - Determine the best lanes that allow the most targets to be engaged.
  - Determine if the facility supports dual-lane scenario or only single-lane firing.
  - Determine the layout of course roads to identify a course speed.
  - Determine if the facility supports firing multiple weapons platforms simultaneously.
- Based on the assessment of the lanes to be used, determine a course speed, using the following criteria:
  - Each offensive firing task will require approximately 65 seconds for a one- or two-target engagement or 90 seconds for a three-target engagement. These times reflect 7.5 seconds on each end of the engagement for speeding up and slowing down of the vehicle. The following shows how far a vehicle will travel at the speeds indicated:

    40 kmph = 11.11 meters per second (m/s).
    35 kmph = 9.72 m/s.
    30 kmph = 8.33 m/s.
    25 kmph = 6.94 m/s.
    20 kmph = 5.56 m/s.
    15 kmph = 4.17 m/s.

  - Given that 65 seconds is constant for one- and two-target engagements and 90 seconds is constant for three-target engagements, base the calculations on the amount of maneuver space available at the facility. For example, if there are 500 meters between BPs and you decide to bound from BP to BP, you will need to incorporate a course speed of 20 kmph for a three-target engagement. If you used 25 kmph in your calculations, you will bound beyond the BP by 125 meters.

    20 kmph = 5.56 m/s x 90 = 500.4 meters.
    25 kmph = 6.94 m/s x 90 = 624.9 meters.

Developing the Scenario

Before developing the scenario, you should be able to answer the following questions:

- How many lanes will be firing?
- What is the maximum distance of the firing box for offensive engagements?
- What is the course speed?
- What is the order of tasks for each scenario?
- Is cross firing allowed on the range?

Once the above questions have been answered, continue to develop the scenario, including the following:

- Identify the first firing position and the first task to be fired.
- Locate targets within the range band for the required conditions of the task. For offensive tasks with delay target(s), you will need to estimate where the firing tank should be (based on course speed) to determine which target(s) to select. Make sure the targets meet lateral dispersion requirements. A rule of thumb is to identify the lateral dispersion mid-point for the engagement, then adjust to the targetry available. Identify alternate targets for each engagement.
- If you are firing a dual-lane scenario, consider where the firing tanks are in relation to each other when one finishes an engagement. Neither firing tank should be placed in the danger zone of the other while firing.
- When listing target information, include the following:
  - Target pit number.
  - Target type.
  - Tank-to-target range.
  - Exposure time (delay time, if applicable).
  - Hostile fire signature (at least five seconds after exposure).
  - Type of ammunition to be fired at the target.
  - Number of hits required to kill the target.
  - Target speed (if moving).
  - Target direction (if moving).
  - Evasive moving target (plan maneuver).
  - Alternate target number (if applicable).

Proofing the Scenario

After the scenario is approved on paper, it must be proofed on the facility using a tank(s). It is imperative that this be conducted before the unit arrives, to prevent lost training time. The effort placed on proofing will reap big benefits when it's time to fire.

If firing a dual-lane scenario, proof both lanes at the same time—the range computer program is set up this way. All conditions must be the same as if actually firing.

Each target should be checked for validity by making sure it can be viewed through the GAS throughout the entire exposure time. Using only the GPS to proof can lead to dead space within the gun-target line. Verify the exposure times that the targets are presented.

TARGETS

Full-scale targets should be of the same shape, size, and color as the enemy targets they represent. FM 17-12-7 describes targets, target mechanisms, and target control, in more detail.

Hard Targets (Live Fire)

When available and where ricochets do not present safety hazards, some hard targets are preferred when firing main gun service ammunition. Old tank hulls and turrets, armored personnel carriers, and wheel vehicles make good hard targets. Filled with sand or dirt, these will withstand many hits.

Soft Targets (Live Fire)

Soft targets made from target cloth or wood by the unit or range control activity should be painted to match the color of the threat vehicles in that theater of operation.

TANK FLAGS

The following illustration shows the flags that may be displayed on a firing tank.

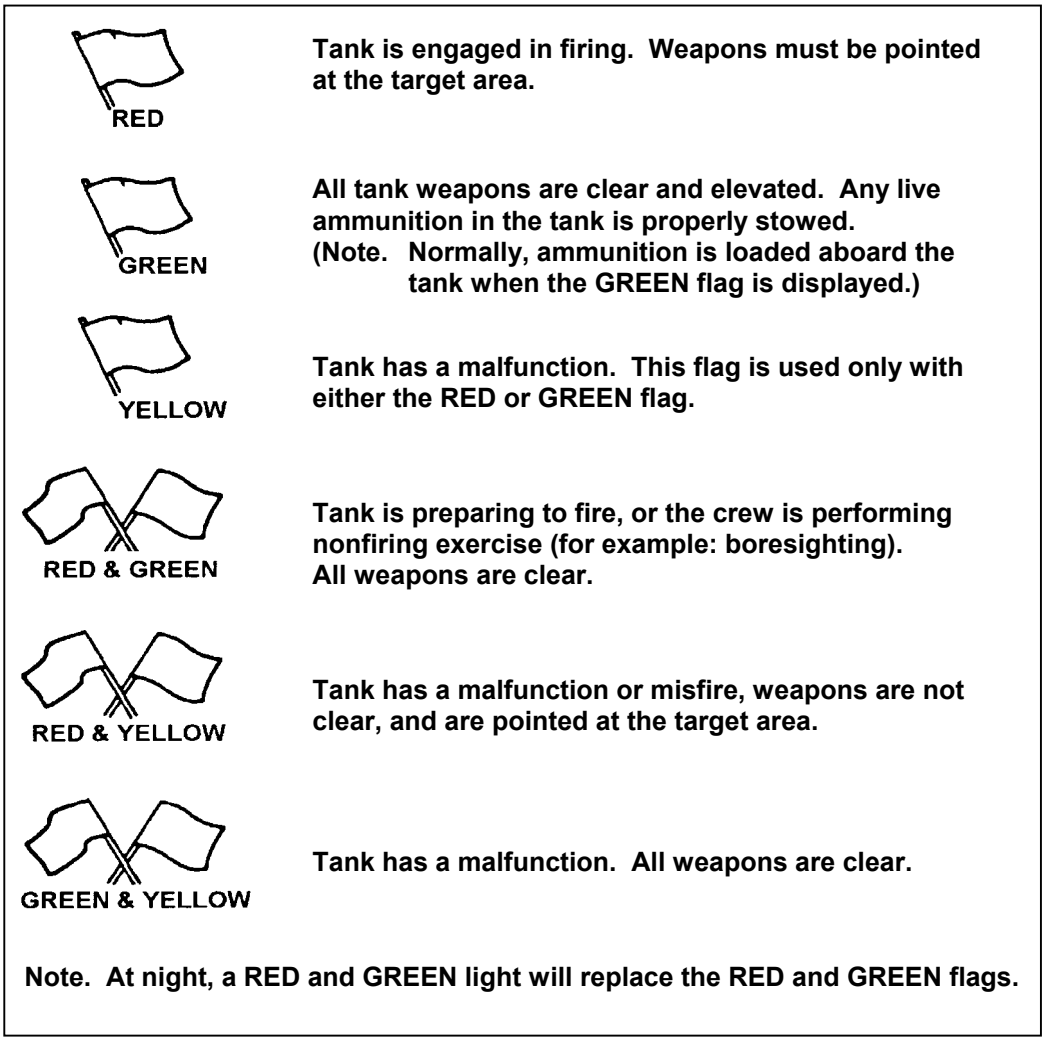


Figure 13-6. Tank Flags.

RANGE CONTROL

The range control officer is responsible for the coordination and safe conduct of range activity for all units using range facilities. Normally, unit leaders will be required to receive a range briefing from the range control officer before occupying a range. Schedule to receive this briefing at least one day prior to range operations to prevent any delay in training. Range control should also provide a set of local range regulations and policies.

RANGE COMMUNICATIONS

The installation range officer controls all ranges by wire and radio to obtain clearance to fire, report, coordinate, and call cease fires. The OIC controls all training activities, including firing, by the best means available. In all cases, the OIC plans for a backup communication system.

RANGE OPERATIONS

A plan must be developed for conducting tank combat training. This plan will vary. The plan should include the following areas.

USE OF ASSETS

There are two suggested ways to conduct training:

- In one system, the battalion will sign for, administer, and clear the range or training site. The training company will assist in range police and other administrative duties. This will allow the company to concentrate on gunnery, tactics, and maintenance. Gunnery Tables XI and XII usually require support from outside the battalion, because of the size of the target array and number of control personnel necessary. The tactical tables should not require assets from sources other than the battalion.
- The other system requires each company to sign for, administer, and clear the range or training area. The battalion would provide the necessary support in details, safety officers, range guards, and administrative duties.

OPENING THE RANGE AND OCCUPYING THE TRAINING SITE

The range is opened and occupied according to local range SOP and the battalion MOI. The following personnel are responsible for the sequence of events used to open the range and occupy the training site:

- The OIC will—
  - Receive range brief from range control personnel a minimum of one day prior to range operations.
  - Move to the range or training site before the company arrives.
  - Check communications and make sure backup communications are available for live fire.
  - Make sure range equipment is present and operational.
- The NCOIC will—
  - Set up the concurrent training area.
  - Supervise ammunition, targets, and administrative details.
  - Supervise placing tanks in the correct order for firing or going through the tables.
- The RSO will—
  - Brief all personnel on range safety.
  - Make sure range guards are posted and briefed on live-fire ranges.
  - Make sure no live ammunition is present on a non-firing range.
  - Inspect ammunition storage and handling.
  - Inspect DA Form 2408-4 for each main gun to be fired.
  - Make sure all safety markers are present and visible on the range.

DURING THE EXERCISE

The following personnel are responsible for certain events during the conduct of the exercise:

- The OIC, with assistance from the unit master gunner or other capable NCO, will—
  - Control the firing of live-fire exercises.
  - Maintain proper spacing between units going through the course.
  - Maintain all required communications.
  - Make sure the standards of FM 3-20.12 are met.
- The NCOIC will—
  - Supervise all details.
  - Control the movement of personnel from firing positions to concurrent training and other administrative areas.

- The RSO will—
  - Make sure misfires are handled in accordance with safety regulations.
  - Make sure the ELF is being used for tactical tables.
  - Watch for any safety violation.
  - Clear each tank once the exercise is complete.
  - Have no additional duties assigned.
- The reporting NCO will—
  - Know the location of other key personnel.
  - Be aware of how the range is being conducted.
  - Stay aware of the results of firing.
  - Know how many personnel are on the range.

CLOSING THE RANGE

The following personnel are responsible for certain events while closing the range:

- The OIC will—
  - Notify range control that firing has ceased.
  - Make sure the range or training area is cleared in accordance with local regulations and SOPs.
- The NCOIC will—
  - Supervise ammunition and target details.
  - Make sure the policing and cleaning of range facilities is completed.
  - Ensure that POL spills are cleaned up either by the using unit, or a supporting engineer unit, and reported to post authorities, depending on the size of the spill.
- The RSO will—
  - Make sure all weapons are cleared.
  - Make sure all misfires are removed from the range.
- The ammunition NCOIC will—
  - Make sure no ammunition is removed from the range by anyone other than authorized personnel.
  - Prepare residue certificates required by the ammunition supply point.

GUIDES TO SUCCESSFUL TRAINING

Brief key personnel. Before moving to the training site, brief key personnel in setting up the site and in reacting to unusual circumstances. This will keep down-time to a minimum.

Start on time. Have the training site ready and communications set up early so that crews can begin firing on time. Plan operations so that training will not have to be interrupted for course maintenance until some prearranged time or normal shutdown time (posted in the range daily bulletin). This means there must be enough targets to complete all training before the scheduled break.

Use range marker lights (live fire). Do not fire at night without a light and a thermal range marker on the range safety markers. If the range marker lights fail, all the ranges that use the same impact area must be closed. To prevent this, consider placing two lights together on each range safety marker, making sure that a backup light is available. Lights in good operating condition and fresh batteries will also add an additional measure of confidence.

Keep a log. The OIC will maintain an accurate log to help keep him better informed of dry-firing and live-firing times and other important events. As a minimum, the log should contain:

- When the unit occupied the range or training site.
- For live fire, when permission to fire was received from range control.
- Who gave permission to fire.

- When the range was in a cease-fire status.
- When the range reopened.
- Compass azimuth to any stray impacts and time of impact.
- When the unit cleared and departed the range.

Change guards frequently. Have a plan to check and change guards frequently. Also make sure the guards are briefed on their job and its importance, and that they understand their instructions.

Make sure the ammunition is correct. Coordinate closely with the support elements responsible for supplying live ammunition or pyrotechnics to ensure you have the correct type of ammunition in the correct amounts at the right time and place. Make sure that the ammunition to be fired has been checked against TB 9-1300-385 for restricted or suspended ammunition lot numbers.

Use safety markers. Make sure range safety markers are present before any live firing begins.

Be prepared to control fires. During the dry season, there is always a danger that tracer ammunition will cause grass and forest fires. Be prepared to control the situation quickly. It may be necessary to reduce the number of tracer rounds in linked ammunition if fires persist. Make sure the fire fighting detail is prepared to deploy on notice of a fire.

Keep the area policed at all times. A clean training site reduces the chance of injury, especially at night. Police as you go to avoid spending valuable time cleaning up after firing.

Have a plan for briefing visitors, and designate a briefing NCO or officer. The concurrent training area is a good place to brief visitors before escorting them to the primary training site.

Stress those areas in which the unit needs additional training. The following list suggests areas for concurrent training:

- Target acquisition.
- Range determination.
- Movement techniques.
- Crew drills.
- Platoon drills.
- Fire commands.
- Methods of adjustment.
- Stabilization training.
- Before-operation checks.
- Misfire procedures.
- Target identification.
- Maintenance of vehicles and weapons.
- Evacuation drill.

Quickly remove disabled tanks from the course to prevent loss of training time. A manned recovery vehicle must be in position to support the unit.

MASTER GUNNER'S RANGE BOX

The following list of items should be carried in the master gunner range box. This list should be amended depending on the situation, whether combat or training.

- Gunner's quadrant.
- Firing tables (120mm or 105mm, caliber .50, and 7.62mm).
- AR 385-63.
- AR 350-38.
- FM 3-20.12.

- TC 25-8.
- Spare tapes (audio and video).
- Timing boards/stopwatches.
- Scoresheets.
- Notebooks.
- Results from last TCGST.
- UCOFT unit backup.
- Firing probes (two or three for 120mm).
- Firing circuit tester.
- DA Forms 2408-4 (current and blanks).
- Spline keys.
- Wrenches (9/16" and 3/4").
- Jewelers screwdriver.
- Multimeter.
- Jump cables/plugs.
- TMs for vehicle, weapons, communications, and other devices.
- Range maps.
- Compass.
- Remote firing device.
- Staple gun and staples.
- Hammer and nails.
- Tape (100 mph).
- Engineer tape.
- Portable AAC panel.
- Portable boresight panel.
- Range book with scenarios, scripts, battle rosters, prior results, and any other pertinent information.

Chapter 14

Crew-Level Gunnery

Tank gunnery tables are designed to develop and test the proficiency of individual, crew, and platoon gunnery techniques. The series of engagements on each table is intended to duplicate (within the safety and resource constraints of live-fire tank ranges) typical battlefield tasks under realistic firing conditions against likely target arrays. This chapter discusses the tank gunnery tables, qualification requirements for crews, scoring procedures and standards, and allowable variations. It also addresses the commander's considerations for ammunition allocation and firing during adverse weather.

Note. An accuracy screening test (Chapter 5) must be performed prior to conducting main gun live-fire.

CONTENTS

Tank Gunnery Methodology

The objectives of this gunnery program are to attain and sustain crew through platoon gunnery proficiency, and to evaluate the use of the tank's fire control system and proper engagement techniques.

A comprehensive gunnery program must address six basic features of tank engagements:

- Type of target/weapon fired (heavy armor, light armor, troops, main gun, coax, etc.).
- Firing tank posture (moving, stationary, NBC).
- Target posture (moving, stationary, fully exposed, defilade).
- FCS status (full-up, degraded).
- Main gun engagement technique (precision or battlesight).
- Visibility (day/night or obscuration).

Tank crews must be trained to defeat a specific enemy. Specifics for determining how to train include—

- Enemy doctrine on the employment of their weapon systems.
- The time-to-fire P_H, and lethality of enemy weapons as a function of range and time.
- Enemy vulnerability to our P_H as a function of range.

Time standards (70 point time) for each task are based on the amount of time available before an average enemy system will be able to destroy you. The 100 point time is based on the best 25 percent of Abrams performance actually demonstrated for each particular set of tasks and conditions.

Abrams tank P_H was generated for a moving and a stationary Abrams tank firing training ammunition (HEAT-TP-T and TPCSDS-T) at various ranges against standard enemy vehicles. This P_H affects both the task and conditions (for each engagement, the average firing tank must have at least a 50 percent P_H) and number of rounds allocated (enough rounds for *at least* a 70 percent chance of completing the engagement).

Tank Gunnery Evaluation Tables

The following tank tables comprise the gunnery proficiency part of the tank combat tables:

- Table I—*Basic Gunnery Skills (Individual).*
- Table II—*Basic Gunnery Skills (Individual/Crew).*
- Table III—*Basic Training Course (Crew).*
- Table IV—*Tank Crew Proficiency Course (TCPC).*
- Table V—*Preliminary Machine Gun Training.*
- Table VI—*Preliminary Main Gun Training*.
- Table VII—*Intermediate Training Course (Crew)*.
- Table VIII—*Intermediate Qualification Course (Crew)*.
- Table XI—*Advanced Training Course (Platoon)* (see Chapter 15).
- Table XII—*Advanced Qualification Course (Platoon)* (see Chapter 15).

The gunnery tables are designed to train crew members progressively in basic, intermediate, and advanced tank gunnery.

- Basic gunnery techniques and engagements are trained on Tables I through III and tested on Table IV (crew).
- Intermediate engagements are trained on Tables V through VII and tested on Table VIII (crew).
- Advanced gunnery engagements are trained on Table XI and tested on Table XII (platoon) (see Chapter 15).

Table I is designed to train TC and gunner teams on basic gunnery skills (including target acquisition, target designation, gun laying, manipulation, and direct-fire adjustment) from a stationary tank. Table II is designed to train TC and gunner teams on the same skills as Table I and introduces full crew interaction from a stationary tank. Table III reinforces the same skills as Tables I and II and provides full crew interaction from a stationary and moving tank. These tasks develop coordination skills and provide the crew an opportunity to identify individual strengths and weaknesses. Table I should be conducted with a TC and gunner from the same crew. Each TC and gunner will serve as the TCE to evaluate the other during their separate tasks during practice. Table I should be conducted on tanks in the motor pool.

Tables I, II, and III should be conducted prior to Table IV. Due to various missions and OPTEMPO, units may need to complete Tables II and III in the COFT, AGTS, or AFIST. The following chart lists the appropriate engagements to qualify in the simulator:

	COFT	AGTS	A-FIST
Table II	Through Reticle Aim 14	Completion of Advanced Skill Level I	Completion of Group 4
Table III	Tasks 1 through 9, Day. Exercise 312110 with I/O announcing degraded conditions to the crew. Tasks 10 through 15, Day and 1 through 8, Night. The I/O uses the Advanced Matrix Special-Purpose Exercise Builder.	Completion of Advanced Skill Level I	Completion of Group 4 (AFIST does not support manual exercises)

Note. See the training program chart in Chapter 13, Table 13-2, page 13-5, for more information.

These tables should be conducted as new gunners are selected and previous gunners become tank commanders. Since a majority of these tables are manipulation drills and not resource intensive, they should be scheduled as part of a unit's routine training plan to maintain individual and crew proficiency. For optimum training benefit, manipulation drills should be integrated with UCOFT or AGTS training, special-purpose exercises.

Tables IV, VIII, and XII are qualification tables and must be fired successfully before advancing to the next higher level of gunnery. All other tables (I, II, III, V, VI, VII, and XI) are recommended for training in sequence.

Two phases and two variations of the tables can be used in a well-rounded tank gunnery program:

- Day firing phase (A tables)—trains and tests the tank crew in rapid engagement and destruction of targets during daylight.
- Night firing phase (B tables)—trains and tests the tank crew in rapid engagement and destruction of targets at night and during periods of reduced visibility.
- Device-based firing—trains gunnery procedures and crew and platoon duties without expenditure of main gun ammunition. (The commander determines when to fire subcaliber tables to sustain skills when live firing is restricted.)
- Dry firing—used to develop teamwork before live firing and to sustain skills when live firing is restricted. (Units are encouraged to use TWGSS, MILES, and TSV during dry-fire exercises.)

Day firing (A tables) should precede night firing (B tables) whenever possible; however, this is not a requirement. All tables except Tables VIII (Intermediate Qualification) and XII (Platoon Qualification) may be fired either dry, device-based, or both, if availability of main gun ammunition is a problem.

Note. Table IV will not be considered qualified if it is fired using COFT, AGTS, or AFIST.

Tank Crew Evaluators

The TCE is critical to the quality of the training and AAR of the firing unit. They not only evaluate the crews during the training event, but they also lead them (during the AAR) to an understanding of their actions in each engagement scenario. To ensure a quality AAR, the same TCE who observed the firing crew will conduct the AAR. Other range evaluation personnel and the unit's chain of command may assist the TCE. TCEs must have training to make sure they are proficient at the needed skills to properly evaluate the firing tank crew, and must continually practice their AAR techniques to make sure they are effective. See Chapter 15, *Collective Gunnery Training*, for information about advanced table evaluator qualifications.

Note. Qualified personnel from outside the firing unit will be used to evaluate Tank Table VIII. TCE teams should consist of an NCOIC (master gunner) and six qualified TCEs per shift (day and night). This will ensure that there are no distractions for personnel having to fire or perform other missions who are organic to the firing unit.

BASIC AND INTERMEDIATE TABLES

The firing unit's company commander is the primary TCE of his unit's performance; however, for basic and intermediate tables, he has designated representatives to evaluate each tank crew. Who the commander, assisted by the company master gunner, appoints as evaluators will depend on the unit's assets, mission, and prior training of personnel available. Basic guidelines for selecting TCEs are:

- Sergeant (Basic NCO Course graduate) and above.
- Qualified on the table being evaluated within the preceding 12 months.
- Extensive knowledge of—
  - FM 3-20.12, Chapter 4, *Ammunition and Target Destruction*.
  - FM 3-20.12, Chapter 8, *Direct Fire.*
  - FM 3-20.12, Chapter 9, *Machine Guns.*
  - FM 3-20.12, Chapter 14, *Crew-Level Gunnery* (Tank Tables I through VIII).

The TCE must have communications with the firing tank so that he can monitor the intercom system for Tank Tables I through VIII and maintain visual contact with the tank at all times.

Notes. The TCE must have received training and passed the Tank Crew Evaluator Exportable Packet evaluation, and be certified as TCE qualified by the unit commander.

Where circumstances do not permit live-fire qualification, such as service with a TSB, the battalion commander/TSB commander can waive the live-fire qualification requirements if the TCE has previously qualified, is fully knowledgeable of applicable gunnery manuals as substantiated by passing the TCEEP evaluation exam, and has demonstrated proficiency in passing gate-to-live-fire exercises in the COFT within six months.

After-Action Reviews

The purpose of an AAR is to help the crew understand their actions and interactions during a training event. An AAR must include a discussion of crew cuts and an analysis of combat actions (critique of tactical proficiency) executed during the conduct of the table.

During the AAR, the TCE emphasizes the training objectives and evaluation points. All tables must be evaluated, and every crew must receive an AAR after each phase (day/night). Quality AARs are the key to successful training.

Note. Digital AARs must be conducted by units equipped with digital AAR capabilities.

The AAR is organized in the following standard format:

- Introduction and rules.
- Review of objectives and intent.
- Summary of firing events.
- Discussion of key issues.
- Discussion of optional issues.
- Discussion of force protection.
- Closing comments.

INTRODUCTION AND RULES

During the introduction, the TCE must establish the objectives for the AAR. The TCE identifies himself and each of the participants. Normally, the participants are arranged in an organized manner. If possible, the TCE should use the actual terrain on which the tasks were conducted. Most range complexes have debriefing areas with a terrain model or map that depicts the range layout. The TCE may use this established area for the AAR.

REVIEW OF OBJECTIVES AND INTENT

The TCE should state the training objective for the specific task(s) being evaluated.

SUMMARY OF FIRING EVENTS

The TCE presents each engagement in chronological order, stating the training objectives for each task. Training aids should be used to show the target arrays, firing points, and other significant overall points, but should avoid detailed examination of the firing events. (The next part of the AAR [discussion of key issues] examines the firing events in detail.)

DISCUSSION OF KEY ISSUES (ANALYSIS OF FIRE COMMANDS AND CREW DUTIES)

The TCE restates each engagement scenario (including the task, conditions, and standards), then asks leading questions to facilitate crew discussion of what actually happened during each engagement. A taped replay (video or audio) of actual crew fire commands and crew duties presented during the AAR is an excellent

way to reinforce strengths, eliminate weaknesses, and reinforce training objectives. When possible, the TCE should have an evaluation of digital communication from each scenario. The TCE should incorporate digital traffic as a portion of the AAR for digitally-equipped units. To achieve a quality AAR, the TCE must guide the discussion in a way that ensures all crew members contribute to the discussion. (Lectures must be avoided because they prevent crew contribution to the discussion.) Finally, the TCE discusses the strengths and weaknesses of each engagement; when possible, the TCE allows the crew to discover its own strengths and weaknesses.

DISCUSSION OF OPTIONAL ISSUES

The TCE must ask thought-provoking questions focusing on the training objectives. These questions must explore alternate courses of action that might have been more effective and help the crew members understand how their own actions influenced the result of each engagement. As the crew learns how to correct the mistakes they made, they improve their gunnery proficiency. The TCE should explore training aids and techniques that may be used to sustain and improve training.

DISCUSSION OF FORCE PROTECTION (SAFETY)

The TCE should emphasize safety strengths or weaknesses.

CLOSING COMMENTS

The TCE reviews the training objectives and summarizes key learning points. The TCE must ensure that the crew understands what was good, bad, or average about their performance. After covering the objectives, learning points, and specific crew performance, the TCE should leave the area so the TC and crew can discuss their performance, in private.

Tank Gunnery Qualification

Each crew member functions as an integral part of his crew and should be recognized for his contribution to the success of that crew. Commanders should award the appropriate qualification badges, in accordance with AR
600-8-22, to all crews meeting the qualification standards. If optional awards are desired, commanders will use the same standards.

PREREQUISITES

Each crew member must have passed the TCGST, as outlined in Chapter 12. Prerequisites for the qualification courses are as follows:

- Table IV, *Tank Crew Proficiency Course (TCPC).* Each crew member must pass the TCGST within six months before progressing to Table IV (live-fire simulation). The tank crew must qualify on Table IV before negotiating the intermediate qualification course.
- Before live-fire. Crews must have conducted live-fire preparatory training in accordance with Chapter 13 before live firing.
- Table VIII, *Intermediate Qualification Course (Crew).* Each crew member must have passed the TCGST and qualified on Table IV within six months before negotiating the intermediate qualification course. The tank crew must successfully complete Table VIII before negotiating the advanced qualification course.
- Table XII, *Advanced Qualification Course (Platoon).* Each crew member must have passed the TCGST and qualified on Tables IV and VIII within six months before negotiating the advanced course.

Note. TC/gunner combinations must meet all live-fire prerequisites and complete all tank tables together (as a team).

QUALIFICATION

BASIC GUNNERY SKILLS (INDIVIDUAL)

Each task on Tables I, II, and III will be rated GO or NO-GO by the TCE. Times in the standards column of the scoresheet are the minimum qualification standards. For a tank crew member to receive a GO on a task, all targets must be hit within the allotted time.

The TCE will rate crew duties for each engagement/drill. If the crew member commits more than one crew-duty error during a task, he will be rated UNSAT in crew duties. Crew duties will be critiqued by the TCE during the AAR; however, they will not affect the overall GO/NO-GO rating for the task. The tank crew member should receive a GO rating on all tasks for Tables I, II, and III before progressing to Table IV, or firing the main gun.

TANK CREW PROFICIENCY COURSE

Crews must qualify Table IV (TCPC) either device-based, or dry fire (obtain a minimum of 700 points overall on Table IVA and IVB and receive 70 points or more on at least 7 of 10 tasks). Table IV must be conducted with TWGSS, if available, on a full or one-half scale range. Table IV cannot be considered qualified if COFT, AGTS, or AFIST is used.

INTERMEDIATE QUALIFICATION COURSE (CREW)

Crews must live-fire Table VIII for qualification. They will be rated by the following standards:

- ***Distinguished.*** The crew obtains a combined score of 900-1,000 (90% or more) on Tables VIIIA and VIIIB with 70 or more points on 9 of the 10 tasks.
- ***Superior.*** The crew obtains a minimum score of 800 on Tables VIIIA and VIIIB with 70 or more points on 8 of the 10 tasks.
- ***Qualified.*** The crew obtains a minimum score of 700 on Tables VIIIA and VIIIB with 70 or more points on 7 out of 10 tasks.
- ***Unqualified.*** The crew obtains a combined score of 699 or less on Tables VIIIA and VIIIB, or 69 points or less on 4 or more of the 10 tasks.

Note. To be considered qualified on Tables IV and VIII, crews must qualify a minimum of two night tasks.

SPECIAL NOTICE

To make sure units use their weapons platform to its full capacity, digitized units *must* use their digital reporting capabilities to qualify on Tables IV and VIII. Crews will start the tables with the intent of completing the table using digital communications. The battalion commander is the approving authority to allow tanks that have lost their digital capability to continue the table. Crews should train all tables digitally to better prepare them for the qualification tables. A digital SPOTREP must be sent to start each engagement. The crew will complete and send a digital SITREP at the completion of the day and night runs. Units should develop standard graphics for each range.

All-Weather Firing

As in combat, firing should continue under all weather conditions. The commander decides what constitutes effective training, based on many factors including mission and range availability. If the training can still be effective during reduced visibility, it should be consistent with the unit's mission requirement. Commanders should take the following into consideration:

- Training effectiveness.
- Operational mission.

- Preparation and planning.
- Safety restrictions.

Plan for close target locations. The unit's mission must be thoroughly analyzed to determine if a reduction in range to targets is acceptable. Target emplacements must be compared with the surface danger area to ensure firing is within the allowable range limits. If it does not affect normal firing, range fan markers should be placed closer to the firing areas or firing lines before the time slated for firing. These markers should be visible during periods of reduced visibility to show limits of fire. Range start points may be adjusted to different areas of the range, within the safety limits. Tank speed may have to be reduced to complete moving engagements.

Safety, combined with the other considerations, will determine when all-weather firing can be continued and when it must be stopped.

Ammunition

Based on missions and resources available, units will need to determine the frequency for firing Tables IV through XII. The current STRAC allocates a 90-round training strategy for TRC Level A units to fire crew qualification tables twice annually, and platoon qualification annually.

Units that have a 90-round STRAC will resource Tank Table VII with 8 rounds of sabot and 5 rounds of HEAT. The commander and master gunner will assess the unit's strengths and weaknesses and adjust the Tank Table VII engagements accordingly. The engagement(s) not fired on Tank Table VII can be fired using TWGSS on Tank Table VI. Rounds saved from first-round hits will resource the additional three rounds needed for Tank Table XII. (For information regarding TRC B and TRC C, see DA Pam 350-38, *Standards in Weapons Training*.)

All engagements begin from a battlecarry posture. The TC must determine the proper ammunition to battlecarry for each engagement. This is determined by the spot report given to the crew (via digital means on the M1A2 and M1A2 SEP or FM for the M1 and M1A1) (see the IVIS log-on and log-off procedures for the M1A2 in Chapter 13, this FM). Some engagements require crews to identify targets as APCs, PCs, tanks, or helicopters, and issue a change of battlecarry command prior to engagement. Because the crew will rely on digital reports (M1A2 and M1A2 SEP) and FM voice reports (M1 and M1A1) to initiate the change of battlecarry, the reports must be accurate enough to allow the crews to distinguish between target types.

SPECIAL NOTICE

When XM 908 or canister rounds become available for training, master gunners and commanders may include them in their training strategy on Tank Tables VI and VII for crew-level training and Tank Tables XI and XII for collective-level training. Units should develop engagements and scenarios to support training.

Targets

All stationary targets should be mounted on pop-up mechanisms (see FM 17-12-7) to facilitate target acquisition and scoring. Moving targets should be presented at speeds between 24 and 32 kmph (15 to 20 mph). Moving, evasive targets should be presented at speeds between 8 and 32 kmph (5 to 20 mph). Currently, an evasive target can be programmed to move at varying speeds, conduct short halts, or change direction. They must be visible from the firing position for the entire exposure time, and must run for a minimum of 15 seconds in each step to allow for acquisition, tracking and engaging. Short halts must be no more than 5 seconds. (This works on most computer-operated ranges. Remote-controlled moving target lifters may need to substitute evasive moving targets for normal moving targets.) For future range upgrades, evasive targets should have the ability to change speed and direction, and alter their appearance or thermal signature as the vehicles' directions change. When helicopter targets are presented, they must be a minimum of 10 meters above the ground. Tank tables incorporate various targets. These targets are defined as tanks, APCs (BMP), PCs (BTR, BRDM), helicopters, trucks, RPG team, and troops. Master gunners and range operations personnel must make sure targets are constructed to the correct dimensions to ensure crews using the stadia reticle determine the proper range.

Target Type	Standard Target
Frontal tank	H-1
Flank tank	H-2
Defilade tank	H-3
Tank Turret	H-5
Frontal HIND-D	H-7
Frontal BMP	M-1
Flank BMP	M-2
Frontal BRDM	M-5
Flank BRDM	M-6
Frontal BTR	M-11
Frontal truck	L-1
Flank truck	L-2
Troops	L-6, L-7, L-9

LATERAL SPREAD OF TARGETS

A minimum and maximum target spread must be used as part of the conditions for certain gunnery tables. The intent is to make sure gunners and TCs are not able to acquire both targets in a two-target engagement while in NFOV, yet limit the spread so that target spread does not become a significant factor in task difficulty from one unit gunnery or range complex to another.

Given the Abrams WFOV is 16 degrees and NFOV is 6.2 degrees, the minimum spread is set equal to the NFOV, or 110 mils, while the maximum spread is set to one and one half times the WFOV or 427 mils. For example, for a target range of 1,400 to 1,600 meters, the minimum spread should be 180 meters and the maximum spread should be 670 meters. Delayed targets may be brought up anywhere in the target area.

Note. Lateral spread only refers to the first two targets in an engagement. In tasks where three or four targets are used, the third and fourth target may be presented anywhere, as long as they are at the proper range.

Range	**Minimum** (meters)	**Maximum** (meters)
1,000	120	420
1,100	130	460
1,200	140	500
1,300	150	540
1,400	160	590
1,500	170	630
1,600	180	670
1,700	190	710
1,800	200	750
1,900	210	790
2,000	220	840
2,100	230	880

Evaluation Procedures and Standards

All tables must be evaluated, and every crew must receive an AAR after each phase (day/night).

Alternate tasks are provided for contingencies (such as lack of resources, weather conditions, or range constraints) that preclude execution of the original engagements.

TABLES IV THROUGH VIII

Each task on Tables IV through VIII will be scored using the appropriate scoresheet. The TCE will rate crew duties for each engagement on Tables IV through VIII and subtract crew-duty penalty points from the total engagement points earned. The crew must obtain a minimum of 700 points and qualify (70 or more points on 7 of 10 tasks) on Tables IV and VIII. Crews must qualify a minimum of 70 percent of the total tasks presented and receive a minimum point value required for each table to be qualified on Tables V, VI and VII. At no time will a crew dry-fire Table VIII prior to their qualifcation run. Crews on digitally equipped vehicles will fire all engagements, except degraded engagements, using digital communications. This will enhance digitally equipped units and provide the users with techniques and procedures for executing gunnery using their digital platform. Crews who do not qualify on the first run of a table may renegotiate the course. Crews firing reruns should execute only the tasks on which they failed to qualify during the first run. In no case will a crew who failed to qualify during their first run receive a rating higher than qualified after a subsequent run. Refires or subsequent run scores will be added to the score only after all the tasks have been negotiated once. After a crew meets the minimum qualification standard during their subsequent run, the local commander may elect, due to resource constraints, to stop that crew's further negotiation of the course. The local commander and master gunner will decide how many times a crew should be rerun. Their decision should be based on the possibility of the crew meeting the minimum requirements, and time and resources available.

TARGET SIGNATURE DEVICES

If the commander wishes to use target signature devices (such as the Hoffman device), he may do so; however, no more than one device will be used for target signature purposes. When used, at least five seconds of target exposure time must elapse before the device is detonated or activated. Target signature device failure is not a valid alibi.

CREW PROTECTION STATUS

All crew members will be buttoned up when wearing protective masks. The M1A1, M1A2, and M1A2 SEP will have the overpressurization system on during NBC attacks. The local commander will decide if the TCs will fight from the open-protected position when they are receiving suppressive small-arms fire, air-burst artillery, or near misses as a result of enemy direct fire.

MACHINE GUN ENGAGEMENTS

Machine gun engagements will be evaluated as follows:

- Point targets (BMPs, BRDMs, and so forth). A target hit will be scored when three or more rounds are fired through the target. Stationary point targets should be mounted on pop-up target mechanisms set on knock-down mode of operation.
- Area targets (troops, RPG teams). Area targets will be shown as troops in the open with full and half silhouettes displayed in a tactical array using both width and depth. Crews must hit a minimum of X sensors in the array within 10 seconds of opening to be considered a target hit using the area scoring system. When the area scoring system is not available, full credit will be given when the gunner sweeps through the target area with an initial burst and achieves a hit on at least one silhouette within the group (engagement time for that group will stop when one target is hit). (The initial burst does not have to knock down a silhouette, however, it must be in the target area. The target area is defined as one target form up, down, left, or right of the array.)

MAIN GUN ENGAGEMENTS

A main gun target is scored as a hit when a round hits anywhere on the panel. A main gun target is considered engaged when a round goes within one target form of the target. Because crews will be penalized

for not engaging all targets, the TCE must determine whether the crew made a valid attempt to engage the target.

TIMING PROCEDURES

Three types of time are used to evaluate gunnery engagements on Tables IV through VIII: exposure time, engagement time, and defilade time. To score Tables IV through VIII engagements, you will need two separate timing devices. One timing device will be the *master* clock. This clock needs to have eight watches with one common start button and an independent stop button for each watch. The *master* clock is used for defilade time and rounds fired, by the person doing the timing. The second timing device is a single stopwatch used by the person doing the scoring to determine target obscuration/break time. On ranges using target lifting devices (or if there is doubt as to whether the delayed target will be presented at its designated time), a third stopwatch may be required to record delay target presentation time. The delayed target's observer should operate this watch.

Target Exposure Time

Exposure time limits the time the target is exposed. The scoring procedures allow for situation-dependent contingencies beyond crew control (such as target obscuration). In the offense and defense, exposure time starts when the first target in an array is fully locked (up position).

For Tables IV through VIII, target exposure time is listed for each target. Tasks are designed so—

- Target arrays with one or two targets have 50-second exposure times.
- Target arrays with three or four targets have 75-second exposure times.
- Engagements with a degraded fire control system may have an additional 10 seconds of exposure time (included in the conditions statement).
- Each target in a target array has its own exposure time.
- Exposure time for all moving targets is 50 seconds. (Range constraints limit target exposure for targets moving 20 miles per hour or more.)
- Exposure times (with the delay times) for all targets (except moving targets) in an array end at the same time.
- The target with the longest exposure time is in the first presentation.

Example: Table VIII, Task B3S (Defense) has four targets:

- *Target 1*. A stationary frontal tank is presented with no delay; exposure time is 75 seconds.
- *Target 2*. A moving flank tank is presented with no delay; exposure time is 50 seconds.
- *Target 3*. A stationary defilade tank is presented after a 15-second delay; exposure time is 60 seconds (15 + 60 = 75).
- Ta*rget 4*. A troop target is presented after a 25-second delay; exposure time is 50 seconds (25 + 50 = 75).

Note. Exposure times for Targets 1 and 2 begin at the same time, with no delay. Target 1 is exposed for the full 75 seconds; Target 2 is a moving target and only exposed for 50 seconds. Target 3 (15-second delay) is exposed for only 60 seconds; and Target 4 (25-second delay) is exposed for only 50 seconds. Because Targets 3 and 4 are exposed after a delay, the exposure times are shorter; exposure times for Targets 1, 3, and 4 end at the same time (after Target 1 has been exposed for 75 seconds). However, because moving targets are exposed for only 50 seconds and Target 2 is a moving target, its exposure time ends before the end of exposure time for the other three targets.

Target Engagement Time

Engagement time begins when a target is in the fully locked (up) position. Engagement timing criteria are the same for offense and defense. Engagement timing events are when the target is hit or the target is missed by less than a target form.

Defilade Time

Defilade time is the time it takes the tank crew to move from a turret-down position to a hull-down firing position during defensive engagements. Defilade time starts when a target is fully locked (up position) (in the event of a delayed target presentation, time starts when the first target is fully locked [up position]). Defilade time stops when the gun tube of the firing tank is unmasked, the tank stops, or the tank fires while on the way to a hull-down position. During darkness, defilade time stops on the command "DRIVER STOP," when the main gun or machine gun is fired, or when it is obvious to the TCE that the gun tube is unmasked. Maximum defilade time is 15 seconds. If the tank crew has not begun to move to the hull-down position after 15 seconds, record the actual time it takes the crew to reach a hull-down position. A maximum of 15 seconds will be subtracted from the last target engagement time.

Crews may pull forward and back down more than once. Only a total of 15 seconds of defilade time will be subtracted. Target exposure time will continue to run if a tank returns to defilade and a target is still exposed. If a target malfunctions, defilade time will not be counted against the crew. When the target that malfunctioned is presented again, defilade time resumes.

Notes. On ranges where turret-down positions are not available, simulated positions may be established using stakes, engineer tape, flashlights, or chemical lights to depict the limits of the turret-down and hull-down positions.

TT VIII, Task A1 may present special considerations. Defilade time stops if the TC opens with the caliber .50 in the defilade. However, if the TC destroys the BRDM before the delayed troops are presented, the crew must not be penalized. The time from when the BRDM is destroyed until the troops are presented is break time because no target is presented. Once the delayed troop target is presented, defilade time begins again until the crew pulls to enfilade.

Example: *Two-target engagement.* (TT VIII, Task A1) The TC identifies the BRDM and opens from the turret-down position with the caliber .50 at 4 seconds with a target hit at 11 seconds. The delay target comes up at 15 seconds. The tank crew pulls forward at 17 seconds, opens with the coax at 19 seconds and achieves a target hit at 22 seconds. Enter a *defilade time* of 4 seconds for target 1 (presentation to 4 seconds) and 2 seconds for Target 2 (15 to 17 seconds). Enter 4 seconds for *break time* (11 to 15 seconds when delayed target was presented). Enter 22 seconds for *last target engagement time*. Subtract the defilade time from the last target engagement time (22 seconds [last target engagement time] - 6 seconds [defilade time] = 16 seconds, then subtract 4 seconds [break time] = 12 seconds [engagement time]).

Target Presentation Considerations

In multiple-target engagements where there are no delay presentations, all targets will be presented within two seconds of each other. Delayed target presentations are designed to train the crew to search continuously and monitor the battlefield. Delayed targets may be brought up anywhere in the target sector after the initial presentation. When pop-up target mechanisms are used, a target that is hit may fail to fall. The control officer or TCE should observe every round fired. To avoid wasting ammunition, the control officer or TCE will announce a sensing of "TARGET" over the control net if the target is hit and fails to fall. This is the only situation, other than wingman assistance, in which a sensing will be announced by anyone other than the firing crew. Targets should be repaired as quickly as possible if they fail to drop after being hit. When feasible, targets should be physically scored and patched.

If a target malfunctions, the crew will be alerted after the engagement during which the target malfunctioned. Based on the availability of targets, the crew may be re-presented the target either at that time or from another location (the target type and conditions for that target must be met). Alternate engagements are provided for use if a moving target fails. However, in tasks with multiple moving targets, at least one moving target (preferably the most difficult, by either range or evasive maneuver) must be engaged.

Dust Down/Wind Down

If either a skip round or near miss knocks down the target, the TCE or control officer will announce "DUST DOWN" or "WIND DOWN." If the target is the only target remaining in a multiple target engagement, *all time* (engagement and exposure) will stop until the target reappears. If the target has to be re-presented, due to dust down, wind down, or target malfunction, the crew will be alerted and told the exposure time remaining for

that target. When the target is re-presented, time will start when the target is fully exposed. In the defense, any remaining defilade time may be used. *If more than one target remains after a dust down or wind down, engagement time will not be stopped unless the other targets are knocked down before the dust-down target reappears.*

Misfires

When a misfire occurs, the TCE will start break time on the second announcement of "MISFIRE," and stop break time when a round is fired or the TCE is sure the firing vehicle is clear of the malfunction. If a misfire occurs during a three-man crew engagement, break time will begin on the TC's first announcement of "MISFIRE," and stop when a round is fired or the TCE is sure the firing tank is clear of the malfunction.

Obscuration

Obscuration time is the time that a target is not viewable to a crew due to obscuration at the vehicle and/or obscuration in the target area. Obscuration time is subtracted from the last target engagement time as part of the scoring procedures.

Since each target in an engagement is timed separately, a separate stopwatch must be used to determine obscuration time between rounds. Accurate timing of obscuration ensures crews receive actual target engagement/ hit time.

In offensive engagements, the crew should move quickly through obscuration and continue the engagement without stopping time. In either offensive or defensive engagements, the TCE should record obscuration time if he determines that obscuration precludes the firing of subsequent main gun or coax rounds. Break time starts after the TC or gunner gives the first announcement of "TARGET OBSCURED," ***and*** the loader announces "UP." The crew will be assessed a 5-point penalty if the TCE observes the loader announcing "UP" prior to loading the round. (In the event of coax engagement following the main gun, obscuration time begins on the announcement of "TARGET OBSCURED" ***and*** after "CEASE FIRE" has been given for the main gun.) Once "TARGET OBSCURED" is announced, the vehicle may return to the defilade position, but obscuration break time does not start until the loader announces "UP." Break time stops when the TC begins another fire command, a round is fired, the gunner announces "IDENTIFIED," or the TCE is sure the firing vehicle is clear of the obscuration. Obscuration time cannot be given for delayed targets that were not presented during the obscuration. Targets can be re-presented for a time period equal to the sum of all the previous obscuration times in that particular task, but not to exceed the target exposure time stated in the task conditions. The TCE must ensure that the specific target being re-presented was presented during the obscuration (see example below). When considering target re-present time, the TCE must determine whether firing the re-presented target(s) will affect the crew's total score. The time that it took the crew to engage the re-presented target will be added to the last target engagement time as the new engagement time for that target. Complete the scoresheet using the scoring procedures outlined in this chapter.

Example*:* (TT VIII, Task B2) The crew engages the evasive flank APC at 17 seconds for a target. The crew announces "TARGET OBSCURED" at 19 seconds. The loader announces "UP" at 22 seconds. The crew identifies the moving flank APC at 33 seconds, the gunner fires at the moving flank APC at 37 seconds with a sensing of "OVER," and the TC announces "CEASE FIRE, TARGET OBSCURED" at 39 seconds. The crew identifies the troops at 52 seconds, opens at 54 seconds, and hits the target in 59 seconds.

In this example, the crew had two separate obscuration times: the time from when the loader announced "UP" at 22 seconds until the crew identified the moving flank APC at 33 seconds was 11 seconds and the time from when the TC announced "TARGET OBSCURED" at 39 seconds until the crew identified the troops at 52 seconds was 13 seconds. This gives the crew a total of 24 seconds of obscuration time. However, the moving flank APC can only be re-presented for 22 seconds because it was on a 50-second exposure and was down for 2 seconds before obscuration time stopped. The crew cannot be given obscuration time for a target that was no longer presented.

Notes. If obscuration time and defilade time occur simultaneously within the same engagement, obscuration time supersedes defilade time.

The crew cannot be given obscuration time for a target that was no longer presented. Special consideration must be given if obscuration occurs or is occuring as time elapses on an engagement.

The represent time must begin at the final target exposure time for that target. For example, if a target is exposed for 50 seconds and the crew does not have an opportunity to engage due to obscuration, then start the represent at 50 seconds. Otherwise, the crew will be given credit twice for the obscuration time.

(M1A2/M1A2 SEP) The TC "designation" to a target area will not be used as an obscuration timing event.

Example: (TT VIII, Task A3) The crew pulls forward at 10 seconds and engages the stationary frontal tank at 11 seconds with a sensing of target. The TC announces "TARGET OBSCURED" at 13 seconds. The crew backs down at 15 seconds and the loader announces "UP" at 16 seconds. The TCE determines the obscuration is clear at 19 seconds and the tank pulls forward at 27 seconds and engages the moving target for a target at 30 seconds.

In this example, the crew had three defilade events: the initial 10 seconds before the crew pulled forward to engage the first target, 1 second between the crew backing into the defilade and the loader saying "UP" to start the obscuration time, and 8 seconds from the time the TCE determines the obscuration is clear until the crew pulls forward to engage target 2. The total defilade time was 19 seconds, however, only 15 seconds can be subtracted on line (b). The crew's total obscuration time was 3 seconds (from the announcement of "UP" at 16 seconds until the TCE determined the obscuration was clear at 19 seconds).

The intent of scoring and timing is to force crews to train as they would fight. Crews should be trained and rewarded for hitting targets rapidly, but not penalized when artificial maneuver constraints prevent them from continuing to engage the target. TCEs are responsible for determining whether local obscuration prevents the crew from continuing to engage their targets.

Other Break Times

The following are considered break times and, once they occur, are timed as a start, then stop item:

- Stoppage. Break time starts after the TC or gunner gives the second announcement of "STOPPAGE," and stops when the TC begins another fire command, a round is fired, or the TCE is sure the firing vehicle is clear of the malfunction.
- Delayed target. If the crew successfully hits the first target(s) and has to wait for the delayed presentation, that wait time will be recorded and added, along with any other event (misfire or stoppage), in the obscuration/break time block. This rule applies if the first target(s) of the initial presentation was successfully hit and is not standing before the delayed targets are presented or in the event of a dust down/wind down (see page 14-11).

The break time noted is recorded in the obscuration/break time block for that round fired. Calculate the total obscuration/break times from the upper portion of the scoresheet and record the total time on the appropriate line.

WINGMAN TANKS

Intermediate Tables V, VI, VII, and VIII are designed to train and evaluate a single firing tank. Only one tank is evaluated; however, the wingman concept may be integrated into these tables with the wing tank in a nonfiring role. The wingman tank will not engage targets; it moves tactically with the firing tank, assisting in target acquisition, sensing, and digital transmissions. The TCE may use a nonfiring vehicle when a digital base station is not available for sending and receiving tactical information to the firing tank. The use of the wingman, and the role he will play during intermediate tables, should be considered by the local commander as a logical step toward the multiple-vehicle fire and maneuver of the advanced tables. The wingman tank will not lase to targets during degraded engagements.

The wingman tank must be the regular wingman for the firing tank. When it is the wingman's turn to fire, the target scenario must be changed to eliminate *gamesmanship*. The TC of the firing tank is responsible for verifying the accuracy of information provided by his wingman. Erroneous information by the wingman (faulty acquisition report, incorrect sensings) or interference by the wingman with the firing tank is not a valid alibi.

ALIBIS

Although commanders have the ultimate authority regarding alibis, they should be limited to two occurrences: target malfunction and TIS or FLIR failure at night. Commanders should ensure that gunnery is as combat realistic as possible. This means that crews should train to fight *through* problems.

EVALUATING CREW DUTIES

During the conduct of tank tables, TCEs monitor crew duties. There is no limit to the number of crew-duty penalty points that can be assessed for a task; however, crew-duty penalties may not be carried over from one task to another. After each phase, the crew will receive an AAR. During this AAR, the TCE will brief the crew on crew duties such as fire commands, crew coordination, sectors of fire, target acquisition, method of engagements, and tactical reporting.

Crew-duty penalties are implemented to ensure crews practice safe firing procedures. There are five categories of crew-duty penalties:

- Immediate disqualification—extremely hazardous conduct.
- Automatic zero point—disregard for announced task, conditions, and standards.
- Failure to adhere to basic safety precepts, Level I (30 points).
- Failure to adhere to basic safety precepts, Level II (20 points).
- Failure to employ correct engagement techniques or respond properly to fire commands (5 points).

Note. The following list of crew-duty penalties is not all-inclusive.

IMMEDIATE DISQUALIFICATION—EXTREMELY HAZARDOUS CONDUCT

Any crew found in violation of the following policies will receive an immediate disqualification for the table they are firing:

- Loader holding a round in his lap.
- Ammunition doors remaining open. (Ammunition doors must be closed, unless the loader is removing a round to load immediately into the empty chamber, restowing a round that has been removed from the chamber, or repositioning ammunition between engagements.)
- Stub base catcher box and aftcap deflector not properly installed and serviceable.
- Crews firing outside the range fan.
- Guards or shields not in place or not properly installed.
- Crew members not in proper uniform.

Note. Proper uniform is complete Nomex (if available), coveralls with gloves; or BDUs with shirt sleeves down, collar up and buttoned, and gloves.

AUTOMATIC ZERO-POINT PENALTY—BLATANT DISREGARD FOR ANNOUNCED TASK, CONDITIONS, AND STANDARDS

Any crew found in violation of the following policies will receive 0 points for the engagement they are firing:

- Not buttoned up during an NBC engagement.
- Not masked or overpressurized during an NBC engagement.
- Using components of the fire control system that are announced as degraded in the engagement conditions.
- TC not firing his main gun engagement.
- Firing the main gun into the berm.
- Firing the main gun at troops (due to range constraints).
- Not using the digital communications on digital engagements.

30-POINT PENALTY (LEVEL I)

Failure to adhere to Level I basic safety precepts:

- Firing or attempting to fire the main gun before announcing "UP," "FIRE," or "ON THE WAY."
- Leaving the main gun armed or the gun select switch in the MAIN position during loading or between engagements (points will be deducted from previous engagement).
- Announcing "ON THE WAY" before "UP" or "FIRE."

20-POINT PENALTY (LEVEL II)

Failure to adhere to Level II basic safety precepts:

- Announcing "FIRE" before the loader announces "UP" (without the gunner or TC attempting to fire).
- The loader arming the gun prior to the fire command.

Note. If a safety violation, or combination of safety violations, indicates it may be unsafe for a crew to continue the course, the OIC, RSO, or TCE will disqualify the crew and remove them from the range. Any unsafe act may be assessed a safety penalty. Any crew that receives three safety crew cuts during any table (day, night, or day and night combined) will be disqualified. Once a crew is disqualified for any reason, they must be recertified by the first field grade officer in the chain of command and cannot be Q1.

5-POINT PENALTY

Failure to use correct engagement techniques or respond properly to fire commands:

- Incorrect response to a fire command or subsequent fire command (safety crew cuts cannot be evaluated as an incorrect response).
- Failure to *choke* the range to a target on an LRF degraded engagement, either gunner (M1 and M1A1) or TC (M1A2 and M1A2 SEP).
- Incorrect initial fire command.
- Gunner failing to announce the ammunition that is indexed during a change of ammunition ("SABOT/ HEAT INDEXED").
- Loader failing to announce the ammunition that is loaded during a change of ammunition ("SABOT/HEAT LOADED").
- Failure to fire *initial burst* through target area on a machine gun engagement.
- Gunner failing to announce "CHOKED" range (M1 and M1A1).
- Loader announcing "UP" when it is abvious to the TCE that the round is not loaded.
- TC not announcing the direction element of the fire command for an engagement using the loader's machine gun.
- Failure to announce "CEASE FIRE" when changing weapon systems or to terminate an engagement.

FAILURE TO ENGAGE ALL PRESENTED TARGETS

SPECIAL NOTICE

Crews that do not engage all presented targets in an engagement will receive a 30-point gunnery penalty for that engagement. Because crews will be penalized for not engaging all targets, the TCE must make the determination whether the crew made a valid attempt to engage the target.

Point Target. A point target is considered engaged when it is either hit or the round goes within one target form of the target.

Area Target. An area target is considered engaged when one target in the array is hit or rounds impact within one target form of the array.

SCORING PROCEDURES

Each task has its own specific scoresheet; you must use the scoresheet for that specific task. The time/points column on the scoresheet for each task is based on the expected results of engagements between the Abrams, selected enemy vehicles, and the performance of the crew. The instructions below explain how to use the scoresheet for defensive and offensive tasks. Pages 14-18 and 14-19 show two examples of completed scoresheets for defensive tasks and pages 14-20 and 14-21 show two examples of completed scoresheets for offensive tasks.

SCORING INSTRUCTIONS FOR DEFENSIVE TASKS

1. Record the defilade time in the defilade time space.

2. Circle the sensing (T [target], D [doubtful], L [lost], O [over], S [short]).

3. Record the engagement time and the target number (the target number corresponds to the target number in the *Conditions* statement).

4. Repeat steps 2 and 3, and record the obscuration/break time (obscuration, stoppage, misfire, and so forth) for all subsequent targets.

5. Record the last target engagement time on line (a).

6. Record the defilade time on line (b) (maximum 15 seconds).

7. Subtract the defilade time (b) from the last target engagement time (a) and record the results on line (c).

8. Add all obscuration/break times (before last target engaged) and record the total time on line (d).

9. Subtract the total obscuration/break time (d) from the resultant target engagement time (c), and record the results on line (e).

10. Record the number of targets hit on line (f).

11. Divide (e) by (f), round this number down (for example, 12.7 is rounded to 12), and enter the number on line (g); this is your target hit time.

12. Using the result from line (g), read down the "time" column to get the points for each hit (misses = 0).

13. Circle the target effect (H/M), and record the points on the line for each target hit (record a 0 for targets missed) for the task.

14. Add the points for all targets, and record the total points.

15. Divide the total points by the number of targets presented and round off to the next whole number (for example, 75.4 is rounded to 75 and 75.5 is rounded to 76).

16. Subtract crew duty penalties (crew cuts); the result is the crew score for that task.

17. Subtract 30 points if all targets were not engaged.

18. After all targets have been hit or target exposure time has elapsed, record the total rounds fired, targets hit, targets missed, and targets not engaged in the appropriate block.

SCORING INSTRUCTIONS FOR OFFENSIVE TASKS

1. Circle the sensing (T [target], D [doubtful], L [lost], O [over], S [short]).

2. Record the engagement time and the target number (the target number corresponds to the target number in the *Conditions* statement).

3. Repeat steps 2 and 3, and record the obscuration/break time (obscuration, stoppage, misfire, and so forth) for all subsequent targets.

4. Record the last target engagement time on line (a).

5. Add all obscuration/break times (before last target engaged) and record the total time on line (b).

6. Subtract the total obscuration/break time (b) from the resultant target engagement time (a), and record the results on line (c).

7. Record the number of targets hit on line (d).

8. Divide (c) by (d), round this number down (for example, 12.7 is rounded to 12), and enter the number on line (e); this is your target hit time.
9. Using the result from line (e), read down the "time" column to get the points for each hit (misses = 0).
10. Circle the target effect (H/M), and record the points on the line for each target hit (record a 0 for targets missed) for the task.
11. Add the points for all targets, and record the total points.
12. Divide the total points by the number of targets presented and round off to the next whole number (for example, 75.4 is rounded to 75 and 75.5 is rounded to 76).
13. Subtract crew duty penalties (crew cuts); the result is the crew score for that task.
14. Subtract 30 points if all targets were not engaged.
15. After all targets have been hit or target exposure time has elapsed, record the total rounds fired, targets hit, targets missed, and targets not engaged in the appropriate block.

SCORING CONSIDERATIONS FOR TARGET MISS

If a crew fires at a target and misses, record that time in the engagement time block. Record the target number, and circle the sensing. Record any obscuration/break time. If the crew reengages the same target without engaging another target, record that time in the next engagement time block for that target. If the second round was a target hit, record the target number, and circle the sensing. Continue with procedures as discussed above.

If the crew fires at a target and misses, then acquires and engages a different target prior to reengaging the missed target, record the engagement time, target number, and sensing in the appropriate blocks for the target missed. Record the engagement time, target number, and sensing for the second round. Continue with the procedures as discussed under scoring procedures.

If the crew then reengages a missed target and achieves a target hit, record the engagement time, target number, and sensing in the appropriate blocks. Continue with the procedures as discussed under scoring procedures.

EXAMPLE DEFENSIVE TASKS

Example 1—Tank Table VIII, Task A1 (Figure 14-1)

The TC identifies the PC (BRDM), opens with the caliber .50 at 5 seconds, and gets a target at 12 seconds. The tank moves forward at 19 seconds. The gunner opens up on the troops at 23 seconds and knocks down a troop silhouette at 33 seconds. There are no crew cuts.

Example 2—Tank Table VIII, Task B3S (Figure 14-2)

The crew identifies the moving flank tank (target 2) and pulls forward at 5 seconds. The crew gets a target on the moving flank tank at 13 seconds. The crew then fires at the stationary frontal tank (target 1) with a sensing of "OVER" at 23 seconds. The crew backs down for 3 seconds, then pulls back up. The crew fires at the stationary defilade target (target 3) and gets a target at 36 seconds. The crew then re-acquires target 1 and reengages with target at 44 seconds. The crew announces "TARGET OBSCURED" at 45 seconds. The loader announces "UP" at 48 seconds. The gunner announces "IDENTIFIED" at 51 seconds, opens with the coax at 53 seconds, and gets a target at 57 seconds. The two initial targets were presented simultaneously.

EXAMPLE OFFENSIVE TASKS

Example 3—Tank Table VIII, Engagement A2S (Figure 14-3)

The crew engages target 1 at 8 seconds and target 2 at 20 seconds. The crew opens on the troops at 28 seconds and knocks down a silhouette at 36 seconds. There are no crew cuts.

Example 4—Tank Table VIII, Engagement B2A (Figure 14-4)

The crew engages target 1 at 13 seconds with a sensing of "OVER." The crew hits target 2 at 28 seconds. The crew announces "TARGET OBSCURED" at 29 seconds. The loader announces "UP" at 33 seconds. The crew opens on the troop target at 38 seconds with a target at 48 seconds. The crew never went back to target 1.

TANK TABLE VIII, TASK A1 (DEFENSE), Bumper Number A-23

TASK
Engage targets with multiple weapon systems from a defensive firing position.

AMMUNITION
Caliber .50: 100 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 2
GPS precision.
Use caliber .50 (commander's weapon).
Use M240 coax machine gun.
Main gun weapon status tight.
Target 1: Stationary frontal PC (BRDM), 600 to 800 meters.
Target 2: Troop target, 300 to 500 meters (15-second delay).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 35 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
90	11	90
80	12	80
70	13	70
68	14	68
66	15	66
64	16	64
62	17	62
60	18	60
58	19	58
56	20	56
54	21	54
52	22	52
50	23	50
48	24	48
46	25	46
44	26	44
42	27	42
40	28	40
38	29	38
36	30	36
34	31	34
32	32	32
30	33	30
28	34	28
26	35	26
24	36	24
22	37	22
20	38	20
18	39	18
16	40	16
14	41	14
12	42	12
10	43	10
8	44	8
6	45	6
4	46	4
2	47	2
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time 5
   Eng Time 12 Target # 1 (T) D L O S
2. Obscuration/Break Time: 3 Defilade Time 4
   Eng Time 33 Target # 2 (T) D L O S
3. Obscuration/Break Time _____ Defilade Time _____
   Eng Time _____ Target # _____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time _____
   Eng Time _____ Target # _____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time _____
   Eng Time _____ Target # _____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time _____
   Eng Time _____ Target # _____ T D L O S

Record last target engagement time	(a) 33
Record defilade time (15 sec or less)	(b) 9
Subtract (a - b = c)	(c) 24
Add total obscuration/break time	(d) 3
Subtract (c - d = e)	(e) 21
Record number of targets hit	(f) 2
Divide (e ÷ f = g) for target time	(g) 10

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal PC) (H) M Points 100
Target 2 (Troops) (H) M Points 100
(add points for all targets) **Total Points** 200

Divide **Total Points** 200 by **Total Targets** 2 = 100
Subtract crew cuts Ø
Subtract 30 points if all targets not engaged Ø
Task Score 100

Rounds Fired _____ Targets Hit 2
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:
CAL .50 OPEN 5
COAX OPEN 23

Figure 14-1. Sample Completed Scoresheet—Example 1.

TANK TABLE VIII, TASK B3S (DEFENSE), Bumper Number A-23

TASK
Engage multiple targets with multiple weapon systems from a defensive firing position, day or night.

AMMUNITION
TPCSDS-T: 4 rounds.
7.62 mm: 50 rounds.
M1 (TPDS-T: 4 rounds).

CONDITIONS
Total Targets: 4

Target 1:
Stationary frontal tank, 1,400 to 1,600 meters.

Target 2:
Moving flank tank, 1,600 to 1,800 meters.
M1 (1,500 to 1,700 meters).

Target 3:
Stationary defilade tank, 700 to 900 meters (15-second delay).

Target 4:
Troop target, 300 to 500 meters (25-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 50 seconds.
Target 3: 60 seconds.
Target 4: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	94
95	8	88
90	9	82
85	10	76
80	11	70
75	12	65
70	13	60
65	14	55
60	15	50
55	16	45
50	17	40
45	18	35
40	19	30
35	20	25
30	21	20
25	22	15
20	23	10
15	24	5
10	25	0
5	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time 5
   Eng Time 13 Target # 2 (T) D L O S
2. Obscuration/Break Time: _____ Defilade Time _____
   Eng Time 23 Target # 1 T D L (O) S
3. Obscuration/Break Time _____ Defilade Time 3
   Eng Time 36 Target # 3 (T) D L O S
4. Obscuration/Break Time: _____ Defilade Time _____
   Eng Time 44 Target # 1 (T) D L O S
5. Obscuration/Break Time: 3 Defilade Time _____
   Eng Time 57 Target # 4 (T) D L O S
6. Obscuration/Break Time: _____ Defilade Time _____
   Eng Time _____ Target # _____ T D L O S

Record last target engagement time	(a) 57
Record defilade time (15 sec or less)	(b) 8
Subtract (a - b = c)	(c) 49
Add total obscuration/break time	(d) 3
Subtract (c - d = e)	(e) 46
Record number of targets hit	(f) 4
Divide (e ÷ f = g) for target time	(g) 11

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

	(Circle One)		
Target 1 (Stationary frontal tank)	(H)	M	Points 80
Target 2 (Moving flank tank)	(H)	M	Points 80
Target 3 (Stationary defilade tank)	(H)	M	Points 80
Target 4 (Troops)	(H)	M	Points 80

(add points for all targets) **Total Points** 320

Divide **Total Points** 320 by **Total Targets** 4 = 80
Subtract crew cuts Ø
Subtract 30 points if all targets not engaged Ø
Task Score 80

Rounds Fired 4 Targets Hit 4
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:
COAX OPENS AT 53

Figure 14-2. Sample Completed Scoresheet—Example 2.

TANK TABLE VIII, TASK A2S (OFFENSE), Bumper Number A-23

TASK
Engage multiple targets with multiple weapon systems from a moving tank, day or night.

AMMUNITION
HEAT-TP-T: 3 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 3
NBC environment (protective mask and over- pressurization on).
M1: NBC environment (protective mask and closed hatch).
Target 1: Stationary frontal APC, 1,400 to 1,600 meters. **M1** (1,200 to 1,400 meters).
Target 2: Stationary frontal APC, 1,400 to 1,600 meters. **M1** (1,200 to 1,400 meters).
Target 3: Troop target, 600 to 800 meters (15-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 75 seconds.
Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	90
100	11	80
90	12	70
80	13	65
70	14	60
65	15	55
60	16	50
55	17	45
50	18	40
45	19	35
40	20	30
35	21	25
30	22	20
25	23	15
20	24	10
15	25	5
10	26	0
5	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time 8 Target # 1 (T) D L O S
2. Obscuration/Break Time: _____
   Eng Time 20 Target # 2 (T) D L O S
3. Obscuration/Break Time _____
   Eng Time 36 Target # 3 (T) D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #____ T D L O S

Record last target engagement time	(a)	36
Add total obscuration/break time	(b)	Ø
Subtract (a - b = c)	(c)	36
Record number of targets hit	(d)	3
Divide (c ÷ d = e) for target time	(e)	12

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) (H) M Points 88
Target 2 (Stationary frontal APC) (H) M Points 88
Target 3 (Troops) (H) M Points 88

(add points for all targets) **Total Points** 264

Divide **Total Points** 264 by **Total Targets** 3 = 88

Subtract crew cuts Ø

Subtract 30 points if all targets not engaged Ø

Task Score 88

Rounds Fired 2 Targets Hit 3
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:
COAX OPENS 28

Figure 14-3. Sample Completed Scoresheet—Example 3.

TANK TABLE VIII, TASK B2A (OFFENSE), Bumper Number A-23

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
HEAT-TP-T: 3 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 3

Target 1:
Stationary frontal APC, 1,500 to 1,700 meters. **M1** (1,200 to 1,400 meters).

Target 2:
Evasive flank APC, 1,500 to 1,700 meters (10-second delay). **M1** (1,200 to 1,400 meters).

Target 3:
Troop target, 400 to 600 meters (15-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 50 seconds.
Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
94	10	90
88	11	80
82	12	70
76	13	66
70	14	62
66	15	58
62	16	54
58	17	50
54	18	46
50	19	42
46	20	38
42	21	34
38	22	30
34	23	26
30	24	22
26	25	18
22	26	14
18	27	10
14	28	6
10	29	2
6	30	0
2	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time 13 Target # 1 T D L (O) S
2. Obscuration/Break Time: _____
   Eng Time 28 Target # 2 (T) D L O S
3. Obscuration/Break Time 5
   Eng Time 48 Target # 3 (T) D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #____ T D L O S

Record last target engagement time	(a)	48
Add total obscuration/break time	(b)	5
Subtract (a - b = c)	(c)	43
Record number of targets hit	(d)	2
Divide (c ÷ d = e) for target time	(e)	21

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H (M) Points Ø
Target 2 (Evasive flank APC) (H) M Points 42
Target 3 (Troops) (H) M Points 42

(add points for all targets) **Total Points** 84

Divide **Total Points** 84 by **Total Targets** 3 = 28
Subtract crew cuts Ø
Subtract 30 points if all targets not engaged Ø
Task Score 28

Rounds Fired 2 Targets Hit 2
Targets Missed 1 Targets Not Engaged _____

Remarks/Reason for crew cuts:
COAX OPENS 38

Figure14-4. Sample Completed Scoresheet—Example 4.

Conduct of Tank Table I—Basic Gunnery Skills (Individual)

Table I is designed to train TC and gunner teams on basic gunnery skills (including target acquisition, target designation, gun laying, manipulation, and direct-fire adjustment) from a stationary tank.

CONCEPT

Table I develops coordination skills, and provides the TC and gunner an opportunity to identify individual strengths and weaknesses. It should be conducted with a TC and gunner from the same crew. Each TC and gunner will evaluate the other during their separate tasks during practice.

EXECUTION

In addition to battle roster TC and gunner teams, commanders should use this table to cross-train drivers, loaders, and nonbattle-roster personnel (TC and gunner alternates) on TC and gunner skills. Table I is not resource intensive, therefore will be fired on the tank. An AAR will be conducted by the TCE for this table.

CONDUCT OF TABLE

Table I tasks are not range dependent; most local training areas or motor pools can support them. Use of manipulation boards, full-size or scaled targets, and switchology drills will allow the TC and gunner to conduct exercises from a stationary tank. In addition to the scheduled gunnery training cycle, Table I tasks should be incorporated into the unit's routine training schedules.

GUN-LAYING EXERCISE FOR THE M1, M1A1, AND M1A2

The TC will be presented targets (one at a time) for which he must initiate a simulated engagement. Full-scale targets should be used when possible; thermal targets are recommended. Viewing through the GPS (day/thermal) in 3X magnification, the gunner will evaluate the TC's gun-laying ability. At the completion of the TC's lay, the gunner should be able to identify the target within his optic.

Note. After the TC becomes proficient in laying the gun on the M1A2 or M1A2 SEP, he will practice acquiring a target from a received (via digital means) contact or spot report and lay the main gun on the target. The TC will review the information received, then orient the main gun from the tactical screen to the terrain around him.

The TC achieves a GO when he lays the main gun and the target appears within the GPS/GPSE 10X or GAS field of view.

Note. Proper seat and platform adjustments, as prescribed in the operators manual, are critical for accurate gun lay.

MANIPULATION EXERCISE

From their respective positions, the TC and gunner will manipulate the turret and main gun. This exercise consists of engaging ten stationary targets on a manipulation silhouette within one minute. The TC will engage the targets using his power control handle and the GPSE or CITV. The gunner will engage the targets using power or manual controls and the GPS (day/thermal) or the GAS.

TRACKING EXERCISES

Tracking exercises using manipulation boards train TCs and gunners in hand-and-eye coordination, turret control, speed, and accuracy. Chapter 13, this FM, shows tracking-board measurements and examples of tracking boards for exercises that combine basic handle movements with switchology.

Tracking exercises will be performed with the GPS, TIS, GAS, GPSE, and/or the CITV. The TC and gunner should practice the tracking exercises from all sights. TCs and gunners will evaluate each other during these practice sessions. Commanders should periodically conduct manipulation drills that evaluate TC/gunner combinations. If there are resources or time constraints, tracking exercises can be accomplished in the UCOFT and AGTS under special-purpose exercises (acquisition/manipulation). Results from these drills will help the commander establish standards for his tank crews, based on their current skill level. He will then be able to establish goals for future manipulation drills.

TARGET DESIGNATE EXERCISES FOR THE M1A2

While viewing predetermined sectors, the TC acquires targets with the CITV and designates to the gunner. One or two targets are presented at a time, at staggered intervals. The TC, using the NFOV, acquires and designates targets to the gunner, who is in 10X. Multiple targets (frontal, flank, or mixed vehicle types) will be presented to allow the TC to designate the *most dangerous* targets and allow the crew to identify targets. TCs and gunners will train target sector hand-off by alternating sectors of responsibility.

RANGE DETERMINATION EXERCISES

The TC and gunner determine range to various flank, frontal and oblique targets, fully exposed or in hull-down positions. With simulated LRF failure, the TC and gunner determine range to targets by using the following methods:

- CITV stadia reticle (M1A2).
- GAS stadia reticle.
- Reticle relationship (Chapter 7, this FM).
- CID tactical screen.

Determining range from the tactical screen requires the TC to use the grid lines of the tactical screen to determine distance from own vehicle (icon) to the perceived threat (icon). Depending on the size and restraints of the training area, several methods may be used.

When possible, conduct training with full-size targets in a laser-safe environment. With a prescribed scenario, allow the crew to practice each range determination method on full-scale targets and use the LRF to verify their estimated ranges. In restricted training areas that are not laser safe, scaled targets may be used. (See TC 25-8 for procedures on constructing scaled ranges.)

Crews can also practice range determination in the motor pool with the use of scaled targets placed on a manipulation board. This board is placed 100 meters from the tank. The following chart lists scaled dimensions for various target types at specific ranges. These figures are based on measurements found in TC 25-8 for a 1:1 scale target and manipulation board placed at 100 meters.

SCALED DIMENSIONS FOR TARGETS AT 100 METERS			
Target Type	**Height (cm)**	**Length (cm)**	**Range (m)**
T-72 Front	44.0	67.0	500
T-72 Flank	33.3	103.0	660
T-72 Front	27.5	41.8	800
T-72 Turret	8.0	10.0	1,000
T-72 Flank	18.3	58.3	1,200
T-72 Front	15.7	23.9	1,400
T-72 Front	14.6	22.3	1,500
T-72 Turret	6.0	5.0	1,600
T-72 Flank	11.0	35.0	2,000
T-72 Front	8.8	13.4	2,500
T-72 Flank	6.0	19.2	3,630
BMP Flank	13.8	19.4	1,600
BMP Front	18.3	25.8	1,200
BMP Flank	11.0	15.5	2,000
T-72 Flank	10.0	31.8	2,200

For additional target ranges: divide 100 (manipulation board distance) by the desired range (to target), then multiply by the full-scale (1:1) dimension.

Example: T-72 flank, 2,200m.

100 ÷ 2,200 = 0.04545 X 220cm (height) = 10cm

100 ÷ 2,200 = 0.04545 X 700cm (length) = 31.8cm

TARGET ENGAGEMENT EXERCISES

Target engagement exercises are designed to train TCs and gunners the direct-fire process. Techniques to be trained include—

- Single, multiple, and multiple weapon systems engagements.
- NORMAL, DEGRADED, and AIR/GROUND modes.
- Reticle relationship.
- GAS stadia reticle.
- Direct-fire adjustments.
- Main gun and machine gun engagements.

These exercises may be conducted dry or with TWGSS or MILES on scaled or full-size target ranges. Normal AGTS, COFT, and AFIST progression will train crews in basic gunnery skills.

SCORING

The TCE will rate crew duties for each engagement on Table I. If the crew member commits more than one crew-duty error during a task, he will be rated UNSAT in crew duties. Crew duties will be critiqued by the TCE during the AAR; however, they will not affect the overall GO/NO-GO rating for the task.

Each crew member should receive a GO rating on all tasks for Table I before progressing to Table II. The TC and gunner should continue to practice Table I until each one obtains a GO rating.

Table 14-1. Tank Table I Task List.

TASK	CONDITIONS	STANDARDS	CREW DUTIES	EFFECT	GO/ NO-GO
1. Negotiate a tracking board from a stationary tank (gunner).	4 tracking board solutions. Use GPS, TIS, and GAS.	Track each board, in sequence, within 60 seconds.	SAT UNSAT		GO NO-GO
2. Negotiate a tracking board from a stationary tank (TC).	4 tracking board solutions. Use GPSE and CITV.	Track each board, in sequence, within 60 seconds.	SAT UNSAT		GO NO-GO
3a. Engage targets from a stationary tank.	10 stationary targets. Use the GPS.	Hit 7 of 10 targets within 60 seconds.	SAT UNSAT	HIT____ MISS___	GO NO-GO
3b. Engage targets from a stationary tank.	10 stationary targets. Use the GAS.	Hit 7 of 10 targets within 60 seconds.	SAT UNSAT	HIT____ MISS___	GO NO-GO
3c. Engage targets from a stationary tank.	10 stationary targets. Use the GPS, manual controls.	Hit 7 of 10 targets within 60 seconds.	SAT UNSAT	HIT____ MISS___	GO NO-GO
3d. Engage targets from a stationary tank.	10 stationary targets. Use the GAS, manual controls.	Hit 7 of 10 targets within 60 seconds.	SAT UNSAT	HIT____ MISS___	GO NO-GO
4a. Apply one-half target form correction from a stationary tank.	1 stationary target. Use the GPS. (First round sensed as “Over” or “Short.”)	Hit target within 8 seconds after first-round miss in elevation.	SAT UNSAT	HIT MISS	GO NO-GO
4b. Apply one-half target form correction from a stationary tank.	1 stationary target. Use the GPS. (First round sensed as “Doubtful.”)	Hit target within 8 seconds after first-round miss in deflection.	SAT UNSAT	HIT MISS	GO NO-GO
5. Lay the main gun from the CWS (TC) (see page 15-27 for instructions).	10 targets presented individually (5 normal mode, 5 emergency mode). Use the commander’s control handle.	Lay main gun within 10 seconds (each target evaluated separately).	SAT UNSAT	HIT____ MISS___	GO NO -GO
6. Select or conduct announced switches or functions from the gunner’s station (switchology) (gunner).	10 switches and functions. Use the GPS.	Select and conduct announced switches and functions within 5 seconds.	SAT UNSAT		GO NO-GO
7. Select and conduct announced switches or functions from the TC’s station in the open-protected position (switchology) (TC) (M1A2 only).	10 switches and functions.	Select and conduct announced switches or functions within 5 seconds.	SAT UNSAT		GO NO-GO
8. Acquire and designate targets from the open-protected position (TC) (M1A2 only).	10 targets (5 AUTO-SCAN mode, 5 SEARCH mode) (sector predetermined).	Acquire and designate each target within 7 seconds.	SAT UNSAT		GO NO-GO

Conduct of Tank Table II—Basic Gunnery Skills (Individual/Crew)

Table II is the first table to begin training full crew interaction. In addition, the TC and gunner refine skills from the previous table.

CONCEPT

Table II is designed to train the individual and crew to engage stationary and moving targets, placed in tactical arrays, from a stationary tank. Each engagement is designed to train a crew to manipulate the controls for each fire control condition against stationary or moving targets, with each type of ammunition and sight. Friendly targets should be included to give the crew practice in target identification.

CONDUCT OF TASKS

Table II tasks can be conducted on a scaled range using scaled targets. The type of training device and training area available will determine what scale targets to use (see TC 25-8). All targets should be mounted on pop-up mechanisms to facilitate target acquisition and scoring. If pop-up mechanisms for scaled targets are not available, stationary (exposed) targets will be placed in an appropriate array. Range to target is determined by the training method or device used (scaled range, AGTS, COFT, or AFIST). If training devices are not available, dry fire with a TCE, or use the AGTS, COFT, or AFIST (see chart on page 14-3).

EXECUTION

The unit commander will determine the frequency of execution of this table. Table II will be conducted on scaled ranges. Targets will be placed to represent the desired engagement range, keeping in mind the effective range of the subcaliber training device used. If an appropriate scaled range is not available, Table II may be conducted using the AGTS, COFT, or AFIST.

Some Table II exercises cannot be fired on a scaled range. The commander must select appropriate exercises to train his crews with available resources.

SCORING

The tank crew must receive a GO rating on 70 percent of the tasks for Table II. Crews should continue to practice Table II until a GO rating is received, before progressing to Table III.

Table 14-2. Tank Table II Task List.

TASK	CONDITIONS	STANDARDS	CREW DUTIES	EFFECT	GO/ NO-GO
1. Engage a target from a stationary tank.	1 stationary tank. Use GPS, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
2. Engage a target from a stationary tank.	1 stationary tank. Use TIS, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
3. Engage a target from a stationary tank.	1 stationary tank. Use GAS (announced range), normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
4. Engage a target from a stationary tank.	1 set of troops. Use GPS/TIS, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
5. Engage a target from a stationary tank.	1 moving PC. Use GPS, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
6. Engage a target from a stationary tank.	1 moving tank. Use TIS, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
7. Engage a target from a stationary tank.	1 moving helicopter. Use GPS/TIS, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
8. Engage a target from a stationary tank.	1 moving PC. Use GPS/TIS, emergency mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
9. Engage a target from a stationary tank.	1 moving tank. Use GAS (announced range), normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
10. Engage a target from a stationary tank.	1 moving PC. Use GAS (announced range), normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
11. Engage a target from a stationary tank.	1 moving tank. Use GAS (announced range), manual mode.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
12. Engage a target from a stationary tank.	1 moving PC. Use GAS (announced range), manual mode.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
13. Engage a target from a stationary tank.	1 moving evasive tank. Use GPS/TIS, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
14. Engage a target from a stationary tank.	1 moving PC. Use GPSE, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
15. Engage a target from a stationary tank.	1 moving tank. Use GPSE, normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
16. Engage a target from a stationary tank.	1 stationary tank. Use CITV (M1A2) or GPSE (M1 and M1A1), normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
17. Engage a target from a stationary tank.	1 moving PC. Use CITV (M1A2) or GPSE (M1 and M1A1), normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
18. Engage a target from a stationary tank.	1 stationary PC. Use CITV (M1A2) or GPSE M1 and M1A1), emergency mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
19. Engage a target from a stationary tank.	1 moving tank. Use CITV (M1A2) or GPSE (M1 and M1A1), emergency mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
20. Engage a target from a stationary tank.	1 set of troops. Use CITV (M1A2) or GPSE (M1 and M1A1), normal mode.	Hit target within 6 seconds.	SAT UNSAT	HIT MISS	GO NO-GO

Conduct of Tank Table III—Basic Training Course (Crew)

Table III tasks the crew to refine skills developed during the two previous tables, and introduces offensive engagements and NBC conditions. Table III also prepares the crew to qualify on Table IV.

CONDUCT OF TASKS

Various tasks will be conducted using single and multiple target arrays, requiring either precision- or degraded-mode gunnery techniques. A minimum of one day and one night engagement will be conducted in an NBC environment. If, due to resource constraints, a range is not available to conduct Table III, it may be conducted and evaluated using the chart on page 14-3 with the AGTS, COFT, or AFIST.

EXECUTION

Table III can be fired incorporating full-size or scaled targets using TWGSS or MILES with the LTID. (See FM 17-12-7 for more information on TWGSS, MILES, and LTID.) If the table is dry fired, the TCE should evaluate the engagements and crew duties. The TCE will conduct an AAR after each run to enhance the training value.

SCORING

The tank crew must receive a GO rating on 70 percent of the tasks for Table IIIA and IIIB to receive an overall GO for the table. Crews should continue to practice Table III until a GO rating is received, before progressing to Table IV.

Table 14-3. Tank Table IIIA Task List.

TASK	CONDITIONS	STANDARDS	CREW DUTIES	EFFECT	GO/ NO-GO
1. Engage a target from a defensive firing position.	Move from turret-down to hull-down. 1 stationary PC, 900 to 1,000 meters. Use GPS.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
2. Engage a target from a defensive firing position.	Move from turret-down to hull-down. 1 stationary tank, 900 to 1,000 meters. Use GAS. NBC environment.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
3. Engage a target from a moving tank.	1 stationary tank, 1,400 to 1,600 meters. Use TIS.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
4. Engage a target from a moving tank.	1 moving tank, 1,200 to 1,400 meters. Use GPS.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
5. Engage a target from a defensive firing position.	1 stationary flank tank, 1,600 to 1,800 meters. LRF failure (determine range using stadia reticle). Stab failure.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
6. Engage a target from a defensive firing position.	1 stationary tank in defilade, 800 to 1,000 meters. Use CITV (M1A2) or GPSE (M1 and M1A1).	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
7. Engage a target from a moving tank during a short halt.	1 stationary tank, 1,400 to 1,600 meters. Stab failure.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
8. Engage a target from a defensive firing position.	1 stationary flank PC, 1,200 to 1,500 meters. Three-man crew. Stab failure. Use GPSE.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
9. Engage a target from a defensive firing position.	1 stationary PC, 800 to 1,200 meters. Three-man crew. LRF failure. Use CITV (M1A2) or GPSE (M1 and M1A1).	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
10. Engage multiple targets from a defensive firing position.	2 stationary tanks, 1,600 to 2,000 meters. Use GPS.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
11. Engage multiple targets from a defensive firing position.	1 stationary tank, 1,400 to 1,600 meters; 1 stationary flank tank, 1,300 to 1,500 meters. Use CITV (M1A2) or GPSE (M1 and M1A1). Three-man crew.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
12. Engage a target from a defensive firing position.	1 moving helicopter, 1,400 to 1,600 meters. Use GPS.	Hit target within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
13. Engage multiple targets from a moving tank.	1 set troops, 400 to 600 meters; 1 set of troops, 700 to 900 meters. Use GPS.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
14. Engage multiple targets from a defensive firing position.	1 moving tank, 1,400 to 1,600 meters; 1 stationary tank, 1,300 to 1,500 meters. Use GPS.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
15. Engage multiple targets from a moving tank.	1 stationary tank, 900 to 1,100 meters; 1 moving tank, 1,600 to 1,800 meters. Use GPSE. Three-man crew.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO

Table 14-4. Tank Table IIIB Task List.

TASK	CONDITIONS	STANDARDS	CREW DUTIES	EFFECT	GO/ NO-GO
1. Engage multiple targets from a defensive firing position.	2 stationary PCs, 1,100 to 1,300 meters. Use TIS.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
2. Engage a target from a moving tank.	1 moving tank, 1,200 to 1,400 meters. Use TIS.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
3. Engage a target from a moving tank.	1 moving tank, 1,200 to 1,400 meters. Use CITV (M1A2) or GPSE (M1 and M1A1).	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
4. Engage a target from a defensive firing position.	1 evasive tank, 900 to 1,100 meters. Use TIS.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
5. Engage a target from a defensive firing position.	1 moving tank, 1,400 to 1,600 meters. Use TIS.	Hit target within 10 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
6. Engage multiple targets from a moving tank.	2 stationary tanks, 900 to 1,100 meters. Use TIS. NBC environment.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
7. Engage multiple targets from a moving tank.	2 stationary tanks, 900 to 1,100 meters. Using TIS.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO
8. Engage multiple targets from a defensive firing position.	1 stationary tank, 1,400 to 1,600 meters; 1 moving tank, 900 to 1,100 meters. Use TIS.	Hit targets within 20 seconds.	SAT UNSAT	HIT MISS	GO NO-GO

Conduct of Tank Table IV—Tank Crew Proficiency Course

Table IV is the basic qualification table for tank crews. This table must be successfully completed before firing the intermediate tables.

CONCEPT

Table IV is designed to evaluate the tank crew's ability to engage stationary and moving targets placed in tactical arrays, from a stationary and moving tank. Table IV tasks are intended to be conducted on a full-scale range using TWGSS against full- or half-scale targets.

Table IV tasks are reflective of the tasks fired with main gun ammunition on Table VIII. Table IV is used to validate that the tank crew can execute various tasks (offense, defense, full-up, or degraded) against various target presentations. Crews on digitally equipped vehicles will fire all engagements, except degraded engagements, using digital communications.

The following table lists the engagements that will be fired for Table IV:

Table 14-5. Tank Table IV Engagement List.

Task	**Target 1** (Target type, range, delay time, exposure time)	**Target 2** (Target type, range, delay time, exposure time)	**Target 3** (Target type, range, delay time, exposure time)	**Ammunition**	**Malfunctions and Limitations**
A1 Defense	Stationary frontal tank, 1,400 to 1,600 meters, exposed for 50 seconds.	Stationary frontal tank, 1,400 to 1,600 meters, exposed for 50 seconds.		2 rounds.	None
A2 Defense	Stationary frontal APC, 1,300 to 1,500 meters (M1, 1,100 to 1,300 meters), exposed for 75 seconds.	Troop target, 400 to 600 meters, exposed for 75 seconds.	Troop target, 400 to 600 meters, exposed for 75 seconds.	1 round. COAX.	None
A3 Offense	Stationary frontal tank, 1,500 to 1,700 meters (M1, 1,400 to 1,600 meters), exposed for 50 seconds.	Moving flank tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), exposed for 50 seconds.		3 rounds.	NBC environment
A4 Defense	Stationary frontal tank, 1,800 to 2,000 meters (M1, 1,600 to 1,800 meters), exposed for 50 seconds.			2 rounds.	None
A5S Defense	Stationary frontal tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), exposed for 60 seconds.	Stationary frontal tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), exposed for 60 seconds.		3 rounds.	LRF failure, closed hatch, overpressuriza-tion on (M1, closed hatch).

continued on next page

Table 14-5 (cont.)

B1S Offense	Stationary flank APC, 1,400 to 1,600 meters (M1, 1,200 to 1,400 meters), exposed for 50 seconds.			2 rounds.	Three-man crew, GPCH failure, TC uses CITV (M1A2) or GPSE (M1 and M1A1).
B2 Defense	Stationary flank tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), exposed for 75 seconds.	Stationary frontal tank, 1,200 to 1,400 meters, exposed for 75 seconds.	Stationary frontal tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), 15-second delay, exposed for 60 seconds.	4 rounds.	NBC environment
B3S Defense	Stationary frontal tank, 1,400 to 1,600 meters, exposed for 75 seconds.	Moving flank tank, 1,800 to 2,000 meters (M1, 1,600 to 1,800 meters), exposed for 50 seconds.	Stationary defilade tank, 700 to 900 meters, 15-second delay, exposed for 60 seconds.	4 rounds.	None
B4 Defense	Stationary frontal tank, 1,200 to 1,400 meters, exposed for 75 seconds.	Stationary frontal tank, 1,800 to 2,000 meters (M1, 1,600 to 1,800 meters), exposed for 75 seconds.	Stationary frontal tank, 2,000 to 2,200 meters (M1, 1,700 to 1,900 meters), 20-second delay, exposed for 55 seconds.	3 rounds.	None
B5 Offense	Stationary frontal APC, 1,400 to 1,600 meters (M1, 1,200 to 1,400 meters), exposed for 50 seconds.	Stationary frontal APC, 1,400 to 1,600 meters (M1, 1,200 to 1,400 meters), exposed for 50 seconds.		2 rounds.	None

CONDUCT OF TASKS

Defensive tasks will be conducted with the firing tank moving from a turret-down to a hull-down position. Offensive tasks will be conducted with the firing tank on the move, traveling at 24 to 40 kmph (15 to 25 mph). Because of relatively short closing distances between the firing tank and some targets, it may be necessary to reduce the speed of the firing tank—the local commander will make this decision.

SAFETY CAUTION

This table includes an offensive (moving) night task (Task B1S, three-man crew). For *safety* reasons, a crewman *should not* dismount the tank at night *if* there is no safety vehicle available to transport him to the tank after the engagement. However, if a safety vehicle is available, the crewman will dismount and the task will be fired in accordance with Chapter 8 (Direct Fire), page 8-26 (Loss of a Crew Member). Ultimately, it is the local commander's decision whether or not the crewman dismounts the tank.

This table consists of three swing tasks (A5S, B1S, and B3S). Swing tasks may be fired during the day or at night (depending on the length of the daylight).

Stationary targets should be mounted on pop-up mechanisms to facilitate target acquisition and scoring. If pop-up targets are not available, exposed stationary targets will be presented in an appropriate array. If exposed targets must be used, targets are presented only to the position from which they should be engaged.

EXECUTION

Table IV will be conducted on a full-scale range using TWGSS or dry against full- or half-scale targets. A stationary target may be substituted for a moving target for ranges with limited movers. An AAR will be conducted by the TCE for each crew, day and night. Table IV cannot be qualified using COFT, AGTS, or AFIST.

Digital engagements will be fired using digital communications. Each *engagement* will be initiated with a digital spot report sent to the firing crew. Upon completion of each *phase* (day or night), a digital spot report will be sent to the tower to terminate the phase.

SCORING

Table IV will be scored using the same standards and procedures as Table VIII. The tank crew must obtain a minimum of 700 points of the 1,000 total points and score at least 70 points on 7 out of 10 tasks.

A sample roll-up scoresheet is provided (Figure 14-5) for the TCE to calculate the overall score for Table IV. Each task on Table IV will be scored using the appropriate scoresheet.

TANK TABLE IV

TANK_____ UNIT _____DATE _____

CREW:TC _____ GNR _____LDR_____DVR_____

DAY: START _____ FINISH _____ NIGHT: START _____FINISH _____

TCE SIGNATURE (DAY) _____

TCE SIGNATURE (NIGHT) _____

TASK	TOTAL TARGETS	RNDS FIRED	TARGETS			PENALTY POINTS	SCORE	QUAL (Y/N)
			HIT	MISSED	NE			
A1								
A2								
A3								
A4								
A5S								
(B1S)								
(B3S)								
TOTALS								
B1S								
B2								
B3S								
B4								
B5								
(A5S)								
TOTALS								
OVERALL								
TOTAL PENALTY POINTS:								
TOTAL QUALIFIED ENGAGEMENTS:								

UNQUALIFIED QUALIFIED SUPERIOR DISTINGUISHED

Figure 14-5. Sample Roll-Up Sheet—Table IV.

TANK TABLE IV, TASK A1 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
2 rounds.

CONDITIONS
Total Targets: 2
Target 1:
Stationary frontal tank, 1,400 to 1,600 meters.
Target 2:
Stationary frontal tank, 1,400 to 1,600 meters.

EXPOSURE TIME
Target 1:
50 seconds.
Target 2:
50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	97
97	5	93
94	6	89
90	7	85
87	8	82
84	9	78
80	10	74
77	11	70
74	12	64
70	13	58
64	14	52
58	15	46
52	16	40
46	17	34
40	18	28
34	19	22
28	20	16
22	21	10
16	22	4
10	23	0
4	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
Target 2 (Stationary frontal tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-6. Sample Scoresheet—Table IV, Task A1.

TANK TABLE IV, TASK A2 (DEFENSE), Bumper Number_____

TASK
Engage multiple targets with multiple weapon systems from a defensive firing position.

AMMUNITION
1 round.
COAX.

CONDITIONS
Total Targets: 3

Target 1:
Stationary frontal APC, 1,300 to 1,500 meters.
M1 (1,100 to 1,300 meters).

Target 2:
Troop target, 400 to 600 meters.

Target 3:
Troop target, 400 to 600 meters.

EXPOSURE TIME

Target 1: 75 seconds.

Target 2: 75 seconds.

Target 3: 75 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	93
94	9	85
88	10	78
82	11	70
76	12	67
70	13	64
67	14	61
64	15	58
61	16	55
58	17	52
55	18	49
52	19	46
49	20	43
46	21	40
43	22	37
40	23	34
37	24	31
34	25	28
31	26	25
28	27	22
25	28	19
22	29	16
19	30	13
16	31	10
13	32	7
10	33	4
7	34	1
4	35	0
1	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____
Target 2 (Troops) H M Points _____
Target 3 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-7. Sample Scoresheet—Table IV, Task A2.

TANK TABLE IV, TASK A3 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
3 rounds.

CONDITIONS
Total Targets: 2

NBC environment (protective mask and over-pressurization on).
M1: NBC environment (protective mask and closed hatch).

Target 1:
Stationary frontal tank, 1,500 to 1,700 meters.
M1 (1,400 to 1,600 meters).

Target 2:
Moving flank tank, 1,600 to 1,800 meters.
M1 (1,500 to 1,700 meters).

EXPOSURE TIME

Target 1*:* 50 seconds.

Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	98
98	9	95
95	10	92
93	11	90
90	12	87
88	13	84
85	14	81
83	15	79
80	16	76
78	17	73
75	18	70
73	19	65
70	20	60
65	21	55
60	22	50
55	23	45
50	24	40
45	25	35
40	26	30
35	27	25
30	28	20
25	29	15
20	30	10
15	31	5
10	32	0
5	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Add total obscuration/break time (b) _____

Subtract (a - b = c) (c) _____

Record number of targets hit (d) _____

Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____

Target 2 (Moving flank tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

Figure 14-8. Sample Scoresheet—Table IV, Task A3.

TANK TABLE IV, TASK A4 (DEFENSE), Bumper Number _____

TASK
Engage a long-range stationary target from a defensive firing position.

AMMUNITION
2 rounds.

CONDITIONS
Total Targets: 1

Target 1:
Stationary frontal tank, 1,800 to 2,000 meters.
M1 (1,600 to 1,800 meters).

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	96
97	7	92
93	8	88
89	9	83
85	10	79
82	11	75
78	12	70
74	13	64
70	14	58
64	15	52
58	16	46
52	17	40
46	18	34
40	19	28
34	20	22
28	21	16
22	22	10
16	23	4
10	24	0
4	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-9. Sample Scoresheet—Table IV, Task A4.

TANK TABLE IV, TASK A5S (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position, day or night.

AMMUNITION
3 rounds.

CONDITIONS
Total Targets: 2
LRF failure.
Closed hatch, overpressurization on.
M1: Closed hatch.

Target 1:
Stationary frontal tank, 1,600 to 1,800 meters.
M1 (1,500 to 1,700 meters).

Target 2:
Stationary frontal tank, 1,600 to 1,800 meters.
M1 (1,500 to 1,700 meters).

EXPOSURE TIME

Target 1: 60 seconds.

Target 2: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	94
95	8	88
90	9	82
85	10	76
80	11	70
75	12	64
70	13	58
64	14	52
58	15	46
52	16	40
46	17	34
40	18	28
34	19	22
28	20	16
22	21	10
16	22	4
10	23	0
4	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
Target 2 (Stationary frontal tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-10. Sample Scoresheet—Table IV, Task A5S.

TANK TABLE IV, TASK B1S (Offense), Bumper Number_____

TASK
Engage a target from a moving tank.

AMMUNITION
2 rounds.

CONDITIONS
Total Targets: 1
Three-man crew (see safety caution on page 14-32).
GPCH failure, TC uses CITV (M1A2) or GPSE (M1 and M1A1).

Target 1: Stationary flank APC, 1,400 to 1,600 meters.

M1 (1,200 to 1,400 meters).

EXPOSURE TIME

Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. Due to range constraints, it may be necessary to substitute the stationary flank APC with a stationary frontal APC. The alternate engagement will be scored using the same points list.

M1/ M1A2 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	90
100	10	80
90	11	70
80	12	64
70	13	58
64	14	52
58	15	46
52	16	40
46	17	34
40	18	28
34	19	22
28	20	16
22	21	10
16	22	4
10	23	0
4	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary flank APC) H M Points _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

_____

Figure 14-11. Sample Scoresheet—Table IV, Task B1S.

TANK TABLE IV, TASK B2 (DEFENSE), Bumper Number_____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
4 rounds.

CONDITIONS
Total Targets: 3

NBC environment (closed hatch with overpressurization system on).
M1 NBC environment (protective mask and closed hatch).

Target 1:
Stationary flank tank, 1,600 to 1,800 meters.
M1 (1,500 to 1,700 meters).

Target 2:
Stationary frontal tank, 1,200 to 1,400 meters.

Target 3:
Stationary frontal tank, 1,600 to 1,800 meters (15-second delay).
M1 (1,500 to 1,700 meters).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 75 seconds.
Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. Due to range constraints, it may be necessary to substitute the stationary flank tank with a stationary frontal tank. The alternate engagement will be scored using the same points list.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	96
97	8	92
93	9	88
89	10	83
85	11	79
82	12	75
78	13	70
74	14	64
70	15	58
64	16	52
58	17	46
52	18	40
46	19	34
40	20	28
34	21	22
28	22	16
22	23	10
16	24	4
10	25	0
4	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary flank tank) H M Points _____
Target 2 (Stationary frontal tank) H M Points _____
Target 3 (Stationary frontal tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:
_____
_____

Figure 14-12. Sample Scoresheet—Table IV, Task B2.

TANK TABLE IV, TASK B3S (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position, day or night.

AMMUNITION
4 rounds.

CONDITIONS

Total Targets: 3

Target 1:
Stationary frontal tank, 1,400 to 1,600 meters.

Target 2:
Moving flank tank, 1,800 to 2,000 meters.

M1 (1,600 to 1,800 meters).

Target 3:
Stationary defilade tank, 700 to 900 meters (15-second delay).

EXPOSURE TIME

Target 1: 75 seconds.

Target 2: 50 seconds.

Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
96	7	94
92	8	88
88	9	82
83	10	76
79	11	70
75	12	65
70	13	60
65	14	55
60	15	50
55	16	45
50	17	40
45	18	35
40	19	30
35	20	25
30	21	20
25	22	15
20	23	10
15	24	5
10	25	0
5	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Record defilade time (15 sec or less) (b) _____

Subtract (a - b = c) (c) _____

Add total obscuration/break time (d) _____

Subtract (c - d = e) (e) _____

Record number of targets hit (f) _____

Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____

Target 2 (Moving flank tank) H M Points _____

Target 3 (Stationary defilade tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-13. Sample Scoresheet—Table IV, Task B3S.

TANK TABLE IV, TASK B4 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
3 rounds.

CONDITIONS
Total Targets: 3

Target 1:
Stationary frontal tank, 1,200 to 1,400 meters.

Target 2:
Stationary frontal tank, 1,800 to 2,000 meters. **M1** (1,600 to 1,800 meters).

Target 3:
Stationary frontal tank, 2,000 to 2,200 meters. **M1** (1,700 to 1,900 meters) (20-second delay).

EXPOSURE TIME

Target 1: 75 seconds.

Target 2: 75 seconds.

Target 3: 55 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	96
97	6	92
93	7	88
89	8	83
85	9	79
82	10	75
78	11	70
74	12	64
70	13	58
64	14	52
58	15	46
52	16	40
46	17	34
40	18	28
34	19	22
28	20	16
22	21	10
16	22	4
10	23	0
4	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Record defilade time (15 sec or less) (b) _____

Subtract (a - b = c) (c) _____

Add total obscuration/break time (d) _____

Subtract (c - d = e) (e) _____

Record number of targets hit (f) _____

Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____

Target 2 (Stationary frontal tank) H M Points _____

Target 3 (Stationary frontal tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-14. Sample Scoresheet—Table IV, Task B4.

TANK TABLE IV, TASK B5 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
2 rounds.

CONDITIONS
Total Targets: 2

Target 1:
Stationary frontal APC, 1,400 to 1,600 meters. **M1** (1,200 to 1,400 meters).

Target 2:
Stationary frontal APC, 1,400 to 1,600 meters. **M1** (1,200 to 1,400 meters).

EXPOSURE TIME

Target 1: 50 seconds.

Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
94	9	90
88	10	80
82	11	70
76	12	64
70	13	58
64	14	52
58	15	46
52	16	40
46	17	34
40	18	28
34	19	22
28	20	16
22	21	10
16	22	4
10	23	0
4	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Add total obscuration/break time (b) _____

Subtract (a - b = c) (c) _____

Record number of targets hit (d) _____

Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____

Target 2 (Stationary frontal APC) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

Figure 14-15. Sample Scoresheet—Table IV, Task B5.

Conduct of Tank Table V—Preliminary Machine Gun Training

Table V is designed to develop crew coordination and train the tank crew on point and area machine gun engagement techniques.

CONCEPT

Table V is designed to train the tank crew to engage stationary and moving targets, placed in tactical arrays, from a stationary and moving tank with tank-mounted automatic weapons. Various tasks are presented using single and multiple machine gun targets, requiring the gunner, loader, and TC to employ point and area target engagement techniques. One day and one night engagement will be fired in an NBC environment. Each task on Table V will be scored using the appropriate scoresheet. The TCE will rate crew duties for each engagement on Table V and subtract crew-duty penalty points from the total engagement points earned.

The following table lists the engagements that will be fired for Table V:

Table 14-6. Tank Table V Engagement List.

Task	**Target 1** (Target type, range, delay time, exposure time)	**Target 2** (Target type, range, delay time, exposure time)	**Target 3** (Target type, range, delay time, exposure time)	**Ammunition**	**Malfunctions and Limitations**
A1 Defense	Stationary flank PC, 800 to 1,000 meters, exposed for 50 seconds.			100 rounds caliber .50.	None
A2 Offense	Troop target, 400 to 600 meters, exposed for 50 seconds.	Troop target, 300 to 500 meters, 10-second delay, exposed for 40 seconds.		100 rounds 7.62mm.	NBC environment
A3 Defense	RPG team, 400 to 600 meters, exposed for 75 seconds.	Troop target, 300 to 500 meters, exposed for 75 seconds.	Stationary frontal BRDM, 800 to 1,000 meters, 15-second delay, exposed for 60 seconds.	100 rounds caliber .50, 100 rounds 7.62mm.	Use all tank-mounted machine guns.
A4 Defense	Stationary flank truck, 600 to 800 meters, exposed for 60 seconds.			100 rounds 7.62mm.	Degraded FCS: LRF, GPS, TIS failure. Use GAS.
B1 Offense	RPG team, 400 to 600 meters, exposed for 50 seconds.	Moving flank truck, 600 to 800 meters, 10-second delay, exposed for 40 seconds.		100 rounds 7.62mm.	None
B2 Offense	RPG team, 400 to 600 meters, exposed for 50 seconds.	RPG team, 400 to 600 meters, exposed for 50 seconds.		100 rounds 7.62mm.	None
B3 Defense	Troop target, 500 to 700 meters, exposed for 50 seconds.	Troop target, 500 to 700 meters, 10-second delay, exposed for 40 seconds.		100 rounds 7.62mm.	NBC environment

CONDUCT OF TASKS

Defensive tasks will be conducted with the firing tank moving from a turret-down to a hull-down position. Offensive tasks will be conducted with the firing tank on the move, traveling at 16 to 32 kmph (10 to 20 mph).

Stationary targets should be mounted on pop-up mechanisms to facilitate target acquisition and scoring. If pop-up targets are not available, exposed stationary targets will be presented in an appropriate array. If exposed targets must be used, targets are presented only to the position from which they should be engaged.

EXECUTION

Table V will be conducted as an integral part of crew progression. The local commander will determine the frequency of firing Table V; however, due to the current lack of proficiency with tank automatic weapons, it is recommended that Table V be fired during every main-gun firing period. An AAR will be conducted for each crew, day and night.

The local commander will determine acceptable alibis for machine-gun failure. Alibis should be accepted only for equipment or ammunition failures that are not a result of crew error. The crew must negotiate the course in main gun weapon status tight. For Table V, the tank crew will be issued all TOE equipment assigned for their tank machine guns. Spare barrels will be carried and used in case of malfunctions.

SCORING

The tank crew must obtain a minimum of 490 of the 700 total points and score at least 70 points on 5 of the 7 engagements on Tables VA and VB combined. Crews should continue to conduct Table V until a qualifying combined score is achieved, before progressing to Table VI. Each task on Table V will be scored using the appropriate scoresheet.

TANK TABLE V

TANK _____ UNIT _____ DATE _____

CREW:TC _____ GNR _____ LDR _____ DVR _____

DAY: START _____ FINISH _____ NIGHT: START _____ FINISH _____

TCE SIGNATURE (DAY) _____

TCE SIGNATURE (NIGHT) _____

TASK	TOTAL TARGETS	RNDS FIRED	TARGETS			PENALTY POINTS	SCORE	QUAL (Y/N)
			HIT	MISSED	NE			
A1								
A2								
A3								
A4								
TOTALS								
B1								
B2								
B3								
TOTALS								
OVERALL								
TOTAL PENALTY POINTS:								
TOTAL QUALIFIED ENGAGEMENTS:								

UNQUALIFIED QUALIFIED SUPERIOR DISTINGUISHED

AMMUNITION REQUIREMENTS

Table VA	*Table VB*	*Total*
600 Caliber .50	None	600 Caliber .50
300 7.62-mm	300 7.62-mm	600 7.62-mm

Figure 14-16. Sample Roll-Up Sheet—Table V.

TANK TABLE V, TASK A1 (DEFENSE), Bumper Number _____

TASK
Engage a target from a defensive firing position.

AMMUNITION
Caliber .50: 100 rounds.

CONDITIONS
Total Targets: 1
Target 1:
Stationary flank PC, 800 to 1,000 meters.
Use caliber .50.

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. Due to range constraints, it may be necessary to substitute the stationary flank PC with a stationary frontal PC. The alternate target will be scored using the same points list.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
90	11	100
80	12	100
70	13	100
64	14	90
58	15	80
52	16	70
46	17	64
40	18	58
34	19	52
28	20	46
22	21	40
16	22	34
10	23	28
4	24	22
0	25	16
0	26	10
0	27	4
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary flank PC) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

Figure 14-17. Sample Scoresheet—Table V, Task A1.

TANK TABLE V, TASK A2 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
7.62 mm: 100 rounds.

CONDITIONS
Total Targets: 2

NBC environment (protective mask and over- pressurization on).
M1: NBC environment (protective mask and closed hatch).

Target 1:
Troop target, 400 to 600 meters.

Target 2:
Troop target, 300 to 500 meters (10-second delay).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 40 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	90
100	11	80
90	12	70
80	13	68
70	14	66
68	15	64
66	16	62
64	17	60
62	18	58
60	19	56
58	20	54
56	21	52
54	22	50
52	23	48
50	24	46
48	25	44
46	26	42
44	27	40
42	28	38
40	29	36
38	30	34
36	31	32
34	32	30
32	33	28
30	34	26
28	35	24
26	36	22
24	37	20
22	38	18
20	39	16
18	40	14
16	41	12
14	42	10
12	43	8
10	44	6
8	45	4
6	46	2
4	47	0
2	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Troops) H M Points _____
Target 2 (Troops) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____

Figure 14-18. Sample Scoresheet—Table V, Task A2.

TANK TABLE V, TASK A3 (DEFENSE), Bumper Number _____

TASK
Engage targets with multiple weapon systems from a defensive firing position.

AMMUNITION
Caliber .50: 100 rounds.
7.62 mm: 100 rounds.

CONDITIONS
Total Targets: 3

Use all tank-mounted machine guns.

Target 1:
RPG team, 400 to 600 meters.

Target 2:
Troop target, 300 to 500 meters.

Target 3:
Stationary frontal BRDM, 800 to 1,000 meters (15-second delay).

EXPOSURE TIME

Target 1: 75 seconds.

Target 2: 75 seconds.

Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
90	11	90
80	12	80
70	13	70
68	14	68
66	15	66
64	16	64
62	17	62
60	18	60
58	19	58
56	20	56
54	21	54
52	22	52
50	23	50
48	24	48
46	25	46
44	26	44
42	27	42
40	28	40
38	29	38
36	30	36
34	31	34
32	32	32
30	33	30
28	34	28
26	35	26
24	36	24
22	37	22
20	38	20
18	39	18
16	40	16
14	41	14
12	42	12
10	43	10
8	44	8
6	45	6
4	46	4
2	47	2
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Record defilade time (15 sec or less) (b) _____

Subtract (a - b = c) (c) _____

Add total obscuration/break time (d) _____

Subtract (c - d = e) (e) _____

Record number of targets hit (f) _____

Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (RPG team) H M Points _____

Target 2 (Troop target) H M Points _____

Target 3 (Stationary frontal BRDM) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-19. Sample Scoresheet—Table V, Task A3.

TANK TABLE V, TASK A4 (DEFENSE), Bumper Number _____

TASK
Engage a target from a defensive firing position.

AMMUNITION
7.62mm: 100 rounds.

CONDITIONS
Total Targets: 1
Degraded fire control system: LRF, GPS, TIS failure.
Use GAS.
Target 1:
Stationary flank truck, 600 to 800 meters.

EXPOSURE TIME
Target 1: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
100	11	100
100	12	100
97	13	95
93	14	90
89	15	85
85	16	80
82	17	75
78	18	70
74	19	68
70	20	66
68	21	64
66	22	62
64	23	60
62	24	58
60	25	56
58	26	54
56	27	52
54	28	50
52	29	48
50	30	46
48	31	44
46	32	42
44	33	40
42	34	38
40	35	36
38	36	34
36	37	32
34	38	30
32	39	28
30	40	26
28	41	24
26	42	22
24	43	20
22	44	18
20	45	16
18	46	14
16	47	12
14	48	10
12	49	8
10	50	6

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary flank truck) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-20. Sample Scoresheet—Table V, Task A4.

TANK TABLE V, TASK B1 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
7.62 mm: 100 rounds.

CONDITIONS
Total Targets: 2

Target 1:
RPG team, 400 to 600 meters.

Target 2:
Moving flank truck, 600 to 800 meters (10-second delay).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 40 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
95	11	93
90	12	85
85	13	78
80	14	70
75	15	68
70	16	66
68	17	64
66	18	62
64	19	60
62	20	58
60	21	56
58	22	54
56	23	52
54	24	50
52	25	48
50	26	46
48	27	44
46	28	42
44	29	40
42	30	38
40	31	36
38	32	34
36	33	32
34	34	30
32	35	28
30	36	26
28	37	24
26	38	22
24	39	20
22	40	18
20	41	16
18	42	14
16	43	12
14	44	10
12	45	8
10	46	6
8	47	4
6	48	2
4	49	0
2	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (RPG team) H M Points _____
Target 2 (Moving flank truck) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____

Figure 14-21. Sample Scoresheet—Table V, Task B1.

TANK TABLE V, TASK B2 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
7.62 mm: 100 rounds.

CONDITIONS
Total Targets: 2

Target 1:
RPG team, 400 to 600 meters.

Target 2:
RPG team, 400 to 600 meters.

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	90
100	9	80
90	10	70
80	11	68
70	12	66
68	13	64
66	14	62
64	15	60
62	16	58
60	17	56
58	18	54
56	19	52
54	20	50
52	21	48
50	22	46
48	23	44
46	24	42
44	25	40
42	26	38
40	27	36
38	28	34
36	29	32
34	30	30
32	31	28
30	32	26
28	33	24
26	34	22
24	35	20
22	36	18
20	37	16
18	38	14
16	39	12
14	40	10
12	41	8
10	42	6
8	43	4
6	44	2
4	45	0
2	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (RPG team) H M Points _____
Target 2 (RPG team) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____

Figure 14-22. Sample Scoresheet—Table V, Task B2.

TANK TABLE V, TASK B3 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
7.62 mm: 100 rounds.

CONDITIONS
Total Targets: 2

NBC environment (protective mask and over- pressurization on).
M1: NBC environment (protective mask and closed hatch).

Target 1:
Troop target, 500 to 700 meters.

Target 2:
Troop target, 500 to 700 meters (10-second delay).

EXPOSURE TIME

Target 1: 50 seconds.

Target 2: 40 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
100	11	100
100	12	90
100	13	80
90	14	70
80	15	68
70	16	66
68	17	64
66	18	62
64	19	60
62	20	58
60	21	56
58	22	54
56	23	52
54	24	50
52	25	48
50	26	46
48	27	44
46	28	42
44	29	40
42	30	38
40	31	36
38	32	34
36	33	32
34	34	30
32	35	28
30	36	26
28	37	24
26	38	22
24	39	20
22	40	18
20	41	16
18	42	14
16	43	12
14	44	10
12	45	8
10	46	6
8	47	4
6	48	2
4	49	0
2	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Troops) H M Points _____
Target 2 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-23. Sample Scoresheet—Table V, Task B3.

Conduct of Tank Table VI—Preliminary Main Gun Training

Table VI is the first table that allows for main gun firing.

CONCEPT

Table VI consists of ten tasks designed to train the tank crew to engage stationary and moving targets. These tasks require the crew to engage single and multiple targets using either precision or degraded-mode gunnery techniques from a stationary or moving tank. TWGSS is recommended for firing Tank Table VI. Units may use the caliber .50 inbore device if resourced. STRAC does not allocate ammunition in the 100- or 90-round training strategy for the conduct of Tank Table VI; however, units that have resourced the ammunition may live fire this table.

The following table lists the engagements that will be fired for Table VI:

Table 14-7. Tank Table VI Engagement List.

Task	Target 1 (Target type, range, delay time, exposure time)	Target 2 (Target type, range, delay time, exposure time)	Ammunition	Malfunctions and Limitations
A1 Defense	Stationary frontal tank, 1,400 to 1,600 meters, exposed for 50 seconds.		1 round TPCSDS-T (M1, 1 round TPDS-T).	None
A2 Defense	Stationary flank tank, 1,400 to 1,600 meters, exposed for 50 seconds.		1 round TPCSDS-T (M1, 1 round TPDS-T).	Three-man crew, GPCH failure, TC uses CITV (M1A2) or GPSE (M1 and M1A1).
A3 Offense	Stationary frontal APC, 700 to 900 meters, exposed for 50 seconds.	Moving flank APC, 800 to 1,000 meters, 10-second delay, exposed for 40 seconds.	2 rounds HEAT-TP-T.	NBC environment
A4 Defense	Stationary frontal APC, 700 to 900 meters, exposed for 60 seconds.	Moving flank APC, 800 to 1,000 meters, 10-second delay, exposed for 50 seconds.	3 rounds HEAT-TP-T.	Degraded FCS: LRF, GPS, TIS failure. Use GAS.
A5 Offense	Stationary frontal BTR, 900 to 1,100 meters, exposed for 60 seconds.	Moving flank APC, 1,200 to 1,400 meters, 10-second delay, exposed for 50 seconds.	2 rounds HEAT-TP-T.	Degraded FCS: LRF, GPS, TIS failure. Use GAS short halt.
B1 Defense	Stationary frontal APC, 1,400 to 1,600 meters (M1, 1,200 to 1,400 meters), exposed for 50 seconds.		1 round HEAT-TP-T.	None
B2 Defense	Moving flank tank, 1,400 to 1,600 meters, exposed for 50 seconds.		1 round TPCSDS-T (M1, 1 round TPDS-T).	None
B3 Offense	Stationary frontal tank, 1,300 to 1,500 meters, exposed for 50 seconds.	Stationary frontal tank, 1,300 to 1,500 meters, exposed for 50 seconds.	2 rounds TPCSDS-T (M1, 2 rounds TPDS-T).	NBC environment
B4 Defense	Moving flank tank, 1,200 to 1,400 meters, exposed for 50 seconds.	Stationary frontal tank, 1,000 to 1,200 meters, 10-second delay, exposed for 50 seconds.	3 rounds TPCSDS-T (M1, 3 rounds TPDS-T).	Degraded FCS: LRF failure. Use TIS battlesight.
B5S Defense	Stationary frontal APC, 1,300 to 1,500 meters (M1, 1,100 to 1,300 meters), exposed for 50 seconds.	Moving flank tank, 1,700 to 1,900 meters, 10-second delay, exposed for 40 seconds.	1 round HEAT-TP-T, 1 round TPCSDS-T (M1, 1 round TPDS-T).	Ammunition change. Must battlecarry HEAT.

CONDUCT OF TASKS

Defensive tasks will be conducted with the firing tank moving from a turret-down to a hull-down position. Offensive tasks will be conducted with the firing tank on the move, traveling at 24 to 40 kmph (15 to 25 mph). Because of relatively short closing distances between the firing tank and some targets, it may be necessary to reduce the speed of the firing tank. The local commander will make this decision.

Stationary targets should be mounted on pop-up mechanisms to facilitate target acquisition and scoring. They will be presented in an appropriate array.

EXECUTION

The local commander will determine the number and degree of difficulty of tasks that the crews will fire. He determines this based on crew proficiency.

SCORING

The tank crew must obtain a minimum of 70 points per engagement and qualify on 70 percent of the selected number of tasks (for example, 700 points and 7 of 10 qualified tasks) selected by the commander. It is recommended that the crew continue to rerun Table VI until a qualifying score is achieved.

Each task on Table VI will be scored using the appropriate scoresheet. The TCE will rate crews for each engagement on Table VI and subtract crew-duty penalty points from the total engagement points earned.

TANK TABLE VI

TANK _____ **UNIT** _____ **DATE** _____

CREW:TC _____ **GNR** _____ **LDR** _____ **DVR** _____

DAY: START _____ **FINISH** _____ **NIGHT: START** _____ **FINISH** _____

TCE SIGNATURE (DAY) _____

TCE SIGNATURE (NIGHT) _____

TASK	TOTAL TARGETS	RNDS FIRED	TARGETS			PENALTY POINTS	SCORE	QUAL (Y/N)
			HIT	MISSED	NE			
A1								
A2								
A3								
A4								
A5								
TOTALS								
B1								
B2								
B3								
B4								
B5S								
TOTALS								
OVERALL								
TOTAL PENALTY POINTS:								
TOTAL QUALIFIED ENGAGEMENTS:								

UNQUALIFIED **QUALIFIED** **SUPERIOR** **DISTINGUISHED**

AMMUNITION REQUIREMENTS

	Table VIA	*Table VIB*	*Total*
	2 TPCSDS-T	7 TPCSDS-T	9 TPCSDS-T
	7 HEAT-TP-T	2 HEAT-TP-T	9 HEAT-TP-T
(M1:	2 TPDS-T	7 TPDS-T	9 TPDS-T)

Notes. Ammunition is not resourced for all engagements.
Units that have procured caliber .50 inbore devices may use 20 rounds of SLAP-T ammunition.

Figure 14-24. Sample Roll-Up Sheet—Table VI.

TANK TABLE VI, TASK A1 (DEFENSE), Bumper Number _____

TASK
Engage a target from a defensive firing position.

AMMUNITION
TPCSDS-T: 1 round.
M1 (TPDS-T: 1 round).

CONDITIONS
Total Targets: 1

Target 1:
Stationary frontal tank, 1,400 to 1,600 meters.

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	96
97	5	92
93	6	88
89	7	83
85	8	79
82	9	75
78	10	70
74	11	64
70	12	58
64	13	52
58	14	46
52	15	40
46	16	34
40	17	28
34	18	22
28	19	16
22	20	10
16	21	4
10	22	0
4	23	0
0	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

_____

Figure 14-25. Sample Scoresheet—Table VI, Task A1.

TANK TABLE VI, TASK A2 (DEFENSE), Bumper Number_____

TASK
Engage a target from a defensive firing position.

AMMUNITION
TPCSDS-T: 1 round.
M1 (TPDS-T: 1 round).

CONDITIONS
Total Targets: 1

Three-man crew.

GPCH failure; TC uses CITV (M1A2) or GPSE (M1 and M1A1).

Target 1:
Stationary flank tank, 1,400 to 1,600 meters.

EXPOSURE TIME

Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	95
96	7	90
92	8	85
88	9	80
83	10	75
79	11	70
75	12	64
70	13	58
64	14	52
58	15	46
52	16	40
46	17	34
40	18	28
34	19	22
28	20	16
22	21	10
16	22	4
10	23	0
4	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Record defilade time (15 sec or less) (b) _____

Subtract (a - b = c) (c) _____

Add total obscuration/break time (d) _____

Subtract (c - d = e) (e) _____

Record number of targets hit (f) _____

Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary flank tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

Figure 14-26. Sample Scoresheet—Table VI, Task A2.

TANK TABLE VI, TASK A3 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
HEAT-TP-T: 2 rounds.

CONDITIONS
Total Targets: 2

NBC environment (protective mask and overpressurization on).

Target 1:
Stationary frontal APC, 700 to 900 meters.

Target 2:
Moving flank APC, 800 to 1,000 meters (10-second delay).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 40 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
97	8	95
93	9	90
89	10	85
85	11	80
82	12	75
78	13	70
74	14	65
70	15	60
65	16	55
60	17	50
55	18	45
50	19	40
45	20	35
40	21	30
35	22	25
30	23	20
25	24	15
20	25	10
15	26	5
10	27	0
5	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____
Target 1 (Moving flank APC) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____
_____

Figure 14-27. Sample Scoresheet—Table VI, Task A3.

TANK TABLE VI, TASK A4 (DEFENSE), Bumper Number_____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
HEAT-TP-T: 3 rounds.

CONDITIONS
Total Targets: 2

Degraded fire control system: LRF, GPS, TIS failure.
Use GAS.

Target 1:
Stationary frontal APC, 700 to 900 meters.

Target 2:
Moving flank APC, 800 to 1,000 meters (10-second delay).

EXPOSURE TIME

Target 1: 60 seconds.

Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
94	7	90
88	8	80
82	9	70
76	10	65
70	11	60
65	12	55
60	13	50
55	14	45
50	15	40
45	16	35
40	17	30
35	18	25
30	19	20
25	20	15
20	21	10
15	22	5
10	23	0
5	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Add total obscuration/break time (b) _____

Subtract (a - b = c) (c) _____

Record number of targets hit (d) _____

Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____

Target 2 (Moving flank APC) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

_____

Figure 14-28. Sample Scoresheet—Table VI, Task A4.

TANK TABLE VI, TASK A5 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
HEAT-TP-T: 2 rounds.

CONDITIONS
Total Targets: 2

Degraded fire control system: LRF, GPS, TIS failure.
Use GAS short halt.

Target 1:
Stationary frontal BTR, 900 to 1,100 meters.

Target 2:
Moving flank APC, 1,200 to 1,400 meters (10-second delay).

EXPOSURE TIME
Target 1: 60 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
94	8	90
88	9	80
82	10	70
76	11	67
70	12	64
67	13	61
64	14	58
61	15	55
58	16	52
55	17	49
52	18	46
49	19	43
46	20	40
43	21	37
40	22	34
37	23	31
34	24	28
31	25	25
28	26	22
25	27	19
22	28	16
19	29	13
16	30	10
13	31	7
10	32	4
7	33	1
4	34	0
1	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal BTR) H M Points _____
Target 2 (Moving flank APC) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____

Figure 14-29. Sample Scoresheet—Table VI, Task A5.

TANK TABLE VI, TASK B1 (DEFENSE), Bumper Number_____

TASK
Engage a target from a defensive firing position.

AMMUNITION
HEAT-TP-T: 2 rounds.

CONDITIONS
Total Targets: 1

Target 1:
Stationary frontal APC, 1,400 to 1,600 meters.

M1 (1,200 to 1,400 meters).

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
97	5	96
94	6	92
90	7	88
87	8	83
84	9	79
80	10	75
77	11	70
74	12	64
70	13	58
64	14	52
58	15	46
52	16	40
46	17	34
40	18	28
34	19	22
28	20	16
22	21	10
16	22	4
10	23	0
4	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S

Record last target engagement time (a) _____

Record defilade time (15 sec or less) (b) _____

Subtract (a - b = c) (c) _____

Add total obscuration/break time (d) _____

Subtract (c - d = e) (e) _____

Record number of targets hit (f) _____

Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

_____

Figure 14-30. Sample Scoresheet—Table VI, Task B1.

TANK TABLE VI, TASK B2 (DEFENSE), Bumper Number _____

TASK
Engage a target from a defensive firing position.

AMMUNITION
TPCSDS-T: 1 round.
M1 (TPDS-T: 1 round).

CONDITIONS
Total Targets: 1

Target 1:
Moving flank tank, 1,400 to 1,600 meters.

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	96
97	8	92
93	9	88
89	10	83
85	11	79
82	12	75
78	13	70
74	14	66
70	15	62
66	16	58
62	17	54
58	18	50
54	19	46
50	20	42
46	21	38
42	22	34
38	23	30
34	24	26
30	25	22
26	26	18
22	27	14
18	28	10
14	29	6
10	30	2
6	31	0
2	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving flank tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

_____

Figure 14-31. Sample Scoresheet—Table VI, Task B2.

TANK TABLE VI, TASK B3 (OFFENSE), Bumper Number_____

TASK
Engage multiple targets from a moving tank.

AMMUNITION
TPCSDS-T: 2 rounds.
M1 (TPDS-T: 2 rounds).

CONDITIONS
Total Targets: 2

NBC environment (protective mask and overpressurization on).

Target 1:
Stationary frontal tank, 1,300 to 1,500 meters.

Target 2:
Stationary frontal tank, 1,300 to 1,500 meters.

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	97
98	8	94
95	9	91
92	10	88
90	11	85
87	12	82
84	13	79
81	14	76
79	15	73
76	16	70
73	17	64
70	18	58
64	19	52
58	20	46
52	21	40
46	22	34
40	23	28
34	24	22
28	25	16
22	26	10
16	27	4
10	28	0
4	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
Target 2 (Stationary frontal tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____
_____

Figure 14-32. Sample Scoresheet—Table VI, Task B3.

TANK TABLE VI, TASK B4 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
TPCSDS-T: 3 rounds.
M1 (TPDS-T: 3 rounds).

CONDITIONS
Total Targets: 2

Degraded fire control system: LRF failure.

Use TIS battlesight.

Target 1:
Moving flank tank, 1,200 to 1,400 meters.

Target 2:
Stationary frontal tank, 1,000 to 1,200 meters (10-second delay).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	94
95	8	88
90	9	82
85	10	76
80	11	70
75	12	65
70	13	60
65	14	55
60	15	50
55	16	45
50	17	40
45	18	35
40	19	30
35	20	25
30	21	20
25	22	15
20	23	10
15	24	5
10	25	0
5	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Add total obscuration/break time (b) _____

Subtract (a - b = c) (c) _____

Record number of targets hit (d) _____

Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving flank tank) H M Points _____

Target 2 (Stationary frontal tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

_____

Figure 14-33. Sample Scoresheet—Table VI, Task B4.

TANK TABLE VI, TASK B5S (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
HEAT-TP-T: 1 round.
TPCSDS-T: 1 round.
M1 (TPDS-T: 1 round.)

CONDITIONS
Total Targets: 2

Ammunition change. Must battlecarry HEAT.

Target 1:
Stationary frontal APC, 1,300 to 1,500 meters.

M1 (1,100 to 1,300 meters).

Target 2:
Moving flank tank, 1,700 to 1,900 meters (10-second delay).

M1 (1,500 to 1,700 meters).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 40 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	97
97	7	93
94	8	89
90	9	85
87	10	82
84	11	78
80	12	74
77	13	70
74	14	65
70	15	60
65	16	55
60	17	50
55	18	45
50	19	40
45	20	35
40	21	30
35	22	25
30	23	20
25	24	15
20	25	10
15	26	5
10	27	0
5	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____
Target 2 (Moving flank tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____
_____

Figure 14-34. Sample Scoresheet—Table VI, Task B5S.

Conduct of Table VII—Intermediate Training Course

Table VII is designed to train the tank crew to engage moving and stationary, air and ground targets with tank-mounted weapons. It requires the crew to call on all the knowledge gained and lessons learned during Tables I through VI, and employ those skills against various targets during day and limited-visibility operations. Table VII will prepare the tank crew for Table VIII (*Intermediate Qualification Course*) by presenting engagements with fire control and target conditions similar to those on Table VIII.

CONCEPT

Table VII is designed to train the tank crew to engage stationary and moving targets, placed in tactical arrays, from a stationary and moving tank. The course will be run with tank weapons loaded, and a wingman tank when possible. Table VII consists of six day and four night tasks with single, multiple, or multiple weapon system engagements.

Various tasks require the crew to use precision or degraded-mode gunnery techniques against main gun and machine gun target arrays. One day engagement will be fired with protective mask and overpressurization.

The following table lists the engagements that will be fired in Table VII:

Table 14-8. Tank Table VII Engagement List.

Task	**Target 1** (Target type, range, delay time, exposure time)	**Target 2** (Target type, range, delay time, exposure time)	**Target 3** (Target type, range, delay time, exposure time)	**Target 4** (Target type, range, delay time, exposure time)	**Ammunition**	**Malfunctions and Limitations**
A1 Defense	Moving flank tank, 1,700 to 1,900 meters (M1, 1,500 to 1,700 meters), exposed for 50 seconds.				2 rounds TPCSDS-T (M1, 2 rounds TPDS-T).	Stabilization failure (emergency mode)
A2 Offense	Stationary tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), exposed for 75 seconds.	RPG team, 400 to 600 meters, exposed for 75 seconds.	RPG team, 500 to 700 meters, 10-second delay, exposed for 65 seconds.		2 rounds TPCSDS-T (M1, 2 rounds TPDS-T), 100 rounds 7.62mm.	None
A3 Defense	Moving helicopter (minimum 10 meters above the ground), 2,200 to 2,400 meters, exposed for 50 seconds.				2 rounds MPAT-TP-T.	None
A3A Defense	Stationary helicopter (minimum 10 meters above the ground), 1,800 to 2,000 meters, exposed for 50 seconds.				2 rounds MPAT-TP-T.	None
A4 Offense	Stationary frontal APC, 1,400 to 1,600 meters, exposed for 75 seconds.	Moving flank APC, 1,200 to 1,400 meters, exposed for 50 seconds.	Troop target, 500 to 700 meters, 10-second delay, exposed for 65 seconds.		2 rounds HEAT-TP-T, 50 rounds 7.62mm.	NBC environment

continued on next page

Table 14-8 (cont.)

A5 Defense	Stationary APC, 700 to 900 meters or 1,000 to 1,200 meters or 1,400 to 1,600 meters (M1, 1,200 to 1,400 meters), exposed for 60 seconds.	Moving APC, 800 to 1,000 meters, exposed for 50 seconds.			2 rounds HEAT-TP-T.	Degraded FCS: LRF, GPS, TIS failure. Use GAS.
A6 Defense	Moving flank PC, 600 to 800 meters, exposed for 50 seconds.	Troop target, 400 to 600 meters, exposed for 75 seconds.	RPG team, 300 to 500 meters, 20-second delay, exposed for 55 seconds.		100 rounds caliber .50 100 rounds 7.62mm.	Main gun weapon status tight. Use caliber .50 and gunner's coax.
B1 Offense	Evasive flank APC, 1,000 to 1,200 meters, exposed for 50 seconds.	RPG team, 400 to 600 meters, exposed for 50 seconds.			2 rounds HEAT-TP-T 50 rounds 7.62mm.	None
B2 Defense	Evasive flank tank, 1,800 to 2,000 meters (M1, 1,600 to 1,800 meters), exposed for 50 seconds.				2 rounds TPCSDS-T (M1, 2 rounds TPDS-T).	Three-man crew. GPCH failure; TC uses CITV (M1A2) or GPSE (M1 and M1A1).
B3 Offense	Stationary flank tank, 1,000 to 1,200 meters, exposed for 75 seconds.	Moving flank tank, 1,400 to 1,600 meters, exposed for 50 seconds.	Troop target, 600 to 800 meters, 15-second delay, exposed for 60 seconds.		3 rounds, TPCSDS-T (M1, 3 rounds TPDS-T) 50 rounds 7.62mm.	NBC environment
B4 Defense	Stationary frontal tank, 1,400 to 1,600 meters, exposed for 75 seconds.	Troop target, 600 to 800 meters, exposed for 75 seconds.	Moving flank tank, 1,600 to 1,800 meters, 20-second delay, exposed for 50 seconds.	Troop target, 600 to 800 meters, 25-second delay, exposed for 50 seconds.	2 rounds TPCSDS-T (M1, 2 rounds TPDS-T) 100 rounds 7.62mm.	None

CONDUCT OF TASKS

Defensive tasks will be conducted with the firing tank moving from a turret-down to a hull-down position. Offensive tasks will be conducted with the firing tank on the move, traveling at 24 to 40 kmph (15 to 25 mph). Because of relatively short closing distances between the firing tank and some targets, it may be necessary to reduce the speed of the firing tank; this decision must be made by the local commander.

Stationary targets should be mounted on pop-up mechanisms to facilitate target acquisition and scoring. If pop-up targets are not available, exposed stationary targets will be presented in an appropriate array. If exposed targets must be used, they are presented only to the position from which they should be engaged.

EXECUTION

The local commander will determine the frequency for firing Table VII. Local commanders are the deciding authority for alibis. Alibis should be accepted only for equipment or ammunition failures that are not a result of crew error. An AAR will be conducted for each crew, day and night.

SCORING

The tank crew must obtain a minimum of 630 of the 900 total points and score at least 70 points on 7 out of 9 tasks on Tables VIIA and VIIB combined. If main gun ammunition is available, crews that fail to qualify on the first run of Table VII should refire failed tasks only until a qualifying score is achieved, before progressing to Table VIII.

Each task on Table VII will be scored using the appropriate scoresheet. The TCE will rate crews for each engagement on Table VII and subtract crew-duty penalty points from the total engagement points earned.

TANK TABLE VII

TANK_____ UNIT _____ DATE _____

CREW: TC _____ GNR_____ LDR_____ DVR _____

DAY: START _____ FINISH_____ NIGHT: START _____FINISH _____

TCE SIGNATURE (DAY) _____

TCE SIGNATURE (NIGHT)_____

TASK	TOTAL TARGETS	RNDS FIRED	TARGETS			PENALTY POINTS	SCORE	QUAL (Y/N)
			HIT	MISSED	NE			
A1								
A2								
A3								
A3A								
A4								
A5								
A6								
TOTALS								
B1								
B2								
B3								
B4								
TOTALS								
OVERALL								
TOTAL PENALTY POINTS:								
TOTAL QUALIFIED ENGAGEMENTS:								

UNQUALIFIED QUALIFIED SUPERIOR DISTINGUISHED

AMMUNITION REQUIREMENTS

	Table VIIA	*Table VIIB*	*Total*
	4 TPCSDS-T	**7 TPCSDS-T**	**11 TPCSDS-T**
	4 HEAT-TP-T	**2 HEAT-TP-T**	**6 HEAT-TP-T**
	4 MPAT-TP-T	**None**	**4 MPAT-TP-T**
	250 7.62-mm	**200 7.62-mm**	**450 7.62-mm**
	100 Caliber .50	**None**	**100 Caliber .50**
(M1:	**4 TPDS-T**	**5 TPDS-T**	**9 TPDS-T)**

Figure 14-35. Sample Roll-Up Sheet—Table VII.

TANK TABLE VII, TASK A1 (DEFENSE), Bumper Number _____

TASK
Engage a moving target from a defensive firing position.

AMMUNITION
TPCSDS-T: 2 rounds.
M1 (TPDS-T: 2 rounds).

CONDITIONS
Total Targets: 1
Stabilization failure (emergency mode).

Target 1:
Moving flank tank, 1,700 to 1,900 meters.
M1 (1,500 to 1,700 meters).

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	96
97	9	92
93	10	88
89	11	83
85	12	79
82	13	75
78	14	70
74	15	66
70	16	62
66	17	58
62	18	54
58	19	50
54	20	46
50	21	42
46	22	38
42	23	34
38	24	30
34	25	26
30	26	22
26	27	18
22	28	14
18	29	10
14	30	6
10	31	2
6	32	0
2	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving flank tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-36. Sample Scoresheet—Table VII, Task A1.

TANK TABLE VII, TASK A2 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
TPCSDS-T: 2 rounds.
7.62 mm: 100 rounds.
M1 (TPDS-T: 2 rounds).

CONDITIONS
Total Targets: 3
Target 1: Stationary tank, 1,600 to 1,800 meters. **M1** (1,500 to 1,700 meters).
Target 2: RPG team, 400 to 600 meters.
Target 3: RPG team, 500 to 700 meters. 10- second delay.

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 75 seconds.
Target 3: 65 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
95	9	93
90	10	85
85	11	78
80	12	70
75	13	67
70	14	64
67	15	61
64	16	58
61	17	55
58	18	52
55	19	49
52	20	46
49	21	43
46	22	40
43	23	37
40	24	34
37	25	31
34	26	28
31	27	25
28	28	22
25	29	19
22	30	16
19	31	13
16	32	10
13	33	7
10	34	4
7	35	1
4	36	0
1	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary tank) H M Points _____
Target 2 (RPG team) H M Points _____
Target 3 (RPG team) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

Figure 14-37. Sample Scoresheet—Table VII, Task A2.

TANK TABLE VII, TASK A3 (DEFENSE), Bumper Number _____

TASK
Engage enemy aircraft from a defensive firing position.

AMMUNITION
MPAT-TP-T: 2 rounds.

CONDITIONS
Total Targets: 1

Target 1:
Moving helicopter (minimum 10 meters above the ground in a cluttered environment), 2,200 to 2,400 meters.

Use doctrinal aim-off procedure.

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. Units that desire to fire this engagement prior to the fielding of the MPAT training round may use sabot. Units using range waivers may decrease the above-ground distance to 3 meters.

M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	96
97	9	92
93	10	88
89	11	83
85	12	79
82	13	75
78	14	70
74	15	64
70	16	58
64	17	52
58	18	46
52	19	40
46	20	34
40	21	28
34	22	22
28	23	16
22	24	10
16	25	4
10	26	0
4	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Record defilade time (15 sec or less) (b) _____

Subtract (a - b = c) (c) _____

Add total obscuration/break time (d) _____

Subtract (c - d = e) (e) _____

Record number of targets hit (f) _____

Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving helicopter) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

Figure 14-38. Sample Scoresheet—Table VII, Task A3.

TANK TABLE VII, TASK A3A (DEFENSE), Bumper Number _____

TASK
Engage enemy aircraft from a defensive firing position.

AMMUNITION
MPAT-TP-T: 2 rounds.

CONDITIONS
Total Targets: 1
Target 1:
Stationary helicopter (minimum 10 meters above the ground in a cluttered environment), 1,800 to 2,000 meters.

Use doctrinal aim-off procedure.

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. Units that desire to fire this engagement prior to the fielding of the MPAT training round may use sabot. Units using range waivers may decrease the above-ground distance to 3 meters.

M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	96
97	7	92
93	8	88
89	9	83
85	10	79
82	11	75
78	12	70
74	13	64
70	14	58
64	15	52
58	16	46
52	17	40
46	18	34
40	19	28
34	20	22
28	21	16
22	22	10
16	23	4
10	24	0
4	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary helicopter) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-39. Sample Scoresheet—Table VII, Task A3A.

TANK TABLE VII, TASK A4 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
HEAT-TP-T: 2 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 3
NBC environment (protective mask and over- pressurization on).
M1: NBC environment (protective mask and closed hatch).

Target 1:
Stationary frontal APC, 1,400 to 1,600 meters.

Target 2:
Moving flank APC, 1,200 to 1,400 meters.

Target 3:
Troop target, 500 to 700 meters (10-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 50 seconds.
Target 3: 65 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
94	11	90
88	12	80
82	13	70
76	14	66
70	15	62
66	16	58
62	17	54
58	18	50
54	19	46
50	20	42
46	21	38
42	22	34
38	23	30
34	24	26
30	25	22
26	26	18
22	27	14
18	28	10
14	29	6
10	30	2
6	31	0
2	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____
Target 2 (Moving flank APC) H M Points _____
Target 3 (Troop target) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____
_____

Figure 14-40. Sample Scoresheet—Table VII, Task A4.

TANK TABLE VII, TASK A5 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
HEAT-TP-T: 2 rounds.

CONDITIONS
Total Targets: 2
Degraded fire control system: LRF, GPS, and TIS failure. Use GAS.

Target 1:
Stationary APC, 700 to 900 meters, or 1,000 to 1,200 meters, or 1,400 to 1,600 meters.
M1 (1,200 to 1,400 meters).

Target 2:
Moving APC, 800 to 1,000 meters.

EXPOSURE TIME
Target 1: 60 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. (M1 and M1A1) GAS stadia reticle must be used to estimate range. M1A2 and M1A2 SEP, use the CITV stadia reticle.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
95	8	93
90	9	85
85	10	78
80	11	70
75	12	65
70	13	60
65	14	55
60	15	50
55	16	45
50	17	40
45	18	35
40	19	30
35	20	25
30	21	20
25	22	15
20	23	10
15	24	5
10	25	0
5	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary APC) H M Points _____
Target 2 (Moving APC) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-41. Sample Scoresheet—Table VII, Task A5.

TANK TABLE VII, TASK A6 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a defensive firing position.

AMMUNITION
Caliber .50: 100 rounds.
7.62 mm: 100 rounds.

CONDITIONS
Total Targets: 3
Main gun weapon status tight.
Use caliber .50 and gunner's coax.

Target 1:
Moving flank PC, 600 to 800 meters.

Target 2:
Troop target, 400 to 600 meters.

Target 3:
RPG team, 300 to 500 meters (20-second delay).

EXPOSURE TIME

Target 1: 50 seconds.

Target 2: 75 seconds.

Target 3: 55 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	90
90	11	80
80	12	70
70	13	68
68	14	66
66	15	64
64	16	62
62	17	60
60	18	58
58	19	56
56	20	54
54	21	52
52	22	50
50	23	48
48	24	46
46	25	44
44	26	42
42	27	40
40	28	38
38	29	36
36	30	34
34	31	32
32	32	30
30	33	28
28	34	26
26	35	24
24	36	22
22	37	20
20	38	18
18	39	16
16	40	14
14	41	12
12	42	10
10	43	8
8	44	6
6	45	4
4	46	2
2	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving flank PC) H M Points _____
Target 2 (Troop) H M Points _____
Target 3 (RPG team) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-42. Sample Scoresheet—Table VII, Task A6.

TANK TABLE VII, TASK B1 (OFFENSE), Bumper Number _____

TASK
Engage targets with multiple weapon systems from a moving tank.

AMMUNITION
HEAT-TP-T: 2 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 2

Target 1:
Evasive flank APC, 1,000 to 1,200 meters.

Target 2:
RPG team, 400 to 600 meters.

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	90
93	10	80
85	11	70
78	12	67
70	13	64
67	14	61
64	15	58
61	16	55
58	17	52
55	18	49
52	19	46
49	20	43
46	21	40
43	22	37
40	23	34
37	24	31
34	25	28
31	26	25
28	27	22
25	28	19
22	29	16
19	30	13
16	31	10
13	32	7
10	33	4
7	34	1
4	35	0
1	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Evasive flank APC) H M Points _____
Target 2 (RPG team) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____
_____

Figure 14-43. Sample Scoresheet—Table VII, Task B1.

TANK TABLE VII, TASK B2 (DEFENSE), Bumper Number _____

TASK
Engage a target from a defensive firing position.

AMMUNITION
TPCSDS-T: 2 rounds.
M1 (TPDS-T: 2 rounds).

CONDITIONS
Total Targets: 1
Three-man crew.
GPCH failure; TC uses CITV (M1A2) or GPSE (M1 and M1A1).

Target 1:
Evasive flank tank, 1,800 to 2,000 meters.
M1 (1,600 to 1,800 meters).

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
100	11	100
100	12	100
100	13	90
93	14	80
85	15	70
78	16	66
70	17	62
66	18	58
62	19	54
58	20	50
54	21	46
50	22	42
46	23	38
42	24	34
38	25	30
34	26	26
30	27	22
26	28	18
22	29	14
18	30	10
14	31	6
10	32	2
6	33	0
2	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Evasive flank tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-44. Sample Scoresheet—Table VII, Task B2.

TANK TABLE VII, TASK B3 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
TPCSDS-T: 3 rounds.
7.62 mm: 50 rounds.
M1 (TPDS-T: 3 rounds).

CONDITIONS
Total Targets: 3
NBC environment (protective mask and overpressurization on).
M1: NBC environment (protective mask and closed hatch).

Target 1:
Stationary flank tank, 1,000 to 1,200 meters.

Target 2:
Moving flank tank, 1,400 to 1,600 meters.

Target 3:
Troop target, 600 to 800 meters (15- second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 50 seconds.
Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. Due to range constraints, it may be necessary to substitute the stationary flank tank with a stationary frontal tank. The alternate target will be scored using the same points list.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	97
97	8	94
94	9	90
91	10	87
88	11	84
85	12	80
82	13	77
79	14	74
76	15	70
73	16	66
70	17	62
66	18	58
62	19	54
58	20	50
54	21	46
50	22	42
46	23	38
42	24	34
38	25	30
34	26	26
30	27	22
26	28	18
22	29	14
18	30	10
14	31	6
10	32	2
6	33	0
2	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary flank tank) H M Points _____
Target 2 (Moving flank tank) H M Points _____
Target 3 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-45. Sample Scoresheet—Table VII, Task B3.

TANK TABLE VII, TASK B4 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a defensive firing position.

AMMUNITION
TPCSDS-T: 2 rounds.
7.62 mm: 100 rounds.
M1 (TPDS-T: 2 rounds).

CONDITIONS
Total Targets: 4

Target 1:
Stationary frontal tank, 1,400 to 1,600 meters.

Target 2:
Troop target, 600 to 800 meters.

Target 3:
Moving flank tank, 1,600 to 1,800 meters (20-second delay).

Target 4:
Troop target, 600 to 800 meters (25-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 75 seconds.
Target 3: 50 seconds.
Target 4: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	94
100	7	88
95	8	82
90	9	76
85	10	70
80	11	65
75	12	60
70	13	55
65	14	50
60	15	45
55	16	40
50	17	35
45	18	30
40	19	25
35	20	20
30	21	15
25	22	10
20	23	5
15	24	0
10	25	0
5	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
Target 2 (Troop target) H M Points _____
Target 3 (Moving flank tank) H M Points _____
Target 4 (Troop target) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-46. Sample Scoresheet—Table VII, Task B4.

Conduct of Table VIII—Intermediate Qualification Course (Crew)

Table VIII is the individual crew qualification table. It is used to test the crew's ability to engage moving and stationary targets with tank-mounted weapons during daylight and limited visibility with a fully operational or degraded fire control system. Crews on digitally equipped vehicles will fire all engagements, except degraded engagements, using digital communications.

CONCEPT

Table VIII is designed to evaluate the crew's ability to put steel on target quickly, while negotiating a course that presents threat target arrays at realistic ranges. The firing tank crew negotiates a course engaging single, multiple, multiple weapon systems, and delayed target presentations from a moving and stationary tank.

Table VIII consists of five day and five night firing tasks. Various tasks will be presented requiring precision or degraded-mode gunnery techniques against main gun targets. Crews on digitally equipped vehicles will fire all engagements, except degraded engagements, using digital communications. One day and one night engagement will be fired in an NBC environment. M1A1 and M1A2 crews will fire the two NBC tasks with the overpressurization system on and protective masks; M1 crews will fire with closed hatch and protective masks on. Crews will not dry-fire TT VIII prior to qualification.

The following table lists the engagements that will be fired in Table VIII:

Table 14-9. Tank Table VIII Engagement List.

Task	**Target 1** (Target type, range, delay time, exposure time)	**Target 2** (Target type, range, delay time, exposure time)	**Target 3** (Target type, range, delay time, exposure time)	**Target 4** (Target type, range, delay time, exposure time)	**Ammunition**	**Malfunctions and Limitations**
A1 Defense	Stationary frontal PC (BRDM), 600 to 800 meters, exposed for 50 seconds.	Troop target, 300 to 500 meters, 15-second delay, exposed for 35 seconds.			100 rounds caliber .50, 50 rounds 7.62mm.	GPS precision. Use caliber .50 (commander's weapon). Use M240 coax machine gun. Main gun weapon status tight.
A2S Offense	Stationary frontal APC, 1,400 to 1,600 meters (M1, 1,200 to 1,400 meters), exposed for 75 seconds.	Stationary frontal APC, 1,400 to 1,600 meters (M1, 1,200 to 1,400 meters), exposed for 75 seconds.	Troop target, 600 to 800 meters, 15-second delay, exposed for 60 seconds.		3 rounds HEAT-TP-T, 50 rounds 7.62mm.	NBC environment
A3 Defense	Stationary turret, 700 to 900 meters; or stationary frontal tank, 1,000 to 1,200 meters; or stationary frontal tank, 1,400 to 1,600 meters, exposed for 60 seconds.	Moving flank tank, 1,200 to 1,400 meters, exposed for 50 seconds.			3 rounds TPCSDS-T (M1, 3 rounds TPDS-T).	Degraded FCS: LRF, GPS, TIS failure. Use GAS stadia reticle (M1 and M1A1) or CITV stadia reticle (M1A2 and M1A2 SEP).

continued on next page

Table 14-9 (cont.).

A4 Defense	Moving flank tank, 2,200 to 2,400 meters (M1, 1,800 to 2,000 meters), exposed for 50 seconds.				2 rounds TPCSDS-T (M1, 2 rounds TPDS-T).	None
A5 Offense	Evasive flank tank, 1,500 to 1,700 meters (M1, 1,400 to 1,600 meters), exposed for 50 seconds.	Troop target, 300 to 500 meters, exposed for 75 seconds.	Moving flank tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), 10-second delay, exposed for 50 seconds.		3 rounds TPCSDS-T (M1, 3 rounds TPDS-T), 50 rounds 7.62mm.	Closed hatch with overpressuriza-tion system on (M1, closed hatch).
A5A Offense	Evasive flank tank, 1,500 to 1,700 meters (M1, 1,400 to 1,600 meters), exposed for 50 seconds.	Troop target, 300 to 500 meters, exposed for 75 seconds.	Stationary frontal tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), 10-second delay, exposed for 65 seconds.		3 rounds TPCSDS-T (M1, 3 rounds TPDS-T), 50 rounds 7.62mm.	Closed hatch with overpressuriza-tion system on (M1, closed hatch).
B1S Offense	Moving flank tank, 1,400 to 1,600 meters, exposed for 50 seconds.				2 rounds TPCSDS-T (M1, 2 rounds TPDS-T).	Three-man crew. GPCH failure; TC uses CITV (M1A2) or GPSE (M1 and M1A1).
B2 Offense	Evasive flank APC, 1,500 to 1,700 meters (M1, 1,200 to 1,400 meters), exposed for 50 seconds.	Moving flank APC, 1,500 to 1,700 meters (M1, 1,200 to 1,400 meters), exposed for 50 seconds.	Troop target, 400 to 600 meters, 15-second delay, exposed for 60 seconds.		3 rounds HEAT-TP-T 50 rounds 7.62mm.	None
B2A Offense	Stationary frontal APC, 1,500 to 1,700 meters (M1, 1,200 to 1,400 meters), exposed for 75 seconds.	Evasive flank APC, 1,500 to 1,700 meters (10-second delay) (M1, 1,200 to 1,400 meters), exposed for 50 seconds.	Troop target, 400 to 600 meters, 15-second delay, exposed for 60 seconds.		3 rounds HEAT-TP-T 50 rounds 7.62mm.	None
B3S Defense	Stationary frontal tank, 1,400 to 1,600 meters, exposed for 75 seconds.	Moving flank tank, 1,600 to 1,800 meters (M1, 1,500 to 1,700 meters), exposed for 50 seconds.	Stationary defilade tank, 700 to 900 meters, 15-second delay, exposed for 60 seconds.	Troop target, 300 to 500 meters, 25-second delay, exposed for 50 seconds.	4 rounds, TPCSDS-T (M1, 4 rounds TPDS-T) 50 rounds 7.62mm.	None
B4 Defense	Stationary frontal tank, 1,200 to 1,400 meters, exposed for 50 seconds.	Stationary frontal tank, 1,800 to 2,000 meters (M1, 1,600 to 1,800 meters), exposed for 50 seconds.			3 rounds TPCSDS-T (M1, 3 rounds TPDS-T).	NBC environment
B5 Offense	Moving flank tank, 1,400 to 1,600 meters, exposed for 50 seconds.	Troop target, 400 to 600 meters, exposed for 75 seconds.	Troop target, 400 to 600 meters, exposed for 75 seconds.		1 round, TPCSDS-T (M1, 1 round TPDS-T) 100 rounds 7.62mm.	None

CONDUCT OF TASKS

Tank Table VIII must be conducted on a full-scale range using full-scale targets. All defensive tasks will be conducted with the firing tank moving from a turret-down to a hull-down position. All offensive tasks will be conducted with the firing tank on the move, traveling at 24 to 40 kmph (15 to 25 mph). Because of the speed of the Abrams tank, crews could find themselves moving beyond engagement firing points before target engagement is complete. In these cases, the speed of the firing tank may need to be reduced. The local commander will determine if modification of course speed is required. The local commander and master gunner will decide how many times a crew should be rerun. Their decision should be based on the possibility of the crew meeting the minimum requirements, and time and resources available.

Note. Crews may not dry-run TT VIII prior to live fire. Units running the wingman task must use the alternate scenario when the wingman qualifies.

SAFETY CAUTION

This table includes an offensive (moving) night task (Task B1, three-man crew). For *safety* reasons, a crewman *should not* dismount the tank at night *if* there is no safety vehicle available to transport him to the tank after the engagement. However, if a safety vehicle is available, the crewman will dismount, and the task will be fired in accordance with Chapter 8, *Direct Fire*, page 8-26, *Loss of a Crew Member*. If the unit chooses to swing the task to the day run, the loader must dismount and be picked up by the safety vehicle. Ultimately, it is the local commander's decision whether or not the crewman dismounts the tank.

This table consists of three swing tasks (Tasks A2S, B1S, and B3S). Swing tasks may be fired either day or night (depending on the length of daylight). The battalion commander may choose to fire both B swing tasks (B1S and B3S) during daylight under extreme situations.

An alternate task is fired only when resources, weather, or range constraints preclude execution of the original engagement. Two alternate tasks have been provided (A5A and B2A).

Note. Tank Tables VIIIA and B are designed to be completed by a tank crew within a 24-hour period. If Table VIIIA and B cannot be completed within a 24-hour period, due to extreme conditions such as dense fog, then it must be completed as follows:

- Active Component: As soon as possible during the same gunnery density.
- Reserve Component: During one continuous inactive-duty training (IDT) or the same annual training (AT).

EXECUTION

Intermediate tables provide for a single tank firing while assisted by a wingman. The *wingman tank does not engage targets*; however, it may assist in target acquisition and observation of target effect (see also page 14-13).

Crews will be formally rated on their performance on target engagements according to scoresheets designed for each task. It incorporates a scoring system based on possible enemy vehicle capabilities and crew performance.

Digital engagements will be fired using digital communications. Each *engagement* will be initiated with a digital spot report sent to the firing crew. Upon completion of each *phase* (day or night), a digital spot report will be sent to the tower to terminate the phase.

SCORING

The tank crew must obtain a minimum of 700 of the 1,000 total points and score at least 70 points on 7 out of 10 tasks on Tables VIIIA and VIIIB combined.

Each task on Table VIII will be scored using the appropriate scoresheet. The TCE will rate crews for each engagement on Table VIII and subtract crew duty penalty points from the total engagement points earned.

To be considered a qualification TT VIII, the range must have a *minimum* of two scenarios per lane. These scenarios will be randomly switched to prevent crews from memorizing the target scenario.

TANK TABLE VIII

TANK _____ **UNIT** _____ **DATE** _____

CREW: TC _____ **GNR** _____ **LDR** _____ **DVR** _____

DAY: START _____ **FINISH** _____ **NIGHT: START** _____ **FINISH** _____

TCE SIGNATURE (DAY) _____

TCE SIGNATURE (NIGHT) _____

TASK	TOTAL TARGETS	RNDS FIRED	TARGETS			PENALTY POINTS	SCORE	QUAL (Y/N)
			HIT	MISSED	NE			
A1								
A2S								
A3								
A4								
A5								
A5A								
(B1S)								
(B3S)								
TOTALS								
B1S								
B2								
B2A								
B3S								
B4								
B5								
(A2S)								
TOTALS								
OVERALL								
TOTAL PENALTY POINTS:								
TOTAL QUALIFIED ENGAGEMENTS:								

UNQUALIFIED **QUALIFIED** **SUPERIOR** **DISTINGUISHED**

AMMUNITION REQUIREMENTS

Table VIIIA	*Table VIIIB*	*Total*
8 TPCSDS-T	10 TPCSDS-T	18 TPCSDS-T
3 HEAT-TP-T	3 HEAT-TP-T	6 HEAT-TP-T
200 7.62-mm	250 7.62-mm	450 7.62-mm
100 Caliber .50	None	100 Caliber .50
(M1: 11 TPDS-T	10 TPDS-T	21 TPDS-T)

Figure 14-47. Sample Roll-Up Sheet—Table VIII.

TANK TABLE VIII, TASK A1 (DEFENSE), Bumper Number _____

TASK
Engage targets with multiple weapon systems from a defensive firing position.

AMMUNITION
Caliber .50: 100 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 2
GPS precision.
Use caliber .50 (commander's weapon).
Use M240 coax machine gun.
Main gun weapon status tight.

Target 1:
Stationary frontal PC (BRDM), 600 to 800 meters.

Target 2:
Troop target, 300 to 500 meters (15-second delay).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 35 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
90	11	90
80	12	80
70	13	70
68	14	68
66	15	66
64	16	64
62	17	62
60	18	60
58	19	58
56	20	56
54	21	54
52	22	52
50	23	50
48	24	48
46	25	46
44	26	44
42	27	42
40	28	40
38	29	38
36	30	36
34	31	34
32	32	32
30	33	30
28	34	28
26	35	26
24	36	24
22	37	22
20	38	20
18	39	18
16	40	16
14	41	14
12	42	12
10	43	10
8	44	8
6	45	6
4	46	4
2	47	2
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal PC) H M Points _____
Target 2 (Troops) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-48. Sample Scoresheet—Table VIII, Task A1.

TANK TABLE VIII, TASK A2S (OFFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a moving tank, day or night.

AMMUNITION
HEAT-TP-T: 3 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 3
NBC environment (protective mask and over- pressurization on).
M1: NBC environment (protective mask and closed hatch).
Target 1:
Stationary frontal APC, 1,400 to 1,600 meters.
M1 (1,200 to 1,400 meters).
Target 2:
Stationary frontal APC, 1,400 to 1,600 meters.
M1 (1,200 to 1,400 meters).
Target 3:
Troop target, 600 to 800 meters (15-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 75 seconds.
Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	90
100	11	80
90	12	70
80	13	65
70	14	60
65	15	55
60	16	50
55	17	45
50	18	40
45	19	35
40	20	30
35	21	25
30	22	20
25	23	15
20	24	10
15	25	5
10	26	0
5	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____
Target 2 (Stationary frontal APC) H M Points _____
Target 3 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-49. Sample Scoresheet—Table VIII, Task A2S.

TANK TABLE VIII, TASK A3 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
TPCSDS-T: 3 rounds.
M1 (TPDS-T: 3 rounds).

CONDITIONS
Total Targets: 2
Degraded fire control system: LRF, GPS, TIS failure. Use GAS.

Target 1:
Stationary turret, 700 to 900 meters; or stationary frontal tank 1,000 to 1,200 meters, or 1,400 to 1,600 meters.

Target 2:
Moving flank tank, 1,200 to 1,400 meters.

EXPOSURE TIME
Target 1: 60 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

Note. (M1 and M1A1) GAS stadia reticle must be used to estimate range. M1A2 and M1A2 SEP, use the CITV stadia reticle.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	94
95	9	88
90	10	82
85	11	76
80	12	70
75	13	65
70	14	60
65	15	55
60	16	50
55	17	45
50	18	40
45	19	35
40	20	30
35	21	25
30	22	20
25	23	15
20	24	10
15	25	5
10	26	0
5	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
Target 2 (Moving flank tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-50. Sample Scoresheet—Table VIII, Task A3.

TANK TABLE VIII, TASK A4 (DEFENSE), Bumper Number_____

TASK
Engage a long-range moving target from a defensive firing position.

AMMUNITION
TPCSDS-T: 2 rounds.
M1 (TPDS-T: 2 rounds).

CONDITIONS
Total Targets: 1
Target 1:
Moving flank tank, 2,200 to 2,400 meters.
M1 (1,800 to 2,000 meters).

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
100	10	100
100	11	95
96	12	90
92	13	85
88	14	80
83	15	75
79	16	70
75	17	66
70	18	62
66	19	58
62	20	54
58	21	50
54	22	46
50	23	42
46	24	38
42	25	34
38	26	30
34	27	26
30	28	22
26	29	18
22	30	14
18	31	10
14	32	6
10	33	2
6	34	0
2	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving flank tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-51. Sample Scoresheet—Table VIII, Task A4.

TANK TABLE VIII, TASK A5 (OFFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
TPCSDS-T: 3 rounds.
7.62-mm: 50 rounds.
M1 (TPDS-T: 3 rounds).

CONDITIONS
Total Targets: 3
Closed hatch with over-pressurization system on.
M1: Closed hatch.

Target 1:
Evasive flank tank, 1,500 to 1,700 meters.
M1 (1,400 to 1,600 meters).

Target 2:
Troop target, 300 to 500 meters.

Target 3:
Moving flank tank, 1,600 to 1,800 meters (10-second delay).
M1 (1,500 to 1,700 meters).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 75 seconds.
Target 3: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	96
97	10	92
93	11	88
89	12	83
85	13	79
82	14	75
78	15	70
74	16	67
70	17	64
67	18	61
64	19	58
61	20	55
58	21	52
55	22	49
52	23	46
49	24	43
46	25	40
43	26	37
40	27	34
37	28	31
34	29	28
31	30	25
28	31	22
25	32	19
22	33	16
19	34	13
16	35	10
13	36	7
10	37	4
7	38	1
4	39	0
1	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Evasive flank tank) H M Points _____
Target 2 (Troops) H M Points _____
Target 3 (Moving flank tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-52. Sample Scoresheet—Table VIII, Task A5.

TANK TABLE VIII, TASK A5A (OFFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
TPCSDS-T: 3 rounds.
7.62-mm: 50 rounds.
M1 (TPDS-T: 3 rounds).

CONDITIONS
Total Targets: 3
Closed hatch with over-pressurization system on.
M1: Closed hatch.

Target 1:
Evasive flank tank, 1,500 to 1,700 meters.
M1 (1,400 to 1,600 meters).

Target 2:
Troop target, 300 to 500 meters.

Target 3:
Stationary frontal tank, 1,600 to 1,800 meters (10-second delay).
M1 (1,500 to 1,700 meters).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 75 seconds.
Target 3: 65 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	95
96	10	90
92	11	85
88	12	80
83	13	75
79	14	70
75	15	66
70	16	62
66	17	58
62	18	54
58	19	50
54	20	46
50	21	42
46	22	38
42	23	34
38	24	30
34	25	26
30	26	22
26	27	18
22	28	14
18	29	10
14	30	6
10	31	2
6	32	0
2	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Evasive flank tank) H M Points _____
Target 2 (Troops) H M Points _____
Target 3 (Stationary frontal tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-53. Sample Scoresheet—Table VIII, Task A5A.

TANK TABLE VIII, TASK B1S (OFFENSE), Bumper Number _____

TASK
Engage a target from a moving tank.

AMMUNITION
TPCSDS-T: 2 rounds.
M1 (TPDS-T: 2 rounds).

CONDITIONS
Total Targets: 1
Three-man crew (see safety caution on page 14-83).
GPCH failure; TC uses CITV (M1A2) or GPSE (M1 and M1A1).
Target 1:
Moving flank tank, 1,400 to 1,600 meters.

EXPOSURE TIME
Target 1: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	97
98	8	94
95	9	91
92	10	88
90	11	85
87	12	82
84	13	79
81	14	76
79	15	73
76	16	70
73	17	66
70	18	62
66	19	58
62	20	54
58	21	50
54	22	46
50	23	42
46	24	38
42	25	34
38	26	30
34	27	26
30	28	22
26	29	18
22	30	14
18	31	10
14	32	6
10	33	2
6	34	0
2	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving flank tank) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

_____

Figure 14-54. Sample Scoresheet—Table VIII, Task B1S.

TANK TABLE VIII, TASK B2 (OFFENSE), Bumper Number_____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
HEAT-TP-T: 3 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 3

Target 1:
Evasive flank APC, 1,500 to 1,700 meters. **M1** (1,200 to 1,400 meters).

Target 2:
Moving flank APC, 1,500 to 1,700 meters. **M1** (1,200 to 1,400 meters).

Target 3:
Troop target, 400 to 600 meters (15-second delay).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 50 seconds.
Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	90
93	10	80
85	11	70
78	12	67
70	13	64
67	14	61
64	15	58
61	16	55
58	17	52
55	18	49
52	19	46
49	20	43
46	21	40
43	22	37
40	23	34
37	24	31
34	25	28
31	26	25
28	27	22
25	28	19
22	29	16
19	30	13
16	31	10
13	32	7
10	33	4
7	34	1
4	35	0
1	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Evasive flank APC) H M Points _____
Target 2 (Moving flank APC) H M Points _____
Target 3 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-55. Sample Scoresheet—Table VIII, Task B2.

TANK TABLE VIII, TASK B2A (OFFENSE), Bumper Number_____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
HEAT-TP-T: 3 rounds.
7.62 mm: 50 rounds.

CONDITIONS
Total Targets: 3

Target 1:
Stationary frontal APC, 1,500 to 1,700 meters. **M1** (1,200 to 1,400 meters).

Target 2:
Evasive flank APC, 1,500 to 1,700 meters (10-second delay). **M1** (1,200 to 1,400 meters).

Target 3:
Troop target, 400 to 600 meters (15-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 50 seconds.
Target 3: 60 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	100
100	9	100
94	10	90
88	11	80
82	12	70
76	13	66
70	14	62
66	15	58
62	16	54
58	17	50
54	18	46
50	19	42
46	20	38
42	21	34
38	22	30
34	23	26
30	24	22
26	25	18
22	26	14
18	27	10
14	28	6
10	29	2
6	30	0
2	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Add total obscuration/break time (b) _____
Subtract (a - b = c) (c) _____
Record number of targets hit (d) _____
Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal APC) H M Points _____
Target 2 (Evasive flank APC) H M Points _____
Target 3 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____
_____
_____

Figure 14-56. Sample Scoresheet—Table VIII, Task B2A.

TANK TABLE VIII, TASK B3S (DEFENSE), Bumper Number _____

TASK
Engage multiple targets with multiple weapon systems from a defensive firing position, day or night.

AMMUNITION
TPCSDS-T: 4 rounds.
7.62 mm: 50 rounds.
M1 (TPDS-T: 4 rounds).

CONDITIONS
Total Targets: 4

Target 1:
Stationary frontal tank, 1,400 to 1,600 meters.

Target 2:
Moving flank tank, 1,600 to 1,800 meters.
M1 (1,500 to 1,700 meters).

Target 3:
Stationary defilade tank, 700 to 900 meters (15-second delay).

Target 4:
Troop target, 300 to 500 meters (25-second delay).

EXPOSURE TIME
Target 1: 75 seconds.
Target 2: 50 seconds.
Target 3: 60 seconds.
Target 4: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	94
95	8	88
90	9	82
85	10	76
80	11	70
75	12	65
70	13	60
65	14	55
60	15	50
55	16	45
50	17	40
45	18	35
40	19	30
35	20	25
30	21	20
25	22	15
20	23	10
15	24	5
10	25	0
5	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
Target 2 (Moving flank tank) H M Points _____
Target 3 (Stationary defilade tank) H M Points _____
Target 4 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-57. Sample Scoresheet—Table VIII, Task B3S.

TANK TABLE VIII, TASK B4 (DEFENSE), Bumper Number _____

TASK
Engage multiple targets from a defensive firing position.

AMMUNITION
TPCSDS-T: 3 rounds.
M1 (TPDS-T: 3 rounds).

CONDITIONS
Total Targets: 2

NBC environment (protective mask and over- pressurization on).
M1: NBC environment (protective mask and closed hatch).

Target 1:
Stationary frontal tank, 1,200 to 1,400 meters.

Target 2:
Stationary frontal tank, 1,800 to 2,000 meters.
M1 (1,600 to 1,800 meters).

EXPOSURE TIME
Target 1: 50 seconds.
Target 2: 50 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	97
97	8	93
94	9	89
90	10	85
87	11	82
84	12	78
80	13	74
77	14	70
74	15	64
70	16	58
64	17	52
58	18	46
52	19	40
46	20	34
40	21	28
34	22	22
28	23	16
22	24	10
16	25	4
10	26	0
4	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____ Defilade Time_____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____
Record defilade time (15 sec or less) (b) _____
Subtract (a - b = c) (c) _____
Add total obscuration/break time (d) _____
Subtract (c - d = e) (e) _____
Record number of targets hit (f) _____
Divide (e ÷ f = g) for target time (g) _____

Note. Use result from (g) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Stationary frontal tank) H M Points _____
Target 2 (Stationary frontal tank) H M Points _____
(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____
Subtract crew cuts _____
Subtract 30 points if all targets not engaged _____
Task Score _____

Rounds Fired _____ Targets Hit _____
Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

Figure 14-58. Sample Scoresheet—Table VIII, Task B4.

TANK TABLE VIII, TASK B5 (OFFENSE), Bumper Number_____

TASK
Engage multiple targets with multiple weapon systems from a moving tank.

AMMUNITION
TPCSDS-T: 1 round.
7.62 mm: 100 rounds.
M1 (TPDS-T: 1 round).

CONDITIONS
Total Targets: 3

Target 1:
Moving flank tank, 1,400 to 1,600 meters.

Target 2:
Troop target, 400 to 600 meters.

Target 3:
Troop target, 400 to 600 meters.

EXPOSURE TIME

Target 1: 50 seconds.

Target 2: 75 seconds.

Target 3: 75 seconds.

STANDARDS
Must score at least 70 points to qualify engagement.

M1/ M1A1 Points	Time	M1A2 Points
100	1	100
100	2	100
100	3	100
100	4	100
100	5	100
100	6	100
100	7	100
100	8	94
95	9	88
90	10	82
85	11	76
80	12	70
75	13	67
70	14	64
67	15	61
64	16	58
61	17	55
58	18	52
55	19	49
52	20	46
49	21	43
46	22	40
43	23	37
40	24	34
37	25	31
34	26	28
31	27	25
28	28	22
25	29	19
22	30	16
19	31	13
16	32	10
13	33	7
10	34	4
7	35	1
4	36	0
1	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0

Note. Circle sensing for each target.

1. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
2. Obscuration/Break Time: _____
   Eng Time _____ Target # _____ T D L O S
3. Obscuration/Break Time _____
   Eng Time _____ Target #_____ T D L O S
4. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
5. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S
6. Obscuration/Break Time: _____
   Eng Time _____ Target #_____ T D L O S

Record last target engagement time (a) _____

Add total obscuration/break time (b) _____

Subtract (a - b = c) (c) _____

Record number of targets hit (d) _____

Divide (c ÷ d = e) for target time (e) _____

Note. Use result from (e) and read down "time" column to get points for each hit (misses = 0).

(Circle One)

Target 1 (Moving flank tank) H M Points _____

Target 2 (Troops) H M Points _____

Target 3 (Troops) H M Points _____

(add points for all targets) **Total Points** _____

Divide **Total Points** _____ by **Total Targets** _____ **=** _____

Subtract crew cuts _____

Subtract 30 points if all targets not engaged _____

Task Score _____

Rounds Fired _____ Targets Hit _____

Targets Missed _____ Targets Not Engaged _____

Remarks/Reason for crew cuts:

_____

_____

_____

Figure 14-59. Sample Scoresheet—Table VIII, Task B5.

Chapter 15

Collective Gunnery Training

Collective gunnery tables are designed to test the unit's and leader's ability to take knowledge learned from the basic and intermediate tank tables and apply it to tactical combat scenarios at the platoon and company team level. This chapter discusses tank tables XI and XII, the fire coordination exercise (FCX), and the combined-arms live-fire exercise (CALFEX).

CONTENTS

Safety

Safety is a major concern in every training event, especially on a live-fire range where combat vehicles and personnel are maneuvering. AR 385-63 provides guidance for firing ammunition during training. Commanders and staff agencies involved in live-fire range planning must comply with all aspects of live-fire safety. The amount of realism that can be achieved in training is often impaired by inaccurate perceptions of safety regulations and policy. Careful planning, coordination with range operations, and an effective training program will allow weapons to be fired in relative proximity to maneuvering elements. Reasonable amounts of risk, based on unit proficiency, may be accepted as long as all due caution is exercised to prevent accidents. The standard is *no accidents during training*. Safety is the responsibility of the chain of command, and must be enforced at every echelon when planning and conducting the exercise. (A risk analysis must be completed before conducting the exercise.)

Early and frequent coordination with range control is imperative during the conceptualization and development of the exercise. Therefore, safety considerations are integrated throughout this chapter for the user's guidance.

Conduct of Table IX (Advanced Training Course) (Section) and Table X (Advanced Qualification Course) (Section)

Table IX is used to train the section to control and distribute section direct fire to destroy enemy targets in a tactical scenario. The platoon should conduct training together except for the live-fire portion. Digital and FM communications should be routed through the platoon leader.

Table X is the section qualification course. It challenges the section leader to integrate fire and maneuver while testing the section's ability to engage moving and stationary ground targets with all tank-mounted weapons during daylight and periods of limited visibility. The targets represent enemy force consistent with a medium density conflict. This is the only table that includes noncombatant target arrays.

CONCEPT

The section is required to fire a scenario linking day and night phases. The section training course should be developed to follow Table X. The section course follows the scenario developed by the U.S. Army Armor Center and Fort Knox for Table X.

The advanced tables must begin with an OPORD issued to the platoon. The platoon leader must disperse his platoon into sections to cover two areas. Graphics used to control movement to the range and platoon and section sectors of fire and axis of advance (range limitations) will be developed as a hard copy and transmitted via digital communications. SITREPs and FRAGOs used to control the platoon and sections will be used in conjunction with the graphics.

Other direct and indirect fires (such as mortars, antitank weapons, and artillery) may be incorporated (live or simulated) to provide enhanced training in fire planning and calling for supporting fires. Advanced tables include—

- A live-fire scenario linked together by maneuver tasks.
- Troop-leading procedures conducted by the platoon leader and platoon sergeant.
- Ground reconnaissance of the platoon BP (range) conducted by the platoon leader and TCs before executing Table IX.
- Administrative and safety briefings required by local regulations.

Note. All reports, orders, and graphics will be sent digitally, along with backup hard copies. During contact, however, FM will be the primary means of communications for the section. Digital communications will continue as soon as the situation permits.

CONDUCT OF THE TABLE

Table IX is fired dry or subcaliber against full-scale targets. The sections should dry run the table to master fire distribution and control techniques and the platoon and section SOPs prior to firing subcaliber ammunition.

Table X must be fired live (full caliber). The platoon must fire the scenario as it links day and night phases together. The target array is based on an enemy task force using guerrilla tactics.

Based on mission-essential training requirements and resource restrictions, the commander may mix these phases in other ways. This allows the commander and master gunner to design their training courses to specific range limitations. It also allows the commander and master gunner to train better section weapon systems proficiency by using flexible arrays. Target arrays must realistically represent METT-TC considerations and provide realistic tactical scenarios.

Notes. AR 385-63 currently does not allocate ammunition for Tables IX and X.
Units that have procured caliber .50 inbore devices may use 20 rounds of SLAP-T.

AMMUNITION REQUIREMENTS	
Main gun rounds	20
7.62-mm rounds	1,000
Caliber .50 rounds	200

MAIN GUN TARGETS

A total of 16 main gun targets (tanks and PCs) will be presented. Main gun targets *not* engaged and destroyed by main gun fire will *not* be counted. The command and control engagement will be presented for 60 seconds. All offensive engagements will be presented for 50 seconds (day) or 60 seconds (night). During these engagements, maximum use of moving targets is recommended.

MACHINE GUN TARGETS

A total of 21 machine gun targets (troops and trucks) will be presented. One RPG team (troop) target consists of four E-type silhouettes dispersed over a 5-meter area. A sapper (troop) target consists of two E-type silhouettes dispersed over a 2-meter area. Area targets will be engaged with the commander's caliber .50 machine gun, loader's machine gun, or the coax machine gun.

NONCOMBATANT TARGETS

Noncombatant targets consist of any number E-type silhouettes dispersed in a small group. Noncombatant targets should be painted with colors that depict civilian attire.

SCORING

The section must hit 70 percent of the aggregate targets presented (machine gun and main gun). Target hit standards are—

- *Main gun*: One round through target.
- *Machine gun* (area targets, troops): Must hit at least one silhouette in each group.

Note. A 10-percent crew duty penalty will be assessed if any of the friendly targets or noncombatants are engaged.

Sections will be evaluated on both target hits, and tactics and procedures. A section must receive a T or P on 70 percent of the tactical tasks (and subtasks) evaluated to be considered a qualified section.

The gunnery score is determined by dividing the number of targets hit by the number of targets presented.

Example: $\frac{\text{Targets Hit}}{\text{Targets Presented}} = \text{Gunnery Score}$

The tactical score is determined by dividing the number of tasks (and subtasks) scored as T or P by the total number of tasks (and subtasks) evaluated.

Example: $\frac{\text{Targets Scored as T or P}}{\text{Total Tactical Tasks Evaluated}} = \text{Tactical Score}$

The overall Table X score is determined by adding the gunnery score and tactical score and dividing by two.

Example: Gunnery Score + Tactical Score ÷ 2 = Overall Table X Score

Note. The section will receive an "Unqualified" if they do not use digital communications.

Overall scoring will be as follows:

- Unqualified—0 to 69 percent.
- Qualified—70 to 79 percent.
- Superior—80 to 89 percent.
- Distinguished—90 to 100 percent.

CODES FOR SCORESHEET BLOCKS

WEATHER

Use the following codes to indicate the type of weather encountered during the test (two codes may be used; for example, a 2 and a 3 means rain and fog).

- 1—Clear.
- 2—Rain.
- 3—Fog.
- 4—Snow.

TEMPERATURE

Use the following codes to indicate the temperature during the test.

- 1—Less than 21°F.
- 2—21°F to 50°F.
- 3—51°F to 90°F.
- 4—Greater than 90°F.

VISIBILITY

Use the following codes to indicate the visibility during the test (distance that can be seen with the unaided eye).

- 1—Less than 1,001 meters.
- 2—1,001 meters to 1,500 meters.
- 3—1,501 meters to 2,000 meters.
- 4—2,001 meters to 2,500 meters.
- 5—Greater than 2,500 meters.

ADVANCED TABLE X—LIVE-FIRE SCENARIO (SAMPLE)

Note. The following format is a sample that a unit can follow when conducting the table. Units are encouraged to develop their own scenarios based on the unit's unique mission.

TASK 1

Conduct assembly area activities (17-3-2000).

SUBTASKS

(1) Conduct troop-leading procedures (17-3-0065).

(2) Conduct a hasty occupation of a platoon battle position (17-3-2601).

CONDITIONS

The platoon receives a FRAGO to occupy an assembly area and prepare for an operation. Enemy contact is not expected. A quartering party has been dispatched to the assembly area and guides are positioned at the RP. The platoon, moving along the route given in the movement order, arrives at the RP. In the assembly area, the platoon receives an OPORD. The platoon is to disperse into sections to protect and overwatch noncombatants moving in the area. A HMMWV scout platoon (friendly) is located to the platoons front. One section (three HMMWVs) is in the platoon sector in the vicinity of a specified TRP (1,000 to 1,500 meters). Many noncombatants are moving about the platoon sector. A terrorist guerrilla unit has been reported in the platoon's sector. They are armed with tanks, PCs, RPGs. They have been reported to attack friendly units with satchel charges and grenades. Their intent is to inflict as much harm to friendly forces and noncombatants as possible.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2000, 17-3-0065, and 17-3-2601).

TASK 2

Conduct a tactical road march (17-3-0212).

CONDITIONS

The platoon road marches to its RP, disperses into sections, occupies their initial battle position, and conducts a deliberate occupation.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-0212).

TASK 3

Conduct a deliberate occupation of a battle position (17-3-2602).

CONDITIONS

No engineer assets are available. As the section prepares to occupy the position, a spot report (of an enemy infantry patrol operating in their sector) is sent to the platoon on the company team net. The scout section has been ordered to pull back through the section position.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2602).

TASK 4

Conduct a section defense.

CONDITIONS

After the section occupies the battle position, it receives a spot report on the company net/platoon net that an enemy dismounted reconnaissance patrol is approaching (specified size, grid, and direction of movement places the patrol in the platoon sector in 5 minutes). After 5 minutes, the HMMWV scout section (two M1 panels) is presented (vicinity of a specified TRP) and exposed for 1 minute. Thirty seconds after the HMMWV section is presented, an enemy infantry patrol is presented (four sets of troops, 400 to 800 meters and one PC, 900 to 1,000 meters). Presentation time for enemy targets is 50 seconds.

STANDARDS

The section does not engage friendly targets. The section engages the infantry patrol with machine-guns and the PC with the main gun.

TASK 5

Assault an enemy position (17-3-0220).

SUBTASKS

(1) Execute actions on contact (17-3-0221).

(2) Conduct consolidation and reorganization activities (12-3-C021).

CONDITIONS

The platoon is in a battle position and receives a spot report of a enemy tank section (two tanks) assaulting a group of fleeing refuges (set of painted troops) and is ordered to conduct a counterattack by fire and movement to complete the destruction of enemy forces and to occupy a hasty battle position.

As the section begins to move, an RPG team and sapper team (one set of troops, 300 to 500 meters and a set of two troops, 50 to 100 meters) attacks the tank section. Fifteen seconds later, the enemy tank platoon (two tank targets, 1,200 to 1,400 meters) is presented and one group of noncombatant targets (one set of painted troops, 800 to 1,000 meters) is encountered. Presentation time is 50 seconds.

STANDARDS

The section does not engage friendly targets. The section engages and destroys the enemy tank section with the main gun.

TASK 6

Conduct a section defense (hasty) (NBC) (17-3-2605).

SUBTASK

React to indirect fires (Battle Drill 4).

CONDITIONS

The section begins to receive indirect fire in the vicinity of their hasty defensive position. The platoon reacts and assumes MOPP-4. The section receives a spot report of an enemy tank platoon (three tanks, 1,400 to 1,600 meters) approaching the section's position. Presentation time is 50 seconds.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2605 and Battle Drill 4).

The section engages and destroys the tanks with the main gun.

SITUATION CONTINUES

The commander grants permission to unmask when the section reports that no chemical agents were detected.

TASK 7

Conduct a section defense.

CONDITIONS

As soon as the section sends its spot report of the three tanks, it is attacked by two sapper teams (50 to 100 meters) and two RPG teams (300 to 400 meters). One set of noncombatant targets will be presented in the section's operating area.

STANDARDS

The section engages the enemy teams with machine guns.

SITUATION CONTINUES

While the section is sending its spot report, it is attacked by one moving suicide truck (evasive moving target, 400 to 700 meters) and two sets of noncombatant targets are presented at various ranges. Presentation time is 50 seconds.

STANDARDS

The section engages the truck with machine guns or the main gun.

TASK 8

Assault an enemy position (17-3-0220).

SUBTASKS

(1) Execute actions on contact (17-3-0221).

(2) Conduct consolidation and reorganization activities (12-3-C021).

CONDITIONS

During the last attack, the leader's tank received damage to the GPS and must fight degraded (GAS). The wingman's loader was killed and must fight with a three-man crew. The leader must send a situation report with this information. The section receives a report that a checkpoint is under siege by four PCs (800 to 1,400 meters). The section is ordered to assault through the checkpoint and destroy the enemy PCs. Presentation time is 50 seconds.

Note. The evaluator or safety must pick up the wingman's loader. They must make sure that both ballistic doors on the leader's tank are closed. They will hold the loader until the platoon consolidates, then they will reorganize in the assembly area.

STANDARDS

The section engages the PCs with the main gun.

SITUATION CONTINUES

The checkpoint has been fortified, and the section receives orders to link up with the rest of the platoon. The platoon is ordered to an assembly area to prepare for night operations. The platoon receives the following FRAGO:

- The platoon is to conduct a rearward passage of lines and road march to an assembly area to prepare for further operations.

- The XO or 1SG has completed the coordination. The passage point and recognition signals are provided to the platoon.
- The assembly area has moved (gives new location of assembly area).
- The assembly area is clear and occupied by a company quartering party.

TASK 9

Prepare for future operations.

SUBTASKS

(1) Conduct assembly area activities (17-3-2000).

(2) Conduct troop-leading procedures (17-3-0065).

(3) Perform consolidation and reorganization activities (12-3-C021).

(4) Conduct resupply operations (17-3-0601).

Note. If the platoon fails to request a replacement for the KIA, the sections will run the night run without them.

CONDITIONS

The platoon prepares for future operations.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2000, 17-3-0065, 12-3-C021, 17-3-0601).

SITUATION CONTINUES

The company has not had the same success as the platoon had during the day. The platoon is again ordered to deploy as sections. The platoon receives a spot report of an enemy convoy moving under the cover of darkness. The enemy convoy's intent is to resupply the enemy operating in your area to bring in more troops. One section must move to a predetermined TRP and conduct a hasty occupation of a battle position. Engage and destroy the enemy convoy.

TASK 10

Conduct a tactical road march (17-3-0212).

CONDITIONS

The platoon road marches to predetermined RP and deploys as sections. The sections conduct a hasty occupation of a battle position.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-0212).

TASK 11

Conduct a section defense.

CONDITIONS

After the section occupies the battle position, it receives a spot report on the company/platoon net that an enemy convoy is approaching (specified size, grid, and direction of movement places the convoy in the platoon sector in 5 minutes). After 5 minutes, the convoy enters the sector (eight truck panels, 600 to 900 meters are presented in the vicinity of a specified TRP and exposed for 60 seconds). Thirty seconds after the convoy is presented, four sets of troops, 400 to 600 meters, are presented for 60 seconds.

STANDARDS

The section engages the convoy and troops with machine guns.

SITUATION CONTINUES

The convoy is destroyed. The section sends a situation report. The section receives a spot report that three PCs that were part of the convoy are occupying a hasty defense in the vicinity of a selected TRP.

TASK 12

Assault an enemy position (17-3-0220).

SUBTASKS

(1) Execute actions on contact (17-3-0221).

(2) Conduct consolidation and reorganization activities (12-3-C021).

CONDITIONS

The section is ordered to attack and destroy the PCs and occupy a hasty battle position. As the section begins to move, they encounter the enemy (three PCs, 1,200 to 1,500 meters). Presentation time is 60 seconds.

STANDARDS

The section engages the PCs with the main gun and occupies a hasty battle position.

SITUATION CONTINUES

The section sends a situation report. It receives a spot report of tanks and PCs moving toward their position and is ordered to destroy the opposing force.

TASK 13

Conduct a section defense.

CONDITIONS

The section is attacked by an enemy tank platoon (three tanks, 1,400 to 1,600 meters and two PCs, 1,000 to 1,400 meters). Presentation time is 60 seconds.

STANDARDS

The section engages the targets with the main gun.

SITUATION CONTINUES

Confident that all enemy elements in their sector have been destroyed, the section is ordered to hold their position while efforts continue with another battle to the section's flank. The section should continue to hold their sector.

CONDITIONS

The section should continue to scan their sector. After 5 to 10 minutes, they are attacked without warning by two sapper teams (50 to 100 meters) and two RPG teams (300 to 400 meters). Presentation time is 60 seconds.

STANDARDS

The section engages the troops with machine guns.

SITUATION CONTINUES

The section sends a situation report. It is low on ammunition and receives orders to link up with the rest of the platoon. The platoon receives a FRAGO (change of mission): Move to a rear assembly area (AAR site) for rearm and refit. When the platoon arrives, they will be given their end-of-mission statement, and the AAR will be conducted.

Conduct of Table XI (Advanced Training Course) (Platoon) and Table XII (Advanced Qualification Course) (Platoon)

Table XI is used to train the platoon to control and distribute platoon direct fire to destroy enemy targets in a tactical scenario.

Table XII is the platoon qualification course. This table challenges the platoon leader to integrate fire and maneuver while testing the platoon's ability to engage moving and stationary, air and ground targets with all tank-mounted weapons during daylight and periods of limited visibility. A platoon that loses the platoon leader and/or platoon sergeant is no longer considered qualified.

CONCEPT

The platoon is required to fire a scenario linking day and night phases. The platoon training course should be developed to follow Table XII. The platoon course follows the scenario developed by the MACOMs based on their theater of operations (for example, European, Desert, Korea) for Table XII.

The advanced tables must begin with an OPORD issued to the platoon. Graphics used to control movement to the range and platoon sectors of fire and axis of advance (range limitations) will be developed as a hard copy and transmitted digitally (if equipped). SITREPs and FRAGOs used to control the platoon will be used in conjunction with the graphics.

Other direct and indirect fires (such as mortars, antitank weapons, and artillery) may be incorporated (live or simulated) to provide enhanced training in fire planning and calling for supporting fires. Advanced tables include—

- A live-fire scenario linked together by maneuver tasks.
- Troop-leading procedures conducted by the platoon leader.
- A ground reconnaissance of the platoon BP (range) conducted by the platoon leader and tank commanders before executing Table XI.
- Administrative and safety briefings required by local regulations.

Note. All reports, orders, and graphics will be sent digitally, along with backup hard copies. During contact, however, FM will be the primary means of communications for the platoon. Digital communications will continue as soon as the situation permits.

PREREQUISITES

All crews will be qualified on a Tank Table VIII prior to participating in a Tank Table XII exercise.

CONDUCT OF THE TABLE

Table XI is fired using gunnery training devices or dry against full-scale targets. The platoon should dry run the table to master fire distribution and control techniques and the platoon SOP.

Note. Units that have procured caliber .50 inbore devices may use 20 rounds of SLAP-T on Table XI.

Table XII must be fired live (full caliber). The platoon must fire the scenario as it links day and night phases. The target array is based on the expected theater mission and threat doctrine tactics. Targets will be presented in bands depicting an advancing enemy force. Targets *not* engaged (or missed) during the initial presentation will be presented at a higher level of difficulty in subsequent presentations. (Flank targets *not* destroyed in the first presentation are changed to frontal [50 percent] and hull-down [50 percent] targets in the second presentation. Those targets *not* destroyed in the second presentation are changed to hull-down targets in the last presentation.) Helicopter targets will be presented only once and must be destroyed during the presentation. If the platoon fails to engage and destroy the helicopters, they will lose points for targets not engaged.

SCENARIO CONSTRUCTION

The U.S. Army Armor Center and Fort Knox guidance for Tank Table XII scenarios are for the MACOMs to develop their scenarios based on their theater of assignment. Select a target option and ammunition authorization from the following tables.

TARGET OPTION 1		
TARGETS	**AMMUNITION AUTHORIZED**	
42 main gun targets	60 main gun rounds	
18 machine gun targets	800 rounds 7.62mm	400 rounds caliber .50
	36 smoke grenades	

TARGET OPTION 2		
TARGETS	**AMMUNITION AUTHORIZED**	
35 main gun targets	52 main gun rounds	
25 machine gun targets	1,200 rounds 7.62mm	400 rounds caliber .50
	36 smoke grenades	

TARGET OPTION 3		
TARGETS	**AMMUNITION AUTHORIZED**	
30 main gun targets	45 main gun rounds	
30 machine gun targets	1,200 rounds 7.62mm	600 rounds caliber .50
	36 smoke grenades	

To make sure the platoon tactically resupplies ammunition, the platoon will not receive all main gun rounds before the day scenario.

An AAR will be conducted for each platoon, day and night.

MAIN GUN TARGETS

Main gun targets (tanks, helicopters, and PCs) will be presented. Main gun targets *not* engaged and destroyed by main gun fire will *not* be counted. A target *not* destroyed in the last presentation will overrun (or bypass) the firing platoon. The command and control engagement will be presented in the scenario for 90 seconds. All offensive engagements will be presented for 50 seconds (day) or 60 seconds (night). All defensive engagements will be presented in a depleting target array of three presentations: 30 seconds (day) or 40 seconds (night). The first presentation will include all main gun targets; the second presentation will include those targets *not* destroyed in the first presentation (displayed 50 percent frontal and 50 percent hull-down); the last presentation will include the targets *not* destroyed in the first two presentations (displayed as hull-down). Helicopter targets will only be presented on the second presentation and must be destroyed. If troop targets are presented in a defensive engagement, they will be presented in the third presentation of targets. Any tank target emplaced beyond 2,800 meters should be presented as a flank target; subsequent bands should be 300 to 400 meters apart. This range change, coupled with presentation time of each band, will simulate movement rates of 20 to 25 kmph. Thus, a third band may be up to 800 meters closer. During these engagements, maximum use of moving targets is recommended.

MACHINE GUN TARGETS

Machine gun targets (RPG teams, sapper teams, infantry squads, trucks, or any other target deemed necessary for the theater) will be presented. One RPG team target consists of four E-type silhouettes dispersed over a 5-meter area. Sapper teams consist of two E-type silhouettes dispersed over a 2-meter area. Infantry squads must consist of more than five E-type silhouettes dispersed over a 10-meter area. Truck targets may be constructed to match any truck that fits the theater. Machine gun targets will be engaged with the commander's caliber .50 machine gun, loader's machine gun, or the coax machine gun.

NONCOMBATANT TARGETS (CIVILIAN)

The U.S. Army Armor Center highly encourages the use of noncombatant targets. Noncombatant targets may consist of any number E-type silhouettes painted to resemble civilian attire.

EVALUATORS

The firing unit company commander is the primary evaluator of his unit's performance; however, he may have assistants for each platoon evaluated. Who the commander appoints as assistant evaluators will depend on the unit's assets and mission at that time. Basic guidelines for selecting assistant evaluators for the advanced tables are:

- Platoon leader.
- Staff sergeant or above (should be an Advanced NCO Course [ANCOC] graduate) for platoon evaluator.
- Qualified on the table being evaluated within the last 12 months (weapon systems qualified) and appointed by their battalion/squadron commander.

Note. Where circumstances do not permit live-fire qualification, such as service with a TSB, the battalion commander or TSB commander can waive the live-fire qualification requirement if the evaluator has qualified previously and is fully knowledgeable of the applicable gunnery manuals.

- Extensive knowledge of:
  - FM 3-20.12, Chapter 4, Ammunition and Target Destruction.
  - FM 3-20.12, Chapter 8, *Direct Fire.*
  - FM 3-20.12, Chapter 15, *Collective Gunnery Training*.
  - FM 17-15 (FM 3-20.15), Chapter 2, *Fire Distribution*.
- Familiar with the portion of the firing platoon SOP that relates to offensive and defensive operations.
- Safety qualified for the firing range being used.

Each evaluator should be in a safe position to allow visual monitoring of the firing unit. The evaluator must establish communications with the firing platoon so that he can monitor the platoon net for Tables XI and XII. For units equipped with M1s and M1A1s firing the advanced Tank Table XII, each evaluator should be equipped with a driver and a vehicle with two net capabilities that allow them to move with the firing unit. For units equipped with the M1A2, at least one evaluator should be in an IVIS-equipped vehicle to send, monitor, and evaluate digital traffic.

SCORING

Platoons will be evaluated on both gunnery and tactical proficiency. A platoon must hit 70 percent of the aggregate targets presented (machine gun and main gun) and receive a T or P on 70 percent of the tactical tasks (and subtasks) evaluated (on Table XII) to be considered a qualified platoon. Tactical tasks are rated as trained (T), practice (P), or untrained (U).

The platoon should acquire the friendly target array and identify them as friendly, as part of the tactical tasks. A 10-percent platoon score penalty will be assessed if any of the friendly targets are engaged. The purpose of this penalty is to reduce the platoon's overall score one qualification level (for example: If a platoon's preliminary score is 95% [Distinguished], and the platoon engaged the friendly array, their overall score would be 85% [Superior]).

Gunnery Proficiency

Target hit standards are—

- *Main gun*. One round through the target.
- *Machine gun* (area targets, troops). Must hit at least one silhouette in each group.
- *Truck* (point target). Must hit the target with three rounds of ammunition.

Gunnery score will be—

- Unqualified—0 to 69 percent.
- Qualified—70 to 79 percent.
- Superior—80 to 89 percent.
- Distinguished—90 to 100 percent.

The gunnery score is determined by dividing the number of targets hit by the number of targets presented.

Example: $\frac{\text{Targets Hit}}{\text{Targets Presented}}$ = Gunnery Score

Tactical Proficiency

A scenario should be constructed from the unit METL to evaluate the tactical proficiency of the element. This scenario should follow the Table XII scenario. Evaluation of the tactical tasks will be based on ARTEP 17-237-10-MTP.

Tactical score will be—

- Unqualified—0 to 69 percent.
- Qualified—70 to 79 percent.
- Superior—80 to 89 percent.
- Distinguished—90 to 100 percent.

The tactical score is determined by dividing the number of tasks (and subtasks) scored as T or P by the total number of tasks (and subtasks) evaluated.

Example: $\frac{\text{Tasks Scored as T or P}}{\text{Total Tactical Tasks Evaluated}}$ = Tactical Score

Overall Scoring

The overall TT XII score is determined by adding the gunnery percentage and the tactical percentage, dividing by two, and subtracting 10 percent from the total score if any friendly target arrays were engaged.

Example: Gunnery Score + Tactical Score ÷ 2 - 10% if friendly engaged = Overall TT XII Score.

Overall scoring will be as follows:

- Unqualified—0 to 69 percent.
- Qualified—70 to 79 percent.
- Superior—80 to 89 percent.
- Distinguished—90 to 100 percent.

Examples:

Gunnery Score	98%	88%	76%
Tactical Score	92%	84%	72%
Divide by 2	÷ 2	÷ 2	÷ 2
Preliminary Score	95%	86%	74%
Penalty for Engaging Friendly Target	-10%	-10%	-10%
Overall Score	85%	76%	64%

Note. The platoon will receive an "Unqualified" if they do not use digital communications.

CODES FOR SCORESHEET BLOCKS

WEATHER

Use the following codes to indicate the type weather encountered during the test (two codes may be used; for example, a 2 and a 3 means rain and fog).

- 1—Clear.
- 2—Rain.
- 3—Fog.
- 4—Snow.

TEMPERATURE

Use the following codes to indicate the temperature during the test.

- 1—Less than 21°F.
- 2—21°F to 50°F.
- 3—51°F to 90°F.
- 4—Greater than 90°F.

VISIBILITY

Use the following codes to indicate the visibility during the test (distance that can be seen with the unaided eye).

- 1—Less than 1,001 meters.
- 2—1,001 meters to 1,500 meters.
- 3—1,501 meters to 2,000 meters.
- 4—2,001 meters to 2,500 meters.
- 5—Greater than 2,500 meters.

ADVANCED TABLE—LIVE-FIRE SCENARIO

Note. The following format is a sample that a unit can follow when conducting the table. Units are encouraged to develop their own scenarios based on the unit's unique mission.

TASK 1

Conduct assembly area activities (17-3-2000).

SUBTASKS

(1) Conduct troop-leading procedures (17-3-0065).

(2) Conduct a hasty occupation of a platoon battle position (17-3-2601).

CONDITIONS

The platoon receives a FRAGO to occupy an assembly area and prepare for a company team defensive operation. Enemy contact is not expected. A quartering party has been dispatched to the assembly area and guides are positioned at the RP. The platoon, moving along the route given in the movement order, arrives at the RP. In the assembly area, the platoon receives an OPORD including the commander's engagement criteria: Until a company-size element or larger is encountered, do not engage with direct fire (except in self defense). A Bradley scout platoon (friendly) is located to the company's front. One section (two Bradleys) is in the platoon sector in the vicinity of a specified TRP (1,000 to 1,500 meters). The enemy has recently used artillery-delivered chemical weapons.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2000, 17-3-0065, and 17-3-2601).

TASK 2

Conduct a tactical road march (17-3-0212).

CONDITIONS

The platoon road marches to its initial battle position and conducts a deliberate occupation.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-0212).

TASK 3

Conduct a deliberate occupation of a battle position (17-3-2602).

CONDITIONS

No engineer assets are available. As the platoon prepares to occupy the position, a spot report (of an approaching enemy reconnaissance patrol) is sent to the platoon on the company team net.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2602).

TASK 4

Conduct a platoon defense (17-3-2605).

CONDITIONS

After the platoon occupies the battle position, it receives a spot report on the company net (an enemy reconnaissance patrol is approaching, specified size, grid, and direction of movement places the patrol in the platoon sector in five minutes). After five minutes, the Bradley scout section (two friendly panels) is presented (vicinity of a specified TRP) and exposed for one minute. Thirty seconds after the Bradley section is presented, an enemy separate reconnaissance patrol (three PCs and one tank, 2,400 to 2,800 meters) enters the platoon area of observation. Presentation time for enemy targets is 90 seconds; targets are presented once.

Note. The enemy reconnaissance patrol does not meet the commander's engagement criteria. If they are engaged with the main gun, no credit is given. The intent is for the platoon leader to adhere to the engagement criteria and engage only with indirect fire.

STANDARDS

The platoon does not engage friendly targets. The platoon calls for indirect fire but does not engage with direct fire.

SITUATION CONTINUES

The platoon continues to occupy the battle position. An enemy forward security element (a tank company with ten tanks, 2,000 to 2,400 meters) conducts a reconnaissance in force against the platoon.

Targets are presented in three bands; presentation time is 30 seconds for each band.

TASK 5

Assault an enemy position (17-3-0220).

SUBTASKS

(1) Execute actions on contact (17-3-0221).

(2) Conduct consolidation and reorganization activities (12-3-C021).

CONDITIONS

The platoon is in a battle position and is ordered to conduct a counterattack by fire and movement to complete the destruction of remaining enemy forces and to occupy a hasty battle position. Other platoons provide overwatching fires. As the platoon begins to move, a combat reconnaissance patrol (two PCs and one tank, 1,000 to 1,400 meters; two sets of troops, 200 to 700 meters) is encountered. Presentation time is 50 seconds.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-0220, 17-3-0221, and 12-3-C021).

TASK 6

Conduct a platoon defense (17-3-2605) (hasty) (NBC).

SUBTASK

React to indirect fires (Battle Drill 4).

CONDITIONS

The platoon begins to receive indirect fire in the vicinity of their hasty defensive position. The platoon reacts and assumes MOPP-4. The platoon receives a spot report of a reinforced motorized rifle company (MRC+) (nine PCs and three tanks, 2,000 to 2,400 meters; four sets of troops, 200 to 700 meters) approaching the platoon position.

Targets are presented in three bands; presentation time is 30 seconds for each band. Troop targets are presented in the third band.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2605 and Battle Drill 4).

SITUATION CONTINUES

Commander grants permission to unmask when platoon reports that no chemical agents were detected.

TASK 7

Conduct a platoon defense (17-3-2605).

CONDITIONS

The platoon continues to occupy a hasty battle position (4 sets of troops, 200 to 700 meters); presentation time is 50 seconds.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2605).

SITUATION CONTINUES

The platoon receives a spot report of an approaching second echelon tank regiment and is ordered to move to a rear assembly area to prepare for night operations. The platoon receives FRAGO:

- The platoon is to conduct a rearward passage of lines and road march to an assembly area to prepare for further operations.
- Coordination has been accomplished by the executive officer or first sergeant. The passage point and recognition signals are provided to the platoon.
- The assembly area has moved (gives new location of assembly area).
- Assembly area is clear and occupied by a company quartering party.

TASK 8

Prepare for future operations.

SUBTASKS

(1) Conduct assembly area activities (17-3-2000).

(2) Conduct troop-leading procedures (17-3-0065).

(3) Perform consolidation and reorganization activities (12-3-C021).

(4) Conduct resupply operations (17-3-0601).

CONDITIONS

Continuing situation.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2000, 17-3-0065, 12-3-C021, and 17-3-0601).

TASK 9

Conduct a tactical road march (17-3-0212).

CONDITIONS

The platoon road marches and conducts a hasty occupation of a battle position.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-0212).

TASK 10

Conduct a hasty occupation of a platoon battle position (17-3-2601).

CONDITIONS

Continuing situation.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2601).

TASK 11

Conduct a platoon defense (17-3-2605).

CONDITIONS

The platoon conducts hasty occupation of a battle position. An aggressive infiltrating CRP (four PCs, 1,100 to 1,800 meters; four sets of troops, 200 to 700 meters) probes the platoon sector.

Targets are presented in three bands; presentation time is 40 seconds for each band. Troop targets are presented in the third band.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2605).

SITUATION CONTINUES

The platoon is ordered to conduct a counterattack.

TASK 12

Assault an enemy position (17-3-0220).

SUBTASK

Conduct a hasty occupation of a platoon battle position (17-3-2601).

CONDITIONS

The platoon is ordered to destroy the remaining elements of the enemy CRP. They receive a FRAGO to assault forward to a designated TRP. Other platoons will provide overwatching fires. Intelligence reports remnants of the advanced guard (two PCs, 1,000 to 1,500 meters; two sets of troops, 200 to 700 meters) withdrawing within the platoon sector. Presentation time is 60 seconds.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-0220 and 17-3-2601).

SITUATION CONTINUES

The platoon receives a spot report (of an approaching tank company) on the company net.

TASK 13

Conduct a platoon defense (17-3-2605).

CONDITIONS

The platoon conducts hasty occupation of a battle position. A tank company (+) (ten tanks and one BMP, 2,000 to 2,400 meters; two sets of troops, 200 to 700 meters) enters the platoon engagement area.

Targets are presented in three bands; presentation time is 40 seconds for each band. Troop targets are presented in the third band.

STANDARDS

See ARTEP 17-237-10-MTP (17-3-2605).

SITUATION CONTINUES

The platoon receives a FRAGO (change of mission): Move to a rear assembly area (AAR site) for rearm and refit. When the platoon arrives they will be given end-of-mission, and the AAR will be conducted.

TANK TABLE XII SCORESHEET				RANGE	
DAY RUN (A)	DATE		NIGHT RUN (B)	DATE	
START TIME	STOP TIME		START TIME	STOP TIME	
EVALUATOR'S NAME (PRINT)			EVALUATOR'S NAME (PRINT)		
EVALUATOR'S NAME (SIGNATURE)			EVALUATOR'S NAME (SIGNATURE)		

TACTICAL						GUNNERY					
TASK	TASK NUMBER	TASK DESCRIPTION	T	P	U	MAIN GUN		MACHINE GUN		TOTAL	
						PRES	HIT	PRES	HIT	PRES	HIT
1	17-3-2000	Conduct Assembly Area Activities									
	17-3-0065	Conduct Troop-Leading Procedures									
	17-3-2601	Conduct a Hasty Occupation of a Platoon BP									
2	17-3-0212	Conduct a Tactical Road March									
3	17-3-2602	Conduct a Deliberate Occupation of a BP									
4	17-3-2605	Conduct a Platoon Defense									
	Friendly Scout Section (1,000 to 1,500 meters)					Platoon does NOT engage.					
	Recon Patrol - 3 BMPs, 1 tank (2,400 to 2,800 meters)					Call for fire					
	FSE - 10 tanks (2,000 to 2,400 meters)										
5	17-3-0220	Assault an Enemy Position									
	17-3-0221	Execute Actions on Contact									
	12-3-C021	Conduct Consolidation and Reorganization Activities									
	CRP - 2 BMPs, 1 tank (1,000 to 1,400 meters), 2 troops (200 to 700 meters)										
6	17-3-2605	Conduct a Platoon Defense									
	Battle Drill 4	React to Indirect Fires									
	MRC(+) - 9 BMPs, 3 tanks (2,000 to 2,400 meters), 4 troops (200 to 700 meters) (NBC)										
7	17-3-2605	Conduct a Platoon Defense									
	4 troops (200 to 700 meters)										
8	17-3-2000	Conduct Assembly Area Activities									
	17-3-0065	Conduct Troop-Leading Procedures									
	12-3-C201	Perform Consolidation and Reorganization Activities									
	17-3-0601	Perform Resupply Operations									
9	17-3-0212	Conduct a Tactical Road March									
10	17-3-2601	Conduct a Hasty Occupation of a Platoon BP									
11	17-3-2605	Conduct a Platoon Defense									
	CRP - 4 BMPs (1,100 to 1,800 meters), 4 troops (200 to 700 meters)										
12	17-3-0220	Assault an Enemy Position									
	17-3-2601	Conduct a Hasty Occupation of a Platoon BP									
	Advance Guard - 2 BMPs (1,000 to 1,500 meters), 2 troops (200 to 700 meters)										
13	17-3-2605	Conduct a Platoon Defense									
	Tank Company (+) - 10 tanks, 1 BMP (2,000 to 2,400 m), 2 troops (200 to 700 m)										
		TOTAL (DAY)							TOTAL (DAY)		
		TOTAL (NIGHT)							TOTAL (NIGHT)		
		TOTAL							TOTAL		
		TOTAL NUMBER OF T or P RATED TASKS							DIVIDE BY TOTAL # OF TGTS		
		DIVIDED BY TOTAL NUMBER OF TASKS (÷ 23)							MULTIPLY BY 100		X 100
		MULTIPLY BY 100		X 100					TOTAL GUNNERY SCORE		
		TOTAL TACTICAL SCORE							TOTAL MAIN GUN AMMO USED		

TACTICAL SCORE _____ + GUNNERY SCORE _____ = _____ ÷ 2 - 10% IF FRIENDLY ENGAGED = TABLE XII SCORE _____

PLATOON	COMPANY/TROOP	BN/SQDN	BDE/REG	DIVISION	CORPS

Figure 15-1. Sample Scoresheet—Table XII.

Conduct of the Fire Coordination Exercise (FCX)

The FCX is used to train commanders in the execution of maneuver unit tasks critical to the successful synchronization of direct and indirect fires with maneuver at the basic level prior to the execution of a CALFEX.

CONCEPT

An FCX can simulate battle conditions to train leaders under mission-unique conditions and standards for training, evaluating, and applying the tactics, techniques, and procedures to the mission being trained.

Training aids, devices, simulators and simulations (TADSS) can be used to conduct the FCX. Some of the available TADSS that can be used to conduct an FCX are:

- Simulation Network Trainer (SIMNET-T).
- Close Combat Tactical Trainer (CCTT).
- JANUS.
- Brigade/Battalion Battle Simulation (BBS).

Refer to TC 71-5, *Fire Coordination Exercise* for more information on the conduct of an FCX.

Conduct of the Combined Arms Live-Fire Exercise (CALFEX)

A CALFEX is the culmination of weapon systems training at the company-team level. It is used to train units to perform primary combat missions in a realistic, live-fire environment.

CONCEPT

A CALFEX is a costly, resource-intensive exercise in which combined-arms teams, or task forces, maneuver and employ organic and supporting weapon systems. It is the most realistic measure of combined-arms combat readiness and should be an integral part of every unit's training program. Commanders must be aware of the limitations of the CALFEX, particularly in regard to flank maneuvering, and firing on live-fire ranges. Available terrain will rarely support this type of maneuver. Commanders should use live-fire exercises to train certain aspects of combat readiness, such as distribution, coordination, and synchronization of fires. Commands should try to link multiple digital multipurpose range complexes (DMPRC) for maximum training value whenever possible.

For an exercise of this nature to be effective, it must involve detailed planning and careful resourcing. Supplementary missions and a wide range of supporting tasks can be integrated into the exercise. Resources, including personnel, equipment, and facilities, must be programmed and coordinated early in the planning process to ensure that the exercise can be conducted day and night.

Notes. This information is not intended to supersede the live-fire program at the National Training Center (NTC), but to compliment it. Certain planning aspects described herein address common constraints at Army posts worldwide. These same constraints are relaxed at the NTC because of the nature of terrain and to enhance realism.

All reports, orders, and graphics will be sent digitally, along with backup hard copies. During contact, however, FM will be the primary means of communications. Digital communications will continue as soon as the situation permits.

PREREQUISITES

Individual and crew-level weapon system proficiency is a critical prerequisite to the effectiveness of CALFEX. It is required that participating platoons be qualified on Tank Table XII or equivalent platoon qualification prior to a CALFEX. Command elements (platoon leaders; platoon sergeants; CS and CSS commanders; and company, battalion, brigade, and division commanders) must successfully participate in and complete an FCX prior to a CALFEX.

Note. DA Pam 350-38 (STRAC) provides the frequency of resourced events.

TRAINING PHILOSOPHY

Command elements (battalion, brigade, or division) participate in all aspects of planning, execution, and evaluation of CALFEX participants. They receive reports from the maneuvering company team, issue FRAGOs, portray the friendly and enemy situation throughout the battlefield, and coordinate the maneuver and support of CS and CSS elements not under the company's span of control. If the exercise actively integrates sustainment tasks, the command elements provide command and control and direct and support resupply and reconstitution. A CALFEX must have at least two different weapon system platforms participating in the event (such as, tank, Bradley, mortars, and so forth).

The primary trainer during a company team CALFEX is the battalion commander. His participation reinforces the chain of command and provides first-hand observation of the subordinate staff, commanders, and supporting assets. A CALFEX gives units the opportunity to accomplish multi-echelon, combined-arms training and evaluation throughout the task force.

The training objective of a CALFEX is to accomplish a designated combat mission (attack, defend, movement to contact) with live ammunition, a realistic target array, and required CS assets. Standards are found in applicable ARTEP MTPs for the selected mission, as modified by local conditions and the commander's guidance.

The training assessment of the unit(s) is important in determining the tasks to be trained during a CALFEX, as well as all preliminary training, which should precede all exercises.

- What is the required level of unit proficiency?
- What is the current level of training?
- What training is necessary?

PLANNING GUIDELINES

A CALFEX is a major training event. To be realistic and effective, it must be well planned and well supported with specific consideration given to each unit and weapon system to be employed. The number of inherent supporting missions and tasks that are exercised may vary according to a number of planning factors, such as the number and types of weapon systems used, the nature of the training land and ranges available, and weather conditions anticipated for the exercise. The capabilities of the ranges (target pits, lifting devices, control console, range limits, weapons authorized, maneuver freedom, and range time available) have an impact on the conduct of the exercise.

Long-range planning considerations is crucial in the allocation of major resources, identification of participants, and the prerequisite training needed prior to a CALFEX.

Short-range planning includes the identification and allocation of ammunition, petroleum, oils, and lubricants equipment and support personnel. Coordination for facilities and resources should be continued. Scenario development is initiated during the short-range planning phase. Prerequisite individual and collective training continues throughout the planning phases.

Detailed planning by the control headquarters focuses on the training objectives and development of the scenario. The mission specified by the control headquarters may be the same primary mission for each company, or it may vary between companies. The inherent tasks to be exercised may be specified in the commander's initial guidance, or developed as the scenario is designed.

The S2 develops the appropriate threat array based on threat doctrine. The participating units' S1, S4, and battalion maintenance officers (BMO) provide the estimate of troops and equipment available for the exercise. The identification of CS assets, internal support capabilities, and external tasking requirements is crucial in the early stages of a CALFEX.

Once the control headquarters approves the scenario concept, the scenario is drafted and submitted for the approval of the range control. The firing overlay is included with the scenario. From the scenario, the OPORD and control plans are developed, and the detailed schedule is finalized and published.

The scenario is written in narrative format with key cues and responses in operational terms. Different installations vary in the degree of detail required. As much maneuver freedom as possible should be retained for the maneuver commanders.

A friendly target array, to be presented within the CALFEX scenario, is recommended to further enforce fire control and discipline among CALFEX players.

Planners must not underestimate the time and resources required in the planning and conduct of a CALFEX.

WEAPON SYSTEM CONSIDERATIONS

Each unit, with its specific weapon systems, involved in CALFEX must be included in the planning process. The following is a discussion of the key considerations for the different types of units.

The unprecedented ground mobility of the M1-series tank and M2/M3 Bradley teams, necessitates the design of deep ranges in order to make maximum use of their advanced capabilities. Targets on ranges, should be heat enhanced to facilitate acquisition. If local conditions require range fan markers, they should also be heat-enhanced.

The use of screening smoke (to include thermal-defeating agents), both friendly and enemy, must be considered in planning. Friendly use is a function of indirect-fire support planning as well as the employment of on-board smoke grenade launchers and vehicle smoke generators. Enemy use is developed in conjunction with the target array and in accordance with threat doctrine. This includes the assumption that the threat will mix chemical agents with smoke, forcing the exercising unit to operate in a protected posture to survive and accomplish the mission. The possibility of smoke (as well as NBC simulations) drifting into adjacent ranges, roads, training areas, and civilian land must be dealt with according to local procedures.

Mechanized Infantry

As mechanized infantry employs a wide variety of organic weapon systems, the exercise must include—

- Long-range targets for TOW missles and 25-mm.
- Medium-range targets for 25-mm, caliber .50 and 7.62-mm automatic weapons, Dragon, and MK19.
- Close-in targets for traditional squad weapons.

For dismounted maneuver and exposed crewmen, the requirements for overwatching fires must be considered. (For example, hazards of 25-mm APDS-T, ATGM, grenades, claymores, MK19, M203, and firing port weapons must be given special consideration.) When exercising ATGM weapon systems, the low allocation and high cost of training and service ammunition may be overcome by using the corresponding TWGSS/PGS/MILES equipment.

Defilade positions for fighting vehicles may be required, depending on the scenario, facilities, and tasks to be trained. Also, improved fighting positions may be required for dismounted personnel.

Armor

With tanks, a key consideration is freedom of maneuver. On many high-technology ranges, roads have been constructed to protect wiring systems and contain the maneuver unit within the range boundaries. Such facilities have a recognized limiting effect on freedom of maneuver. The design of the target array and the use of obstacles can facilitate a realistic scenario in a constrained environment.

Another element of the maneuver equation is the extent to which cross fires and overwatching fires can be used. Cross fires are often limited on training ranges, precluding attacks on the flanks of objectives and into the flanks of target arrays. Long-range, high-velocity rounds such as tank cannon projectiles, 25mm, and missiles are most restricted in this regard. The doctrinal application of the cross-fire control technique seeks to attack targets from the flank. Ways to incorporate this technique involve the following:

- Limit available positions that maneuvering vehicles may occupy.
- Present concentrated target groups (correlated to engagement area) that can be engaged safely using cross fires.
- Administratively control the presentation sequence to preclude exposing targets to an element that would result in a violation of the approved SDZ.
- Emplace flank vehicle targets and firing (overwatch) positions in a way that simulates trapping the OPFOR in a multiunit cross fire, where the other units are notional.

Tanks and other weapons may not be fired over the heads of unprotected troops, as outlined in AR 385-63. Discarding sabot rounds should not be fired overhead if armored personnel carriers or other lightly armored vehicles are in the down-range field of view of the firing tank (the sabots may penetrate the vehicle).

Buttoned-up vehicles may maneuver parallel to the line of fire to a certain extent. The exact limit of advance is determined by the SDZ for the overwatch element, and corresponds to a 15-degree fan outside the limit of fire. An additional SDZ extends farther to the flank when firing sabot rounds (or when unprotected troops are maneuvering down range). Dimensions of SDZs are given in AR 385-63.

Laser Safe Designation (LRF)

The procedures for designating a range facility laser safe are discussed in AR 385-63, Chapter 19. All laser devices should be treated as direct-fire weapons. Eye-safe laser attenuators detract from LRF performance; therefore, reflective material must be placed on targets to enhance LRF performance.

Scouts

Maneuver battalion and cavalry scouts may be integrated into both offensive and defensive scenarios to exercise security and reconnaissance missions. This may be accomplished independently or in conjunction with a company team exercise. If scouts are to be deployed forward of uploaded weapon systems, their safety must be paramount.

Army Aviation

When aviation assets are to be integrated, the range control office requires enough lead time to coordinate airspace management issues with the installation airspace management office. The battalion task force headquarters will assume operational control, approve their maneuver, and coordinate the aviation element and ground maneuver company team. To fully exploit the mobility and stand-off range advantage of aviation assets, increased range depth must be considered.

The use of aviation requires additional SDZ applications, as outlined in AR 385-63, Chapter 13. They may fire from the flanks of ground maneuver units, or between them, but not from their rear (no overhead fire). When ATGMs or aerial rockets are to be fired, the backblast area must be considered. If helicopters are to maneuver down range from the ground element, their safety must be considered.

If Hellfire is being used in the indirect mode, special consideration must be given to the locations of the firing aircraft and the designator. The SDZ for the Hellfire includes a seeker angle 20 degrees to either side of the gun-target line. The designator may not be located anywhere within the seeker angle, and preferably would be masked from the launch point by terrain or foliage.

If joint air attack team (JAAT) operations are planned, the FSO, forward air controller (FAC), and air battle captain (ABC) exercise the necessary command and control measures. While the aviation systems involved are entirely out of the sphere of control of the maneuver company team commander, the event may be integrated into the scenario without interfering with the flow of the exercise. This is a valid training objective for Army aviation units, close air support (CAS) pilots, and battalion fire support elements.

Note. Most installations have an Air Force representative that assists in the planning of CAS.

Field Artillery (FA)

FA units may support a CALFEX as an externally evaluated exercise or as internally evaluated sustainment training. The internally evaluated sustainment training requires greater coordination between the maneuver and FA headquarters in the planning stage, so that required FA tasks are included in the exercise. The direct-support FA battalion is encouraged to incorporate CALFEX support into its field training and live-fire exercises. CALFEX offers the FA commander an opportunity to observe and evaluate his subordinate battalion fire support elements and fire support teams. If necessary, the firing points that support the CALFEX range must be identified, and the sequence of events may have to allow for FA registration.

The impact area must be large enough (within the limits of local range constraints) to accommodate the adjustment of indirect fires. Units will not normally be allowed to maneuver into permanent artillery impact areas because of the possibility of duds. Temporary impact areas may be established, if necessary. With the concurrence of range control, certified ammunition may be fired into a temporary impact area that is to be maneuvered through later. Participants should be alert to the possibility of duds and take appropriate action if one is encountered. After the exercise is completed, the user clears the area, with the assistance of the explosive ordnance disposal (EOD) detachment.

Units may maneuver in proximity to indirect fires under certain conditions. Troops and vehicles involved in training may operate under the gun-target line in certain areas during firing. Armored vehicles may maneuver

under air bursts if variable time (VT) or time fuses are used on certified ammunition, and if the firing data meet certain conditions explained in AR 385-63, paragraph 11-5e. In this case, all down range vehicles must remain buttoned up.

Waivers may be pursued to facilitate the maneuver of helicopters near and under the gun-target line and around the flanks of the SDZ; the key to imaginative training is detailed planning.

Personnel may occupy approved bunkers within 200 meters of impacting artillery in areas surrounding the impact area; however, this situation must be planned to fit into the CALFEX scenario.

As many variables become known, the supporting artillery unit can compute a relatively accurate buffer zone (safety diagram) for planning purposes. When constructing laser range danger fans for Copperhead employment, safety computations are especially critical (from the standpoint of eye-safe laser designator use). These data will have to be approved by the local range control office before the scenario is finalized.

The use of illumination and smoke and the employment of Copperhead should be incorporated into CALFEX fire support. The FIST chief must perform a detailed analysis of the terrain to support the company team commander's scheme of maneuver, especially when employing Copperhead. The FIST chief should accompany the company team commander on his leader's reconnaissance of the maneuver area. (Fire support planning and coordination are accomplished in accordance with FM 6-20. FM 6-30 provides a detailed explanation of Copperhead and the ground/vehicular laser locator designator [G/VLLD].)

Mortars

When supporting a live-fire exercise, mortar firing points must be planned to avoid firing over the heads of troops. To increase the training benefit for mortar crews, the exercise should be planned to cause mortars to displace and provide continuous support. (Many of the safety considerations discussed for FA are applicable to mortars.)

As required by each installation, a certified safety officer must be on the mortar point. The mortar platoon/section leader and FSO must know the location of the maneuver units so they can make sure the SDZ is enforced with respect to the gun-target line. If the mortars are fired from direct lay, it is relatively easy to verify friendly unit positions.

Close Air Support

Employment of USAF assets requires a certified forward air controller to assume the responsibility for integrating tactical aircraft into the scenario. Considerations for employment include identification of friendly troops and the target area, and control of surface fires. SDZs are discussed in Air Force Instruction (AFI) Regulation 13-212.

When employed, the sorties should be allocated to the battalion task force and controlled by the unit's FAC. Within the constraints of local range regulations, an airspace coordination area should be established to allow surface fires while CAS is employed. An alternative method is to apply CAS against a second-echelon battalion in a defensive scenario, or the main defensive belt or a reserve unit in an offensive scenario. If ingress is parallel to the gun-target line and the aircraft break away to the opposite side, airspace coordination is vastly simplified. Overflight by participating aircraft before the exercise meets USAF regulatory guidance without disrupting the scenario.

Note. Most installations have an Air Force representative that assists in the planning of CAS.

Air Defense Artillery (ADA)

Missile systems (Stinger, Redeye) may be maneuvered on the range in accordance with the unit's task organization; however, the availability of missiles is normally too low to facilitate live fire. Also, ADA missile systems are more difficult to integrate into CALFEX. Therefore, it may be more effective to employ gun systems.

Note. If local conditions preclude live fire, the supporting ADA unit should still maneuver with the combined arms team.

There are several alternatives to exercising ADA systems in CALFEX:

- Missile systems may be exercised with tracker-trainer systems during assembly area or reconsolidation operations when the live-fire phase is not in progress, pursuant to local restrictions.

Note. Radio-controlled miniature aerial targets (RC MAT) are currently available. However, the constraints applicable to firing the ballistic aerial target system (BATS) could prove very cumbersome if integrated into the scenario. Until infrared-capable RC MATs are available, alternative (tracker-trainer) systems will continue to require live aircraft targets and will be difficult to employ without disrupting the remainder of the exercise. Future models of RC MATs will include an infrared source that provides a signature sufficient for tracker-trainer interface.

- MILES/AGES (air-to-ground engagement system)/AD (air defense) equipment may be used (with laser-interfaced targets, if available).
- The Stinger Training Launch/Simulator (STLS) provides a method by which man-portable air defense system (MANPADS) teams can effectively train their primary mission in conjunction with a CALFEX. STLS replicates actual launch conditions, and fires a reusable, inert missile approximately 50 feet. This short range should accommodate 360-degree engagement on all facilities.

CAUTION

MANPADS gunners will be required to avoid launching in the direction or dismounted personnel and thin-skinned vehicles, because of the possibility of injury or damage. Projectiles should be retrieved as soon as possible to avoid damage to the missile by armored vehicles.

- Use of gun systems in a ground support role may be exercised, but the appropriate doctrinal conditions should be accurately portrayed. Gun systems may move with the company team and engage static helicopters or RC MATs. (Maneuver unit organic weapon systems may be used in an air defense role, if local conditions permit.)

Note. Caution must be exercised to ensure that the target remains within the appropriate range limit with respect to the firing weapons. Gun crews should be aware of their proximity to the remainder of the company team to ensure safe firing. A realistic technique is to cause the supporting gun systems to engage an RC MAT off to the side of the maneuver axis. This equates to an OPFOR aircraft attacking the friendly unit's flank from a crossing air avenue of approach. The gun section leader must be prepared to maneuver his element to achieve a clear field of fire. Scenario cues may be used to facilitate the employment of air defense systems.

Engineers

The extent and nature of engineer tasks are based, in part, on the type of scenario and range facility. The task force and engineer unit are involved in the planning, execution, and selection of the maneuver area prior to the occupation of the range facility.

Countermobility. Minefields, demolitions, and other obstacles should be planned in support of a defensive exercise. On some facilities, the actual emplacement of obstacles may be restricted for various reasons. If the obstacle is to be simulated, it must be emplaced (as much as the situation will allow) on an adjacent training area. Obstacles that are planned, resourced, and emplaced should be granted obstacle effect by increasing target engagement times and decreasing the array according to the type of obstacle. If demolition is authorized on the range, the required safety precautions must be strictly enforced. Except for Claymores used in defensive scenarios, training with live land mines is strongly discouraged.

Survivability. Defilade and improved positions may already exist on some range facilities. If not, survivability may be exercised in the preparation of a defensive position, based on the priority of work established by the task force commander.

Mobility. In an offensive scenario, obstacle-breaching tasks may require the employment of organic or supporting engineer equipment and offensive munitions. Threat doctrine for obstacle employment should be reflected in the scenario and target array. The obstacle should be realistic, but not so much that it overwhelms the unit. It must key certain responses, resulting in certain actions to reduce or bypass the obstacle. Safety constraints for any munitions planned in the operation (bangalore torpedoes, line charges, mine-clearing line charges [MICLIC], XM908) must be briefed to all participants (for example, if the MICLIC is to be used to breach a minefield, all personnel within 1,000 meters must be buttoned up in a combat vehicle.) The engineers maneuver with the company team as appropriate to the scenario.

Ground Surveillance Radar (GSR)

Radar requires some form of movement to track. Moving targets may be used to provide such a radar signature. In an offensive scenario, GSR may be used to vector friendly elements. Target acquisition and tracking reports that GSR would normally provide for long-range or flank surveillance might be as effectively portrayed by inputs from the incident list. If GSR is employed, the protection of the system and personnel should be considered in positioning, setup, breakdown, and maneuver to avoid detracting from the firing unit's operation. GSR should be employed to supplement the unit's limited-visibility operation, and can also be used to monitor range boundaries.

Combat Service Support (CSS)

The extent to which CSS is portrayed is again determined from training objectives. Ammunition and fuel should be dispensed in the tactical assembly area prior to the exercise. The company combat trains should displace as appropriate in the scenario. If desired, some of the ammunition allocated may be prestocked in a secondary battle position for a defensive scenario, or maintained with a logistics package to perform emergency resupply on the objective during consolidation. Ammunition redistribution should be an integral part of the tactical scenario. CSS must include the cross-attached CSS slice.

Broken-down vehicles or designated battle-damaged vehicles may be used to exercise maintenance and recovery crews in any phase of the exercise. Enemy prisoners of war (EPW) processing or casualty treatment should be exercised throughout the operation.

A decontamination exercise may also be integrated into the CALFEX during the reconsolidation/ reorganization phase. Simulation agents will provide realism in portraying a chemical environment. The simulation used must conform to local regulations. The decontamination exercise will require decontaminating apparatus, other decontaminators, spare chemical suits for exchange, and mask filters.

Ammunition Requirements

The ammunition requirements must conform to the allocations in DA Pam 350-38 as much as possible. The tables below depict recommended ammunition allocations for units that do not have a specific CALFEX allocation. These tables are based on a general assessment of the level of support envisioned for a standard company-team level exercise. These must be resourced from the existing allocation for evaluation or sustainment. DA Pam 350-38 represents rounds per weapon per exercise, and assumes one exercise per year by each system. These figures use an annual company team exercise as the base figure, with some CS units supporting multiple iterations.

AMMUNITION ALLOCATION FOR ARMOR/CAVALRY UNITS (per vehicle)

	SABOT	HEAT	Cal .50	7.62mm	RP	HOFF	25mm TPDS-T	25mm TPT	TOW
DODIC	**C785**	**C784**	**A557**	**A131**	**G978**	**L602**	**A940**	**A976**	**PB96/ PB94**
M1-series	5	*	200	200	4	20	-	-	-
M2/M3	-	-	-	200	16	12	24	24	1

*M1-series vehicles are resourced only five sabot rounds for a CALFEX. M1 units need to resource additional ammunition for a CALFEX from the round savings gained throughout the fiscal year.

AMMUNITION ALLOCATION FOR MORTARS (per gun)

	HE	WP	ILLUM	HE	WP	ILLUM	HE	WP	ILLUM	HE	WP
DODIC	**B632**	**B630**	**B627**	**C256**	**C276**	**C226**	**C697**	**C708**	**C706**	**C623/ C788**	**C624**
60mm	18	2	3	-	-	-	-	-	-	-	-
81mm	-	-	-	29	2	5	-	-	-	-	-
107mm	-	-	-	-	-	-	11	2	6	-	-
120mm	-	-	-	-	-	6*	-	-	-	11	2

* Must use 81-mm sleeve.

AMMUNITION ALLOCATION FOR ARTILLERY UNITS (per Bn/Btry)								
	HE	WP	ILLUM	SMOKE	HE	WP	ILLUM	SMOKE
DODIC	C445	C454	C449	C452	D544	D550	D505	D528
105 Btry 3X6	71	0	18	6	-	-	-	-
105 Bn 3X6	223	6	18	-	-	-	-	-
155 DS Btry 3X8	-	-	-	-	99	6	12	8
155 DS Bn 3X8	-	-	-	-	227	6	18	-
155 GS Btry 3X8	-	-	-	-	99	6	12	8
155 DS Btry 3X6	-	-	-	-	77	6	12	6
155 DS/GS Bn 3X6	-	-	-	-	173	6	18	-
155 GS Btry 3X6	-	-	-	-	83	6	12	-
155 CAV Btry 1X6	-	-	-	-	81	6	-	8
155 CAV Bn 1X6	-	-	-	-	76	6	16	
155 SEP Btry 1X8	-	-	-	-	95	6	-	8
155 SEP Bn (LID) 1X8	-	-	-	-	77	6	18	-

AMMUNITION ALLOCATION FOR INFANTRY UNITS (per gun)									
DODIC	A131	A071	A059	A557	A171/ A136	A064	B519	B584	A358
M16A2/M4		120	10						
M21/24 Sniper Rifle					10				
M249 SAW						200			
M60/M240B	200								
M2 HB				100					
M203 GL							12		
MK19								24	
Note. This table is not all-inclusive. Refer to the appropriate chapter and weapon systems in DA Pam 350-38 (STRAC) for any questions concerning allocations of ammunition and pyrotechnics not covered in this table.									

RANGE REQUIREMENTS

Many military training areas have areas suitable for company-level live-fire exercises. Digital multipurpose range complexes and supporting digital doctrine are under construction or programmed for most active training posts. The generic design concept for the DMPRC allows it to support a CALFEX; however, local conditions and final construction details may necessitate use of adjacent ranges and remote targets with the DMPRC to establish a realistic company-level exercise. (Range 301 at Grafenwoehr was specifically designed for company-level use.)

Optimally, a CALFEX range maneuver area would be 5 to 10 km deep, 3 to 5 km wide (possibly smaller for a defensive scenario), with multiple terrain features, and would allow for some cross and flanking fires. The target array should be capable of portraying a mechanized infantry company or tank company in the offense or a mechanized infantry company (-) with at least one platoon forward in the defense. The SDZ required could extend up to 25 km deep and 15 km wide. (This can be smaller if cross fires are limited and the terrain provides a backstop.) Appropriate sites should be available for the tactical operation center (TOC), battalion trains, after-action review (AAR) site, and company team assembly areas (AA). The CALFEX range should be supported by suitable areas for a forward arming and refueling point (FARP), if attack helicopters are included, as well as mortar and FA firing points. Other areas may be required for decontamination exercises.

Range occupation will involve a series of administrative requirements. Unless the range has a hard-wired power system, batteries may be required for target lifters. The responsibility for servicing and emplacing targets and other administrative requirements will rest with a range support organization or the using unit. Local range regulations and FM 17-12-series (FM 3-20-series) manuals will assist the unit in establishing range responsibilities. The unit must identify its needs for targets, operators, target operator training, transportation, lift capability, and engineer support.

Composite Surface Danger Zones

A composite SDZ is an overlay of all the SDZs involved in a given exercise. It considers each type of weapon to be employed, the scheme of maneuver, and the resulting relationships between each firing position and group of targets. It represents the worst case for each phase of the operation and is used to coordinate known constraints with realistic training. This process is somewhat tedious to carry out, but is a necessary step in detailed planning.

Templates of SDZs must be created for all weapons to be employed. These may be made using clear acetate, straight edge, compass, protractor, and the data in AR 385-62 and AR 385-63.

PERSONNEL REQUIREMENTS

The number and type of personnel required to support an exercise depend in part on local range requirements. Wherever possible, the existing command and control apparatus should accomplish the range control functions. The training unit chain of command (assisted by evaluator personnel) is responsible for range safety.

Command and Control

The battalion task force commander is the senior trainer/evaluator during a company-level CALFEX. He is assisted by his staff and any external support personnel provided to control the maneuvering and supporting units and range operations.

Evaluators

As a rule, observer-controllers (evaluators) should be assigned to every maneuver platoon and supporting element. The existing chain of command should be augmented by as many evaluators as necessary to assure the safe execution of the exercise, and to observe the performance of each participating unit. After the exercise, each evaluator will conduct an AAR with the subunit he observed, then provide input to the senior evaluator for the unit AAR.

Evaluators should provide coaching and encouragement during pre-exercise training, but remain as passive and unobtrusive as possible during the actual live-fire maneuver.

EQUIPMENT

All personnel forward of the baseline should be aboard their designated combat vehicles, unless conducting dismounted operations. Evaluators moving with the maneuver unit should be provided the same protection, communications, and mobility as the unit being observed. Distinctive markings for evaluators and their vehicles will help prevent confusion among the exercise participants. Evaluators should select positions to the rear of the unit (immediately behind the unit or well behind on a suitable vantage point) where they can best evaluate tactical movement, fire distribution, and effect.

Communications equipment must be provided to allow all participating units to operate on all internal frequencies and report and monitor on the appropriate external (task force) frequencies. A separate frequency must be provided for evaluator use, and evaluators must monitor the training unit. The TOC must monitor the designated range control frequency. Units digitally equipped will report and monitor digitally to appropriate higher echelons. An evaluator will be present in the TOC to monitor all digital traffic as required.

TRAINING

Success during a CALFEX depends largely on the preparatory training that a unit conducts. While CALFEX focuses on gunnery through the direct-fire score, the correct use of terrain and movement enables the unit to maximize its combat power. Therefore, all aspects of company-level tactical training support CALFEX.

The live-fire exercise is not, however, the end goal of training. The ultimate goal of combat training is the ability to fight and win. CALFEX and company-level force-on-force training with tactical engagement

simulations are the two exercises that most closely replicate the conditions of combat; therefore, are the most important events in the overall unit training program.

PROGRESSIVE TRAINING

Training should be conducted in a crawl-walk-run sequence to build on previous training. An accurate assessment of a unit's capabilities is imperative to ensure that each event focuses on known weaknesses and reinforces previous training. Throughout the training program, unit status is continually updated, and each event is organized to continue the building process. If the CALFEX is seen as the most stressful, realistic training event in a training program, then a unit's success depends entirely on progressive training that increases the level of complexity and causes leaders and soldiers to learn during each step of the process.

The parent battalion trains all subordinate units to platoon/section level in the maneuver and employment of organic combat and CS systems. Training within the maneuver unit includes crew, squad, section, and platoon drills; weapons qualification; and situational training exercises. Aviation and FA battalions train to company level in similar fashion. Proficiency at the small unit level is fundamental. It is the basis for more complex training, as well as a very valuable tool in a sustainment program where personnel rotation and support taskings are common distractors.

An equally important part of the training program is leader training. Units can make extremely effective use of map exercises (MAPEX), tactical exercise without troops (TEWT), terrain-board exercises, leader's reconnaissance, and battle simulations to develop and sustain tactical skills. With fairly little coordination, all elements of the combined arms team can be represented in leader training. This affords the various players the opportunity to build and reinforce relationships that become critical in combat, while developing their ability to fight together as a potent combined arms force. Finally, these basic types of leader training can be accomplished while soldiers are involved in other types of training or on support details, allowing the leaders to make the most of training opportunities.

Maneuver battalions train company team commanders to integrate organic, attached, and supporting fires and to maneuver their combat forces. Where CS elements are maneuvered or controlled by headquarters other than the company team, the battalion-level headquarters either coordinates the support or requires the company team to do so. *The emphasis is on training the way the unit intends to fight or support.*

TRAINING ALTERNATIVES

Fire Coordination Exercise

The FCX is a scaled-down CALFEX. It allows the unit commander to integrate direct and indirect fires using subcaliber munitions, TWGSS/precision gunnery system (PGS), and representative portions of the combined arms team on a scaled range complex. It is an extremely effective training event, if properly prepared, and can be accomplished at platoon, company, or battalion level. TC 25-4-1 provides additional guidance on the preparation of an FCX.

Dry-Fire Exercise

A dry-fire exercise can be used to drill or rehearse the maneuver team prior to live-fire, or as a separate training event. As a separate event, it allows the unit to practice company and platoon drills, to shake down communications and SOPs, and to establish intervals and sectors of observation/responsibility. As a final rehearsal, it affords the company and battalion commanders the opportunity to correct last-minute problems in movement techniques and overwatching fires. It also allows the controllers to ensure that the players will comply with the planned scenario, at least with regard to a safe target sequence. If the firing unit commander is to be afforded complete maneuver freedom, the rehearsal allows the exercise controller to verify the suitability of the target sequence and make necessary last-minute corrections.

Dry-fire exercises involve little or no expenditure of Class B (training ammunition), and no impact area is required; however, a maneuver area, personnel, time, fuel, and a realistic target array are essential to an effective exercise.

When OPTEMPO and mileage inhibits a unit's ability to conduct a pre-exercise rehearsal, simulators can be utilized (CCTT, SIMNET).

Subcaliber Training

Subcaliber training provides most of the benefits of a live-fire exercise, to include the integration of indirect fires, while conserving high-cost ammunitions. Among its drawbacks is the fact that it does not fully exercise the crews in the delivery of main gun ammunition. Subcaliber ranges require a maneuver area commensurate with the full-up, live-fire range, and an impact area (SDZ) commensurate with the munitions being fired. Subcaliber training also requires the mounting and servicing of subcaliber devices. In addition, subcaliber weapons vary in effective range, but fall short of the maximum range of the replicated weapon systems. This problem may be overcome by establishing a scaled range.

KEY PERSONNEL TRAINING

Leader training is a critical element of the training program. Crew commanders and squad-, team- section-, and platoon-level leaders and sergeants must be afforded the opportunity to participate in leader exercises that sharpen their tactical skills away from the scrutiny of their subordinates. The exercises previously mentioned (MAPEX, TEWT, FCX) provide a convenient forum to train leaders at a reduced cost.

Evaluator training should include supervised range reconnaissance, rehearsals, and detailed briefings. Controller-evaluators must be thoroughly familiar with the scenario and range facility. Their preparation should include a thorough wargaming session that seeks to address all possible problems and develop appropriate solutions. Evaluators must be able to apply all aspects of mission, enemy, terrain, troops, and time and weather (METT-TC) to the unit's performance to reinforce strengths as well as identify weaknesses.

During the evaluator rehearsals, communications are verified on the control net. Evaluators must thoroughly understand their relationship to the exercising unit. Safety is a command and control function. Therefore, it is the responsibility of the unit commander and each of his subordinates to control fires and movement to preclude friendly casualties. Controller-evaluators accompany the maneuvering element and advise the tower of its progress. The target operator, at the direction of the chief controller, presents targets that can be engaged safely by the maneuver element. By use of such passive measures, the evaluators support the chain of command without interfering with its function. Unity of command is achieved by designating the player unit's battalion task force commander as the chief controller.

To increase the training value of CALFEX at battalion staff level, every phase of staff planning and conduct are evaluated as well. By establishing separate radio stations to represent other (notional) units within the battalion task force and brigade, the radio traffic on the command nets is more realistic, and the staff is exercised in conjunction with the company team. If a separate battalion performs the control and evaluation function, evaluators are stationed within the TOC and administrative/logistics center (ALC) to provide feedback to the player headquarters. By using CALFEX as a staff STX, and using battalion task force level command post exercises (CPX) and FCX, the headquarters sustains its ability to command and control the combined arms battle.

Controller/Evaluator Preparation

All controllers, umpires, and evaluators must be trained in AAR techniques and prepared to conduct AARs with subgroups. The chief controller should debrief all controllers and assistants prior to the AARs.

Commanders and controllers should not critique or lecture. They should guide the discussions by asking leading questions and enter the discussion only to sustain the AAR, to get the discussion back on the right track, or bring out new points.

EXECUTION

The sequence of events for the exercise will vary according to local conditions. Whether the CALFEX is a separate evaluation or an integral part of a larger training exercise, the exercise falls into three distinct phases.

PHASE ONE

The unit receives a warning order, conducts its before-operation checks, receives its OPORD, and conducts troop-leading procedures. If units are digitized, information will be sent digitally.

Controller-evaluators must be present throughout to observe the process and provide feedback. Depending on the unit's level of proficiency and the objectives of the exercise, the controller-evaluators should coach and train during the pre-live-fire phase.

A pre-exercise rehearsal may be programmed, at the commander's discretion. It may be accomplished on the range with the same target array as the live-fire, or on adjacent terrain with a representative array. The rehearsal is a dry-fire training event. It should be accomplished tactically; time should be allocated at its conclusion for an AAR and final coordination. A walk-through using TWGSS/PGS/MILES equipment and interfaced targets increase the target acquisition and the fire distribution training value of the rehearsal. When OPTEMPO and mileage inhibits a unit's ability to conduct a pre-exercise rehearsal, simulators can be utilized (CCTT, SIMNET). Deficiencies should be identified and corrected, if possible. Where specific deficiencies can be related to actual or potential combat failures, those points should be made and reinforced.

To allow the company team commander to receive feedback on his concept, he should back-brief the battalion task force commander before issuing his OPORD. This provides the battalion commander an opportunity to train his subordinates and ensures that the scenario is followed.

PHASE TWO

The unit moves tactically from the AA and performs a forward passage of lines as part of a movement to contact, or occupies the initial defensive position. On order, weapons are loaded and the first target sequence is presented. The unit fires and moves against the array, integrating the appropriate supporting elements. During the battle, emergency ammunition resupply and medical evacuation may be accomplished. Once the target array is defeated or the training objectives are met, the unit conducts a rearward passage of lines and clears the range.

PHASE THREE

The unit withdraws to a designated AA for reorganization and reconstitution. If required, the unit is decontaminated. Vehicles are downloaded and ammunition is turned in. Once all training objectives are attained, AARs are conducted.

EVALUATION

A fundamental principle of training is that performance is evaluated and feedback is provided to the unit. The aspect that sets a CALFEX apart from a firepower demonstration is that its objective is to train the combined-arms team to fight. The most important factor in reinforcing that training is an appropriate set of standards (against which the unit is evaluated) and the application of those standards by qualified evaluators.

The standards for a CALFEX are extracted from respective ARTEP MTPs and gunnery manuals. Those references are listed at the end of this publication. Conditions and standards discussed in the ARTEP may be modified to reflect local range standards and limitations for mechanized infantry and tank company teams.

STANDARDS FOR EVALUATION

As a minimum, the company team must accomplish the standards, based on the conditions, for an attack, defense, and movement to contact mission.

The general conditions for the attack, defend, and movement to contact missions are:

- Given a general situation in which the battalion task force is attacking, a task organization, a warning order, and an OPORD.
- CSS elements (organic, attached, operational controlled [OPCON], or DS to the battalion task force) may support the company team.
- The target array represents a threat-style mechanized infantry or tank unit in a defensive posture, grouped in platoon or depleted platoon-size positions in depth (security zone), with a reserve (counterattack force) up to battalion strength.
- The mission is conducted under all environmental conditions, day or night. The company team operates under threat of NBC attack or in an active (simulated) NBC environment.
- A friendly target array is to be included within the scenario to further enhance controlling of fires among CALFEX players.
- The company team may be the lead element or may be following other units and attack through them. The attack may be hasty or deliberate.
- A security force may be employed forward of the company team. The company team may defend in sector or in a battle position or strongpoint.

The general standards for the attack, defend, and movement to contact missions are:

- Perform troop-leading procedures allowing subordinate units enough time to prepare for the operation.
- If digitally equipped, send and receive all reports digitally as required and as the situation permits.
- Transfer data and update the situational awareness digitally.
- Coordinate the fire support plan and mobility operations with battalion task force headquarters.
- Resupply, as required, to sustain combat power.
- Upon gaining contact, develop the situation rapidly and choose an appropriate course of action.
- Employ all available combat power to suppress or destroy OPFOR weapons and gain a favorable ratio at the decisive point.
- Report the situation as required to the battalion task force headquarters. Reports must be secure, accurate, and timely.
- Achieve a direct-fire score of 70 percent or better.
- Extract specific supporting task training and evaluation outlines (T&EOs) from the appropriate manuals; modify to fit local conditions, as required. Unit SOPs and the battalion task force orders are sources for standards regarding load plans, specified tasks, and combat priorities.
- Plan for and rehearse counterattack options.
- Detect and report OPFOR elements. Reports must be accurate, timely, and secure.

The standards for the attack mission are:

- Initiate the attack at the specified time.
- Before gaining contact, select and execute the appropriate movement techniques and combat formations.
- Make effective use of terrain, movement, and smoke to minimize exposure of friendly forces to enemy systems.
- Breach or bypass OPFOR obstacles encountered during the attack.
- Destroy, capture, or force the withdrawal of OPFOR encountered during the attack.
- Seize or secure the designated objective in accordance with the battalion task force OPORD and FRAGOs. Consolidate and reorganize on the objective and prepare to continue the mission.
- Repel enemy counterattacks in accordance with the defend mission.
- Accomplish coordination with adjacent and supporting units, as required.

The standards for the defend mission are:

- Occupy and prepare initial positions not later than the time specified in the battalion task force OPORD.
- Reconnoiter and prepare subsequent positions not later than the time specified in the battalion task force OPORD.
- Use obstacles to increase enemy exposure times, slow his advance, turn his flanks, and facilitate disengagement, in accordance with priorities in the battalion task force OPORD.
- Assist the rearward passage of security and engineer elements through the company team position.
- Conduct direct-fire engagements in accordance with the company team fire plan.
- Prevent the OPFOR attack from succeeding.
- Make effective use of cover, concealment, and smoke to minimize exposure of friendly forces to enemy systems.
- On order, counterattack in accordance with the attack mission.

The standards for the movement to contact mission are:

- Initiate movement at the specified time.
- Before gaining contact, select and execute the appropriate movement techniques and combat formations.
- Destroy, capture, or force the withdrawal of OPFOR vehicles during the movement to contact.

- Make effective use of terrain, movement, and smoke to minimize exposure of friendly forces to enemy weapon systems.
- Seize or secure the designated objective in accordance with the battalion task force OPORD and FRAGOs. Consolidate and reorganize on the objective and prepare to continue the mission.
- Repel enemy counterattacks.

SCORING

Indirect-fire evaluation is applied against time and accuracy standards contained in ARTEP 6-115-MTP. While no points are directly allocated for indirect-fire planning and usage, use of indirect fires can directly attrite the threat target arrays leading to a potentially higher direct-fire score. Timely and accurate calls for fire should enable the company team to achieve a higher direct-fire score.

The direct-fire scoring system provides a way to evaluate the company team's ability to engage a threat array quickly, efficiently, and effectively. The scoring system developed for the direct-fire portion of the CALFEX provides both objective, measurable evaluation by established standards and subjective comments on the tactical and procedural strengths and weaknesses of the evaluated unit. The evaluated unit will receive a numerical direct-fire score and a subjective tactical proficiency score. The methodology is threat-based, yielding an objective measurement of direct-fire effectiveness and a subjective measurement of the unit's tactical proficiency.

Direct-Fire Scoring

The direct-fire score for the company team will be expressed as a percentage, based on the number of target hits divided by the total number of targets presented. A 10-percent penalty will be deducted from the overall direct-fire score if a friendly target array is engaged. The purpose of this penalty is to reduce the platoon's overall score one qualification level (for example: If a platoon's preliminary score is 95% [Distinguished], and the platoon engaged the friendly array, their overall score would be 85% [Superior]). Evaluation will be based on the ratings currently applied to all gunnery tables. Overall scoring will be as follows:

- Unqualified—0 to 69 percent.
- Qualified—70 to 79 percent.
- Superior—80 to 89 percent.
- Distinguished—90 to 100 percent.

Example:

Gunnery Score	98%	88%	76%
Penalty for Engaging a Friendly Target	-10%	-10%	-10%
Overall Score	88%	78%	66%

Direct-Fire Standards and Applications

The evaluated unit's direct-fire effectiveness and distribution are measured by structuring the threat scenario. The unit's allocation of ammunition will be limited, forcing the company team commander to control and distribute his direct-fire weapon systems onto the appropriate targets.

The target-kill standards are as follows:

- Tanks and missiles (TOW and Dragon): one round through the target.
- 25-mm: at least three rounds through the target.
- MK-19: at least three rounds through the point target or three rounds within 10 meters of the area target.
- Machine guns and small arms: 25 percent hits on each set of troop targets and three rounds through the respective thin-skinned vehicles.

On computerized ranges, target kill sensors should be set for minimum kills according to the probability of kill (P_K) of the weapon systems capable of killing that particular target (for example, the 25-mm would register a kill only on certain vehicles [such as a PC] when the vehicle is within the killing range of the weapon system).

Tactical and Procedural Scoring

Units will be evaluated on their tactical and procedural proficiency as well as their direct-fire proficiency. The tactical and procedural evaluation is rated as trained (T), practice (P), or untrained (U), based on the judgment of the unit evaluator.

Checklists and Scoresheets

Checklists and scoresheets are provided to record aspects of performance during the exercise and provide feedback after the exercise. Items included in the checklist are doctrinally based (FM 17-12-series [FM 3-20-series], FM 71-1, and FM 71-2) and are developed from ARTEP standards. Checklists are prepared by the controlling headquarters.

To calculate a direct-fire score for a combined arms team, determine target hits in two areas: vehicle targets and troop targets. For the score for vehicle targets, divide the total vehicle targets hit by the total vehicle targets presented (minimum score for qualification is 70 percent). To receive a hit on troop targets, the combined arms team must hit 25 percent of each individual set of troop targets presented. (See Figure 15-2 for a sample direct-fire computation sheet.)

Evaluator checklists are used to record key observations that bear on unit performance. The items on the checklist should directly support exercise objectives and be graded on a GO/NO-GO basis. The checklist should be self-explanatory, and its use should not detract from the observation of the unit. Items on the checklist may be used to formulate the AAR; the checklist can be used to outline standards. (See Figure 15-3 for a sample evaluator checklist.)

The CALFEX summary sheet is a one-page synopsis of unit performance in the seven operations. An overall rating (Trained/Practice/Untrained) is assigned for each operation, and the weak areas within the operation are circled. The standards for each area are applied as outlined in Chapter 4. Additional comments are entered at the bottom of the summary sheet as required. The summary sheet is used as a cover sheet for the CALFEX evaluation packet. (See Figure 15-4 for a sample CALFEX summary sheet.)

Note. Many of the operations addressed are not within direct control or the participating maneuver commander. Consequently, the results of the exercise are not attributed to a single company team, but to the entire combined arms organization.

DIRECT-FIRE COMPUTATION SHEET				
Ammunition	**Ammunition Expended**		**Targets Killed**	
	Offense	**Defense**	**Offense**	**Defense**
Point Targets				
120-mm				
105-mm				
TOW				
Dragon/Javelin				
25-mm				
20-mm				
Point Target Totals				
Area Targets (Machine Gun)				

Computation:

	Targets Presented		**Targets Killed**		**Percentages**	
Targets	**Offense**	**Defense**	**Offense**	**Defense**	**Offense**	**Defense**
Point						
Area						

Offense Score: _____

\+

Defense Score: _____

\-

Penalty for Engaging Friendly Target Array: **10%**

Overall Score: _____

Rating: (circle one)

UNQUALIFIED (0 to 69%)
QUALIFIED (70 to 79%)
SUPERIOR (80 to 89%)
DISTINGUISHED (90 to 100%)

Figure 15-2. Sample Direct-Fire Computation Sheet.

EVALUATOR CHECKLIST

Class V Expenditure

Type	Drawn		Turned In		Used
		-		=	
		-		=	
		-		=	
		-		=	
		-		=	

Plt/Sec _____ Co Tm _____

Date _____

Evaluator _____

	Yes	No	Not Observed
1. Precombat Checks. Overall evaluation of the platoon/section is based on observation and spot checks. Enter comments on reverse. Note impact on combat operation.			
SOP:			
Load plans.			
Local security.			
Hotloop.			
NBC alarms deployed.			
Camouflage.			
Maintenance:			
PMCS accomplished per TM.			
DA Form 2404 initiated.			
All subsystems checks.			

(Circle exceptions)

Turret	Hull	Crew-served weapons
Communications	NBC	Generators
Ammunition	NODs	PEWs
Personal weapons	Engineer tools	

Overall Rating: GO _____ NO-GO _____

2. Troop-Leading Procedures. Observe the platoon/section leader and spot check the TCs/squad leaders. Enter comments in margin or on reverse.	Time			
Co Tm warning order received: (Digitally if applicable)				
Plt/sec warning order issued: (Digitally if applicable)				
Co Tm OPORD received: (Digitally if applicable)				
Plt/sec OPORD issued: (Digitally if applicable)				

Overall Rating: GO _____ NO-GO _____

3. Leader's reconnaissance conducted by TC.			
Sqd ldr level.			
Supervision.			
Rehearsals conducted.			

Overall Rating: GO _____ NO-GO _____

4. React to indirect fires.			
Button up.			
Assume MOPP 4.			
Report digitally			

Overall Rating: GO _____ NO-GO _____

CONTINUED ON NEXT PAGE

Figure 15-3. Sample Evaluator Checklist.

	Yes	No	Not Observed
5. Employ supporting fires.			
Digitally request indirect fires.	_____	_____	_____
Digitally adjust indirect fires.	_____	_____	_____
Overall Rating: GO_____NO-GO_____			
6. Employ direct fires.			
Control plt/sec fires.	_____	_____	_____
Plt/sec fires distributed laterally/in-depth.	_____	_____	_____
Overall Rating: GO_____NO-GO_____			

Figure 15-3. Sample Evaluator Checklist (cont.).

CALFEX SUMMARY SHEET

UNIT _____ **DATE** _____

OPERATION	TRAINED	PRACTICE	UNTRAINED
Maneuver: Offense. Defense. Infantry Mounted/Dismounted. Tanks. Movement. Direct Fire (Score _____). Aviation. TOW.	_____	_____	_____
Fire Support Missions Standards Achieved Mortars _____ _____ Field Artillery _____ _____ Close Air Support _____ _____	_____	_____	_____
Intelligence Collection Analysis Digital Reporting Reporting	_____	_____	_____
Air Defense Small Arms Dedicated Assets Passive	_____	_____	_____
Mobility/Countermobility/Survivability Obstacle Employment Obstacle Breaching Survivability Measures	_____	_____	_____
Combat Service Support Maintenance/Recovery Resupply Medical Digital Reporting	_____	_____	_____
Command and Control Planning Execution	_____	_____	_____

Notes. 1. Areas circled indicate weaknesses.
2. Under fire support, both time and accuracy standards must be met for satisfactory achievement of the objective.

Figure 15-4. Sample CALFEX Summary Sheet.

Integration of Indirect and Supporting Fires

The company team commander's effective integration of the combined arms team should be reflected with an appropriate attrition rate within the threat array. Many ranges do not support engineer efforts, indirect fires, or close air support within the target area of the range**.** Units firing a CALFEX on such ranges should be evaluated on their ability to plan for, request, and pinpoint supporting fires. (For example, if the evaluated unit request a fire mission that would have achieved target effect, the succeeding target array presentation should reflect threat losses by presenting fewer targets. An engineer plan that would effectively structure the engagement area would delay the threat arrays appropriately.)

The direct-fire score can be affected by the use of available combat multipliers. By effectively using combat multipliers, the company team commander can attrite the threat array both before it moves within the effective range of his direct-fire systems and by slowing the threat rate of advance, creating a more favorable engagement environment for his forces. Commanders who do not make effective use of their combat multipliers will face corresponding greater numbers of threat targets advancing toward them at a higher rate, automatically penalizing the evaluated company team. The attrition of the threat target arrays by planning combat multipliers effectively provides a direct link, readily apparent to the commander, between the direct-fire fight and the integration of combat multipliers.

After-Action Review

The AAR is the forum for the feedback and discussion of a unit's performance during an exercise. The AAR format and procedures are located in FM 25-4 and may be modified by the actual situation.

Once the exercise is completed, each subunit evaluator will conduct an AAR with the element he observed. This review focuses specifically on the performance of that small unit, and should involve all personnel in the unit. A terrain model of the range or a vantage point overlooking the range will help focus the discussion.

Once all subunit AARs are completed, the evaluators, unit commander, and all subordinate and supporting leaders gather for the overall AAR conducted by the battalion commander. Evaluators gather first and provide information to help the commander develop a complete picture of the exercise. If video equipment is used, it should be reviewed beforehand and included in the AAR. Once the commander organizes his notes, he assembles all participants. The battalion commander conducts the AAR in his role as senior controller-evaluator. He may require the S3 or another officer to conduct the AAR but should actively participate.

Chapter 16
Tank Tactical Tables

This chapter addresses the organization of crew drills, battle drills, and reaction exercises that make up the Armor Force tactical tables. These tables provide guidance to active or reserve component units for training crews, sections, and platoons at the basic, intermediate, and advanced levels in any environment, day or night. The crew is placed in a scenario that allows maximum tactical decision-making by the crews. The crew encounters controlled OPFOR as it negotiates the course. TWGSS and MILES add a degree of realism and stress that will reinforce gunnery skills while training tactical tasks.

A *crew drill* is a weapon- or equipment-specific action performed by a crew to use the weapon or equipment. Crew drills—

- Save time and reduce the probability of misunderstanding an order.
- Ensure automatic reaction to a standard order.
- Ensure standardization of training (for replacement crewmen).
- Reduce the likelihood of injury to the crew.

A *battle drill* is a collective action that is memorized and rapidly executed (by crews, sections, and platoons) in the same way under every condition without applying a deliberate decision-making process. Battle drills—

- Represent mental steps followed for offensive and defensive actions in training and combat.
- Ensure trained responses to enemy actions or leader orders.
- Require minimal leader orders to accomplish, and are standard throughout the Armor Force.
- Ensure sequential actions vital to success in combat or critical to preserving life.

CONTENTS

Organization of the Tactical Tables

Tactical tables are constructed to provide training progression horizontally, from basic to intermediate to advanced, and vertically, from individuals to drills to reaction exercises (see Table 16-1). Tables A, D, and G emphasize the coordination necessary between individuals to accomplish the mission. For example, the TCs in a platoon must know the position of each of the other tanks if the platoon is to execute a perimeter defense. This type of coordination is critical to the correct performance of the task. Tables B, E, and H deal with a crew or crews acting together to carry out specific drills. These drills require more planning and movement than

Tables A, D, and G. The OPFOR are simulated in Tables B, E, and H. Tables C, F, and I are reaction exercises that use rigidly controlled OPFOR. Each of these tables is executed tank-pure and requires the skills learned in lower tables for satisfactory performance.

Table 16-1. Table Depicting the Relationship of the Tactical Tables.

RELATIONSHIP OF THE TACTICAL TABLES		
Basic Crew	**Intermediate Section**	**Advanced Platoon**
Note. Tactical tables are constructed to provide training progression horizontally, from basic to intermediate to advanced, and vertically, from individuals to drills to reaction exercises.		
Table A, Individual Crew Member Tasks.	**Table D,** Battle Drills (Coordination Between Crews).	**Table G,** Battle Drills (Coordination Within Platoon).
Table B, Crew Drills.	**Table E,** Section Battle Drills.	**Table H,** Platoon Battle Drills.
Table C, Crew Reaction Exercises.	**Table F,** Section Reaction Exercises.	**Table I,** Platoon Reaction Exercises.

BASIC TABLES A, B, AND C

Table A, *Individual Crew Member Tasks*, addresses the individual combat essential tasks that the individual crew member must be able to perform to survive and be effective in combat (for example, *Negotiate a route using terrain for cover and concealment—mobility course*). Once the crew member has mastered these tasks, he progresses to Table B.

Table B, *Crew Drills*, consists of a series of standardized actions to be performed instinctively upon receiving a given cue (for example, "CREWMAN INJURED"). Since minimal support is required, this table can be practiced in garrison or as concurrent training.

After becoming proficient in the crew drills, the crew is ready for Table C, *Crew Reaction Exercises* (for example, *Engage OPFOR security element at close range [surprise engagement]*). While a single tank should not be employed unsupported in combat, the individual crew must be proficient in combat skills before it can function as a member of a larger team, be it section or platoon. The skills learned in Tables A and B are used in Table C. The crew is placed in a scenario that allows maximum tactical decision-making by the crews. The crews encounter controlled OPFOR as it negotiates the Table C course. TWGSS and MILES add a degree of realism and stress.

INTERMEDIATE TABLES D, E, AND F

Tables D, E, and F develop the teamwork necessary for two tanks, using the wingman concept, to function efficiently within the platoon.

Table D, *Battle Drills (Coordination Between Crews)*, trains the tasks required for coordination between members of one tank crew and their counterparts in their wingman tank so that both can operate effectively and survive on the battlefield (for example, *Move tactically using the wingman concept*).

In Table E, *Section Battle Drills*, two crews train critical, standardized tasks until they are performed instinctively (for example, *React to indirect fire [simulated]*), similar to Table B.

Table F, *Section Reaction Exercises*, ties together everything trained to this point. Like Table C, this table exercises two tanks working together (for example, *Engage multiple machine gun targets*).

ADVANCED TABLES G, H, AND I

Tables G, H, and I bring the platoon together to perfect its skills as a fighting unit.

In Table G, *Battle Drills (Coordination Within Platoon),* tank crews in a platoon coordinate their actions to conduct combat operations on a three dimensional, 360-degree battlefield (for example, *Execute wedge formation*).

Table H, *Platoon Battle Drills*, requires the platoon to react spontaneously to a specific situation in a predetermined way; that is, execute a battle drill (for example, "ACTION LEFT").

Table I, *Platoon Reaction Exercises*, uses the tasks learned in Tactical Tables A through H. The platoon will face MILES-equipped OPFOR in a combat scenario. Advancing through the maneuver area, the platoon will react to a series of combat situations that can be expected in the defense (hasty attack) or as a result of a friendly force penetration (for example, *Engage targets of opportunity—OPFOR regimental command post [CP]*).

Tactical Tables in Training

The combat tables were developed to train weapon system proficiency—mastery of gunnery and tactics. Successful conduct of the combat tables shows that the crew, section, and platoon can employ the tank to full advantage in combat. In the past, gunnery tables alone were used to measure combat effectiveness. The tactical tables bring together crew and platoon drills, related ARTEP tasks, and gunnery tables to determine overall weapon system proficiency. This does not reduce the importance of gunnery tables; it adds the tactical context of gunnery.

The tactical tables train tank crews and platoons to fire rapidly and effectively while moving. The Abrams tank's maneuverability allows crews to take evasive action and still engage targets with a high degree of accuracy. For the crew and platoon to become proficient and maximize the speed, agility, and accuracy of the Abrams tank, they must train over different types of terrain at varying speeds in all environmental conditions (day, night, smoke, and MOPP).

Integrate tactical tables and gunnery tables as much as possible (for example, Table IV, the basic qualification table for crew gunnery, would be followed immediately by Table C, crew reaction exercises). This way, the unit receives the greatest benefit from the tables and comes closer to the goal of training as it will fight. This requires more planning, since the tactical course should be located near the gunnery range. Where this is not possible, the next best procedure is to run the tactical tables immediately after completion of gunnery training.

The conduct of tactical tables is limited only by the training creativity and experience of units setting up the tables. The course should be similar to a leadership reaction course with the tactical scenarios or tasks set up as stations. Run the tables in any environment, day or night, based on the commander's decision and available equipment. Determine the shape of the course and the order of tasks within a table by available terrain. Units going through the tables can start either at predetermined intervals or when the previous unit has completed the course, depending on time available and the number of units going through the table. For added realism, all tasks will begin with crew members at MOPP Level 2. If MOPP equipment is not available, use wet weather gear and black gloves.

Training Resources

The resources required to conduct the tables may depend on what is available. In determining targets and terrain, for example, remember that tactical tables must not only challenge a unit's ability to react effectively in combat, but they must also be as inexpensive as possible to execute. TWGSS and MILES are an essential part of this combat realism. Units must be able to exchange fire with the OPFOR. TWGSS is the preferred engagement device.

An enemy can appear from any direction on the nonlinear battlefield, and engagements requiring the full capabilities of a unit should be the norm. Follow the basic scenarios in the tactical tables as closely as possible. Some allowances in target types and sequence of tasks within a table are permitted to allow for terrain differences. VISMODS, if available, add realism. Pop-up targets can be used, but the loss of target mobility detracts from realism. Space required for the tables depends on available terrain and vegetation. A company-size training area is recommended for conducting tactical tables.

Evaluation

The AAR is the primary means of evaluating performance on the tactical tables. The ultimate measure of success or failure on the tactical tables is the same as in combat: if the unit accomplishes its mission and survives, it is successful; if the unit is destroyed or is unable to achieve its objective, it is a failure. The tank crew, section, or platoon that fails to use terrain properly will probably not survive the mission. If they fail to

give proper fire commands or shoot a tank, they probably will not survive the mission. The tactical tables highlight mistakes so that they are not repeated in combat.

Opposing Forces

Tactical tables require rigidly controlled OPFOR. The OPFOR must act and react the same way for each unit conducting the tables. This ensures that each unit is stressed in the same way for target acquisition and weapon system employment. OPFOR personnel will not be allowed personal creativity in trying to defeat the friendly force going through the tables. The OIC uses the OPFOR instructions in each task to determine the actions taken by the OPFOR, and the OPFOR take only those actions to contact friendly forces. The OIC uses the positions shown in the diagrams as a basis for placing the OPFOR. Exact placement of OPFOR will depend on the terrain. To be consistent from one unit to the next, timing will conform to the standards in each task for OPFOR engagements. The appearance and tactics of the OPFOR as they contact friendly forces should be as realistic as possible, to include direct-fire signatures. The use of VISMODS will add course realism. OPFOR uniforms and weapons should be consistent with Threat doctrine, if possible.

Tactical Table A—Individual Crew Member Tasks

Table 16-2. Individual Crew Member Task List for Tactical Table A.

Task No.	Crew Task	SM Task Number
TANK COMMANDER		
Task 1	Negotiate a route using terrain for cover and concealment.	No task applicable
Task 2	Communicate using visual signaling techniques while mounted.	071-326-0608
Task 3	React to chemical or biological hazards.	031-503-1019
Task 4	Navigate while mounted.	04-3303.2-0037
Task 5	Select firing positions.	No task applicable
Task 6	Analyze terrain.	071-331-0820
Task 7	Prepare/submit intelligence spot reports.	171-133-5111
Task 8	Process known or suspected enemy personnel, documents, and equipment (other crew members may assist).	171-720-0005
Task 9	Install the M21 metallic antitank mine (simulated).	052-192-1117
Task 10	Install the M15 heavy antitank mine (simulated) using an M603 fuze.	052-192-1105
Task 11	Send and receive tactical reports/overlays on the commander's integrated display (CID) (M1A2).	171-126-1130
Task 12	Operate commander's independent thermal viewer (CITV) (M1A2).	No task applicable
GUNNER		
Task 1	Identify targets using the thermal imaging system (TIS).	No task applicable
Task 2	Recognize friendly and threat armored vehicles and aircraft .	878-920-1002
Task 3	Detect a target and give crew acquisition report.	No task applicable
LOADER		
Task 1	Communicate using visual signaling techniques while mounted.	071-326-0608
Task 2	Install the M21 metallic antitank mine (simulated).	052-192-1117
Task 3	Install the M15 heavy antitank mine (simulated) using an M603 fuze.	052-192-1105
Task 4	Recognize friendly and threat armored vehicles and aircraft.	878-920-1002
Task 5	Operate SINCGARS (single channel).	113-587-2070
Task 6	Load/unload 105-mm main gun (M1).	171-126-1026
Task 6A	Load/unload the 120-mm main gun (M1A1 and M1A2).	171-126-1059
Task 7	Detect a target and give a crew acquisition report.	No task applicable
DRIVER		
Task 1	Drive an M1 or M1A1 tank.	171-126-1002
Task 2	Drive an M1A2 tank.	171-126-1136
Task 3	Communicate using visual signaling techniques while mounted.	071-326-0608

Task 4	React to indirect fire (simulated).	No task applicable
Task 5	Detect a target and give a crew acquisition report.	No task applicable

INDIVIDUAL CREW MEMBER TASKS, CONDITIONS, AND STANDARDS

TANK COMMANDER

TASK 1

Negotiate a route using terrain for cover and concealment.

CONDITIONS

Given a fully operational Abrams tank and a driving range with various types of terrain and natural obstacles. (May also be conducted using other vehicles.)

STANDARDS

Within five minutes, direct the driver to destination without exposing the tank to enemy fire, damaging or immobilizing the tank, or injuring the crew.

TASK 2

Communicate using visual signaling techniques while mounted.

CONDITIONS

Given a field training situation with necessary flags or flashlights.

STANDARDS

Demonstrate the correct procedure for each signal as stated in STP 17-19K1-SM.

TASK 3

React to chemical or biological hazards.

CONDITIONS

Given a field training situation in which you are in MOPP Level 2. Chemical and biological weapons have been used (simulated), and it is expected they will be used again by the enemy.

STANDARDS

Recognize hazard. Put on protective mask and hood within 15 seconds. Give the alarm. Seek protective cover. Finish dressing for MOPP Level 4.

TASK 4

Navigate while mounted.

CONDITIONS

Given a standard 1:50,000-scale military map of the area, a compass, a protractor, and a designated start and finish point no more than 3,000 meters apart.

STANDARDS

Within 15 minutes, move from the start point to the finish point.

TASK 5

Select firing positions.

CONDITIONS

Given a fully operational Abrams tank in a simulated tactical situation.

STANDARDS

Select firing positions that are not on prominent terrain and offer covered and concealed routes into and out of the positions. Make sure the positions are as level as possible and provide for hull-down firing without limiting the gunner's field of fire. In defensive operations, the final positions allow coverage of assigned sectors of fire. In offensive operations (in the overwatch), the firing positions allow placement of suppressive fire on known or suspected enemy positions and early warning of ATGM.

TASK 6

Analyze terrain.

CONDITIONS

Given a tactical mission that involves a specified route or location on the ground or map.

STANDARDS

Analyze the route or location in terms of the five military aspects of terrain (observation and fields of fire, cover and concealment, obstacles, key terrain, and avenues of approach), and determine how each aspect affects the mission.

TASK 7

Prepare/submit intelligence spot reports.

CONDITIONS

Given a simulated tactical situation that includes enemy soldiers engaged in any type of activity who can be seen either with the naked eye, binoculars, or tank optics.

STANDARDS

Make a complete and accurate oral or written report to your leader describing each point of interest expressed by the letters of the word SALUTE (size, activity, location, unit, time, and equipment). (Location may be descriptive; it need not be grid coordinates.)

TASK 8

Process known or suspected enemy personnel, documents, and equipment (other crew members may assist).

CONDITIONS

Given an area with friendly civilians and other friendly elements, two surrendering OPFOR personnel with weapons (rifles, pistols, bayonets) and military documents, a designated PW collection point, and PW tags.

STANDARDS

Without letting the prisoners talk to each other, and without letting anyone harm them, remove all weapons and documents except individual identification papers; tag prisoners and their equipment with your complete unit identification, date, time, and circumstances of capture; and turn the prisoners' weapons and documents over to the collection point.

TASK 9

Install the M21 metallic antitank mine (simulated).

CONDITIONS

Given an inert M21 metallic antitank mine, M607 fuze, M120 booster, M26 arming wrench, empty sandbag, and entrenching tool.

STANDARDS

Assemble all components in proper sequence, and emplace the mine in a simulated minefield.

TASK 10

Install the M15 heavy antitank mine (simulated) using an M603 fuze.

CONDITIONS

Given an inert M15 heavy antitank mine, M603 fuze, M20 arming wrench, entrenching tool, firing devices (M1, M1A1, M3, or M5), and M1 activator.

STANDARDS

Assemble all components in proper sequence, and emplace the mine in a simulated minefield.

TASK 11

Send and receive tactical reports/overlays on the commander's integrated display (CID) (M1A2).

CONDITIONS

Given an M1A2 tank in a field or combat environment and a tactical situation requiring you to send or receive a report on the CID.

STANDARDS

Reports are sent and received from the other CID-equipped vehicles without errors, except for those that may be caused by environmental factors such as weather or frequency disturbances. Reports are managed so that reports critical to the tactical situation are stored, and nonessential reports are deleted.

TASK 12

Operate commander's independent thermal viewer (CITV) (M1A2).

CONDITIONS

Given a fully operational M1A2 in a field or combat environment.

STANDARDS

Power up and operate the CITV in the GPS GUN LINE-OF-SIGHT mode, and the CITV GUN LINE-OF-SIGHT mode, SEARCH mode, and AUTO-SCAN mode.

GUNNER

TASK 1

Identify targets using the thermal imaging system (TIS).

CONDITIONS

Given a fully operational Abrams tank, TIS, and thermal targets at various ranges between 500 and 2,000 meters during reduced visibility (smoke, fog, night).

STANDARDS

Within six seconds per target, using the TIS, correctly identify four of five targets (by type).

TASK 2

Recognize friendly and threat armored vehicles and aircraft.

CONDITIONS

Given a garrison or field environment in which armored vehicles, in tactical or simulated tactical settings, are visible. (Models or cards may be used.)

STANDARDS

Identify 18 of 20 vehicles by vehicle nomenclature.

TASK 3

Detect a target and give crew acquisition report.

CONDITIONS

Given a fully operational Abrams tank in a field environment and a thermal target approximately 500 meters in front of and not more than 100 mils left or right of the tank's front slope.

STANDARDS

Within ten seconds, detect the target and give an acquisition report consisting of the alert, target description, and location (clock method) to the TC.

LOADER

TASK 1

Communicate using visual signaling techniques while mounted.

CONDITIONS

Given a field training situation with necessary flags or flashlights.

STANDARDS

Demonstrate the correct procedure for each signal, as stated in STP 17-19K1-SM.

TASK 2

Install the M21 metallic antitank mine (simulated).

CONDITIONS

Given an inert M21 metallic antitank mine, M607 fuze, M120 booster, M26 arming wrench, empty sandbag, and entrenching tool.

STANDARDS

Assemble all components in proper sequence, and emplace the mine in a simulated minefield.

TASK 3

Install the M15 heavy antitank mine (simulated) using an M603 fuze.

CONDITIONS

Given an inert M15 heavy antitank mine, M603 fuze, M20 arming wrench, entrenching tool, firing devices (M1, M1A1, M3, or M5), and M1 activator.

STANDARDS

Assemble all components in proper sequence, and emplace the mine in a simulated minefield.

TASK 4

Recognize friendly and threat armored vehicles and aircraft.

CONDITIONS

Given a garrison or field environment in which armored vehicles, in tactical or simulated tactical settings, are visible. (Models or cards may be used.)

STANDARDS

Identify 18 of 20 vehicles by vehicle nomenclature.

TASK 5

Operate SINCGARS (single channel).

CONDITIONS

Given a fully operational radio, TM 11-5820-890-10-1, and SOI.

STANDARDS

Preset radio on company and platoon nets, place into operation, and take out of operation.

TASK 6

Load/unload 105-mm main gun (M1).

CONDITIONS

Given a stationary M1 tank, a crew, main gun ammunition, and a fire command. All crew stations have been prepared for operation. This task should be conducted in all environmental conditions (day, night, and MOPP).

STANDARDS

Within five seconds after the ammunition element of the fire command is announced, load the main gun with the announced ammunition, clear the path of recoil, move the spent case ejection guard to the ARMED position, and announce "UP."

TASK 6A

Load/unload 120-mm main gun (M1A1 and M1A2).

CONDITIONS

Given a stationary M1A1 or M1A2 tank, a crew, main gun ammunition, and a fire command. All crew stations have been prepared for operation. This task should be conducted in all environmental conditions (day, night, and MOPP).

STANDARDS

Within seven seconds (eight seconds for MPAT AIR) after the ammunition element of the fire command is announced, load the main gun with the announced ammunition, clear the path of recoil, move the armed/safe lever to the ARMED position, and announce "UP."

TASK 7

Detect a target and give a crew acquisition report.

CONDITIONS

Given a fully operational Abrams tank in a field environment and a target approximately 800 meters to the left flank of the tank. The loader is observing for targets from the open-hatch position.

STANDARDS

Within ten seconds, detect the target and give an acquisition report consisting of the alert, target description, and location (clock method) to the TC.

DRIVER

TASK 1

Drive an M1 or M1A1 tank.

CONDITIONS

In a field or driving range location, given an operational M1 or M1A1 tank with BII, before-operations checks completed, driver's and TC's stations powered up, and engine running. The driver is instructed to drive the tank.

STANDARDS

Negotiate the prescribed route without injury to personnel or damage to equipment.

TASK 2

Drive an M1A2 tank.

CONDITIONS

In a field or driving range location, given an operational M1A2 tank with BII, before-operations checks completed, driver's and TC's stations powered up, and engine running. The driver is instructed to drive the tank.

STANDARDS

Negotiate the prescribed route without injury to personnel or damage to equipment.

TASK 3

Communicate using visual signaling techniques while mounted.

CONDITIONS

Given a field training situation with necessary flags or flashlights.

STANDARDS

Demonstrate the correct procedure for each signal as stated in STP 17-19K1-SM.

TASK 4

React to indirect fire (simulated).

CONDITIONS

Given a fully equipped, operational Abrams tank while in a tactical situation (moving).

STANDARDS

Follow the driving commands given by the TC, stop the tank, put on mask and position hood, turn on gas particulate filter unit (M1), and announce "DRIVER UP."

TASK 5

Detect a target and give a crew acquisition report.

CONDITIONS

Given a fully equipped, operational Abrams tank in a field environment and a target approximately 1,000 meters in front of and not more than 100 mils left or right of the tank's front slope.

STANDARDS

Within ten seconds, detect the target and give an acquisition report consisting of the alert, target description, and location (clock method) to the TC.

Tactical Table B—Crew Drills

PROTECT AGAINST CHEMICAL AGENT ATTACK TRAINING GUIDELINES

TASK B-1

Put on a protective mask, resume intercommunications, close hatches, and connect the mask to the gas particulate filter unit.

CONDITIONS

- Vehicle:
  - A fully equipped, operational tank is moving across moderate terrain.
  - Each crew member is at MOPP Level 2 and is equipped with a protective mask stowed in its carrier.
  - A chemical agent attack (simulated) is announced.
  - All safety guards are in position.
  - Preoperation checks have been completed.
- TC's Station:
  - TC's hatch is locked in the full-open or protected-open position.
  - TC is scanning his sector.
- Gunner's Station:
  - Gunner is scanning the tank's sector of responsibility through the GPS in 3X magnification.
- Loader's Station:
  - Loader's hatch is locked in the full-open position.
  - Loader is scanning his sector.
- Driver's Station:
  - Driver's hatch is locked in the closed position.
  - Driver is monitoring the driver's alert panel.
  - Driver is scanning his sector through his periscope.
  - Driver is driving.

STANDARDS

Within 1 minute, 26 seconds after the initial announcement of "GAS," complete the drill as follows: put on a mask in 15 seconds and position the hood in 6 additional seconds; close hatches, replace the CVC helmets, plug in the microphones, and resume intercommunication within 30 seconds. Connect the protective mask to the gas particulate filter unit (M1), operate the overpressure system (M1A1, M1A2, and M1A2 SEP), and resume the mission within 35 seconds after intercommunication is restored. Each crew member must perform all of his performance steps.

CREW DRILL INSTRUCTIONS

Read the following instructions to the crew exactly as written:

"The purpose of this drill is to determine our ability to put on our masks, resume intercommunication, close hatches, connect masks to the gas particulate filter unit (M1), and turn on overpressure system (M1A1, M1A2, and M1A2 SEP). Assume that we are moving in a combat environment, and we receive a report from our platoon leader that we are under a chemical attack. Upon initial command, we must stop the tank in a hide position, put on our masks within 15 seconds, and position our hoods within 6 additional seconds. We must close all hatches, replace our CVC helmets, and resume intercommunications within 30 seconds. Finally, we must connect our protective masks to the gas particulate filter unit (M1) or turn on the overpressure system (M1A1, M1A2, and M1A2 SEP) within 35 seconds after intercommunication is restored. I will observe our actions to determine if we follow the correct procedures. Upon completion of this drill, I will review our performance. Do you have any questions concerning the administration of the drill? (Answer questions.) *Crew—prepare to begin drill."*

Table 16-3. Protect Against Chemical Agent Attack—Procedures Guide.

TC	Gunner	Loader	Driver
A crew member announces "GAS."			
1. Remove CVC helmet.	Remove CVC helmet.	Remove CVC helmet.	Stop tank.
2. Put on mask and position hood.	Put on mask and position hood.	Put on mask and position hood.	Remove CVC helmet.
3. Remove CVC mike plug from helmet.	Remove CVC mike plug from helmet.	Remove CVC mike plug from helmet.	Put on mask and position hood.
4. Insert mask mike plug in CVC helmet.	Insert mask mike plug in CVC helmet.	Insert mask mike plug in CVC helmet.	Remove CVC mike plug from helmet.
5. Put on CVC helmet.	Put on CVC helmet.	Put on CVC helmet.	Insert mask mike plug in CVC helmet. Put on CVC helmet.
6. Announce "CREW REPORT."	Announce "GUNNER READY."	Announce "LOADER READY."	Announce "DRIVER READY."
7. Close and lock TC's hatch.		Close and lock loader's hatch.	
8. Announce "REMOVE SPRING CLIP." (M1)	Elevate main gun to expose gas particulate filter.	Move GUN/TURRET DRIVE switch to MANUAL.	
		Remove spring clip from gas clip from gas particulate filter.	
		Announce "CLIP REMOVED."	
		Move GUN/TURRET DRIVE switch to POWERED position.	Turn on gas particulate filter unit.
8A. Move NBC MODE MAIN switch to ON position (M1A1 and M1A2).			Move ENGINE TACTICAL IDLE switch to ON position.
9. Disconnect air duct hose breakaway socket from orifice connector on tank.	Disconnect air duct hose breakaway socket from orifice connector on tank.	Disconnect air duct hose breakaway socket from orifice connector on tank.	Disconnect air duct hose breakaway socket from orifice connector on tank.
10. Connect air duct hose breakaway socket to protective mask canister coupling.	Connect air duct hose breakaway socket to protective mask canister coupling.	Connect air duct hose breakaway socket to protective mask canister coupling.	Connect air duct hose breakaway socket to protective mask canister coupling.
11. Command "DRIVER—MOVE OUT."		Adjust periscope (mirrors).	Follow driving commands.
12. Send NBC-1 report to platoon leader.			

Note. To prevent severe frostbite to the face in extremely cold weather, allow the individual heaters in the air lines to operate 15 to 20 minutes before performing steps 9 and 10. While the heaters are warming up, use respiratory protection provided by the mask canister. Use of the canister may cause slight breathing difficulty.

Table 16-4. Protect Against Chemical Agent Attack—Performance Checklist.

Time:_____(Min/Sec)		
Overall Performance: GO _____ NO-GO _____		
Performance Steps	**Crew Member**	**SM STP Task Number**
1. Announced "GAS."	GO NO-GO TC: _____ _____ G: _____ _____ L: _____ _____ D: _____ _____	No task applicable
2. Stopped tank.	D: _____ _____	171-126-1002
3. Removed CVC helmet, put on protective mask, and positioned hood.	TC: _____ _____ G: _____ _____ L: _____ _____ D: _____ _____	031-503-1012
4. Plugged in microphone, replaced CVC helmet, and announced "CREW REPORT."	TC: _____ _____	031-503-1012
5. Plugged in microphone, replaced CVC helmet, and announced "READY."	G: _____ _____ L: _____ _____ D: _____ _____	031-503-1012
6. Closed and locked hatches.	TC: _____ _____ L: _____ _____	031-503-1012
7. Announced "REMOVE SPRING CLIP" (M1).	TC: _____ _____	No task applicable
7A. Moved NBC MODE MAIN switch to ON position (M1A1 and M1A2). (Go to step 13.)	TC: _____ _____	No task applicable
8. Elevated main gun to expose gas particulate filter.	G: _____ _____	No task applicable
8A. Moved engine tactical idle switch to the ON position.	D: _____ _____	No task applicable
9. Moved GUN/TURRET DRIVE switch to MANUAL position.	L: _____ _____	No task applicable
10. Removed spring clip from gas particulate filter and announced "CLIP REMOVED."	L: _____ _____	No task applicable
11. Turned on gas particulate filter unit.	D: _____ _____	No task applicable

Table 16-4 (cont.)

Performance Steps	Crew Member		SM STP Task Number
	GO	NO-GO	
12. Disconnected air duct hose breakaway socket from orifice connector tank.	TC: _____ G: _____ L: _____ D: _____	_____ _____ _____ _____	No task applicable
13. Moved GUN/TURRET DRIVE switch to POWERED position.	L: _____	_____	No task applicable
14. Connected air duct hose breakaway socket protective mask canister coupling.	TC: _____ G: _____ L: _____ D: _____	_____ _____ _____ _____	No task applicable
15. Adjusted periscope (mirrors).	L: _____	_____	No task applicable
16. Commanded "DRIVER—MOVE OUT."	TC: _____	_____	No task applicable
17. Followed driving commands.	D: _____	_____	171-126-1002, 171-126-1136
18. Sent NBC-1 report to platoon leader.	TC: _____	_____	031-503-3005
REMARKS: _____ _____ _____ _____ _____			

Table 16-5. Protect Against Chemical Agent Attack—Task-to-Training Product Linkage.

Task Number	Task Description	Training Product
031-503-1012	Put on, wear, remove, and store your protective mask with hood.	TM 3-4240-280-10
031-503-3005	Prepare and submit NBC-1 reports.	GTA 3-6-8
171-126-1002	Drive an M1 tank.	TM 9-2350-255-10-1/-2
171-126-1002	Drive an M1A1 tank.	TM 9-2350-264-10-1/-2
171-126-1136	Drive an M1A2 tank.	TM 9-2350-288-10-1/-2

PROTECT AGAINST NUCLEAR ATTACK TRAINING GUIDELINES

TASK B-2

Protect against a simulated nuclear attack.

CONDITIONS

- Vehicle:
  - A fully equipped, operational tank in a hull-down position.
  - A flash from a nuclear detonation (simulated) is 15,000 meters from the tank.
  - All safety guards are in position.
  - Preoperation checks have been completed.
- TC's Station**:**
  - TC's hatch is locked in the full-open or protected-open position.
  - TC is scanning his sector.
- Gunner's Station**:**
  - Gunner is scanning the tank's sector of responsibility through the GPS in 3X magnification.
- Loader's Station**:**
  - Loader's hatch is locked in the full-open position.
  - Loader is scanning his sector.
  - Main gun breech is closed (main gun is loaded with dummy round).
- Driver's Station:
  - Driver's hatch is locked in the closed position.
  - Engine is running.
  - Driver is monitoring driver's alert panel.
  - Driver is scanning his sector through his periscope.

STANDARDS

Within seven seconds after simulated nuclear flash, protect crewmen from blast, thermal radiation, and initial nuclear radiation. Each crew member must perform all of his performance steps.

Note. Threat doctrine standards normally require a chemical attack to follow a nuclear attack. Crews should be prepared to go to MOPP level 4 after the nuclear attack.

CREW DRILL INSTRUCTIONS

Read the following instructions to the crew exactly as written:

"The purpose of this drill is to determine our ability to protect ourselves against nuclear attack. Assume we are in a combat environment in a defensive position and have just observed the flash from a nuclear detonation (simulated). We must perform the correct protective steps within seven seconds after nuclear flash (simulated). I will observe our actions to determine if we follow the correct procedures. Upon completion of this drill, I will review our performance. Do you have any questions concerning the administration of the drill? (Answer questions.) *Crew—prepare to begin drill."*

Table 16-6. Protect Against Nuclear Attack—Procedures Guide.

TC	Gunner	Loader	Driver
A crew member announces “NUCLEAR ATTACK.”			
	Close ballistic doors.	Drop down into turret.	Shut off engine (leave VEHICLE MASTER POWER switch on).
	Turn main gun away from blast.		Make sure parking brake is set.
1. Drop down into turret.	Cradle face in folded arms and close eyes.	Cradle face in folded arms and close eyes.	Cradle face in folded arms and close eyes.
2. Stow CITV (M1A2).			
3. Cradle face in folded arms and close eyes.	Brace.	Brace.	Brace.
4. Brace.	Remain in this position until TC announces "ALL CLEAR."	Remain in this position until TC announces "ALL CLEAR."	Remain in this position until TC announces "ALL CLEAR."
5. Remain in this position until shock wave has passed and returned.			
6. Announce "ALL CLEAR."			
7. Send NBC-1 report to platoon leader.			
Note. Threat doctrine standards normally require a chemical attack to follow a nuclear attack. Crews should be prepared to go to MOPP level 4 after the nuclear attack.			

Table 16-7. Protect Against Nuclear Attack—Performance Checklist.

Time: _____ (Min/Sec)		
Overall Performance: GO _____ NO-GO_____		
Performance Steps	**Crew Member**	**SM STP Task Number**
1. Announced “NUCLEAR ATTACK.”	GO NO-GO TC: _____ _____ G: _____ _____ L: _____ _____ D: _____ _____	031-510-1905
2. Dropped down into turret.	TC: _____ _____ L: _____ _____	031-510-1905
3. Closed ballistic doors.	G: _____ _____	031-510-1905
4. Stowed CITV (M1A2).	TC: _____ _____	
5. Turned main gun away from blast.	G: _____ _____	031-510-1905
6. Shut off engine (left VEHICLE MASTER POWER switch on) and made sure parking brake was set.	D: _____ _____	171-126-1001
7. Cradled face in folded arms and closed eyes.	TC: _____ _____ G: _____ _____ L: _____ _____ D: _____ _____	031-510-1905
8. Remained in this position until TC announced “ALL CLEAR.”	G: _____ _____ L: _____ _____ D: _____ _____	031-510-1905
9. Remained in this position until shock wave had passed and returned.	TC: _____ _____	031-510-1905
10. Announced “ALL CLEAR.”	TC: _____ _____	031-510-1905
11. Sent NBC-1 report to platoon leader.	TC: _____ _____	031-503-3005
REMARKS:_____ _____ _____ _____		

**Table 16-8. Protect Against Nuclear Attack—
Task-to-Training Product Linkage.**

Task Number	Task Description	Training Product
031-510-1905	Prepare a tracked vehicle for nuclear attack.	FKSM 17-13-1
031-503-3005	Prepare and submit NBC-1 reports.	GTA 3-6-8
171-126-1001	Start/stop the engine on an M1 tank.	TM 9-2350-255-10-1/-2
	Start/stop the engine on an M1A1 tank.	TM 9-2350-264-10-1/-2
	Start/stop the engine on an M1A2 tank.	TM 9-2350-288-10-1/-2

DISABLE AND ABANDON AUTOMOTIVELY CRIPPLED TANK TRAINING GUIDELINES

TASK B-3

Disable (simulated) and abandon an automotively crippled tank (simulated).

CONDITIONS

- Vehicle:
  - A tank automotively crippled by loss of engine power (simulated) is in a hull-down position.
  - Training aids to represent 9-mm pistols, M4 rifles, practice thermite grenades, SOI, magazines, rations, and protective masks should be used.
  - All safety guards are in position.
  - Preoperation checks have been completed.
  - Tank is loaded in accordance with current load plan.
- TC's Station:
  - TC's hatch is locked in the full-open or protected-open position.
  - TC is scanning his sector.
- Gunner's Station**:**
  - Gunner is scanning the tank's sector of responsibility through the GPS in 3X magnification.
- Loader's Station:
  - Loader's hatch is locked in the full-open position.
  - Loader is scanning his sector.
  - Main gun breech is closed (main gun loaded with dummy round).
- Driver's Station**:**
  - Driver's hatch is locked in the closed position.
  - Engine is off.
  - Driver is scanning his sector through his periscope.

STANDARDS

Within five minutes after the initial command, disable (simulated) and abandon an automotively crippled tank (simulated). Each crew member must perform all of his performance steps.

Note. If enemy contact or capture is not imminent, TC will take SOI with him.

CREW DRILL INSTRUCTIONS

Read the following instructions to the crew exactly as written:

"The purpose of this drill is to determine our ability to disable (simulated) and abandon our tank. Assume our tank has been automotively crippled. After explaining the situation to our platoon leader, he orders us to prepare our tank for destruction and abandon the tank. Within five minutes after the initial command, we must simulate destroying the tank and SOI with four grenades and abandon the tank carrying our individual weapons, protective mask, rifles, rations, and ammunition. I will observe our actions to determine if we follow the correct procedures. Upon completion of this drill, I will review our performance. Do you have any questions concerning the administration of the drill? (Answer questions.) *Crew—prepare to begin drill."*

Table 16-9. Disable and Abandon Tank—Procedures Guide.

TC	Gunner	Loader	Driver
1. Report crew status.			
2. Command “ABANDON TANK—ASSEMBLE RIGHT (LEFT) REAR.”			Announce “CLEAR” so the TC knows he is clear and can traverse the turret.
3. Traverse to 3 o’clock position.		Set radio to unused frequency.	
4. Ensure main gun is level.		Open breech and remove main gun round. Stow round (leave ammunition door open).	
5. Remove caliber .50 machine gun backplate and place it in breech.	Remove coax machine gun backplate and place it in breech.		
6. Secure protective mask, individual weapon, rations, and SOI.	Secure protective mask, individual weapon, rations, and all grenades, to include four thermite grenades.	Secure protective mask, individual weapon, M4 rifle, ammunition, rations, and loader’s mittens.	Secure protective mask, individual weapon, M4 rifle, ammunition, and rations.
7. Place SOI in breech and receive two thermite grenades from gunner.	Pass two thermite grenades to the TC and two thermite grenades to the loader.	Place one thermite grenade in the breech and stand by.	Rupture heater fuel line, turn heater on, and dismount tank.
8. Exit through TC's hatch and move to back deck.	Exit through TC's hatch, secure loader's machine gun and two boxes of ammunition, and dismount tank.		
9. Open right top grille doors to expose fuel cell.	Move to area announced by TC, and establish security watch.		Move to area announced by TC, and establish security watch.
10. Command “PULL PIN.”		On command, pull pin on remaining thermite grenade and place it in breech and close breech.	
11. Pull pin on one thermite grenade (as loader exits tank) and place both grenades on top of fuel cell.		Exit through the loader’s hatch and dismount tank.	
12. Dismount tank and conduct personnel accountability.		Move to location announced by the TC, and provide security watch.	

Notes. If thermite grenades are not available for disabling the tank, a sledge hammer and other heavy instruments should be used to disable sensitive equipment (computer, optical instruments, communication equipment, and gauges). The main gun firing pin and machine gun backplates should be taken from tank and destroyed. If combustible material is available, pour fuel and engine oil over TA-50 inside the turret and ignite by lighting or using hand grenade.

Table 16-10. Disable and Abandon Tank—Performance Checklist.

Time: _____ (Min/Sec)		
Overall Performance: GO _____ NO-GO _____		
Performance Steps	**Crew Member**	**SM STP Task Number**
Note. All tasks performed per unit SOP unless otherwise indicated.		
	GO NO-GO	
1. Reported crew status.	TC: _____ _____	No task applicable.
2. Commanded "ABANDON TANK—ASSEMBLE (RIGHT/LEFT/REAR)."	TC: _____ _____	No task applicable.
3. Announced clear to TC.	D: _____ _____	No task applicable
4. Traversed turret to 3 o'clock position.	TC: _____ _____	No task applicable
5. Set radio to unused frequency.	L: _____ _____	No task applicable
6. Made sure main gun was level.	TC: _____ _____	No task applicable
7. Opened the breech, and removed and stowed the main gun round (left the ammunition door open).	L: _____ _____	No task applicable
8. Placed caliber .50 backplate in breech.	TC: _____ _____	No task applicable
9. Placed coax backplate in breech.	G: _____ _____	No task applicable
10. Secured SOI.	TC: _____ _____	No task applicable
11. Secured M4 rifle and ammunition.	D: _____ _____ L: _____ _____	No task applicable
12. Secured protective mask, individual weapon, and ration.	TC: _____ _____ L: _____ _____ D: _____ _____ G: _____ _____	No task applicable
13. Secured all grenades.	G: _____ _____	No task applicable
14. Secured loader's mittens.	L: _____ _____	No task applicable
15. Placed SOI in breech.	TC: _____ _____	No task applicable
16. Gave TC and loader two thermite grenades each.	G: _____ _____	No task applicable
17. Placed one thermite grenade in breech.	L: _____ _____	No task applicable
18. Ruptured heater fuel line and turned on heater.	D: _____ _____	No task applicable
19. Exited through TC's hatch..	TC: _____ _____ G: _____ _____	No task applicable
20. Secured loader's machine gun and two boxes of ammunition.	G: _____ _____	No task applicable

Table 16-10 (cont.)

Performance Steps	Crew Member		SM STP Task Number
	GO	NO-GO	
21. Opened top right grill doors.	TC: _____	_____	No task applicable
22. Moved to area announced by TC, and established security watch.	G: _____ D: _____	_____ _____	No task applicable
23. Commanded “PULL PIN.”	TC: _____	_____	No task applicable
24. Pulled pin, placed thermite grenade in breech, and closed breech.	L: _____	_____	No task applicable
25. Exited through loader’s hatch.	L: _____	_____	No task applicable
26. Pulled pin on one thermite grenade, and placed both grenades on fuel cell.	TC: _____	_____	No task applicable
27. Dismounted tank, moved to area announced by TC, and provided security watch.	L: _____	_____	No task applicable
28. Dismounted tank and conducted personnel accountability.	TC: _____	_____	No task applicable

REMARKS: _____

_____

_____

_____

_____

_____

EVACUATE INJURED CREWMAN TRAINING GUIDELINES

TASK B-4

Evacuate an injured (simulated) crewman through the loader's hatch.

CONDITIONS

- Vehicle:
  - A fully equipped, operational tank is in a hull-down position.
  - All safety guards are in position.
  - Preoperation checks have been completed.
- TC's Station:
  - TC's hatch is locked in the full-open or protected-open position.
  - TC is scanning his sector.
- Gunner's Station**:**
  - Gunner is scanning the tank's sector of responsibility through the GPS in 3X magnification.
- Loader's Station:
  - Loader's hatch is locked in the full-open position.
  - An injured (simulated) crewman is in the loader's position.
- Driver's Station:
  - Driver's hatch is locked in the closed position.
  - Engine is running.
  - Driver is monitoring driver's alert panel.
  - Driver is scanning his sector through his periscope.

STANDARDS

Within two minutes after the initial command, remove the injured (simulated) crewman. Each crew member must perform all of his performance steps.

CREW DRILL INSTRUCTIONS

Read the following instructions to the crew exactly as written:

"The purpose of this drill is to determine our ability to evacuate an injured crewman from the loader's position on a tank. Assume an enemy sniper has injured a crewman. Assume the enemy sniper has been killed. We must remove the injured crewman from the tank within two minutes after the initial command. I will observe our actions to determine if we follow the correct procedures. Upon completion of this drill, I will review our performance. Do you have any questions concerning the administration of the drill? (Answer questions.) *Crew—prepare to begin drill."*

Table 16-11. Evacuate Injured Crewman—Procedures Guide.

TC	Gunner	Loader	Driver
A crew member announces "LOADER INJURED."			
1. Direct driver into hide position.			Follow driving commands.
2. Command "EVACUATE LOADER FROM THE TURRET."		Simulate casualty.	
3. Traverse turret to 9 o'clock position and elevate the main gun to maximum elevation.			Shut off engine; leave VEHICLE MASTER POWER switch on.
4. Stow knee guard and seat and move to loader's position.	Move FIRE CONTROL MODE switch to MANUAL.		Exit through driver's hatch.
5. Move spent case ejection guard (M1) to SAFE position and stow knee switch.			Take position at edge of loader's hatch.
5A. Move the SAFE/ARMED lever to SAFE (down) position and stow knee switch (M1A1/M1A2).	Move to loader's station and stow stub base catcher assembly (M1A1 and M1A2), knee guard, and shoulder guard.		
6. Lift loader from loader's station.	Lift loader from loader's station.		
7. Hold loader high enough for driver to grasp him under arms.	Hold loader high enough for driver to grasp him under arms.		Grasp loader under arms.
8. Help driver lay loader on top of turret.	Help driver lay loader on top of turret.		Lay loader on top of turret.
9. Exit turret and help driver administer first aid.	Occupy TC's position, observe area, report tank and crew status to platoon leader, and request evacuation.		Administer first aid to loader.
Note. If TC or gunner is injured, the loader assumes the duties of the injured crew member for evacuation. After evacuation is complete, revert to three-man crew.			

Table 16-12. Evacuate Injured Crewman—Performance Checklist.

Time: _____ (Min/Sec)			
Overall Performance: GO _____ NO-GO _____			
Performance Steps	**Crew Member**		**SM STP Task Number**
		GO NO-GO	
1. Announced "LOADER INJURED."	TC: G: D:	_____ _____ _____ _____ _____ _____	171-126-1040
2. Directed driver into hide position.	TC:	_____ _____	No task applicable
3. Followed driving commands.	D:	_____ _____	171-126-1002, 171-126-1136
4. Commanded "EVACUATE LOADER FROM THE TURRET."	TC:	_____ _____	171-126-1040
5. Traversed turret to 9 o'clock position and elevated the main gun to maximum elevation.	TC:	_____ _____	171-126-1040
6. Stowed knee guard and seat and moved to loader's position.	TC:	_____ _____	No task applicable
7. Moved FIRE CONTROL switch to MANUAL.	G:	_____ _____	171-126-1040
8. Shut off engine; left VEHICLE MASTER POWER switch on.	D:	_____ _____	171-126-1001
9. Exited tank and took position beside loader's hatch.	D:	_____ _____	171-126-1040
10. Moved spent case ejection guard (M1) to SAFE (forward) position and stowed knee switch.	TC:	_____ _____	171-126-1040
10A. Moved the SAFE/ARMED lever to SAFE (down) position and stowed knee switch (M1A1 and M1A2).	TC:	_____ _____	171-126-1040
11. Moved to loader's station and stowed stub base catcher assembly (M1A1 and M1A2), knee guard, and shoulder guard.	G:	_____ _____	171-126-1040
12. Lifted crewman from loader's station.	TC: G:	_____ _____ _____ _____	171-126-1040

Table 16-12 (cont.)

Performance Steps	Crew Member		SM STP Task Number
	GO	NO-GO	
13. Held loader high enough for driver to grasp him under arms.	TC: _____	_____	171-126-1040
	G: _____	_____	
14. Laid loader on top of turret.	TC: _____	_____	171-126-1040
	G: _____	_____	
	D: _____	_____	
15. Exited turret and helped driver administer first aid to loader.	TC: _____	_____	081-831-1000
16. Occupied TC's position, observed area, reported tank and crew status to platoon leader, and requested evacuation.	G: _____	_____	171-126-1040
17. Administered first aid to loader.	D: _____	_____	081-831-1000
REMARKS: _____			
_____			
_____			
_____			
_____			

Table 16-13. Evacuate Injured Crewman— Task-to-Training Product Linkage.

Task Number	Task Description	Training Product
081-831-1000	Evaluate a casualty.	FM 21-11
171-126-1001	Start/stop the engine on an M1 tank.	TM 9-2350-255-10-1/-2
	Start/stop the engine on an M1A1 tank.	TM 9-2350-264-10-1/-2
	Start/stop the engine on an M1A2 tank.	TM 9-2350-288-10-1/-2
171-126-1002	Drive an M1 tank.	TM 9-2350-255-10-1/-2
	Drive an M1A1 tank.	TM 9-2350-264-10-1/-2
171-126-1136	Drive an M1A2 tank.	TM 9-2350-288-10-1/-2
171-126-1040	Evacuate a wounded crewman from an M1, M1A1, or M1A2 tank.	TM 9-2350-264-10-1/-2 TM 9-2350-288-10-1/-2

EVACUATE INJURED DRIVER TRAINING GUIDELINES

TASK B-5

Evacuate an injured (simulated) driver from a tank.

CONDITIONS

- Vehicle:
  - A fully equipped, operational tank is in a hull-down position.
  - An injured (simulated) driver is in his station.
  - All safety guards are in position.
  - Preoperation checks have been completed.
- TC's Station**:**
  - TC's hatch is locked in the full-open or protected-open position.
  - TC is scanning his sector.
- Gunner's Station:
  - Gunner is scanning the tank's sector of responsibility through the GPS in 3X magnification.
- Loader's Station:
  - Loader's hatch is locked in the full-open position.
  - Loader is scanning his sector.
- Driver's Station**:**
  - Driver's hatch is locked in the closed position.
  - Engine is idling.
  - Tank transmission is in N (neutral) and the parking brake is set.

STANDARDS

Within two minutes after the initial command, remove the injured (simulated) driver from the tank. Each crew member must perform all of his performance steps.

CREW DRILL INSTRUCTIONS

Read the following instructions to the crew exactly as written:

"The purpose of this drill is to determine our ability to evacuate an injured driver from our tank. We are in a forward assembly area. Enemy contact is not expected. Assume the driver is unconscious and the injury is unknown. We must remove the injured driver from the tank within two minutes after the initial command. I will observe our actions to determine if we follow the correct procedures. Upon completion of this drill, I will review our performance. Do you have any questions concerning the administration of the drill? (Answer questions.) *Crew—prepare to begin drill."*

Table 16-14. Evacuate Injured Driver—Procedures Guide.

TC	Gunner	Loader	Driver
A crew member announces "DRIVER INJURED."			
1. Command "EVACUATE DRIVER THROUGH DRIVER'S HATCH."		M1: Make sure spent case ejection guard is in SAFE position.	Simulate casualty.
		M1A1/M1A2: Make sure SAFE/ARMED lever is in the SAFE (down) position and stub base catcher is stowed.	
2. Traverse turret to 6 o'clock position to allow access to driver's station through turret.		Lock turret traverse lock and make sure GUN/TURRET DRIVE switch is in MANUAL.	
		Open loader's toe guard.	
		Shut off engine.	
		Unlock driver's hatch and, using handcrank, open driver's hatch to full-open position.	
		Unlock traverse lock and move the GUN/TURRET DRIVE switch to POWERED position.	
3. Exit turret and take position on edge of driver's hatch.	Traverse turret to 9 o'clock position.	Lock turret traverse lock and make sure GUN/TURRET DRIVE switch is in MANUAL.	
4.	Exit turret and take position on edge of driver's hatch.	Exit turret and take position on edge of driver's hatch.	
5. Reach into driver's hatch, raise the head rest to stowed position, and gently lower driver's head. Grasp right leg, pull it out and lay it over the hull.		Reach into driver's hatch, grasp injured driver's left leg, pull it out, and lay it over hull.	
6.	Grasp both ankles of injured driver.		
7. Help loader remove injured driver from driver's compartment.	Help TC and loader remove injured driver from driver's compartment.	Help TC remove injured driver from driver's compartment.	
8. Place driver on front slope.	Place driver on front slope.	Place driver on front slope.	
9. Administer first aid.	Report tank and crew status to platoon leader, and request evacuation.	Administer first aid.	
Note. Under hostile fire, evacuate driver through the turret.			

Table 16-15. Evacuate Injured Driver—Performance Checklist.

Time: _____ (Min/Sec)		
Overall Performance: GO _____ NO-GO _____		
Performance Steps	**Crew Member**	**SM STP Task Number**
1. Announced “DRIVER INJURED.”	GO NO-GO TC: _____ _____ G: _____ _____ L: _____ _____	171-126-1040
2. Commanded “EVACUATE DRIVER THROUGH DRIVER’S HATCH.”	TC: _____ _____	171-126-1040
3. Traversed turret to 6 o’clock position to allow access to driver’s station through turret; then exited turret and took position on edge of driver’s hatch.	TC: _____ _____	171-126-1040
4. Made sure spent case ejection guard (M1) was in SAFE position. Made sure SAFE/ARMED lever was in SAFE (down) position and stowed stub base catcher (M1A1 and M1A2).	L: _____ _____	171-126-1040
5. Locked turret traverse lock and made sure GUN/TURRET DRIVE switch was in the MANUAL position.	L: _____ _____	171-126-1040
6. Opened loader’s toe guard and shut off engine.	L: _____ _____	171-126-1001
7. Unlocked driver’s hatch and used handcrank to open driver’s hatch to the FULL-OPEN position.	L: _____ _____	171-126-1040
8. Unlocked traverse lock and moved the GUN/TURRET DRIVE switch to the POWERED position.	L: _____ _____	171-126-1040
9. Traversed turret to the 9 o’clock position.	G: _____ _____	171-126-1040
10. Moved the GUN/TURRET DRIVE switch to the MANUAL position and locked the traverse lock.	L: _____ _____	171-126-1040
11. Exited the turret and took position on the edge of the driver’s hatch.	G: _____ _____ L: _____ _____	171-126-1040
12. Stowed the head rest and lowered the driver’s head.	TC: _____ _____	171-126-1040
13. Pulled the driver’s legs out and laid them over the hull.	TC: _____ _____ L: _____ _____	171-126-1040

Table 16-15 (cont.)

Performance Steps	Crew Member			SM STP Task Number
		GO	NO-GO	
14. Grasped both ankles of the injured driver.	G:	_____	_____	171-126-1040
15. Lifted the driver out of the driver's compartment.	TC: G: L:	_____ _____ _____	_____ _____ _____	171-126-1040
16. Placed the driver on the front slope.	TC: G: L:	_____ _____ _____	_____ _____ _____	171-126-1040
17. Administered first aid to the driver.	TC: L:	_____ _____	_____ _____	081-831-1000
18. Reported the tank and crew status to the platoon leader, and requested evacuation.	G:	_____	_____	No task applicable
REMARKS: _____ _____ _____ _____				

Table 16-16. Evacuate Injured Driver— Task-to-Training Product Linkage.

Task Number	Task Description	Training Product
081-831-1000	Evaluate a casualty	FM 21-11
171-126-1001	Start/stop the engine on an M1 tank. Start/stop the engine on an M1A1 tank. Start/stop the engine on an M1A2 tank.	TM 9-2350-255-10-1/-2 TM 9-2350-264-10-1/-2 TM 9-2350-288-10-1/-2
171-126-1040	Evacuate a wounded crewman from an M1, M1A1, or M1A2 tank.	FKSM 17-13-1

REACT TO INDIRECT FIRE TRAINING GUIDELINES

TASK B-6

React to indirect fire (simulated).

CONDITIONS

- Vehicle:
  - A fully equipped, operational tank is in a hull-down position in a defensive situation.
  - All safety guards are in position.
  - Preoperation checks have been completed.
- TC's Station:
  - TC's hatch is locked in the full-open or protected-open position.
  - TC is scanning his sector.
- Gunner's Station:
  - Gunner is scanning the tank's sector of responsibility through the GPS in 3X magnification.
- Loader's Station:
  - Loader's hatch is locked in the full-open position.
  - Loader is scanning his sector.
- Driver's Station:
  - Driver's hatch is locked in the closed position.
  - Engine is idling.
  - Tank transmission is in N (neutral) and parking brake is set.
  - Driver is monitoring driver's alert panel.

STANDARDS

Within one minute, 26 seconds after the announcement of "INCOMING," complete drill as follows: put on mask in 15 seconds and position hood in 6 additional seconds; close hatches; replace CVC plugs in microphones and replace CVC helmets in 30 seconds; and connect the protective mask to the gas particulate filter unit (M1), move NBC MODE MAIN switch to ON position (M1A1 and M1A2) close ballistic doors, stow CITV (M1A2), and report status within 35 seconds. Each crew member must perform all of his performance steps.

CREW DRILL INSTRUCTIONS

Read the following instructions to the crew exactly as written:

"The purpose of this drill is to determine our ability to react to indirect fire (simulated) by protecting ourselves and the sights, and moving to our turret-down position. After initial announcement of "incoming," we must put on our mask in 15 seconds and position the hood in six additional seconds. We must close all hatches, replace the CVC plugs in the microphones, and replace our CVC helmets in 30 seconds. Finally, we must connect the protective masks to the gas particulate filter unit (M1), move the NBC MODE MAIN switch to the on position (M1A1 and M1A2), close the ballistic doors, stow the CITV (M1A2), and report status within 35 seconds. I will observe our actions to determine if we follow the correct procedures. Upon completion of this drill, I will review our performance. Do you have any questions concerning the administration of the drill? (Answer questions.) *Crew—prepare to begin drill."*

Table 16-17. React to Indirect Fire—Procedures Guide.

TC	Gunner	Loader	Driver
A crew member announces "INCOMING."			
1. Drop down into turret.	Search for targets.	Drop down into turret.	Maintain engine rpm.
2. Remove CVC helmet.	Remove CVC helmet.	Remove CVC helmet.	Remove CVC helmet.
3. Put on mask and position hood.	Put on mask and position hood.	Put on mask and position hood.	Put on mask and position hood.
4. Remove CVC mike plug from helmet.	Remove CVC mike plug from helmet.	Remove CVC mike plug from helmet.	Remove CVC mike plug from helmet.
5. Insert mask mike plug in CVC helmet.	Insert mask mike plug in CVC helmet.	Insert mask mike plug in CVC helmet.	Insert mask mike plug in CVC helmet.
6. Put on CVC helmet.	Put on CVC helmet.	Put on CVC helmet.	Put on CVC helmet.
7. Close and lock TC's hatch.		Close and lock loader's hatch.	
8. Announce “CREW REPORT.”	Announce “GUNNER READY.”	Announce “LOADER READY.”	Announce “DRIVER READY.”
9. Announce "REMOVE SPRING" CLIP" (M1).	Elevate main gun to expose gas particulate filter.	Move GUN/ TURRET DRIVE switch to MANUAL position.	
		Remove spring clip from gas particulate filter.	Turn on gas particulate filter unit.
		Announce "CLIP REMOVED."	
		Move GUN/ TURRET DRIVE switch to POWERED position.	
10. Move NBC MODE MAIN switch to ON position (M1A1 and M1A2).			Move engine tactical idle switch to the ON position.
11.	Close ballistic doors.		
12. Stow CITV (M1A2).			
13. Disconnect air duct hose breakaway socket from orifice connector on tank.	Disconnect air duct hose breakaway socket from orifice connector on tank.	Disconnect air duct hose breakaway socket from orifice connector on tank.	Disconnect air duct hose breakaway socket from orifice connector on tank.
14. Connect air duct hose breakaway socket to protective mask canister coupling.	Connect air duct hose breakaway socket to protective mask canister coupling.	Connect air duct hose breakaway socket to protective mask canister coupling.	Connect air duct hose breakaway socket to protective mask canister coupling.
15. Report indirect fire and tank and crew status to platoon leader.		Adjust periscope (mirrors).	
Note. To prevent severe frostbite to the face in extremely cold weather, allow the individual heaters in the air lines to operate 15 to 20 minutes before performing steps 10 and 11. While the heaters are warming up, use respiratory protection provided by the mask canister. Use of the canister may cause slight breathing difficulty.			

Table 16-18. React to Indirect Fire—Performance Checklist.

Time: _____ (Min/Sec)		
Overall Performance: GO _____ NO-GO _____		
Performance Steps	**Crew Member**	**SM STP Task Number**
1. Announced “INCOMING.”	GO NO-GO TC: _____ _____ G: _____ _____ L: _____ _____ D: _____ _____	No task applicable
2. Dropped down into turret.	TC: _____ _____ L: _____ _____	No task applicable
3. Searched for targets.	G: _____ _____	No task applicable
4. Maintained engine rpm.	D: _____ _____	No task applicable
5. Removed CVC helmet, put on protective mask, and positioned hood.	TC: _____ _____ G: _____ _____ L: _____ _____ D: _____ _____	031-503-1035
6. Plugged in microphone, replaced CVC helmet, and announced “CREW REPORT.”	TC: _____ _____	031-503-1035
7. Plugged in microphone, replaced CVC helmet, and announced “READY.”	G: _____ _____ L: _____ _____ D: _____ _____	031-503-1035
8. Closed and locked hatches.	TC: _____ _____ L: _____ _____	No task applicable
9. Made sure hatch was closed and locked.	D: _____ _____	No task applicable
10. Announced “REMOVE SPRING CLIP” (M1).	TC: _____ _____	No task applicable
11. Moved NBC MODE MAIN switch to ON position (M1A1 and M1A2).	TC: _____ _____	No task applicable
11A. Moved the engine tactical idle switch to the ON position.	D: _____ _____	No task applicable
12. Stowed CITV (M1A2).	TC: _____ _____	No task applicable

Table 16-18 (cont.)

Performance Steps	Crew Member		SM STP Task Number
	GO	NO-GO	
13. Elevated main gun to expose gas particulate filter.	G: _____	_____	No task applicable
14. Closed ballistic doors.	G: _____	_____	No task applicable
15. Moved GUN/TURRET DRIVE switch to MANUAL position.	L: _____	_____	No task applicable
16. Removed spring clip from gas particulate filter and announced “CLIP REMOVED.”	L: _____	_____	No task applicable
17. Turned on gas particulate filter unit.	D: _____	_____	No task applicable
18. Moved GUN/TURRET DRIVE switch to POWERED position.	L: _____	_____	No task applicable
19. Disconnected air duct hose breakaway socket from orifice connector on tank.	TC: _____ G: _____ L: _____ D: _____	_____ _____ _____ _____	No task applicable
20. Connected air duct hose breakaway socket to protective mask canister coupling.	TC: _____ G: _____ L: _____ D: _____	_____ _____ _____ _____	No task applicable
21. Adjusted periscope (mirrors).	L: _____	_____	No task applicable
22. Reported indirect fire and tank and crew status to platoon leader.	TC: _____	_____	No task applicable
REMARKS: _____ _____ _____			

Table 16-19. React to Indirect Fire— Task-to-Training Product Linkage.

Task Number	Task Description	Training Product
031-503-1012	Put on, wear, remove, and store your M24 or M25-series protective mask with hood.	TM 3-4240-280-10
031-503-1028	Put on, wear, remove, and store your M42-series protective mask with hood.	TM 3-4240-300-10-2

EVADE ANTITANK GUIDED MISSILE TRAINING GUIDELINES

TASK B-7

Evade an ATGM (simulated).

CONDITIONS

- Vehicle:
  - A fully equipped, operational tank is powered up and moving.
  - All safety guards are in position.
  - Preoperation and prefire checks have been completed.
- TC's Station:
  - TC's hatch is locked in the full-open or protected-open position.
  - TC is scanning his sector.
- Gunner's Station:
  - Gunner is scanning the tank's sector of responsibility through the GPS in 3X magnification.
- Loader's Station:
  - Loader's hatch is locked in full-open position.
  - Loader is scanning his sector.
- Driver's Station:
  - Driver's hatch is locked in the closed position.
  - Driver is driving tactically.
  - Driver is monitoring driver's alert panel.
  - Driver is scanning his sector through his periscope.
- Target:
  - An ATGM launch signature (simulated) is 1,800 to 2,000 meters from tank.

STANDARDS

After ATGM launch signature (simulated), evade missile, and reach cover and concealment within eight seconds (time of flight of AT-5 SPANDREL). Each crew member must perform all of his performance steps.

CREW DRILL INSTRUCTIONS

Read the following instructions to the crew exactly as written:

"The purpose of this drill is to determine our ability to evade an ATGM. We are to maneuver our tank over this terrain. An ATGM launch signature will appear 1,800 to 2,000 meters from our position. Within eight seconds, we must evade the missile, reach cover and concealment, and provide suppressive fires, if appropriate. I will observe our actions to determine if we follow the correct procedures. Upon completion of this drill, I will review our performance. Do you have any questions concerning the administration of the drill? (Answer questions.) *Crew—prepare to begin drill."*

Table 16-20. Evade Antitank Guided Missile—Procedures Guide.

TC	Gunner	Loader	Driver
A crew member announces "MISSILE" and direction of attack, using clock method.			
1. Announce "MISSILE," and give direction of attack.	Identify target area, and listen for fire command.	Drop down into turret.	Take evasive action using radical turns and alternate speeds.
2. Brace for radical turn.	Brace for radical turn.	Brace for radical turn.	Attempt to place trees, brush, power lines, or any available obstacle between target signature and tank.
3. Secure TC's hatch (if opened).			
Announce "GRENADE LAUNCHER—(fire salvos and announce which salvo was fired, if time permits) DRIVER—SMOKE."		Make sure turret is clear. Secure loader's hatch.	* Activate VEESS and drive tank using cover of smoke.
4. Make sure driver has taken appropriate action; if not, issue appropriate commands.			Search for covered and concealed position. Notify TC when covered and concealed position is located.
5. *Issue fire command.	*Respond to fire command.	*Respond to fire command.	
*This step may not be performed every time the engagement is performed.			
6. Report actions taken and crew status to platoon leader and await further instructions.			

* Do not use VEESS if only JP4 or MOGAS are available for fuel.

Notes. If a covered and concealed position is not available, step 5 is not optional.

The more rapid the acceleration and deceleration of the tank, the more difficult it is for an enemy gunner to track the tank.

SIMULATION OPTIONS

Use a TOW missile launcher with MILES TOW tracking system to track the tank's movement. A controller can then evaluate the tank's evasive movements or effectiveness of cover and concealment. This device provides training for both tank and TOW crews.

Table 16-21. Evade Antitank Guided Missile—Performance Checklist.

Time: _____ (Min/Sec)			
Overall Performance: GO _____ NO-GO _____			
Performance Steps	**Crew Member**		**SM STP Task Number**
		GO	NO-GO
1. Announced "MISSILE," and gave direction of attack.	TC:	_____	_____	171-123-1012
	G:	_____	_____	
	L:	_____	_____	
	D:	_____	_____	
2. Dropped down into turret.	L:	_____	_____	No task applicable
3. Identified target area and listened for fire command.	G:	_____	_____	171-126-1036
4. Made sure turret was clear and secured loader's hatch..	L:	_____	_____	No task applicable
5. Braced for radical turns.	TC:	_____	_____	No task applicable
	G:	_____	_____	
	L:	_____	_____	
6. Evaded missile by driving tactically.	D:	_____	_____	171-126-1002 171-126-1136
7. Announced "DRIVER—SMOKE."	TC:	_____	_____	171-126-1002 171-126-1136
8. Activated VEESS.	D:	_____	_____	No task applicable
9. Secured hatch, announced "GRENADE LAUNCHER," and fired salvo(s).	TC:	_____	_____	171-123-1012
10. Searched for covered and concealed position. Notified TC when covered and concealed position was located, if available.	D:	_____	_____	No task applicable
11. Issued driving commands, if appropriate.	TC:	_____	_____	171-126-1002 171-126-1136
12. Responded to driving commands, if issued.	D:	_____	_____	171-126-1002 171-126-1136

Table 16-21 (cont.)

Performance Steps	Crew Member		SM STP Task Number
	GO	NO-GO	
13. Issued fire command, if appropriate.	TC : _____	_____	171-126-3009
14. Responded to fire command, if issued.	G: _____	_____	171-126-1036
	L: _____	_____	
15. Reported actions taken and crew status to platoon leader, and awaited further instructions.	TC : _____	_____	
REMARKS: _____			

Table 16-22. Evade Antitank Guided Missile— Task-to-Training Product Linkage.

Task Number	Task Description	Training Product
071-331-0804	Perform surveillance without the aid of electronic devices.	FM 21-75
171-123-1012	Evade enemy antitank guided missiles (ATGM).	FM 7-7
171-126-1002	Drive an M1 tank. Drive an M1A1 tank.	TM 9-2350-255-10-2 TM 9-2350-264-10-2
171-126-1136	Drive an M1A2 tank.	TM 9-2350-288-10-2
171-126-1036	Engage targets with the main gun from the gunner's station on an M1, M1A1, or M1A2 tank.	TM 9-2350-255-10-1/-2, TM 9-2350-264-10-1/-2, TM 9-2350-288-10-1/-2
171-126-3009	Direct machine gun engagements on an M1, M1A1, or M1A2 tank.	Chapter 9, *Machine Guns*
171-126-3010	Direct main gun engagements on an M1, M1A1, or M1A2 tank.	Chapter 8, *Direct Fire*

Tactical Table C—Crew Reaction Exercises

ENGAGE TARGETS WITH MULTIPLE WEAPONS SYSTEMS

TASK C-1

Engage targets with multiple weapon systems (TC, gunner, loader).

CONDITIONS

The tank crew is moving cross-country at 32 to 40 kmph (20 to 25 mph). The tank crew observes a disabled OPFOR wheel vehicle being worked on by two mechanics. Another OPFOR truck is moving away from the tank to its front.

OPFOR INSTRUCTIONS

The disabled OPFOR vehicle is fully exposed to the tank. The two mechanics have assault rifles and RPGs, and engage the friendly tank with rifle fire when they see it. The OPFOR truck begins to move away as soon as the tank appears. If the mechanics are still combat effective 30 seconds after the first round is fired, they will engage the tank with an RPG (the controller uses his control gun to kill the tank).

PERFORMANCE STEPS

- Crew member identifies OPFOR targets and alerts crew.
- TC initiates fire command for loader and gunner to engage with their machine guns.
- TC indicates he will be engaging with the caliber .50 machine gun.
- Gunner engages designated target with the coax machine gun until target is destroyed or TC issues a "CEASE FIRE" command.
- Loader engages designated target with the M240 machine gun until target is destroyed or TC issues a "CEASE FIRE" command.
- Driver maintains a steady firing platform.
- SPOTREP is sent to the platoon leader or platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the platoon leader or platoon sergeant.

STANDARDS

- Tank crew correctly identifies OPFOR vehicles.
- TC initiates commands to crew as soon as target acquisition is reported.
- All targets are destroyed.
- SPOTREP is sent.

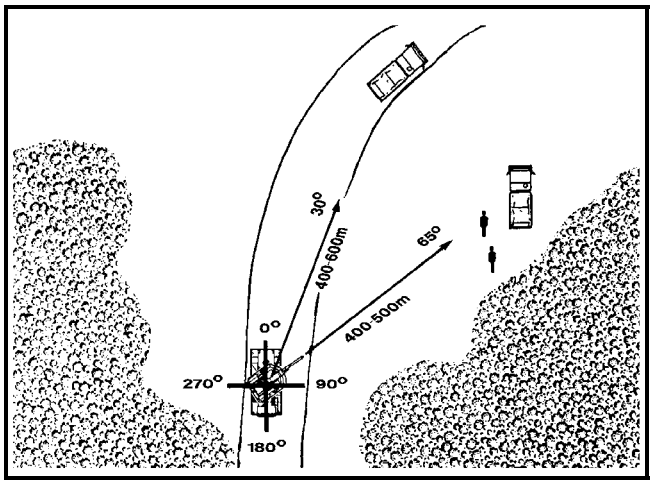


Figure 16-1. Sample Layout for Task C-1.

ENGAGE A HELICOPTER

TASK C-2

Engage a helicopter.

CONDITIONS

The tank crew is moving cross-country at 32 to 40 kmph (20 to 25 mph), when it is attacked on its right flank by an OPFOR helicopter.

OPFOR INSTRUCTIONS

OPFOR helicopter maintains concealment to the right flank of the friendly tank until friendly tank is in the open. The helicopter will then expose itself and initiate an attack run on the tank. The attack run should simulate Threat doctrine (pop up 60 to 90 meters [200 to 300 feet] above terrain and attack from a 20- to 30-degree angle with constant forward motion [no hovering]). The helicopter will fire ten seconds after it exposes itself to the tank.

PERFORMANCE STEPS

- Air guards alert crew that helicopter is attacking.
- Driver moves tank to covered and concealed location, using evasive maneuvers.
- TC initiates engagement procedures against aircraft by engaging helicopter with main gun and/or machine guns.
- Smoke systems are used to screen movement (if practical or possible).
- After destroying the hostile helicopter or forcing it to break off attack, crew resumes original mission.
- SPOTREP is sent to the platoon leader or platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the platoon leader or platoon sergeant.

STANDARDS

- Tank crew identifies helicopter correctly as OPFOR.
- Tank crew destroys or forces the OPFOR helicopter to break contact.
- SPOTREP is sent.

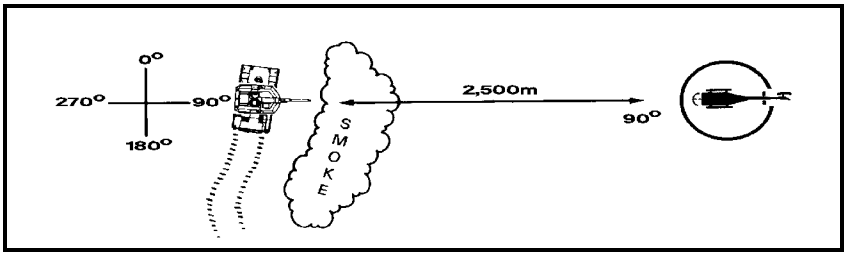


Figure 16-2. Sample Layout for Task C-2.

ENGAGE OPFOR TANKS

TASK C-3

Engage OPFOR tanks to the rear.

CONDITIONS

The tank crew is moving cross-country at 24 to 32 kmph (15 to 20 mph) when an OPFOR platoon emerges from a tree line to the tank's rear.

OPFOR INSTRUCTIONS

The OPFOR platoon (three tanks or BMPs) initially remains concealed from the friendly tank in a woodline. Once the friendly tank is 300 meters past the OPFOR platoon's position, the platoon will move out of the

woodline in the opposite direction of the friendly tank. Upon detection and engagement by the friendly tank, the OPFOR platoon will conduct evasive movements and immediately engage the friendly tank.

PERFORMANCE STEPS

- TC or loader identifies targets and alerts the crew.
- TC initiates fire command for gunner to engage targets with main gun.
- TC directs contact drill to the rear.
- (M1A2) TC designates subsequent targets using CITV.
- Smoke systems are used to screen movement (if practical or possible).
- Gunner continues to fire at targets until directed to cease fire.
- SPOTREP is sent to the platoon leader or platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the platoon leader or platoon sergeant.

STANDARDS

- Crew member identifies targets correctly as OPFOR.
- TC initiates commands to crew as soon as target acquisition is reported.
- All targets are destroyed.
- (M1A2) TC utilized target designate.
- SPOTREP is sent.

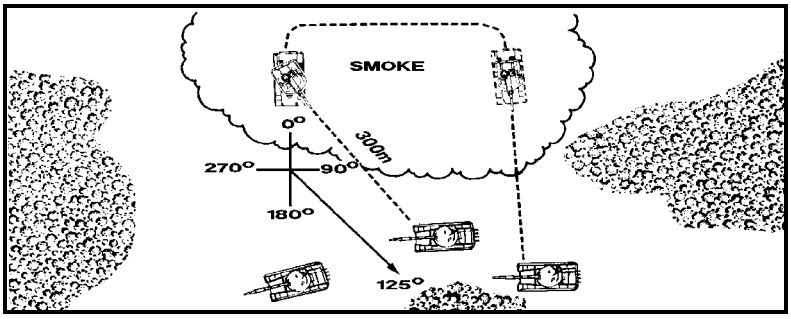


Figure 16-3. Sample Layout for Task C-3.

ENGAGE OPFOR SECURITY ELEMENT

TASK C-4

Engage OPFOR security element at close range (surprise engagement).

CONDITIONS

The tank crew, moving at 24 to 32 kmph (15 to 20 mph), is rounding a curve, skirting the woodline. An OPFOR tank, followed by an OPFOR BMP, is moving toward the friendly tank on the same road, 400 meters from the curve.

OPFOR INSTRUCTIONS

Both OPFOR vehicles initially locate 450 meters from the curve and wait for the friendly tank. When the friendly tank appears, both OPFOR vehicles will begin to move down the road toward the friendly tank. The OPFOR tank and BMP will remain on the road and engage the friendly tank within 20 seconds after detection of the friendly tank.

PERFORMANCE STEPS

- Crew member identifies OPFOR vehicles and alerts crew.
- TC initiates fire command to engage both targets.
- (M1A2) TC designates to second target, utilizing CITV.

- Gunner engages targets with main gun until both targets are destroyed or TC issues a cease fire.
- Driver maintains steady firing platform.
- SPOTREP is sent to the platoon leader or platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the platoon leader or platoon sergeant.

STANDARDS

- Crew identifies targets correctly as OPFOR.
- The *most dangerous* target is engaged first.
- (M1A2) TC utilized target designate for the *least dangerous* target.
- Both targets are destroyed.
- SPOTREP is sent.

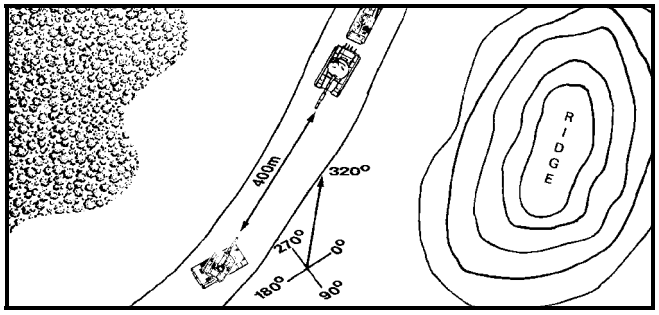


Figure 16-4. Sample Layout for Task C-4.

REACT TO AMBUSH

TASK C-5

React to an ambush.

CONDITIONS

The tank crew is moving along a road at 16 to 24 kmph (10 to 15 mph) when it encounters an obstacle (logs across road), and is fired on by an ATGM and an OPFOR squad with machine guns and rifles.

OPFOR INSTRUCTIONS

The OPFOR personnel are dug in at an ambush site. They will wait to fire until the friendly tank stops. Once the tank has stopped, the OPFOR will engage it with the ATGM (the controller should use his control gun to register a near hit on the friendly tank). The OPFOR squad will then engage the tank with all weapons. After 20 seconds, the ATGM (if still combat effective) will reengage the tank (the controller uses his control gun to kill the tank).

PERFORMANCE STEPS

- Tank crew acquires ATGM signature and gives the command "ACTION LEFT (RIGHT/FRONT/REAR)."
- TC initiates command to engage the ATGM and the OPFOR personnel.
- Smoke systems are used to screen tank movement (if practical or possible).
- Obstacle location is reported (or neutralized if time allows) before resuming the mission.
- SPOTREP is sent to the platoon leader or platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the platoon leader or platoon sergeant.

STANDARDS

- ATGM is engaged and destroyed within 20 seconds after target exposure.
- Tank initially takes evasive measures and seeks cover within 10 seconds after target exposure.

- Infantry is engaged and destroyed.
- SPOTREP is sent.

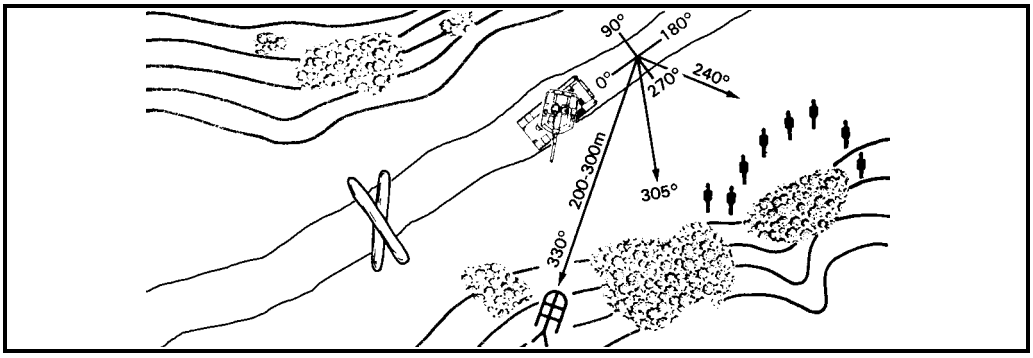


Figure 16-5. Sample Layout for Task C-5.

Tactical Table D—Battle Drills (Coordination Between Crews)

MOVE TACTICALLY USING THE WINGMAN CONCEPT

TASK D-1

Move tactically using the wingman concept.

CONDITIONS

A section, using the wingman concept, is moving tactically cross-country, participating in offensive operations.

PERFORMANCE STEPS

- Lead tank and wingman move and maintain relative positions as shown in the illustration.
- Gun tubes are oriented in assigned sectors IAW OPORD/FRAGO and/or SOP.
- (M1A2) TC utilizes CITV to scan assigned sector.
- Lead tank and wingman maintain an interval consistent with METT-TC.
- Lead tank and wingman use terrain driving techniques.
- Tank crews maintain radio-listening silence.

STANDARDS

- Both tanks move tactically, IAW METT-TC.
- 360-degree ground and air security is maintained for each tank.
- Wingman mirrors leader's movement.
- Wingman maintains visual contact with the lead tank at all times.

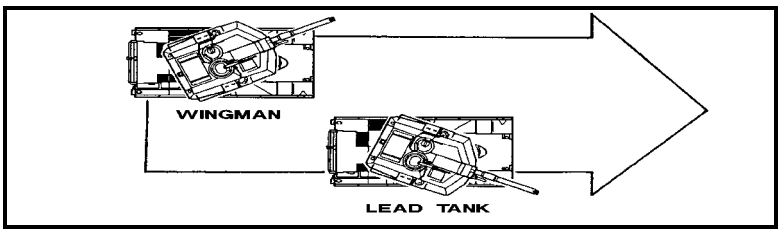


Figure 16-6. Tactical Movement Graphic for Task D-1.

EXECUTE HERRINGBONE FORMATION

TASK D-2

Execute herringbone formation.

CONDITIONS

A tank section is moving in column formation and is ordered to form a herringbone.

PERFORMANCE STEPS

- Lead tank moves to the right and oblique from the route of movement (30 to 45 degrees).
- Wingman moves to the left and oblique from the route of movement (30 to 45 degrees).
- Tanks orient gun tubes over the front slope.
- Crews maintain ground and air security.
- Crews maintain radio-listening silence.

STANDARDS

- Lead tank and wingman position themselves on both sides of the route so route is clear.
- Tanks occupy firing positions that maximize available cover and concealment.
- Crews maintain 360-degree ground and air security.

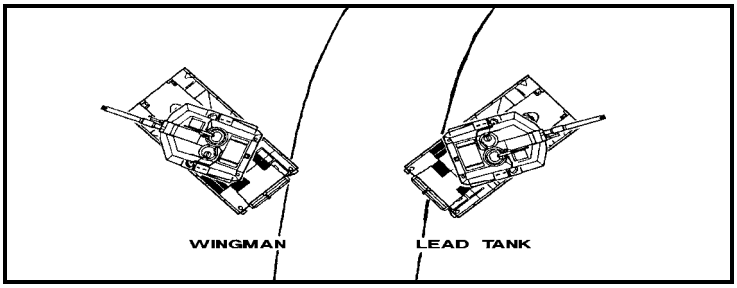


Figure 16-7. Herringbone Formation Graphic for Task D-2.

Tactical Table E—Section Battle Drills

EXECUTE ACTION DRILL

TASK E-1

Execute action drill.

CONDITIONS

A tank section is moving in formation cross-country at 32 to 40 kmph (20 to 25 mph).

PERFORMANCE STEPS

- Section leader issues contact report to section.
- Section leader gives command "ACTION LEFT (RIGHT/FRONT/ REAR)."
- The initial means of communications is FM voice.
- Section leader sends contact report to section, platoon, and company.
- (M1A2) Section leader is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- Tanks turn in direction indicated, maintaining wingman orientation.
- Tank crews prepare to fire on suspected OPFOR positions.
- (M1A2) After designating target, TC utilizes CITV to scan sector in the direction of travel.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed or bypassed.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Without delay, lead tank and wingman turn in direction indicated by command.
- Gun tubes are oriented toward likely OPFOR positions.
- (M1A2) Tank crew maintains security in assigned sector and in the direction of travel by utilizing the CITV and observation.
- Contact report and SPOTREP are sent.

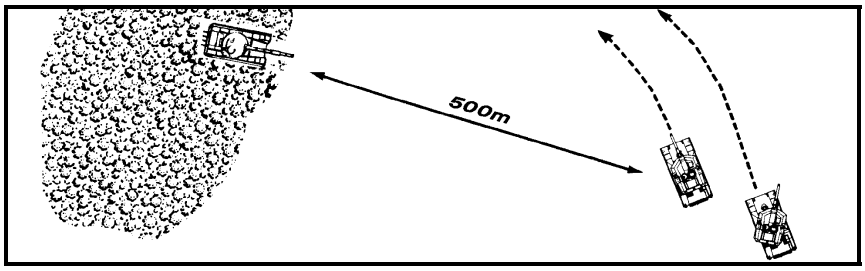


Figure 16-8. Sample Layout for Task E-1.

EXECUTE CONTACT DRILL

TASK E-2

Execute contact drill.

CONDITIONS

A tank section is moving cross-country at 32 to 40 kmph (20 to 25 mph) when it receives sniper fire (simulated). The section has been ordered to bypass the light enemy resistance.

PERFORMANCE STEPS

- Section leader gives command "CONTACT RIGHT (LEFT/FRONT/ REAR)."
- The initial means of communications is FM voice.
- (M1A2) Section leader is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- Tanks orient gun tubes in the direction indicated in the command.
- Tanks maintain original formation orientation, speed, and direction.
- Tank crews prepare to fire on suspected OPFOR position.
- (M1A2) After designating target, TC utilizes the CITV to scan sector in the direction of travel.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed or bypassed.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Without delay, tanks orient gun tubes in direction indicated in command.
- Neither tank obstructs the other's fire.
- (M1A2) Tank crew maintains security in assigned sector and in the direction of travel by utilizing the CITV and observation.
- Contact report and SPOTREP are sent.

Figure 16-9. Sample Layout for Task E-2.

REACT TO INDIRECT FIRE

TASK E-3

React to indirect fire (simulated).

CONDITIONS

A tank section is moving tactically cross-country when indirect fire (simulated) impacts near the tanks.

PERFORMANCE STEPS

- Tank crews close and lock hatches and shields.
- (M1A2) Rotate CITV to the stowed position.
- Tank crews mask IAW OPORD/FRAGO and/or METT-TC.
- Tanks increase speed and move out of the impact area, if terrain allows, or find cover in the impact area.
- Tanks maintain their wingman orientation during maneuver.
- SITREP, to include type of indirect fire and location, is sent to platoon leader.
- (M1A2) An IVIS SITREP is sent to platoon leader, to include type of indirect fire and location.

STANDARDS

- Individual protection from indirect fire is obtained.
- MOPP level dictated by unit SOP is assumed.
- Tanks maneuver out of impact area, maintaining wingman orientation, if terrain permits, or find adequate cover in the impact area.
- SITREP is sent.

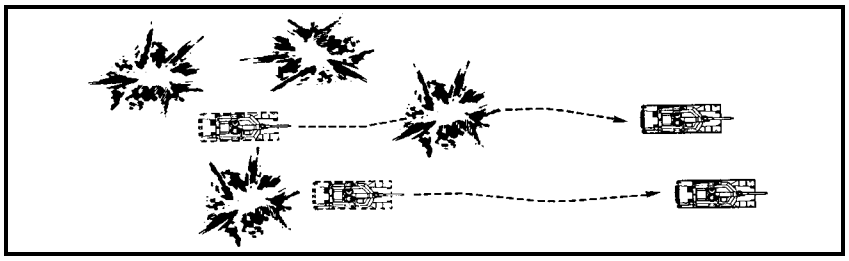


Figure 16-10. Sample Layout for Task E-3.

Tactical Table F—Section Reaction Exercises

ENGAGE MULTIPLE TARGETS

TASK F-1

Engage multiple targets with machine guns and main gun.

CONDITIONS

A tank section is moving cross-country at 40 to 48 kmph (25 to 30 mph) when it encounters an OPFOR squad on its right flank and an OPFOR BMP to its left flank, traveling away from it.

OPFOR INSTRUCTIONS

The squad is in the open, with RPGs and rifles. When both friendly tanks are exposed, the squad engages them with rifles. The squad will wait 30 seconds, then engage tanks with RPGs (controller uses control gun to kill a tank).

The OPFOR BMP will wait until the lead tank exposes itself, then begin to move away from the tanks at 8 kmph (5 mph). The BMP will wait 15 seconds after initial exposure of the tanks, then (if still combat effective) engage the tanks.

PERFORMANCE STEPS

- Crew member identifies OPFOR vehicle and troops and alerts crew, with an acquisition report.
- Contact report is sent to section leader (if wingman acquires targets).
- The initial means of communications is FM voice.
- Section leader issues fire command.
- (M1A2) Section leader is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed.
- Left tank engages BMP in his sector.
- Wingman engages troops in his sector with machine guns.
- Both tanks continue to engage remaining targets until all targets are destroyed.
- (M1A2) TC utilizes CITV to designate to the remaining target.
- After destroying all targets, the tanks resume their original mission.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Tank crews identify targets correctly as OPFOR vehicle and troops.
- Tank crews engage OPFOR targets in their sectors.
- All targets are destroyed.
- (M1A2) TC utilized target designate.
- Contact report and SPOTREP are sent.

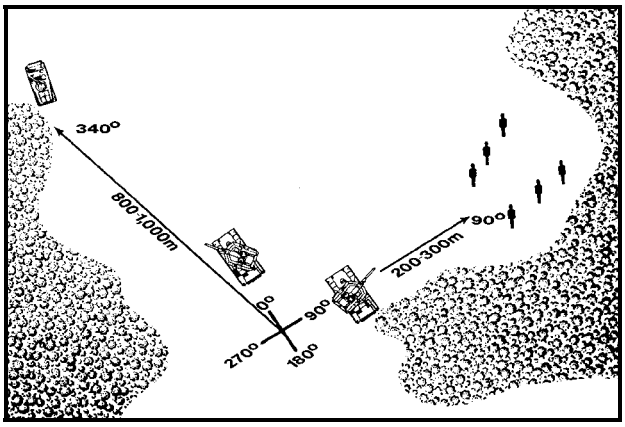


Figure 16-11. Sample Layout for Task F-1.

ENGAGE MULTIPLE MACHINE GUN TARGETS

TASK F-2

Engage multiple machine gun targets.

CONDITIONS

A tank section is moving cross-country at 32 to 40 kmph (20 to 25 mph) when it comes upon three OPFOR wheel vehicles.

OPFOR INSTRUCTIONS

The three OPFOR wheel vehicles (1/4-ton trucks or HMMWVs) are concealed from the two tanks initially. Once the tanks are in the area, the OPFOR vehicles will move in column formation parallel to and to the rear of

the movement of the tanks. The OPFOR vehicles will stay in column formation until they are engaged by the tanks. Once engaged, the OPFOR vehicles will attempt to escape.

PERFORMANCE STEPS

- Crew member identifies OPFOR vehicles and alerts crew.
- Contact report is sent to section leader (if wingman acquires targets).
- The initial means of communications is FM voice.
- Section leader issues fire command.
- (M1A2) Section leader is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed.
- Lead tank engages the lead OPFOR vehicle with machine gun.
- Rear tank engages the rear OPFOR vehicle with machine gun.
- (M1A2) TC utilizes CITV to designate remaining targets.
- After OPFOR vehicles are destroyed, the tanks resume original mission.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Tank crews identify targets correctly as OPFOR.
- All targets are destroyed.
- (M1A2) TC utilized target designate.
- Contact report and SPOTREP are sent.

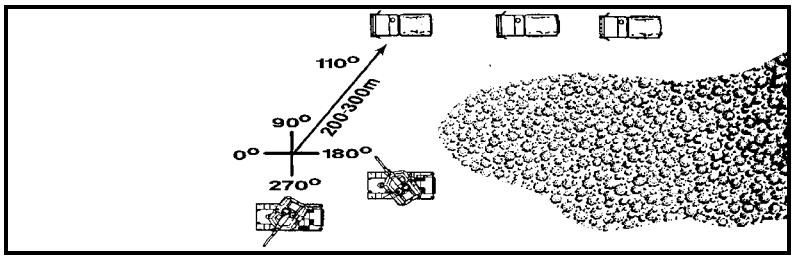


Figure 16-12. Sample Layout for Task F-2.

REACT TO AMBUSH/RECONNAISSANCE BY FIRE

TASK F-3

React to ambush/reconnaissance by fire.

CONDITIONS

A tank section is moving along a road at 32 to 40 kmph (20 to 25 mph) when the lead tank encounters an obstacle (logs across the road), and is fired on by an ATGM and an OPFOR squad (eight troops) with machine guns and rifles.

OPFOR INSTRUCTIONS

OPFOR personnel are dug in at an ambush site. They will wait to fire until both tanks come to a halt. The OPFOR will wait 15 seconds to see if the friendly tanks conduct reconnaissance by fire for possible OPFOR locations. If the tanks fire into the area where the OPFOR troops are hiding, the troops will throw a smoke grenade, and the controller will kill four OPFOR troops with his control gun. The OPFOR ATGM will wait 20 seconds after the first tank engages the troops, then engage the rear tank with the ATGM (the controller should use his control gun to register a near hit on the rear tank). The OPFOR squad will then engage both tanks with

all weapons. After 30 seconds, the ATGM (if still combat effective) will reengage the tanks (the controller uses his control gun to kill the tanks).

PERFORMANCE STEPS

- Crew member identifies obstacle and alerts crew.
- Section leader issues contact report to the wingman.
- The initial means of communications is FM voice.
- Tanks assume a herringbone formation to initiate reconnaissance of obstacle.
- Section maintains 360-degree security and conducts reconnaissance by fire for possible OPFOR locations.
- Tank acquiring ATGM signature engages ATGM and takes evasive action.
- Tank acquiring OPFOR troops engages troops and takes action IAW SOP.
- (M1A2) TC in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed.
- (M1A2) TC utilizes CITV to designate remaining targets.
- Both tanks continue to engage targets until all targets are destroyed.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Tanks take evasive action within 10 seconds after initial engagement by OPFOR troops.
- ATGM is engaged and destroyed within 20 seconds after target exposure.
- OPFOR troops are engaged and destroyed.
- (M1A2) TC utilized target designate.
- Contact report and SPOTREP are sent.

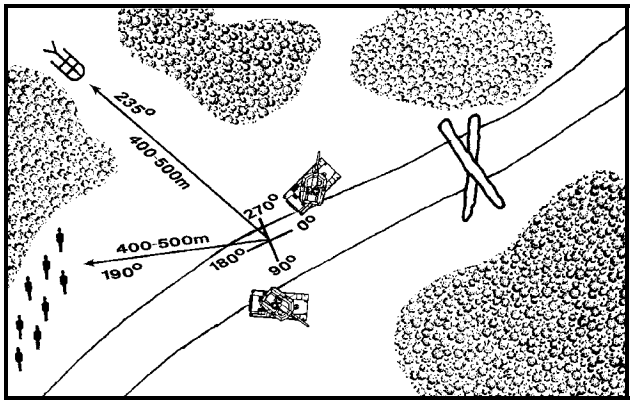


Figure 16-13. Sample Layout for Task F-3.

ENGAGE ENEMY TANK PLATOON

TASK F-4

Engage enemy tank platoon.

CONDITIONS

A tank section is moving tactically cross-country at 32 to 40 kmph (20 to 25 mph). As it emerges from behind a hill, it is engaged by an OPFOR tank platoon (three tanks) on its right flank.

OPFOR INSTRUCTIONS

OPFOR tanks will initially locate 1,200 to 1,500 meters from where the friendly tanks expose themselves to the OPFOR tanks. When the friendly tanks expose themselves, the OPFOR tanks will start moving toward the friendly tanks and engage them immediately. The OPFOR tanks will be in a line formation and will not break up their formation once the engagement starts.

PERFORMANCE STEPS

- Crew member identifies OPFOR tanks and alerts crew.
- TC in contact gives contact report.
- The initial means of communications is FM voice.
- (M1A2) TC in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed or bypassed.
- Section leader issues fire command.
- Section executes contact and/or action drills.
- Tanks engage and destroy targets within their sectors of responsibility.
- Tanks orient gun tubes in the direction given in the command.
- Tank crews identify targets in their sector.
- (M1A2) After designating target, TC scans sector with CITV in the direction of travel.
- Tanks maintain formation orientation, speed, and direction .
- (M1A2) TC utilizes CITV to designate remaining targets.
- Section employs fire and movement to develop situation.
- Section takes evasive action.
- Both tanks continue to engage remaining targets until all targets are destroyed.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the section leader.

STANDARDS

- Crews identify targets correctly as OPFOR tanks.
- Tanks engage targets within 10 seconds after initial exposure.
- OPFOR tanks are destroyed.
- (M1A2) TC utilized target designate.
- Contact report and SPOTREP are sent.

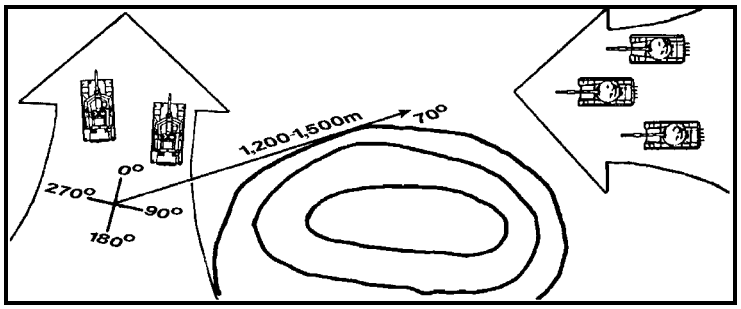


Figure 16-14. Sample Layout for Task F-4.

Tactical Table G—Battle Drills (Coordination Within Platoon)

EXECUTE COLUMN FORMATION

TASK G-1

Execute column formation.

CONDITIONS

The platoon is a part of a company conducting offensive operations. Since speed is essential, the platoon is ordered to form a column and move at high speed (48 to 56 kmph [30 to 35 mph]).

PERFORMANCE STEPS

- On command of the platoon leader, platoon moves into the column formation without delay.
- Visual contact with lead vehicle is maintained in accordance with wingman concept.
- 360-degree platoon security is maintained with main gun orientation as shown in the illustration.
- (M1A2) TC scans assigned sector with CITV.
- Platoon maintains maneuverability by dispersing laterally and in depth.

STANDARDS

- Tanks line up one behind another maintaining dispersion in depth.
- Tank intervals are maintained in accordance with platoon leader direction or unit SOP.
- Platoon maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

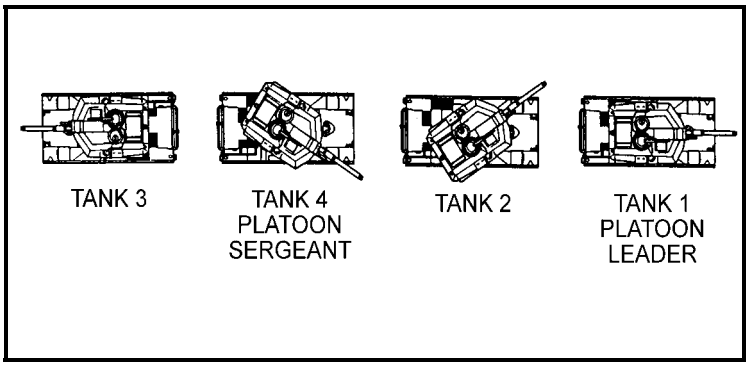


Figure 16-15. Column Formation Graphic for Task G-1.

EXECUTE PERIMETER DEFENSE

TASK G-2

Execute a perimeter defense.

CONDITIONS

The platoon is part of a company conducting offensive operations. The platoon is ordered to form a perimeter defense and redistribute ammunition.

PERFORMANCE STEPS

- Platoon leader orders the perimeter defense.
  - Uses the proper visual signals or voice command over FM.
  - Directs the lead vehicle to take up the 12 o'clock position in the current direction of travel.

  - Directs the second and third vehicles to take up the 3 o'clock and 9 o'clock positions (IAW SOP/OPORD/FRAGO).
  - Directs the trail vehicle to take up the 6 o'clock position.
  - Directs each TC to occupy covered and concealed positions (IAW METT-T and/or SOP/OPORD/ FRAGO).
- 360-degree security is maintained with main gun orientation, as shown in the illustration.
- (M1A2) TC scans assigned sector with CITV.

STANDARDS

- Tanks are positioned in coil formation.
- Tank dispersion is in accordance with platoon leader's direction or unit SOP.
- Platoon maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

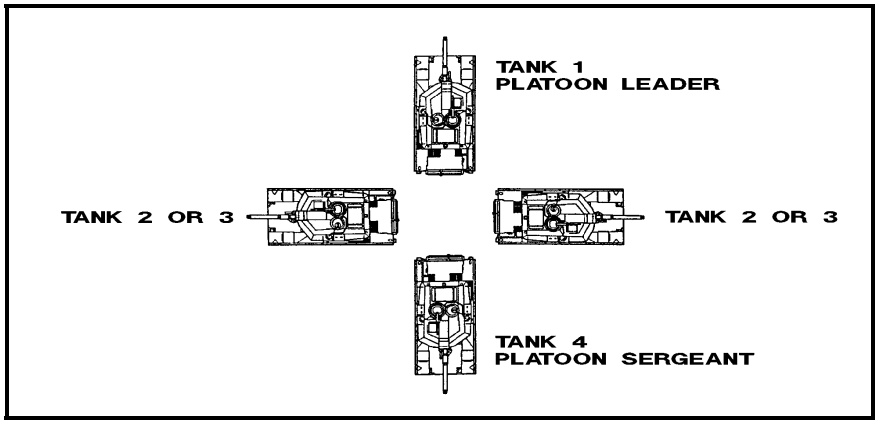


Figure 16-16. Execute Perimeter Defense Graphic for Task G-2.

EXECUTE HERRINGBONE FORMATION

TASK G-3

Execute herringbone formation.

CONDITIONS

The platoon is moving at 48 to 56 kmph (30 to 35 mph) in column formation as part of a company conducting offensive operations and is ordered to form a herringbone.

PERFORMANCE STEPS

- Platoon leader moves to the left or right and oblique from the route of movement (30 to 45 degrees).
- Tanks 2, 3, and 4 move to the left or right of route of movement, also at a 30- to 45-degree angle from the route of movement.
- Tanks orient gun tubes generally over front slope.
- Each tank maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

STANDARDS

- The tanks are positioned on both sides of the route so the route is clear.
- Tanks occupy firing positions that maximize available cover and concealment.

- Platoon maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

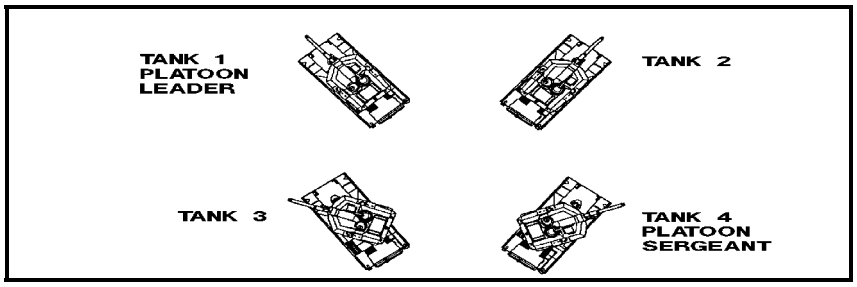


Figure 16-17. Herringbone Formation Graphic for Task G-3.

EXECUTE WEDGE FORMATION

TASK G-4

Execute wedge formation.

CONDITIONS

The platoon is moving at 48 to 56 kmph (30 to 35 mph) in a column formation as part of a company conducting offensive operations. In anticipation of contact, the platoon leader orders the platoon to form a wedge.

PERFORMANCE STEPS

- On command of the platoon leader, platoon moves into wedge formation.
- Visual contact is maintained in accordance with wingman concept.
- Platoon maintains maneuverability by dispersing laterally and in depth.
- Each tank maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

STANDARDS

- Tanks are positioned in wedge formation.
- Tank intervals are maintained in accordance with the platoon leader's direction or unit SOP.
- Platoon maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

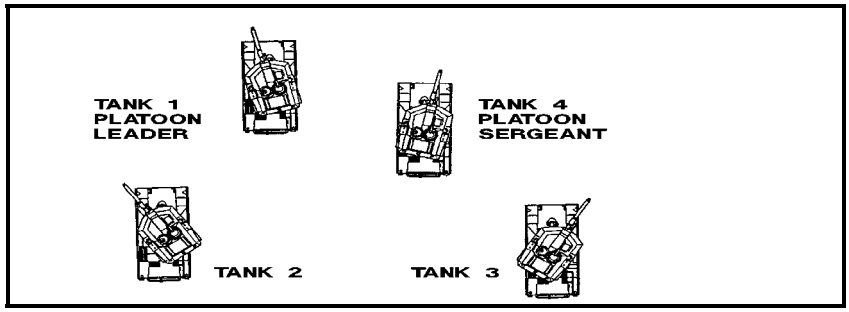


Figure 16-18. Wedge Formation Graphic for Task G-4.

EXECUTE LINE FORMATION

TASK G-5

Execute line formation.

CONDITIONS

The platoon is part of a company conducting operations in the deep attack. The platoon is ordered to assault an enemy observation post.

PERFORMANCE STEPS

- Platoon moves into a line formation without delay.
- Visual contact is maintained between tanks.
- Platoon maintains maneuverability by dispersing laterally and in depth.
- Each tank maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

STANDARDS

- Tanks are aligned laterally, maintaining dispersion.
- Lateral dispersion is in accordance with platoon leader's direction or unit SOP.
- Platoon maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

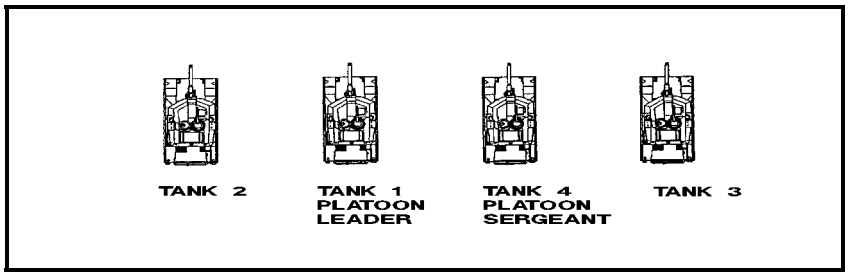


Figure 16-19. Line Formation Graphic for Task G-5.

EXECUTE BOUNDING OVERWATCH

TASK G-6

Execute bounding overwatch.

CONDITIONS

The platoon is moving in a wedge formation as part of a company conducting offensive operations. METT-TC forces the platoon to use bounding overwatch.

PERFORMANCE STEPS

- Bounding section initiates movement on order from the platoon leader/platoon sergeant, without delay, moving on covered and concealed route to next overwatch position.
- Visual contact is maintained between tanks in a section and between bounding and overwatch sections.
- Each tank maintains 360-degree security.
- (M1A2) TC scans assigned sector with CITV.

STANDARDS

- Bounding section moves using covered and concealed routes; crew continues to search for enemy targets.
- Overwatch section positions itself to provide good fields of fire and, when available, cover and concealment.
- Platoon maintains 360-degree security.

- (M1A2) TC scans assigned sector with CITV.
- Main guns are oriented toward likely OPFOR positions.

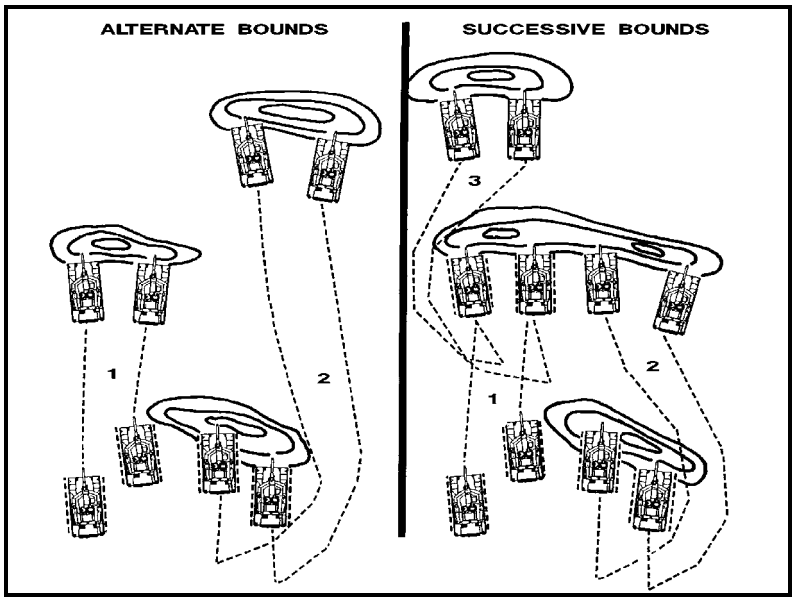


Figure 16-20. Bounding Overwatch Graphic for Task G-6.

Tactical Table H—Platoon Battle Drills

EXECUTE ACTION DRILL

TASK H-1

Execute action drill.

CONDITIONS

The platoon is the lead platoon of a company conducting offensive operations. The platoon is moving cross-country in a wedge formation at 32 to 40 kmph (20 to 25 mph) when it receives antitank fire (simulated).

PERFORMANCE STEPS

- Platoon leader issues contact report to platoon.
- Platoon leader gives command "ACTION LEFT (RIGHT/FRONT/ REAR)."
- The initial means of communications is FM voice.
- (M1A2) TC in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- Tanks turn in direction indicated, maintaining wingman orientation.
- Crews prepare to fire on suspected OPFOR positions.
- (M1A2) After designating target, TC scans sector with CITV in the direction of travel.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Without delay, platoon turns in direction indicated by command.
- Gun tubes are oriented toward likely OPFOR positions.

- Tanks maintain their relative position within the formation.
- Contact report and SPOTREP are sent.

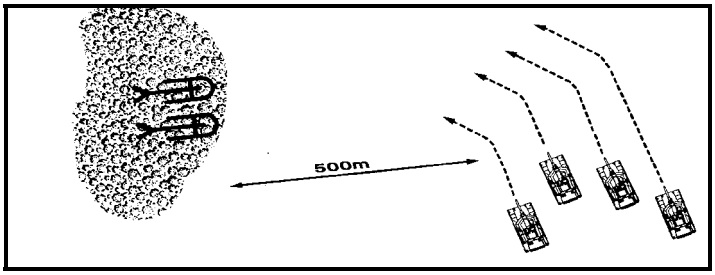


Figure 16-21. Sample Layout for Task H-1.

EXECUTE CONTACT DRILL

TASK H-2

Execute contact drill.

CONDITIONS

The platoon is the lead platoon of a company conducting offensive operations. The platoon is moving cross-country in a wedge formation at 32 to 40 kmph (20 to 25 mph) when it receives small arms (simulated).

PERFORMANCE STEPS

- Platoon leader gives command "CONTACT RIGHT (LEFT/FRONT/ REAR)."
- The initial means of communications is FM voice.
- (M1A2) TC in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- Tanks orient gun tubes in the direction given in the command.
- Tanks maintain original formation orientation, speed, and direction.
- Crews prepare to fire on suspected OPFOR position.
- (M1A2) After designating target, TC scans sector with CITV in the direction of travel.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed or bypassed.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Without delay, platoon orients gun tubes in direction indicated in the command.
- Crews maintain 360-degree security.
- Individual tank fire is not obstructed by other friendly tanks.
- Contact report and SPOTREP are sent.

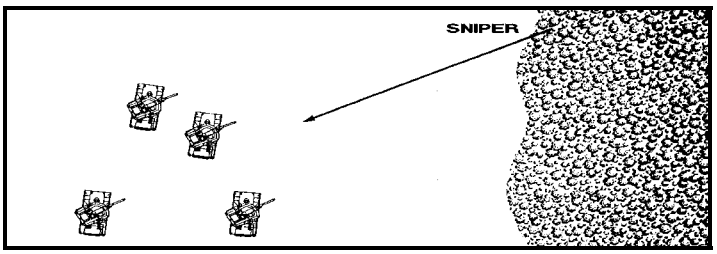


Figure 16-22. Sample Layout for Task H-2.

EXECUTE AIR ATTACK DRILL

TASK H-3

Execute air attack drill.

CONDITIONS

The platoon is the lead platoon of a company conducting offensive operations. The platoon is moving cross-country in a wedge formation at 32 to 40 kmph (20 to 25 mph) when an OPFOR helicopter (simulated) is sighted. An air attack drill is initiated by the platoon. The platoon executes passive or active air defense measures and prevents the aircraft from effectively engaging the platoon.

PERFORMANCE STEPS

- Air guards alert platoon upon acquiring helicopter.
- Platoon leader issues contact report to platoon.
- The initial means of communications is FM voice.
- (M1A2) TC in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon.
- If the platoon leader determines that the platoon is not in the direct path of an attacking aircraft, he initiates the *Passive React to Air Attack Drill*, which entails these actions:
  - Deploy or take the appropriate actions. If the platoon is not in the direct path of an attacking aircraft, the platoon leader orders tanks to seek cover and concealment and halt with at least a 100-meter interval between vehicles; the platoon also may be ordered to continue moving as part of the company.
  - Prepare to engage. TCs and loaders get ready to engage the aircraft with machine gun or main gun fire on order of the platoon leader.
- If the platoon leader determines that the platoon is in the direct path of an attacking aircraft, he initiates the *Active React to Air Attack Drill*, which entails these actions:
  - The platoon initiates fire. Machine gun volume is the key to effectiveness of these fires; tanks throw up a *wall of steel,* through which aircraft must fly. The platoon leader may also direct some vehicles to engage with MPAT main gun rounds.
  - Tanks create a nonlinear target by moving as fast as possible at a 45-degree angle away from the path of flight and toward attacking aircraft (see FM 3-20.15 [FM 17-15], Chapter 3). The platoon maintains an interval of at least 100 meters between tanks, forcing aircraft to make several passes to engage the entire platoon.
  - Tanks move quickly to covered and concealed positions and freeze their movement for at least 60 seconds after the last flight of aircraft has passed.
- SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.

STANDARDS

- Platoon reacts without delay.
- Tanks move obliquely to the direction of movement.
- Dispersion between tanks is increased.

- Tank crews prepare to fire in the general direction of the reported air attack.
- Contact report and SPOTREP are sent.

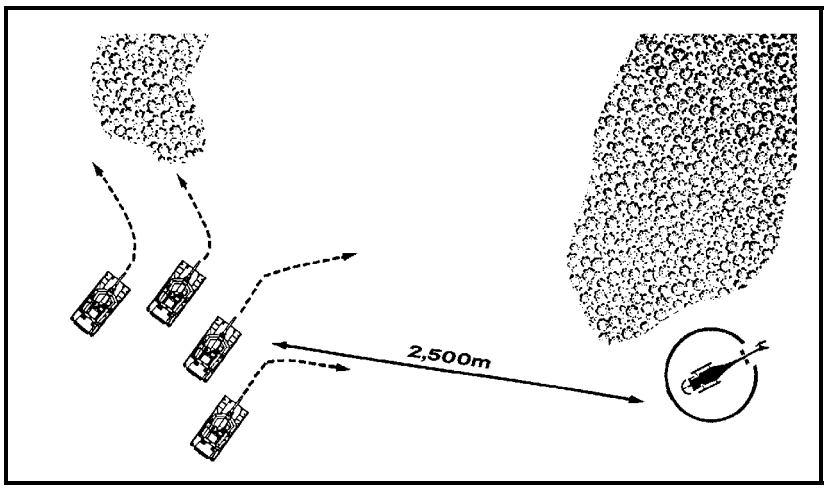


Figure 16-23. Sample Layout for Task H-3.

REACT TO INDIRECT FIRE

TASK H-4

React to indirect fire.

CONDITIONS

The tank platoon is operating as part of a company conducting offensive operations. The platoon is in a wedge formation moving tactically cross-country at 32 to 40 kmph (20 to 25 mph). The platoon receives indirect fire (simulated).

PERFORMANCE STEPS

- TCs place their hatches in the open-protected position; other crewmen close their hatches.
- Crews also close ballistic doors (M1A2 crews stow the CITV).
- Crews assume MOPP level dictated by unit SOP.
- The platoon leader sends a SPOTREP to the commander.
- If the platoon is moving when it receives suppressive artillery fire, it executes an *action drill* to avoid the impact area or continues to move to clear the impact area and continue the mission.
- Tanks maintain their wingman orientation during maneuver.
- If it is stationary, the platoon should attempt to clear the impact area.
- Once the platoon clears the artillery impact area, individual crews place their hatches in the appropriate position, open ballistic doors (M1A2 crews turn on the CITV), check antennas, and return to positions or continue the mission.
- A SITREP is sent to the higher to include type of indirect fire and location.
- (M1A2) An IVIS SITREP, to include type of indirect fire and location, is sent to the higher.

STANDARDS

- SPOTREP is sent.
- Crews assume MOPP level dictated by unit SOP.

- Tanks maneuver out of area, maintaining wingman orientation as terrain permits.
- SITREP was sent.

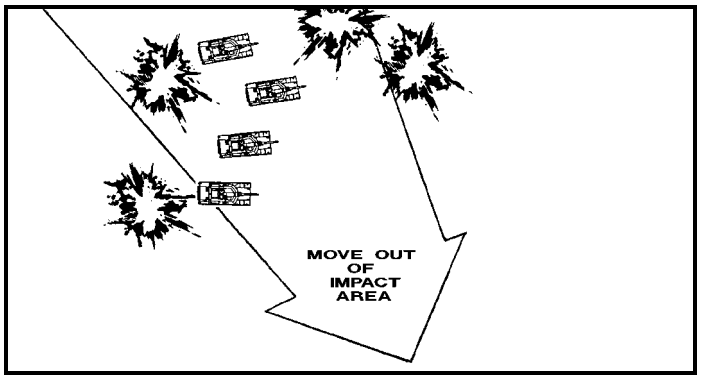


Figure 16-24. Sample Layout for Task H-4.

Tactical Table I—Platoon Reaction Exercises

ENGAGE MULTIPLE MACHINE GUN TARGETS

TASK I-1

Engage multiple machine gun targets.

CONDITIONS

A tank platoon is operating as part of a company conducting offensive operations. The tank platoon is the lead platoon and is moving cross-country in a wedge formation at 32 to 40 kmph (20 to 25 mph). As the tank platoon comes out of a woodline, it makes contact with several (no less than three) OPFOR infantry squads and two BMPs in an assembly area.

OPFOR INSTRUCTIONS

The squads are armed with machine guns, rifles, and RPGs. They are on the edge of a clearing, in the process of digging foxholes and preparing fighting positions. The two BMPs are also on the edge of the clearing, and the crews are putting camouflage on their vehicles. They will engage the friendly tank platoon with all weapons as soon as all four tanks are in the clearing. The squads will not move into the woodline, but may move into foxholes. The BMPs will not move.

PERFORMANCE STEPS

- Platoon leader gives command "CONTACT RIGHT (LEFT/FRONT/ REAR)."
  - Platoon leader gives action drill (if appropriate).
  - The initial means of communications is FM voice.
  - (M1A2) Section leader in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- The platoon leader issues a platoon fire command, as appropriate.
- Tank crews identify targets in their sector.
- Tanks orient gun tubes in the direction given in the command.
- Tanks engage and destroy targets within their sectors of responsibility.
- (M1A2) After designating target, TC scans sector with CITV in the direction of travel.
- Tanks maintain formation orientation, speed, and direction.
- Platoon employs fire and movement to develop situation.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed or bypassed.

- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- SPOTREP is sent to commander, and platoon resumes original mission.

STANDARDS

- Tank crews identify targets in their sector of responsibility.
- Section fire commands are given.
- *Most dangerous* targets (BMPs) are engaged first.
- All targets are destroyed.
- Contact report and SPOTREP are sent.

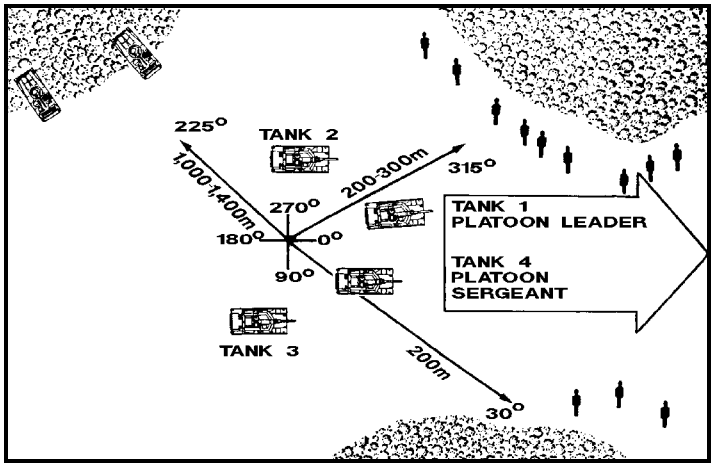


Figure 16-25. Sample Layout for Task I-1.

ENGAGE MULTIPLE TARGETS (OPFOR REGIMENTAL CP)

TASK I-2

Engage multiple targets (OPFOR regimental CP).

CONDITIONS

A tank platoon is operating as part of a tank company conducting offensive operations. The tank platoon is the lead platoon and is moving cross-country in a wedge formation at 32 to 40 kmph (20 to 25 mph). As the tank platoon comes over a hill, it makes contact with a stationary OPFOR regimental CP (five BMPs and four tanks).

OPFOR INSTRUCTIONS

The regimental CP will locate 600 to 800 meters from the crest of the hill that the friendly tank platoon is expected to come over. The BMPs will be clustered (as in a tactical operations center configuration), and the tanks will be circled around the BMPs to provide protection. The BMPs and tanks will fire ten seconds after they are engaged by the friendly tank platoon. The tanks may move to engage the friendly tanks, but the BMPs will remain stationary throughout the engagement.

PERFORMANCE STEPS

- Platoon leader gives command "CONTACT RIGHT (LEFT/FRONT/ REAR)."
  - Platoon leader gives action drill (if appropriate).
  - The initial means of communications is FM voice.
  - (M1A2) Section leader in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon and company.
- Platoon leader issues the platoon fire command, as appropriate.

- Tank crews identify targets in their sector.
- Tanks orient gun tubes in the direction given in the command.
- Tanks engage and destroy targets within their sectors of responsibility.
- (M1A2) After designating target, TC scans sector with CITV in the direction of travel.
- Tanks maintain formation orientation, speed, and direction.
- Platoon employs fire and movement to develop situation.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed or bypassed.
- (M1A2) An IVIS SPOTREP is sent to the commander by the platoon leader or the platoon sergeant.
- SPOTREP is sent to commander, and platoon resumes original mission.

STANDARDS

- Without delay, platoon orients gun tubes and hulls (if appropriate) in direction indicated in the command.
- Platoon leader issues fire command.
- Tank crews identify targets.
- Individual tank fire is not obstructed by other friendly tanks.
- All targets are destroyed.
- Contact report and SPOTREP are sent.

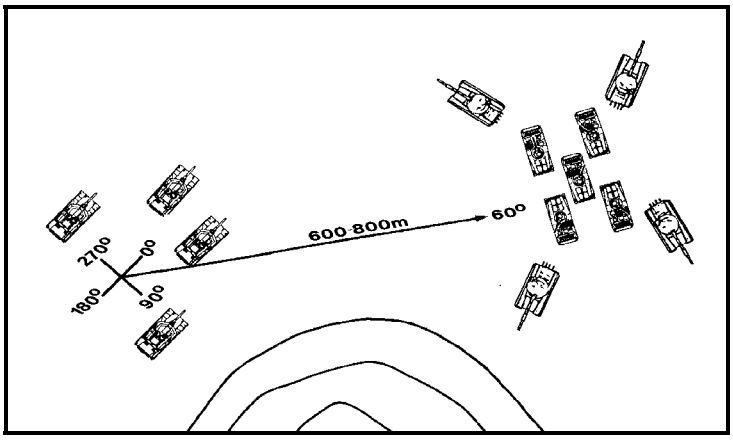


Figure 16-26. Sample Layout for Task I-2.

ENGAGE A HELICOPTER

TASK I-3

Engage a helicopter.

CONDITIONS

A friendly tank platoon is operating as part of a company in the deep attack. The platoon is the lead platoon and is moving cross-country in a wedge formation. The platoon is crossing an open area when it is attacked by an OPFOR helicopter (HIND-D) from its right flank. The platoon executes passive air defense measures and prevents the aircraft from effectively engaging the platoon.

OPFOR INSTRUCTIONS

The helicopter remains concealed to the right flank of the tank platoon until it moves into the open. The helicopter will then expose itself and make an attack run on the tank platoon. The attack run should simulate Threat doctrine (pop up 60 to 90 meters [200 to 300 feet] above terrain and attack from a 20- to 30-degree

angle with constant forward motion [no hovering]). The helicopter will fire ten seconds after it exposes itself to the platoon.

PERFORMANCE STEPS

- The vehicle or individual identifying the enemy aircraft alerts the platoon with a contact report containing the following elements:
  - "CONTACT."
  - "BANDIT(s)."
  - "NORTH, EAST, WEST, SOUTH" (cardinal direction).

Note. Tank commanders and loaders prepare to engage aircraft with a high volume of machine gun fire (M1A1/M1A2 use the MPAT round, if available) on order of the platoon leader. (Hovering helicopters may be engaged with the main gun.)

- The platoon leader determines whether the platoon is or is not the target and/or in the direct path of the enemy aircraft and, based on the OPORD, orders the platoon to seek cover and concealment, maintaining a minimum of 100 meters between vehicles, and halt.
- Tank commanders prepare to engage on order from the platoon leader.
- All platoon members scan for follow-on aircraft. (M1A2: TC use the CITV opposite the gunner's sector.)

Note. The platoon may be ordered to continue movement by the commander.

- Platoon leader/sergeant sends SPOTREP (voice/digital) to the commander.
- Platoon destroys helicopter (with main gun fire) or forces helicopter to break off attack.
- After destroying or evading the helicopter, platoon resumes original mission.

STANDARDS

- Tank crews identify helicopter.
- Crews maintain 360-degree security.
- Platoon leader issues fire command.
- Platoon executes evasive action.
- Aircraft is destroyed or forced to break off attack within ten seconds.

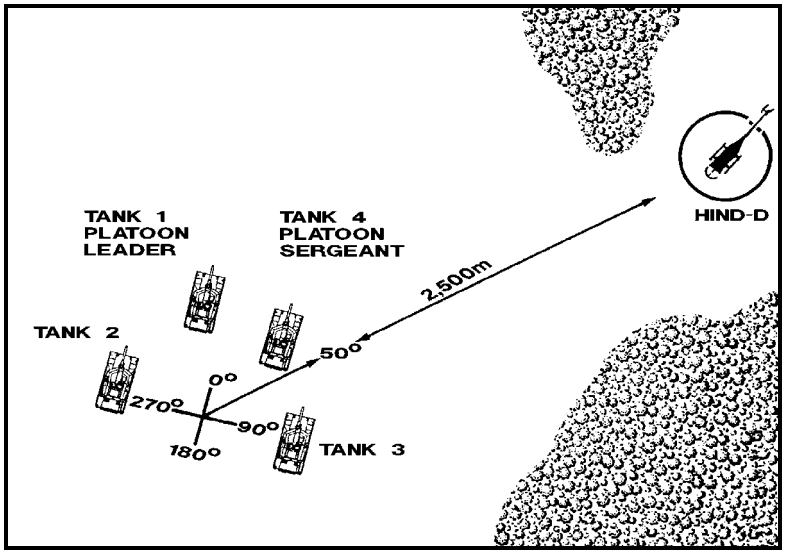


Figure 16-27. Sample Layout for Task I-3.

REACT TO AMBUSH

TASK I-4

React to ambush.

CONDITIONS

A friendly tank platoon is operating as part of a company in the deep attack. The platoon is the lead platoon of a company in a high-speed, tactical road march in column formation. The platoon encounters an obstacle (logs across road) and is fired on by two ATGMs and an OPFOR infantry squad armed with machine guns and rifles.

OPFOR INSTRUCTIONS

Personnel are dug in at an ambush site. They will wait to fire until the tank platoon comes to a halt. The OPFOR will wait 15 seconds to see if the friendly tanks conduct reconnaissance by fire for possible OPFOR locations. If the tanks fire into the area where the OPFOR troops are hiding, the OPFOR will throw a smoke grenade and the controller will kill four OPFOR troops or one ATGM with his control gun. The OPFOR ATGMs will wait 20 seconds, then engage the front and rear tank. (The controller will use his control gun to register two near hits on the tank platoon.) The OPFOR squad will then engage the platoon with all weapons. Thirty seconds after initial friendly tank exposure, the ATGMs (if still combat effective) will reengage the platoon (the controller uses his control gun to kill the tanks).

PERFORMANCE STEPS

- Crew member identifies obstacle and alerts crew.
- The TC that makes initial contact reacts as appropriate.
  - If contact entails enemy antitank fire, the TC returns fire immediately to destroy or suppress the enemy.
  - The TC immediately alerts the platoon with a contact report.
- (M1A2) TC in contact is responsible for designating the target with the LRF and transmitting the IVIS contact report digitally to the platoon.
- (M1A2) All subsequent tactical reporting is accomplished by FM voice until the enemy is destroyed or bypassed.
- Tanks take evasive actions to seek cover and concealment to evade antitank fire.
- Platoon leader deploys the platoon based on the appropriate situation.
  - Platoon leader initiates a battle drill (this is usually a contact or action drill, with the platoon attempting to acquire and engage the enemy). Platoon leader gives command "CONTACT RIGHT (LEFT/FRONT/REAR)."
- Tanks orient gun tubes in the direction given in the command.
- Tank crews acquire ATGM signature and identify target.
- TCs activate on-board smoke, as appropriate.
- Tank platoon conducts reconnaissance by fire for possible OPFOR locations.
- (M1A2) After designating target, TC scans sector with CITV for additional targets.
- Platoon leader or the platoon sergeant sends SITREP and/or SPOTREPs (voice/digital).

STANDARDS

- Tank platoon takes evasive action within 10 seconds after initial target exposure.
- ATGMs are destroyed.
- Enemy troops are suppressed or destroyed.

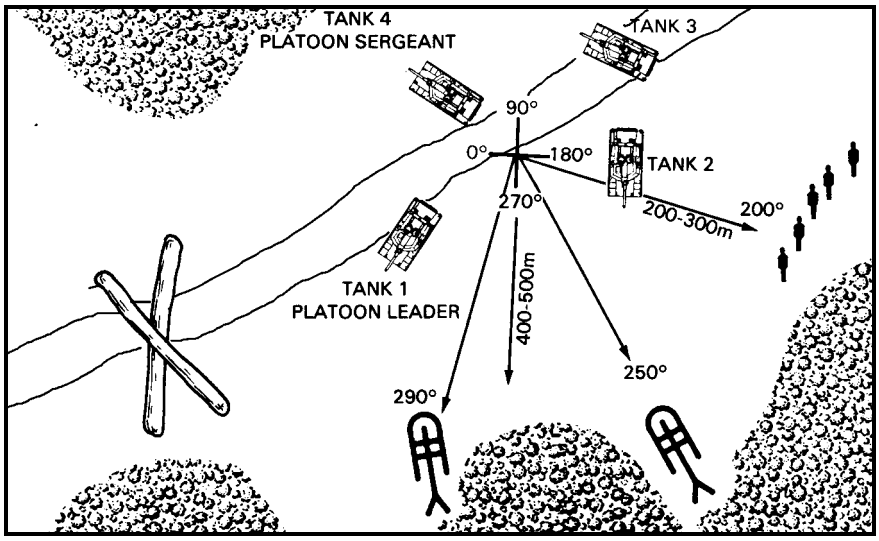


Figure 16-28. Sample Layout for Task I-4.

CONDUCT A PLATOON DEFENSE

TASK I-5

Conduct a platoon defense.

CONDITIONS

A tank platoon is operating as part of a company conducting a delay. It has received a report that an OPFOR motorized rifle regiment is moving into its area. The friendly tank platoon has just established a hasty BP. Twenty minutes after occupying the BP, it encounters elements of the OPFOR reconnaissance elements (one squad and three BMPs).

OPFOR INSTRUCTIONS

The squad will break up into two fire teams and locate on the right and left flank, 300 meters from the platoon's BP. The troops will be armed with RPGs, rifles, and grenades. They will remain in covered and concealed areas and wait for 20 minutes after the tank platoon has moved into the BP. The OPFOR infantry will then stand up and attack toward the platoon BP. They will continue to move until engaged by the tank platoon. They will wait five seconds then return fire. The three BMPs will remain concealed on the tank platoon's left front flank until they hear the squad being engaged. They will then begin movement toward the BP. The BMPs will not fire until engaged by the tank platoon. Once engaged, they can conduct evasive movements and fire back.

PERFORMANCE STEPS

The platoon leader—

- Controls fires by issuing a fire command that will, at a minimum, include alert, description, location, control (optional command), and execution.
- Issues the fire command upon—
  - Individual TC reporting that his crew is engaging OPFOR targets.
  - Section leader reporting that his section is engaging an OPFOR target array.
  - Platoon or section leader observing target array and determining that OPFOR are to be fired on.

  - Platoon or section leader receiving SPOTREP (voice or digital) from TC and determining OPFOR are to be fired on.
- Employs indirect fire (as appropriate).

The platoon—

- Distributes fires so—
  - Each crew engages the *most dangerous* target in the sector of fire designated to it in the platoon fire command:
    - Tank 1 or 2 engages troops on left flank.
    - Tank 1, 2, or 4 engages BMPs.
    - Tank 3 or 4 engages troops on right flank.
  - Each crew follows the controls specified in the fire command:
    - Number and type of rounds fired.
    - Target array identified.
    - Type of target to be engaged (if engagement priorities are specified).
    - Firing in accordance with its responsibilities in the fire pattern specified.
    - Commences firing only on the command of execution (unless fires by the crew initiated the platoon engagement).
- Avoids target overkill by—
  - Shifting fires once a target has been destroyed.
  - Sensing target misses (TCs) and relaying those sensings and appropriate corrections to the firing tank.
  - Using appropriate force to destroy identified targets (two friendly tanks deal with two OPFOR vehicles).

STANDARDS

- Destroys or suppresses all OPFOR infantry.
- Destroys BMPs.
- Sends SPOTREP to commander.
- Platoon leader/platoon sergeant uses vehicle smoke, and/or indirect fire IAW OPORD/FRAGO and/or METT-TC.

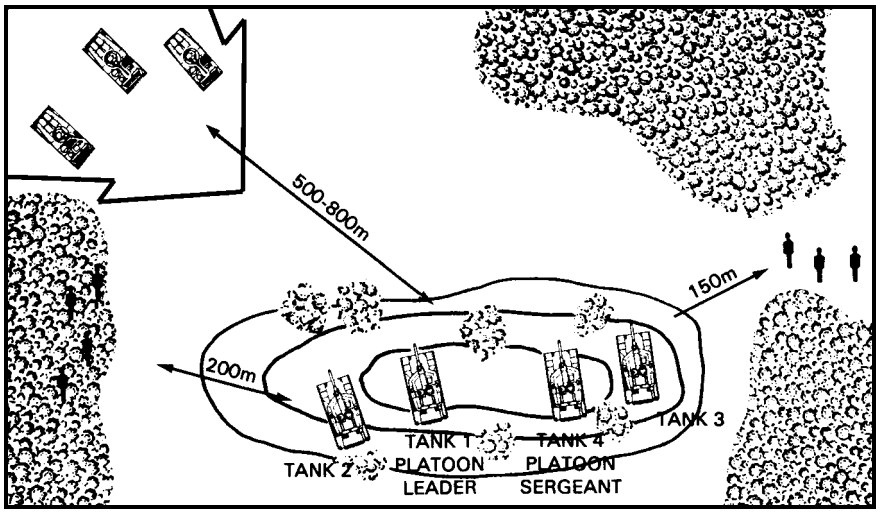


Figure 16-29. Sample Layout for Task I-5.

Appendix
Risk Management

Risk is the chance of injury or death for individuals and damage to or loss of vehicles and equipment. Risks, and/or the potential for risks, are always present in every combat and training situation the tank platoon faces. Risk management must take place at all levels of the chain of command during each phase of every operation; it is an integral part of tactical planning. The tank platoon leader, his NCOs, and all other platoon soldiers must know how to use risk management, coupled with fratricide reduction measures, to ensure that the mission is executed in the safest possible environment within mission constraints.

The primary objective of risk management is to help units protect their combat power through accident prevention, enabling them to win the battle quickly and decisively, with minimum losses. This appendix outlines the process that leaders can use to identify hazards and implement a plan to address each identified hazard. It also includes a detailed discussion of the responsibilities of the platoon's leaders and individual soldiers in implementing a sound risk management program. For additional information on risk management, refer to FM 100-14.

CONTENTS

Risk Management Procedures

This section outlines the five steps of risk management. Leaders of the tank platoon must always remember that the effectiveness of the process depends on situational awareness. They should never approach risk management with "one size fits all" solutions to the hazards the platoon will face. Rather, in performing the steps, they must keep in mind the essential tactical and operational factors that make each situation unique.

There are two types of hazards: tactical and accident. Tactical hazards deal with hazards imposed upon us by the threat (such as ATGM positions or untemplated threat positions on our flanks). Accident hazards are those hazards imposed upon us due to terrain, weather, or mission requirements (such as traveling an unimproved road at night in a snow storm).

STEP 1 - IDENTIFY HAZARDS

A hazard is a source of danger. It is any existing or potential condition that could entail injury, illness, or death of personnel; damage to or loss of equipment and property; or some other sort of mission degradation. Tactical and training operations pose many types of hazards.

The tank platoon leader must identify the hazards associated with all aspects and phases of the platoon's mission, paying particular attention to the factors of METT-TC. Risk management must never be an afterthought; leaders must begin the process during their troop-leading procedures and continue it throughout the operation.

Figure A-1 lists possible sources of risk that the tank platoon might face during a typical tactical operation. The list is organized according to the factors of METT-TC.

SOURCES OF BATTLEFIELD RISK
MISSION • Duration of the operation. • Complexity/clarity of the plan. (Is the plan well developed and easily understood?) • Proximity and number of maneuvering units.
ENEMY • Knowledge of the enemy situation. • Enemy capabilities. • Availability of time and resources to conduct reconnaissance.
TERRAIN AND WEATHER • Visibility conditions, including light, dust, fog, and smoke. • Precipitation and its effect on mobility. • Extreme heat or cold. • Additional natural hazards (broken ground, steep inclines, water obstacles).
TROOPS • Equipment status. • Experience the units conducting the operation have working together. • Danger areas associated with the platoon's weapon systems. • Soldier/leader proficiency. • Soldier/leader rest situation. • Degree of acclimatization to environment. • Impact of new leaders and/or crew members.
TIME AVAILABLE • Time available for troop-leading procedures and rehearsals by subordinates. • Time available for PCCs/PCIs.
CIVILIAN CONSIDERATIONS • Applicable ROE and/or ROI. • Potential stability and/or support operations involving contact with civilians (such as NEOs, refugee or disaster assistance, or counterterrorism). • Potential for media contact/inquiries.

Figure A-1. Examples of potential hazards.

STEP 2 - ASSESS HAZARD TO DETERMINE RISKS

Hazard assessment is the process of determining the direct impact of each hazard on an operation (in the form of hazardous incidents). Use the following steps:

- Determine which hazards can be eliminated or avoided.
- Assess each hazard that cannot be eliminated or avoided to determine the probability that the hazard can occur.
- Assess the severity of hazards that cannot be eliminated or avoided. Severity, defined as the result or outcome of a hazardous incident, is expressed by the degree of injury or illness (including death), loss of or damage to equipment or property, environmental damage, or other mission-impairing factors (such as unfavorable publicity or loss of combat power).
- Taking into account both the probability and severity of a hazard, determine the associated risk level (extremely high, high, moderate, and low). Figure A-2 summarizes the four risk levels.
- Based on the factors of hazard assessment (probability, severity, and risk level, as well as the operational factors unique to the situation), complete the risk management worksheet. Figure A-3 outlines the risk assessment matrix used to determine the level of risk. Figure A-4 shows an example of a risk management worksheet that can be used in lieu of the risk assessment matrix.

LEVELS OF RISK	
Extremely High	Someone will die or suffer permanent disability.
High	More often than not, someone will suffer an injury that requires less than 3 months to heal.
Moderate	More often than not, someone will require first aid or minor medical treatment.
Low (Worst Case)	Someone is likely to need first aid or minor medical treatment.

Figure A-2. Risk levels and impact on mission execution.

RISK ASSESSMENT MATRIX					
	Probability				
Severity	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L
E - Extremely High Risk H - High Risk			M - Moderate Risk L - Low Risk		

Figure A-3. Risk assessment matrix.

Risk Management

RISK MANAGEMENT WORKSHEET

1. Organization and Unit Location:					2. Page		of	
3. Mission/Task:			4. Begin Date:		5. End Date:		6. Date Prepared:	
7. Operational Phase in which the Mission/Task will be conducted:								
8. Prepared by: (Name/Rank/Duty Position)								

9. Identify Hazards	10. Assess the Hazards & Determine Initial Risk Level				11. Develop Controls & Make Decisions (Specific measures taken to reduce the probability and severity of a hazard)	12. Determine Residual Risk Level				13. Implement Controls (Include SOPs, References, OPORD, etc.)	14. Supervise and Evaluate (Continuous, Leader Checks, Buddy System, AAR, etc.)
(Be Specific)	L	M	H	E	(Be Specific)	L	M	H	E	(Be Specific)	(Be Specific)

15. Remaining Risk Level After Countermeasures Are Implemented: (CIRCLE HIGHEST REMAINING RISK LEVEL) →	LOW	MEDIUM	HIGH	EXTREMELY HIGH
16. RISK DECISION AUTHORITY: (Approval Authority Signature Block)				

Figure A-4. Example risk management worksheet.

STEP 3 - DEVELOP CONTROLS AND MAKE RISK DECISIONS

DEVELOPING CONTROLS

After assessing each hazard, develop one or more controls that will either eliminate the hazard or reduce the risk (probability and/or severity) of potential hazardous incidents. When developing controls, consider the reason for the hazard, not just the hazard by itself.

MAKING RISK DECISIONS

A key element in the process of making a risk decision is determining whether accepting the risk is justified or, conversely, is unnecessary. The decision-maker (the tank platoon leader, if applicable) must compare and balance the risk against mission expectations. He alone decides if the controls are sufficient and acceptable and whether to accept the resulting residual risk. If he determines the risk is unnecessary, he directs the development of additional controls or alternative controls; as another option, he can modify, change, or reject the selected COA for the operation.

STEP 4 - IMPLEMENT CONTROLS

Controls are the procedures and considerations the unit uses to eliminate hazards or reduce their risk. Implementing controls is the most important part of the risk management process; this is the chain of command's contribution to the safety of the unit. Implementing controls includes coordination and communication with appropriate superior, adjacent, and subordinate units and with individuals executing the mission. The tank platoon leader must ensure that specific controls are integrated into operational plans (OPLAN), OPORDs, SOPs, and rehearsals. The critical check for this step is to ensure that controls are converted into clear, simple execution orders understood by all levels.

If the leaders have conducted a thoughtful risk assessment, the controls will be easy to implement, enforce, and follow. Examples of risk management controls include the following:

- Thoroughly brief all aspects of the mission, including related hazards and controls.
- Conduct thorough PCCs and PCIs.
- Allow adequate time for rehearsals at all levels.
- Drink plenty of water, eat well, and get as much sleep as possible (at least 4 hours in any 24-hour period).
- Use buddy teams.
- Enforce speed limits, use of seat belts, and driver safety.
- Establish recognizable visual signals and markers to distinguish maneuvering units.
- Enforce the use of ground guides in assembly areas and on dangerous terrain.
- Establish marked and protected sleeping areas in assembly areas.
- Limit single-vehicle movement.
- Establish SOPs for the integration of new personnel.

STEP 5 - SUPERVISE AND EVALUATE

During mission execution, it is imperative for leaders to ensure that risk management controls are properly understood and executed. Leaders must continuously evaluate the unit's effectiveness in managing risks to gain insight into areas that need improvement.

SUPERVISION

Leadership and unit discipline are the keys to ensuring that effective risk management controls are implemented. All leaders are responsible for supervising mission rehearsals and execution to ensure standards and controls are enforced. In particular, NCOs must enforce established safety policies as well as controls developed for a specific operation or task. Techniques include spot checks, inspections, SITREPs, confirmation briefs, buddy checks, and close supervision.

During mission execution, leaders must continuously monitor risk management controls, both to determine whether they are effective and to modify them as necessary. Leaders must also anticipate, identify, and assess new hazards. They ensure that imminent danger issues are addressed on the spot and that ongoing planning and execution reflect changes in hazard conditions.

EVALUATION

Whenever possible, the risk management process should also include an after-action review (AAR) to assess unit performance in identifying risks and preventing hazardous situations. Leaders should then incorporate lessons learned from the process into unit SOPs and plans for future missions.

Implementation Responsibilities

Leaders and individuals at all levels are responsible and accountable for managing risk. They must ensure that hazards and associated risks are identified and controlled during planning, preparation, and execution of operations. The tank platoon leader and his senior NCOs must look at both tactical risks and accident risks. The same risk management process is used to manage both types. The platoon leader alone determines how and where he is willing to take tactical risks. With the assistance of his PSG, NCOs, and individual soldiers, the platoon leader manages accident risks.

Sometimes, despite the need to advise higher headquarters of a risk taken or about to be assumed, the risk management process may break down. Such a failure can be the result of several factors; most often, it can be attributed to the following:

- The risk denial syndrome in which leaders do not want to know about the risk.
- A soldier who believes that the risk decision is part of his job and does not want to bother his platoon leader or section leader.
- Outright failure to recognize a hazard or the level of risk involved.
- Overconfidence on the part of an individual or the unit in the capability to avoid or recover from a hazardous incident.
- Subordinates not fully understanding the higher commander's guidance regarding risk decisions.

The tank platoon leader gives the platoon direction, sets priorities, and establishes the command climate (values, attitudes, and beliefs). Successful preservation of combat power requires him to embed risk management into individual behavior. To fulfill this commitment, the platoon leader must exercise creative leadership, innovative planning, and careful management. Most importantly, he must demonstrate support for the risk management process. The tank platoon leader and others in the platoon chain of command can establish a command climate favorable to risk management integration by taking the following actions:

- Demonstrate consistent and sustained risk management behavior through leading by example and by stressing active participation throughout the risk management process.
- Provide adequate resources for risk management. Every leader is responsible for obtaining the assets necessary to mitigate risk and for providing them to subordinate leaders.
- Understand their own and their soldier's limitations, as well as their unit's capabilities.
- Allow subordinates to make mistakes and learn from them.
- Prevent a "zero defects" mindset from creeping into the platoon's culture.
- Demonstrate full confidence in subordinates' mastery of their trade and their ability to execute a chosen COA.
- Keep subordinates informed.
- Listen to subordinates.

For the platoon leader, his subordinate leaders, and individual soldiers alike, responsibilities in managing risk include the following:

- Make informed risk decisions; establish and then clearly communicate risk decision criteria and guidance.
- Establish clear, feasible risk management policies and goals.

- Train the risk management process. Ensure that subordinates understand the "who," "what," "when," "where," and "why" of managing risk and how these factors apply to their situation and assigned responsibilities.
- Accurately evaluate the platoon's effectiveness, as well as subordinates' execution of risk controls during the mission.
- Inform higher headquarters when risk levels exceed established limits.

Glossary

Section I. ACRONYMS AND ABBREVIATIONS

A

A	alternate
AA	assembly area; avenue of approach
AAC	armament accuracy check
AAR	after-action review
ABC	air battle captain
AD	air defense
ADA	air defense artillery
admin	administrative
AFIST	Abrams full-crew interactive simulator trainer
AFVID	armed forces vehicle identification
AGES	air-to-ground engagement system
AGTS	armored gun training system
AIR TEMP	air temperature (panel nomenclature)
ALC	administrative/logistics center
ammo	ammunition
AMMO SUBDES	ammunition subdesignation (panel nomenclature)
AMMO TEMP	ammunition temperature (panel nomenclature)
ANCOC	Advanced NCO Course
APC	armored personnel carrier
APDS	armor-piercing discarding sabot (ammunition)
APDS-T	armor-piercing discarding sabot tracer (ammunition)
APERS	antipersonnel (ammunition)
APERS-T	antipersonnel tracer (ammunition)
APFSDS	armor-piercing fin-stabilized discarding sabot (ammunition)
API-T	armor-piercing incendiary tracer (ammunition)
AR	armor; Army regulation
ARTEP	Army Training and Evaluation Program
AT	annual training; antitank
ATGM	antitank guided missile
ATTD	attitude
attn	attention
AUTO	automatic (panel nomenclature)
aux	auxiliary
AUX HYDR POWER	auxiliary hydraulic power (panel nomenclature)
AZ	azimuth (See also Section II)

B

BAL SOLN CHECK	ballistic solution check (computer control panel nomenclature)
BARO PRESS	barometer pressure (panel nomenclature)
BATS	ballistic aerial target system
BATTLE SGT	battlesight (panel nomenclature)

BBS	brigade/battalion battle simulation
bde	brigade
BDU	battle dress uniform
B/H	black/hot
BII	basic issue items
BIOC	binocular (panel nomenclature)
bldg	building
BMO	battalion maintenance officer
BMP	Soviet vehicle
bn	battalion
BP	battle position (See also Section II)
BRDM	Soviet vehicle
BS	battlesight (panel nomenclature)
BTR	Soviet vehicle
btry	battery (unit)

C

cal	caliber (See also Section II)
CALFEX	combined arms live-fire exercise *(See also Section II)*
CAS	close air support
CB	circuit breaker; control box
CCF	computer correction factor *(See also Section II)*
CCH	commander's control handle
CCHA	commander's control handle assembly
CCTT	Close Combat Tactical Trainer
CCP	computer control panel
cdr	commander
CE	chemical energy
CEU	computer electronics unit
CID	commander's integrated display
CITV	commander's independent thermal viewer
cm	centimeter
co	company
CO	commanding officer
coax	coaxially-mounted machine gun *(See also Section II)*
COFT	conduct-of-fire trainer
commo	communication
config	configuration
CP	command post (See also Section II)
CPCH	commander's power control handle
CPX	command post exercise
CRP	combat reconnaissance patrol
crtg	cartridge
CS	combat support
CSS	combat service support
CVC	combat vehicle crewman
CWS	commander's weapon station

D

D	down (computer control panel nomenclature), driver
DA	Department of the Army
DCT	digital control transformer
def	deflection
DMPRC	digital multipurpose range complex
DODIC	Department of Defense Identification Code
DS	dead space
DU	depleted uranium

E

EL	elevation (See also Section II)
ELF	eye-safe laser filter
EL UNCPL	elevation uncouple (panel nomenclature)
eng	engagement
ENT	enter (computer control panel nomenclature)
EOD	explosive ordnance disposal
EPW	enemy prisoner of war

F

F	Fahrenheit, fire (machine gun safety), fault (fire control system symbol)
FA	field artillery
FAC	forward air controller
FARP	forward arming and refueling point
FCC	flexible communications circuit
FCS	fire control system
FCX	fire coordination exercise
FISA	frontal impact switch assembly
FIST	fire support team
FLIR	forward-looking infrared (radar)
FLTR	filter (panel nomenclature)
FM	field manual, frequency modulated radio)
FOV	field of view
FRAGO	fragmentary order *(See also Section II)*
1SG	first sergeant
FSO	fire support officer
ft	foot (feet)
FT	firing tables (See also Section II)
FTX	field training exercise

G

G	gunner
gal	gallon(s)
GAS	gunner's auxiliary sight *(See also Section II)*
GCDP	gunner’s control and display panel

GL	grenade launcher
GLOS	gunner’s line of sight
gnr	gunner
GPCH	gunner's power control handles
GPS	gunner's primary sight *(See also Section II)*, global positioning system
GPSE	gunner's primary sight extension *(See also Section II)*
GS	general support
GSR	ground surveillance radar
GTA	graphic training aid
GTD	gun/turret drive
G/VLLD	ground/vehicular laser locator designator

H

H	HEAT (target panel abbreviation), hit; heavy
HB	heavy barrel
HE	high explosive
HEAT	high-explosive antitank (ammunition)
HEAT-MP-T	high-explosive antitank multipurpose tracer (ammunition)
HEAT-TP-T	high-explosive antitank target practice tracer (ammunition)
HE-OR-T	highly explosive, obstacle-reducing (round) with tracer
HEP	high-explosive plastic (ammunition)
HEP-T	high-explosive plastic tracer (ammunition)
HEU	hull electronics unit
HIND-D	Soviet helicopter
HMMWV	high-mobility multipurpose wheel vehicle
HQ	headquarters
Hz	hertz

I

IAW	in accordance with
ID	identification
IDT	inactive-duty training
IFOR	International forces
IFV	Infantry fighting vehicle
illum	illumination
in	inch(es)
ind	individual(s)
inf	Infantry
int	intersection
I/O	instructor/operator
IP	improved product
IVIS	intravehicular information system

J

JAAT	joint air attack team

K

KE	kinetic energy *(See also Section II)*
KIA	killed in action
kmph	kilometers per hour
KY	Kentucky

L

L	left (computer control panel nomenclature); loader; lost; light
lbs	pounds
ldr	leader, loader
LFAST	live-fire accuracy screening test
lg	large
LID	light infantry division
LOS	line of sight (See also Section II)
LP	listening post
LR	long rifle
LRF	laser range finder *(See also Section II)*
LTID	laser target interface device

M

m	meter; miss; medium
~~m~~	mil(s) (See also Section II)
MACOM	Major Command (U.S. Army)
MAINT	maintenance (panel nomenclature)
MANPADS	man-portable air defense system
MAPEX	map exercise
MBD	muzzle boresight device *(See also Section II)*
med	medical
MEDEVAC	medical evacuation
METL	mission-essential task list
METRL DATA	meteorological data (computer control panel nomenclature)
METT-TC	mission, enemy, terrain (weather), troops, time available, and civilian considerations (factors taken into account in situational awareness and in the mission analysis process)
MFR	memorandum for record
MICLIC	mine-clearing line charge
MILES	multiple integrated laser engagement system
mil(s)	see Section II for definition
min	minute(s)
mm	millimeter
MOGAS	motor gasoline
MOI	memorandum of instruction
MOPP	mission-oriented protective posture *(See also Section II)*
MOS	military occupational specialty
MPAT	multipurpose antitank (ammunition)

MPAT-TP-T	multipurpose antitank-target practice with tracer (ammunition)
mph	miles per hour
MPI	mean (average) point of impact *(See also Section II)*
MRC	motorized rifle company
MRS	muzzle reference system *(See also Section II)*
m/s	meters per second
mt	mechanical time
MTP	mission training plan

N

N	neutral (transmission shift control nomenclature), no, north
NA	not applicable
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, and chemical
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
NCS	net control station
NE	not engaged
NFOV	narrow field of view
NOD	night observation device
NOHD	nominal ocular hazard distance *(See also Section II)*
NSN	national stock number
NTC	National Training Center
NVG	night-vision goggles

O

O	over
OCONUS	outside continental United States
OIC	officer in charge
OP	observation post
OPCON	operational control
OPFOR	opposing forces
OPORD	operation order
OPTEMPO	operations tempo
OR	obstacle reducing
OSUT	one-station unit training

P

P	primary, practice
pam	pamphlet
para	paragraph
PC	personnel carrier (in fire command)
PEW	platoon early warning
PGS	precision gunnery system
PGT	Platoon Gunnery Trainer
P_H	probability of hit *(See also Section II)*

PIP	product improvement program
P_K	probability of kill *(See also Section II)*
plt	platoon
PMCS	preventive maintenance checks and services
POL	petroleum, oils, and lubricants
POS/NAV	position/navigation (system)
pres	presented
PSG	platoon sergeant
psi	pounds per square inch
PW	prisoner of war
PWR	power (panel nomenclature)

R

R	right (computer control panel nomenclature)
RC MAT	radio controlled miniature aerial targets
REDCON	readiness condition
ref pt	reference point (on sketch card)
reg	regiment
RIU	radio interface unit
RL	right limit
rnds	rounds
ROC-V	recognition of combat vehicles
RP	rally point, red phosphorus
RPG	rocket-propelled grenade
RSO	range safety officer
RTN	return (panel nomenclature)

S

S	safe (machine gun safety), supplementary, sabot (target panel abbreviation)
S1	personnel staff officer (U.S. Army)
S2	intelligence staff officer (U.S. Army)
S3	operations and training staff officer (U.S. Army)
S4	logistics staff officer (U.S. Army)
SALUTE	size, activity, location, unit, time, and equipment
sat	satisfactory
SAW	squad automatic weapon
SCF	sight correction factor
SDZ	surface danger zone
sec	second(s)
2d Gen FLIR	second generation forward-looking infrared (radar thermal sighting system)
SEP	system enhancement package
seq	sequence
SGT	sergeant, sight (panel nomenclature)
SHTR	shutter (panel nomenclature)
SIMNET	simulations networking

SINCGARS	single channel ground/airborne radio system
SITREP	situation report *(See also Section II)*
sm	small
SM	soldier's manual
SMCT	soldier's manual of common tasks
SOI	Signal Operation Instructions
SOP	standing operating procedure
SPOTREP	spot report
sqdn	squadron
SSG	staff sergeant
ST	screening test (target)
stab	stabilization
STAFF	smart target-activated fire and forget
STBY	standby (panel nomenclature)
STLS	Stinger Training Launch/Simulator
STP	soldier's training publication
STRAC	Standards in Training Commission
STX	situational training exercise

T

T	target, thermal, trained
TA	table of allowance
TADSS	training aids, devices, simulators, and simulations
TB	technical bulletin
TC	tank commander, training circular
TCCT-I	Tank Commander Certification Test—Level I
TCE	tank crew evaluator
TCGST	Tank Crew Gunnery Skills Test
TCPC	Tank Crew Proficiency Course
TEMP	temperature (panel nomenclature)
T&EO	training and evaluation outline
TEU	turret electronics unit
TEWT	tactical exercise without troops
tgts	targets
THPD	turret hydraulic power distribution
thru	through
TIS	thermal imaging system *(See also Section II)*
TL	trigger line
TM	technical manual
TMDE	test, measurement, and diagnostic equipment
TNB	turret networks box
TOC	tactical operations center
TOE	table(s) of organization and equipment
TOW	tube-launched, optically tracked, wire-guided (missile)
TP	target practice
TPCSDS-T	target-practice cone-stabilized discarding sabot tracer (ammunition)
TPDS-T	target practice discarding sabot tracer (ammunition)

TRADOC	United States Army Training and Doctrine Command
TRC	training readiness condition
TRP	target reference point *(See also Section II)*
TSB	technical safety bulletin
TSC	Training Service Center
TSV	thru-sight video
TT	tank table
TWGSS	tank weapons gunnery simulation system

U

U	up (computer control panel nomenclature), untrained
UAAPU	under-armor auxiliary power unit
UCOFT	unit conduct-of-fire trainer
UK	United Kingdom
ULLS	unit-level logistics system
UNSAT	unsatisfactory
U.S.	United States (of America)
USAARMC	United States Army Armor Center
USAF	United States Air Force
USMC	United States Marine Corps

V

VEESS	vehicle engine exhaust smoke system
via	by way of
VIP	very important person
VISMODS	visual modification sets
vs	versus
vt	variable time

W

WFOV	wide field of view
W/H	white/hot
WP	white phosphorus (ammunition) *(See also Section II)*
WP-T	white phosphorus tracer (ammunition)

X

X	power (magnification)

Y

Y	yes

SECTION II. DEFINITIONS

acquisition report
A report given internally between crew members when one crew member acquires a target.

air density
An index of the property of air which tends to slow down a projectile in flight.

area fire
Fire delivered on a prescribed area. The term is applicable regardless of the tactical purpose of the fire, but area fire is generally suppressive fire.

area target
A target consisting of an area rather than a single point.

armor
Steel, iron, or other materials used as a protective covering on tanks. See also composite armor; spaced armor.

automatic self-test
A continuous test of the fire control system conducted by the ballistic computer (30 times per second) when the turret power is on.

auxiliary fire control equipment
Equipment that supplements primary fire control equipment or takes the place of primary fire control equipment when the primary equipment becomes inoperative. On the Abrams tank it is the gunner's auxiliary sight.

avenue of approach
An air or ground route of an attacking force of a given size leading to its objective or to key terrain in its path.

axis of advance
A line of advance assigned for purposes of control; often a road or a group of roads, or a designated series of locations, extending in the direction of the enemy.

azimuth (AZ)
A direction expressed as a horizontal angle, usually in degrees, and measured clockwise from a reference datum. This azimuth will be true azimuth, grid azimuth, magnetic azimuth, or relative azimuth, depending on which reference datum is used.

ballistic computer
A mechanical, electromechanical, or electrical instrument for solving mathematical problems, giving a ballistic solution. The ballistic computer system calculates and provides ballistic corrections for the indexed ammunition, lead, and parallax offsets.

ballistic match
A condition of having identical ballistic characteristics. Projectiles are ballistically matched when their burst point distributions have the same mean and equal standard deviations when fired under common conditions.

ballistics
The science or art that deals with the motion, behavior, appearance, or modification of missiles or other vehicles acted upon by propellants, wind, gravity, temperature, or any other modifying substance, condition, or force.

ballistic solution
The offset applied by the ballistic computer between the sight and gun based on inputs to the computer.

base fuze
A fuze located in the base of a projectile. (See also fuze.)

base stub
The rear portion of the 120-mm round that is ejected after firing and provides rearward obturation.

basic load (ammunition)
That quantity of ammunition authorized to be on hand in a unit to meet combat needs until resupply can be accomplished. Size of the basic load is normally determined by corps or the major overseas commander.

battalion task force
A force generally organized by combining tank and mechanized infantry elements under a single battalion commander to conduct specific operations. A battalion task force may be tank-heavy, mechanized infantry-heavy, or balanced, depending on the concept and plan of operation.

battlecarry
A posture in which the main gun is preloaded with a round of ammunition, the AMMUNITION SELECT switch is set for the type of ammunition loaded, and a specific range is applied to the computer; the proper sight reticle is selected and the SCFs are on the GAS. The crew places their tank in a battlecarry posture before moving into a tactical situation. All engagements begin from this posture.

battle position (BP)
A defensive location on the ground, selected on the basis of terrain and weapon analysis from which units can defend or attack. Such units can be as large as battalion task forces and as small as platoons.

battlesight
1. A predetermined sight setting carried on a weapon that enables the firer to engage targets effectively at battle ranges when conditions do not permit precision engagements.
2. Carrying a preloaded ammunition with a preset range indexed in the fire control computer.

BEEHIVE
A term sometimes associated with antipersonnel projectiles, loaded with flechettes.

bias
The difference between the point of aim and the projectile point of impact:

- Fixed bias. Constant and measurable deviations between the estimated point of impact and the mean point of impact caused by inherent characteristics of the weapon system. Once established, these can be compensated for in the sighting system.
- Variable bias. Deviations between the estimated point of impact and the mean point of impact, usually constant over a short period (one engagement) but varies from one engagement to another.
- Random errors and dispersions. Randomly affects the spread of shots around the mean point of impact.

boresighting
The process by which the axis of a weapon is aligned optically or electronically to converge with the line of sight of its associated sighting instruments, at some predetermined range.

bounding overwatch
A movement technique used when contact with enemy forces is expected. The unit moves by bounds. One unit is always halted in position to overwatch another element while it moves. The overwatching element is positioned to support the moving unit by fire or fire and maneuver.

bourrelet
A raised metal or plastic ring around the outer forward surface of the projectile. Its purpose is to center the forward portion of the projectile as it travels through the bore.

caliber (cal)
1. The diameter of the bore of a gun. In rifled gun barrels, the caliber is obtained by measuring between opposite lands.
2. The diameter of a projectile.

cant
The tilt of the gun trunnion axis. Cant occurs when the tank is on uneven ground and one gun trunnion is higher than the other.

cartridge case
A container that holds the primer, propellant, and projectile.

center of dispersion
The theoretical center of hits or bursts that would have been made if an unlimited number of shots had been fired with the same data. See also dispersion zone.

chemical ammunition
A type of ammunition in which the filler is primarily a chemical compound.

coax machine gun
A machine gun mounted in the turret of a tank in a way that its line of fire is parallel (coaxial) to that of the cannon set on the same mounting.

combined arms live-fire exercise (CALFEX)
A resource-intensive exercise in which combined arms teams (or task forces) maneuver and employ organic and supporting weapon systems using service or large caliber inert training ammunition.

command post (CP)
A unit or subunit headquarters where the commander and staff perform their activities. In combat, a unit or subunit headquarters is often divided into echelons; the echelon in which the unit or subunit commander is located or from which he operates is called a command post.

company team
A team formed by attachment of one or more nonorganic tank, mechanized, or infantry platoons to a tank, mechanized, or infantry company either in exchange for or in addition to organic platoons.

composite armor
A protective covering consisting of two or more materials as distinguished from a single plate or piece of laminated structure with all laminae of the same material. A composite armor structure may consist of laminae of different materials or a matrix of one material in which pieces or particles of one or more different materials are embedded.

computer correction factors (CCF)
Factors entered into the ballistic computer to correct the ballistic solution for part of the jump error.

concealment
The protection from observation or surveillance.

conduct of fire
The technique and procedures by which effective fire is placed on a selected target.

cover
Shelter or protection, either natural or artificial, from enemy observation and fire.

crawl, walk, run
A training methodology of teaching the fundamentals, practicing until soldiers can do them well, then executing in training as in battle.

crew search
The crew's collective efforts, using both the unaided eye and optics, within assigned sectors of observation, to explore the area of operations visually for enemy presence.

crosswind sensor
An instrument mounted on the tank used to determine the speed and direction of the wind.

dead space
An area that cannot be observed by direct-fire sights (gullies, dense forests) and, therefore, cannot be engaged with direct-fire weapons.

defilade
The protection from hostile observation and fire provided by a terrain feature such as a hill or ridge.

deflection correction
A correction that must be applied to the azimuth so the line of fire will pass through the target.

deflection error
The distance to the right or left of the target between the point aimed at and the strike of a projectile.

deflection scale
The scale on a deflection boresight knob, marked in mils, for applying corrections in deflection.

deflection shift
A change in the deflection setting.

degraded mode gunnery
Fighting with less than a fully operational system.

depleted uranium
A uranium by-product that is a very hard, dense metal.

detection
The discovery by any means of the presence of a person, object, or phenomenon of potential military significance.

direct fire
Fire directed at a visible target (a direct line of vision from the direct-fire sights to the target).

direct-fire sights
Sights that permit laying directly on the target as distinguished from those used to lay on an aiming point.

dispersion
A scattered pattern of hits around the mean point of impact of projectiles fired under identical conditions.

dispersion zone
The area around the aiming point into which 90 percent of all rounds fired will fall.

drift
A shift in projectile direction due to cannon rifling and atmospheric conditions.

dry-fire
The simulation of engagement without expenditure of ammunition.

dummy ammunition
Ammunition that is used for practicing gunnery-related tasks; it has no propellant or explosive charge.

dynamic cant
A measuring of the hull pitch and roll in the M1A2, which is used as part of the ballistic solution.

elevation (EL)
The degree above the horizon to which a gun is aimed.

elevation scale
The scale on an elevation boresight knob marked in mils for applying elevation corrections to the sight.

equilibrator
A device that balances the weight of a weapon tube so it can be elevated without difficulty.

eye-safe laser filter (ELF)
A filter made of glass that reduces the power of the laser beam to change it from conditionally eye safe to totally eye safe.

final protective fire (FPF)
An immediately available prearranged barrier of fire designed to impede enemy movement across defensive lines or areas.

fire control system
A group of interrelated fire control equipment and instruments designed for use with a weapon or group of weapons.

fire support
Assistance to those elements of the ground forces that close with the enemy (infantry and armor units); may be rendered by artillery fire, Naval gun fire, aircraft strafing, and bombardment.

firing table (FT)
A table or chart giving the data needed for firing a weapon accurately on a target under standard conditions and also the corrections that must be made for special conditions such as wind or variations of temperature.

flechette
A small fin-stabilized missile used in antipersonnel ammunition.

fragmentary order (FRAGO)
An abbreviated operation order used to make changes in missions to units and to inform them of changes in the tactical situation.

fragible (ammunition)
A round that breaks into powder or fragments upon contact with the target and does not penetrate.

fuze
A device with explosive components designed to initiate a train of fire or detonation in an item of ammunition.

groove
One of the channels in the bore of a rifled gun barrel.

group center of impact
The center of the dispersion pattern of impact bursts or rounds.

gun bore line
A reference line established by the linear extension of the bore axis of a gun.

gun jump
The angle between the direction of the gun bore at the instant the charge is fired and the line of departure of the projectile as it leaves the muzzle.

gunner's auxiliary sight (GAS)
An articulated telescope coaxially-mounted to the main gun as a backup to the primary sighting system. Includes illuminated ballistic reticles for specific types of ammunition.

gunner's primary sight (GPS)
The primary optics for tank-mounted weapons; it includes day channel and thermal channel. Provides gunner with optics for aiming the main gun and coax machine gun during the day or at night. Allows gunner to control ranging and sighting.

gunner's primary sight extension (GPSE)
An extension that provides the tank commander the same sight picture and symbology display the gunner receives. Provides commander with optics for aiming the main gun and coax machine gun during the day or at night.

gunner's quadrant
An instrument used to measure the superelevation applied to a gun.

gun trunnions
Mounting pins on each side of the cannon on which the cannon pivots in elevation.

gun tube droop
The drooping of a long (unsupported) gun tube.

gyro
A device used to stabilize the gun, the turret, or the gunner's primary sight. It is mounted with a motor driven wheel that spins rapidly; the gyro rotates freely about the axis perpendicular to the axis of the spinning wheel. When the housing is moved about the axis, it generates an air signal proportional to the speed and rate of movement.

hull-down
The position of a tank in which the muzzle of the gun is the lowest part of the vehicle exposed to the front.

identification
The process of determining the friendly or hostile character of an unknown detected contact.

image
A representation of an object on any medium by optical or electronic means.

incendiary
Ammunition with an inflammable filling.

indirect fire
Fire delivered at a target that cannot be seen by the gunner.

inert ammunition
A munition, or component thereof, that contains an inactive filler.

initialize
To set to a starting position or value.

intervisibility
The condition of being able to see one point from another. This condition may be altered or interrupted by weather, obscuration, or terrain masking.

killing burst
The first group of rounds of machine gun fire directed at a target to kill as many personnel as possible before they take cover.

kinetic energy ammunition
The primary armor-defeating round for the 105-mm main gun and the most accurate of all tank ammunition. Kinetic energy is a combination of mass (weight) and velocity (speed) of the projectile; no explosives are needed to penetrate the target.

laser
Light amplification by stimulated emission of radiation.

laser range finder (LRF)
A device that uses laser energy for determining the distance from the device to a place or object.

laser ranging
The use of laser transmissions to determine range to the target, normally as an input to the weapon delivery computer.

lead
The distance ahead of a moving target that a gun must be aimed in order to hit the target.

lead angle
The angle between the line of sight to a moving target and the line of sight to the predicted position of the target at the time the projectile intercepts the target.

limited platoon intervisibility
The condition in which a target is visible to one element of a platoon but not another.

line of contact (LC)
A general trace delineating the location where two opposing forces are engaged.

line of departure (LD)
A line designated to coordinate the commitment of attacking units or scouting elements at a specified time of attack. A jump-off line.

line of departure is line of contact (LD/LC)
The designation of forward friendly positions as the line of departure when opposing forces are in contact.

line of sight (LOS)
The line between the target aiming point and the aiming mark of the reticle.

lot number
An identification number assigned to a particular quantity or lot of materiel, such as ammunition, from a single manufacturer.

manual self-test
A crew initiated test of the fire control system (computer self-test), evaluates system response in the vicinity of threshold values.

maximum ordinate
The highest point that a projectile reaches in its flight from the gun to the target.

mean point of impact (MPI)
The point whose coordinates are the arithmetic mean of the coordinates of the separate points of impact/burst of a finite number of projectiles fired or released at the same aiming point under a given set of conditions.

mil (m)
A unit of measurement for angles based on the angle subtended by 1/6400 of the circumference of a circle. A mil is the angle subtended by one unit at one thousand units.

mission-oriented protective posture (MOPP)
A flexible system for protection against a chemical attack devised to maximize the unit's ability to accomplish its mission in a toxic environment. This posture requires personnel to wear individual protective clothing and equipment consistent with the chemical threat, work rate imposed by their mission, temperature, and humidity without excessive mission degradation.

muzzle boresight device (MBD)
An instrument used to align the gun and sights from the muzzle end of the gun.

muzzle reference system (MRS) collimator
As part of the muzzle reference system, provides the gunner a reference point to determine gun tube bend caused by heat for manual input to the ballistic computer.

muzzle velocity
The velocity of a projectile with respect to the muzzle at the instant the projectile leaves the weapon.

nominal ocular hazard distance (NOHD)
An additional buffer area added to the surface danger area diagram when lasers are used.

oblique
1. Neither perpendicular nor parallel.
2. At a 45-degree angle.

obscuration
The effects of weather, battlefield dust and debris, or the use of smoke munitions to hamper observation and target acquisition capability or to conceal activities or movement. (Flash, blast, dust, smoke.)

obstacle
Any natural or man-made obstruction that canalizes, delays, restricts, or diverts movement of a force. The effectiveness of an obstacle is considerably enhanced when covered by fire. Obstacles include abatis, antitank ditches, blown bridges, built-up areas, minefields, rivers, road craters, terrain, and wire.

obturator seal
The rubber seal that helps the rotating band seal the propellant gas behind the projectile (105-mm sabot and all 120-mm rounds); used with the rotating band for spin-stabilized ammunition and without the rotating band for fin-stabilized ammunition.

ogive
The forward part of the projectile, up to and including the pointed end of a projectile, designed to reduce air resistance and provide aerodynamic stability. Also called head or windshield.

parallax
1. The apparent displacement or the difference in apparent direction of an object as seen from two different points not on a straight line with the object.
2. A movement between the reticle aiming cross and the target aiming point.

parallax correction
An allowance made for difference in position of a target as measured from the gun and the observer's position.

parallax error
1. An error in an observation caused by making the observation from a position different from the normal one or from the one where the firing data are used.
2. An error made by reading the dial of an instrument from a slant rather than directly from the front.

phase line
A line used for control and coordination of military operations. It is usually a recognizable terrain feature extending across the zone of action. Units always report crossing phase lines, but do not halt unless specifically directed. Phase lines are often used to prescribe the timing of delay operations.

platform rock
The backward and upward movement of the vehicle caused by firing the main gun, causing severe movement of the sights.

point target
A target of such a small dimension that it requires the accurate placement of ordnance in order to neutralize or destroy it.

potentiometer
An instrument for measuring electromotive forces; a voltage divider.

precision fire
Fire in which the center of impact is accurately placed on a limited target; fire based on precision adjustment. Precision fire differs from area fire, which is directed against a general area rather than against a given target in the area.

precision gunnery
The engagement of a target using the full capability of the fire control system. During a precision engagement, the fire control system provides an automatic, full ballistic solution for the ammunition selected.

primer
The cap in the base of the cartridge case that ignites the propellant charge. It may be actuated by friction, blow, pressure, or electricity.

probability of hit (P_H)
The probability that a single projectile fired against a target will hit that target under a given set of conditions regardless of whether or not the target is defeated or destroyed by the single hit.

probability of kill (P_K)
The probability that a single projectile fired at a target will destroy or effectively disable that target.

projected reticle
The pattern reflected on the surface of an optical instrument.

projectile
That part of the round that travels through the gun tube.

proofing team
Group of technically competent TCs and gunners chosen by the commander to train tank crews, inspect tanks for mechanical errors, and assist in conducting the screening and proofing tests.

propellant
An explosive charge for propelling a projectile.

propelling charge
The powder charge (propellant) that is set off to propel a projectile from the weapon. Burning of the confined propelling charge produces gases that force the projectile out.

pyrotechnic
A mixture of chemicals that, when ignited, is capable of reacting exothermically to produce light, heat, smoke, sound, or gas and may also be used to introduce a delay into an explosive train because of its known burning time. The term excludes propellants and explosives.

range correction
The changes in firing data necessary to allow for deviations of range due to weather, ammunition, or other nonstandard conditions.

reconnaissance
A mission undertaken to obtain information, by visual observation or other detection methods, about the activities and resources of an enemy or potential enemy or about the meteorologic, hydrographic, or geographic characteristics of a given area.

reconnaissance by fire
A method of reconnaissance in which fire is placed on a suspected enemy position to cause the enemy to disclose his presence by movement or return fire.

refer
To bring the gun sights on a chosen aiming point without moving the gun.

reticle
A mark such as a cross or a system of lines, lying in the image plane of a viewing apparatus and used singly as a reference mark on certain types of monocular instruments.

rifling
A system of spiral grooves cut in the surface of the bore of a gun leaving intervening lands that, when fired, cut into the projectile or a metal band secured to it and rotate it about its longer axis.

rotating band
The hard plastic or metallic ring(s) around the base of the projectile. It seals the propellant gas behind the base of the projectile and imparts spin (for rifled guns) to a spin-stabilized round, or absorbs spin on fin-stabilized rounds.

round of ammunition
A round of ammunition comprises all the components necessary to fire the weapon once. In general, these components are primer, propellant, container or holder for propellant (cartridge case or bag), and projectile, with fuze and booster if necessary for the proper functioning of the projectile.

sabot
A lightweight carrier in which a subcaliber projectile is centered to permit firing the projectile in the larger caliber weapon. The carrier fills the bore of the weapon from which the projectile is fired; it is normally discarded a short distance from the muzzle.

scabbing
1. Breaking fragments of concrete due to the impact or explosion of a projectile on the concrete surface.
2. Breaking off of fragments on the inside of a wall of hard material due to the impact or explosion of a projectile on the outside.

security
1. The measures taken by a command to protect itself from espionage, observation, sabotage, annoyance, or surprise.
2. A condition that results from the establishment and maintenance of protective measures that ensure a state of inviolability from hostile acts or influences.

self-test
A test or series of tests performed by an equipment upon itself, which shows whether or not it is operating within designated limits.

sensing
Observing the location of the striking or bursting point of a projectile with respect to range as a hit, over, short, lost, or doubtful. Sensing does not include accurate determination of distances.

servo (servo mechanism)
A device for controlling large amounts of power by means of a very small amount of power and correcting performance by an error sensing feedback.

shaped charge
An explosive charge shaped so the explosive energy is focused and concentrated to move in one direction.

shock effect
The combined destructive (physical and psychological) effect on the enemy produced by the violent impact of mounted and mobile armor protected firepower of tanks and supporting troops.

signature
The visible or audible effects, such as noise, smoke, flame, heat, or debris, produced when a weapon is fired or a piece of equipment operated; also, an electronic emission subject to detection and traceable to the equipment producing it.

situation report (SITREP)
A report giving the situation in the area of a reporting unit or formation.

smoke blanket
A dense concentration of smoke established over and around friendly areas to protect them from air visual observation and visual precision bombing attack, or established over enemy areas to

protect attacking aircraft from air defense fire; may also be used at night to prevent enemy observed air attack by flare light.

smoke curtain
A vertical smoke screen placed between friendly and hostile troops or installations to prevent enemy ground observation.

spaced armor
A protective covering consisting of two or more plates or pieces (of the same material or of different material) with intervening unfilled space or spaces.

spall
Fragments torn from either the outer or inner surface of armor plate as the result of a complete or partial penetration of the armor, or by dynamic effects of an explosive charge.

spot report
A concise narrative report of essential information covering events or conditions that may have an immediate and significant effect on current planning and operations. It is afforded the most expeditious means of transmission consistent with requisite security.

standard muzzle velocity
The speed at which a given projectile is supposed to leave the muzzle of a gun. The speed is calculated on the basis of the particular gun, the propelling charge used, and the type of projectile fired from the gun. Firing tables are based on standard muzzle velocity.

subcaliber ammunition
Practice ammunition of a caliber smaller than standard for the gun on which practice is being given. Subcaliber ammunition is economical and may be fired in relatively crowded areas. It is, therefore, used with special subcaliber equipment to simulate firing conditions with standard ammunition.

subprojectile
That part of a kinetic energy projectile that penetrates the target.

superelevation
An added positive angle that compensates for the fall of the projectile during the time of flight due to the pull of gravity.

suppressive fire
Fires on or about a weapon system to degrade its performance below the level needed to fulfill its mission objectives during the conduct of the fire mission.

surface danger area
An area on the ground or water where missiles make it dangerous to personnel and material.

tank gun error budget
The systemic, environmental, and human factors involved in any target engagement. Error sources include fixed biases, variable biases, and random errors.

tank sketch card
A small geographical chart on which range bands are marked and directions to various targets and other important points in the assigned area are recorded.

target acquisition
The detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons.

target classification
The grouping of potential targets by the relative level of danger they represent. Targets are classified as most dangerous, dangerous, or least dangerous.

target confirmation
The rapid verification of the initial identification and classification of the target.

target location
The determination of where a potential target is on the battlefield.

target of opportunity
A target that has not been planned (that is, one on which fire has not been prearranged).

target practice ammunition
Ammunition used for target practice; ammunition with a propelling charge, but with either an inert filler or a low-explosive filler to serve as a spotting charge.

target reference point (TRP)
An easily recognizable point on the ground (either natural or man-made) used for identifying enemy targets or controlling direct fires. Target reference points are usually designated by company commanders or platoon leaders for company teams, platoons, sections, or individual weapons. They can also designate the center of an area where the commander plans to distribute or converge the fires of all his weapons rapidly. Target reference points are designated using the standard target symbol and target numbers issued by the fire support team or fire support officer. Once designated, target reference points also constitute indirect-fire targets.

thermal bending
Uneven cooling or heating of one part of the gun tube which may cause it to distort about its axis, and cause a loss of accuracy.

thermal imaging system (TIS)
The system that provides the Abrams fire control system with night-vision capability by presenting a thermal scene in the gunner's primary sight. It operates on emitted thermal radiation rather than visible light.

tracer
A powder element inserted in the base of some projectiles that, when ignited, burns and allows the projectile to be observed during flight.

trajectory
The flight path of a projectile from the point of fire to impact.

trigger line/point
An easily recognizable point where the platoon will begin its engagement if the platoon leader is unable to issue a fire command. Trigger lines or points are normally placed at points of entry into an engagement area.

turret-down
A position in which the entire vehicle is behind cover, but the commander can still observe to the front from the turret hatch or cupola.

white phosphorus (WP)
A yellow, waxy chemical that ignites spontaneously when exposed to air; used as a filling for various projectiles; a smoke-producing agent with an incendiary effect.

wind correction

Any adjustment that must be made to allow for the effect of wind; especially, the adjustments to correct for the effect on a projectile in flight, on sound received by sound ranging instruments, and on an aircraft flown by dead reckoning navigation.

wind velocity
The horizontal direction and speed of air motion relative to the ground.

wingman
One of two tanks in a section, normally the other tank in the platoon leader's or platoon sergeant's section.

yaw
The angle between the axis of the projectile at any moment and the tangent of the trajectory.

zeroing
Establishing a relationship between the trajectory of the round fired and the reference line of the sights established during boresighting. Corrects differences in gun tubes, recoil systems, and ammunition lots. Zeroing is not performed when an MBD is available.

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By Order of the Secretary of the Army:

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