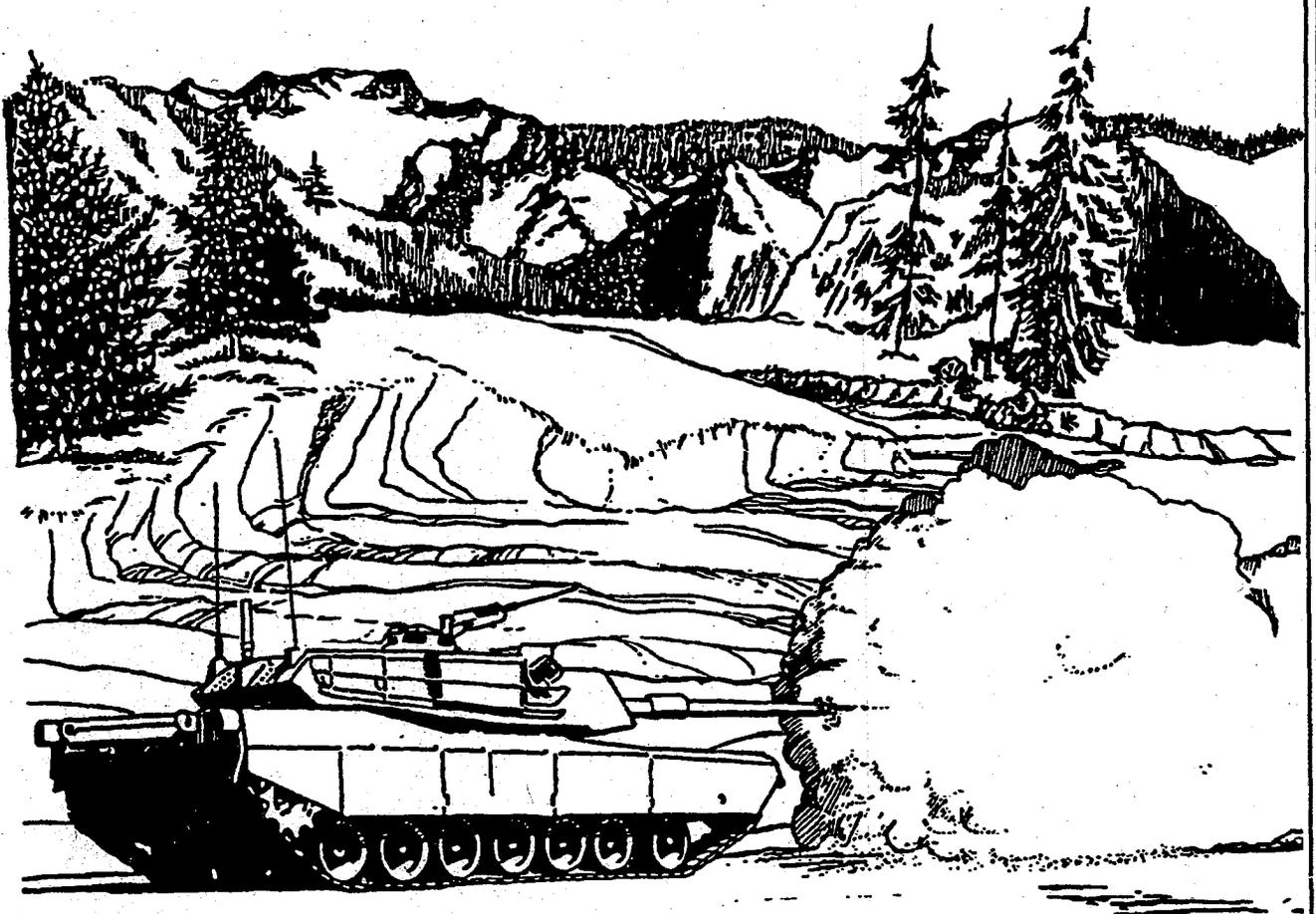


# Tank Gunnery Lessons Learned II



*50 Years of Forging the Thunderbolt*



WEAPONS DEPARTMENT • FORT KNOX, KY  
NOVEMBER 1990



DEPARTMENT OF THE ARMY  
HEADQUARTERS, U.S. ARMY ARMOR SCHOOL  
FORT KNOX, KENTUCKY 40121-5200

ATSB-AC

28 November 1990

MEMORANDUM FOR ARMOR TRAINERS

SUBJECT: Tank Gunnery Lessons Learned II

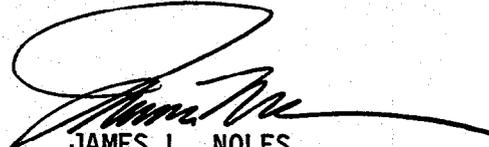
1. We published our first Lesson Learned Bulletin in April and still receive requests from the field for it. Since April we have published an Approved Final Draft of Change 3 to FM 17-12-1 and are preparing to disseminate the Coordinating Draft of the Revision to FM 17-12-1. Input received from the field has assisted our efforts to get the best, most up to date information possible to our Armor Force in the field.

2. Recent events in Southwest Asia (SWA) have re-emphasized the importance of Armor as both a deterrent and as the powerful offensive combat arm of decision that we know it to be. The Armor School is now focusing on issues and situations that arise during Desert Operations. We welcome input from those of you with extensive NTC experience or, better yet, experience with Armor Forces in SWA.

3. Steel on Target with the first round continues to be our goal. If you have lessons learned that have not been covered in this Bulletin, our April Bulletin, or are not addressed in Change 3, FM 17-12-1, we need your input. Write, call, or TWX your lessons to the Weapons Department at:

Commander, USAARMC  
ATTN: ATSB-WPG-F  
Fort Knox, KY 40121-5000

Phone Numbers are AUTOVON 464-1736/4462/5765, Commercial (502) 624-1736/4462 5765, FAX is AUTOVON 464-5708 or Commercial (502) 624-5708.

  
JAMES L. NOLES  
Brigadier General, US Army  
Assistant Commandant

# TANK GUNNERY LESSONS LEARNED

## TABLE OF CONTENTS

	Page
PREPARE-TO-FIRE CHECKS (Maintain the 120-mm Main Gun) . . . . .	1
1. Inspect the Stub Base Deflector . . . . .	1
2. Adjust the Stub Base Deflector . . . . .	1
3. Service the Bore Evacuator . . . . .	2
4. Clean the Firing Mechanism Assembly (Firing Pins and Contact Probe) . . . . .	3
ARMAMENT ACCURACY CHECKS . . . . .	5
1. Combined Solution Board . . . . .	5
2. Dimensions of the Combined Solution Board . . . . .	6
3. M1A1 Tanks with Sabot AMMO SUBDES 5 . . . . .	6
CHECK 4 (Special Input M1A1) . . . . .	8
CHECK 5 (Ballistic Solution M1A1) . . . . .	12
M26A1/M27A1 (LENZAR) MUZZLE BORESIGHT DEVICE . . . . .	16
ENGAGING DISMOUNTED TROOPS WITH THE M240 COAX MACHINE GUN . . . . .	17
1. LRF Returns . . . . .	17
2. Engagement Techniques . . . . .	17
BORESIGHTING PROCEDURE GTA . . . . .	17
M1/M1A1 OPERATOR'S MANUAL CHANGES . . . . .	18
COAX BATTLESIGHT UPDATE . . . . .	18
THERMAL TARGETS . . . . .	18

**USER COMMENTS:** The Weapons Department produces *Tank Gunnery Lessons Learned* as reminders to units or to disseminate input we received from the field. The Armor School has also finished Change 3 (AFD) to FM 17-12-1. Units are encouraged to read FM 17-12-1 with Change 3 AFD; there are significant changes made. As with the Lessons Learned publication, responses from the field are crucial to improving the gunnery manual. Comments should include constructive suggestions for improvement of wording or material in the publication. Key your comments to a specific page and paragraph and give a brief reason for the change so your comments can be properly evaluated. Send your comments to--

CDR, USAARMC  
ATTN: ATSB-WPG  
Fort Knox, KY 40121-5212

or call AUTOVON 464-1736/4462/5767.

DEPARTMENT OF THE ARMY  
HEADQUARTERS, U.S. ARMY ARMOR SCHOOL  
FORT KNOX, KENTUCKY 40121-5200

## PREPARE-TO-FIRE CHECKS (Maintain the 120-mm Main Gun)

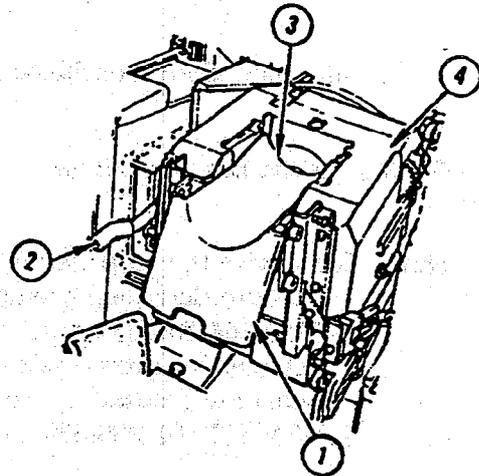
### 1. Inspect the Stub Base Deflector.

**Note.** A correctly aligned stub base deflector is essential to ensure the 120-mm gun system functions properly. Deflectors that are out of alignment cause rounds to stick during loading and the stub base to jam during recoil. In addition to causing the loss of engagement time in combat and training time on ranges, deflectors out of alignment create potentially hazardous safety problems. To avoid these problems, the following procedure should be applied before firing, after firing, and as needed during firing.

**References:** TM 9-2350-264-10-3 (Changes 1 through 10), page 3-182.1/TM 9-2350-264-10-2 (September 1990), page 3-192; TM 9-2350-264-20-2-4, page 8-53.

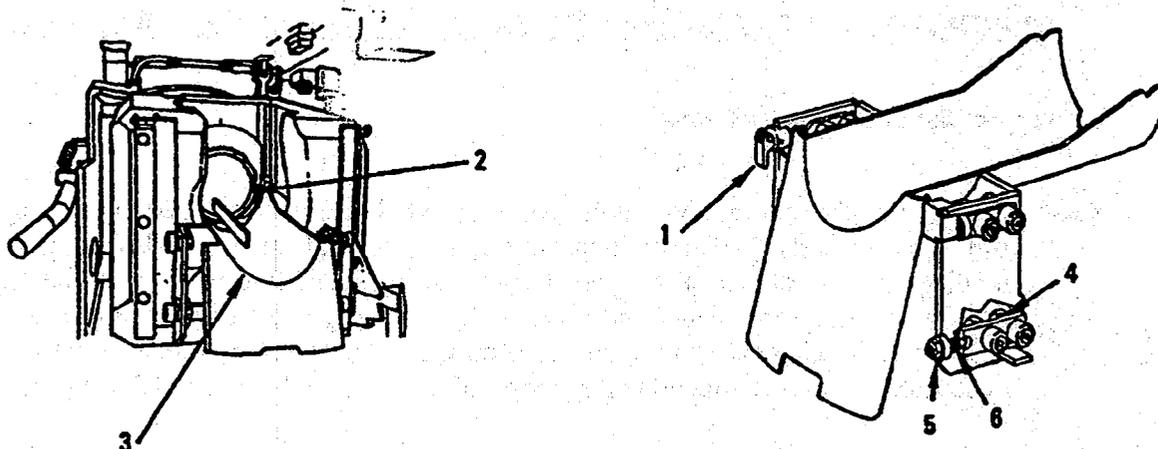
**Note.** If stub base deflector (1) does not operate as described in each step, notify unit maintenance.

- a. Make sure the VEHICLE MASTER POWER switch is set to OFF (see TM 9-2350-264-10-3, page 3-99/TM 9-2350-264-10-2 (September 1990), page 3-173).
- b. Make sure main gun is cleared (see TM 9-2350-264-10-2, page 2-336/TM 9-2350-264-10-2 (September 1990), page 3-374) and close breechblock (see TM 9-2350-264-10-2, page 2-332/TM 9-2350-264-10-2 (September 1990), page 2-368).
- c. Remove stub base deflector (1) (see TM 9-2350-264-10-3, page 3-182/TM 9-2350-264-10-2 (September 1990), page 3-191).
- d. Put SAFE/ARMED lever (2) up to ARMED position. Manually open breechblock (3).
- e. Install stub base deflector (1) (see TM 9-2350-264-10-3, page 3-183/TM 9-2350-264-10-2 (September 1990), page 3-193).
- f. Put SAFE/ARMED lever (2) down to SAFE position. Stub base deflector (1) should drop quickly and smoothly to bottom of breechblock (3).
- g. Manually close breechblock (3). Breechblock (3) and stub base (1) should rise smoothly to top of breech ring (4).



### 2. Adjust the Stub Base Deflector.

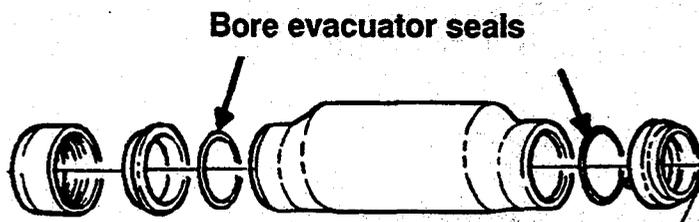
**Note.** Position lever (1) must point down.



- a. Set rule part way in gun tube (2) and part way over bottom of tray (3). If bottom of tray (3) is flush with bottom edge of rule, and flush with gun tube (2), go to step (c).
- b. Adjust tray (3).
  - (1) Remove tray (TM 9-2350-264-10).
  - (2) Loosen four bottom cam follower nuts (4).
  - (3) Install tray (TM 9-2350-264-10).
  - (4) Loosen two nuts (5). Turn two screws (6) until tray (3) is flush with gun tube (2). Tighten nuts (4) and (5).
  - (5) Remove tray (TM 9-2350-264-10).
  - (6) Tighten nuts (4). Install tray (TM 9-2350-264-10).
- c. Manually close breechblock (TM 9-2350-264-10).

### 3. Service the Bore Evacuator.

**Note.** To service the bore evacuator on the 120-mm gun tube of the M1A1 tank, follow the procedure described beginning on page 3-180, TM 9-2350-264-10-3/page 3-185, TM 9-2350-264-10-2 (September 1990). Steps E and G require the crewman to clean and check packing (bore evacuator seals). When a seal must be replaced, the proper type of seal must be used. The only seal that will allow the gun system to function properly is NSN 5330-01-280-6787, PN MS9021-371, regardless of color.



**Reference:** AMCCOM News, Volume 1, Issue 3, LAO 7th ATC, Vilseck, Germany, 15 June 1990.

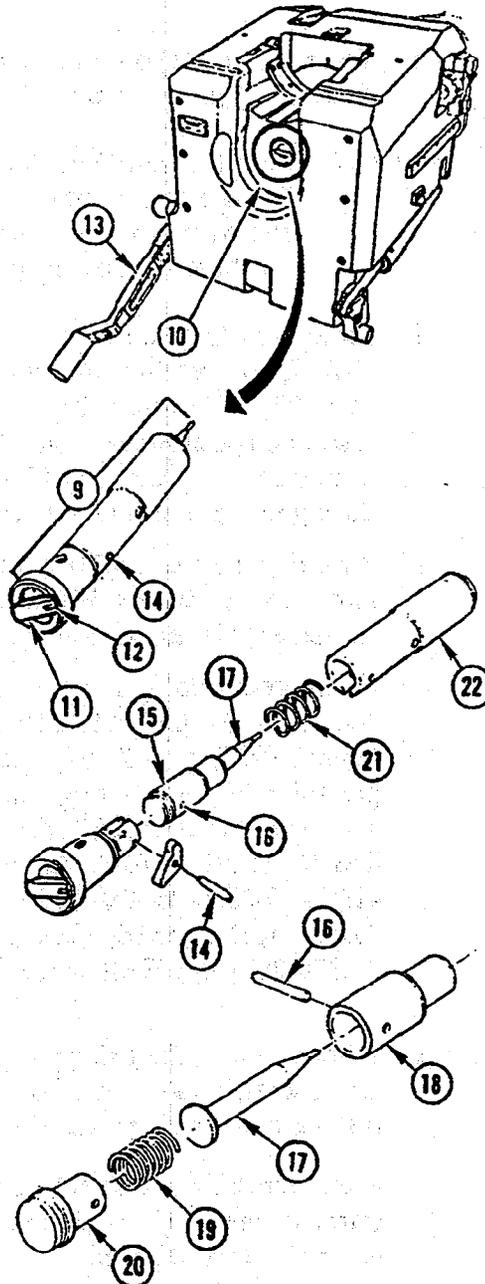
TM 9-2350-264-10-3/TM 9-2350-264-10-2 (September 1990).

**4. Clean the Firing Mechanism Assembly (Firing Pins and Firing Contact Probes).**

**Note.** Main gun misfires are often the result of failing to make proper electrical contact. Two of the most common causes are dirty firing pins and contact probes. Crews can avoid this problem by thoroughly cleaning the breechblock and paying close attention to prepare-to-fire checks, including the caution to keep the firing pin clean and dry (see TM 9-2350-264-10-1, page 2-82/TM 9-2350-264-10-1 (September 1990), page 2-90).

**References:** TM 9-2350-264-10-2.

- a. Close breechblock (10) (see TM 9-2350-264-10-2, page 2-332/TM 9-2350-264-10-2 (September 1990), page 2-368).
- b. Open breechblock (10) approximately 1 inch (see TM 9-2350-264-10-2, page 2-332/TM 9-2350-264-10-2 (September 1990), page 2-368).
- c. With breechblock (10) held in open position, remove firing mechanism assembly (9) by turning lever (11) counterclockwise until mark (12) is at 2 o'clock position. Pull firing mechanism assembly (9) out.
- d. Close breechblock (10) (see TM 9-2350-264-10-2, page 2-332/TM 9-2350-264-10-2 (September 1990), page 3-368). Remove operating handle (13).
- e. Disassemble firing mechanism assembly (9) by removing straight pin (14) using drive pin and hammer. Lay parts on a clean dry rag (see TM 9-2350-264-10-3, Appendix D, Item 36/TM 9-2350-264-10-2 (September 1990), Appendix D, Item 36).
- f. Disassemble firing pin assembly (15) by removing straight pin (16) using drive pin and hammer.
- g. Check all parts for damage. If any part is damaged, notify organizational maintenance.
- h. Wipe probe (17) and all other parts with a clean dry rag (see TM 9-2350-264-10-3, Ap-



pendix D, Item 42/TM 9-2350-264-10-2 (September 1990), Appendix D, Item 36).

- i. Insert probe (17) into guide (18) and place spring (19) behind probe (17). Push cap (20) into guide (18) and insert straight pin (16) into guide (18) to hold assembly together.

**CAUTION.** Spring (21) and firing pin assembly (15) must be placed in housing (22) as shown. Failure to assemble firing mechanism assembly (9) as shown will cause damage to firing mechanism assembly (9).

- j. Place spring (21) on firing pin assembly (15). Place firing pin assembly (15) in housing (22).

**CAUTION.** Cam (23) must be assembled as shown. Failure to assemble the cam (23) as shown may result in damage to firing mechanism assembly (9).

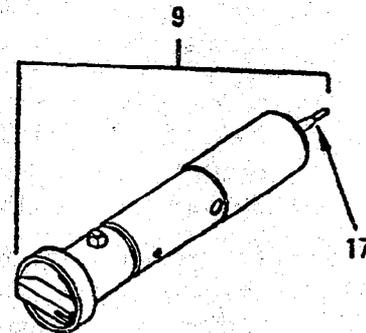
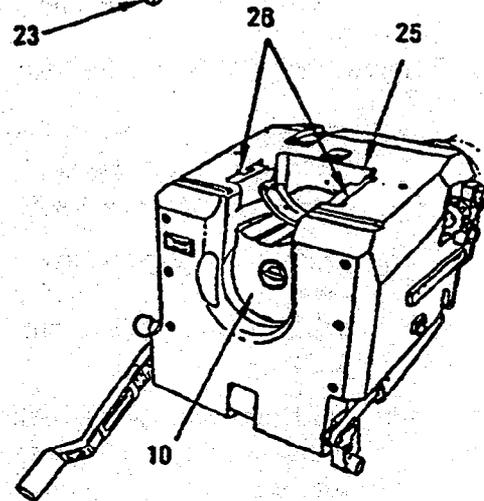
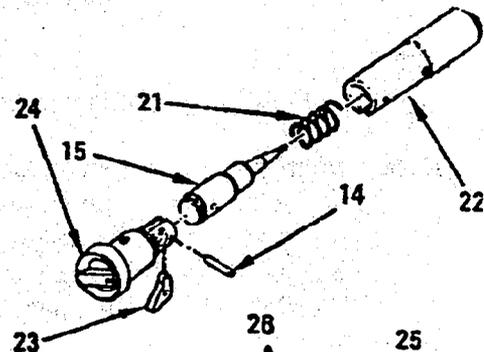
- k. Place cam (23) in slot of retainer assembly (24). Insert retainer assembly (24) holding cam (23) in housing (22), so holes line up. Insert and push straight pin (14) through hole of housing (22) and cam (23) until it comes through the other side of housing (22).

- l. Push down on cam (23). Probe (17) should move approximately 3/16 of an inch. If no movement is present, go back to step e.

- m. Open breechblock (10) (see TM 9-2350-264-10-3, page 2-332/TM 9-2350-264-10-2 (September 1990), page 2-367). Clean rear face of gun tube (25) breech ring side surfaces (26), and top of breechblock (10) with dry rag (see TM 9-2350-264-10-3, Appendix D, Item 42/TM 9-2350-264-10-2 (September 1990), Appendix D, Item 36). Close breechblock (10) (see TM 9-2350-264-10-3, page 2-333/TM 9-2350-264-10-2 (September 1990), page 2-368).

**Note.** When cleaning the firing pin and firing pin well, the crewman should use the standard green scratch pad issued from the unit supply. This scratch pad will easily remove any rust, carbon, or other dirt without removing the firing pin assembly protective coating.

After punching and swabbing the 120-mm gun tube dry, inspect the breech face and extractor area and dry all cleaner, lubricant, preservative (CLP) to prevent the firing pin from becoming wet.



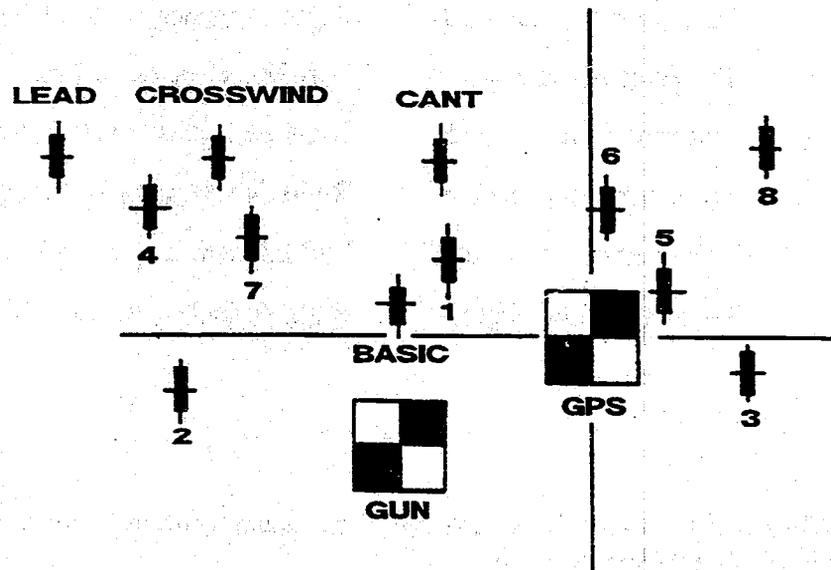
## ARMAMENT ACCURACY CHECKS

### 1. Combined Solution Boards.

References: FM 17-12-1 with Change 3 AFD.

Previously, units needed two solution boards to complete Armament Accuracy Checks (AAC) 4 and 5. Reports from units in the field indicate that combining the solution boards for Checks 4 and 5 simplifies the procedures. Combining the solution boards also reduces the space needed to transport the boards for field use.

### M1/M1A1 Combined Solution Board



## 2. Dimensions of the Combined Solution Board.

Minimum solution board dimensions are 96 inches wide by 60 inches high.

GUN and GPS squares are 12 inches on a 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, 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.** When constructing this solution board, measure accurately. Inaccurate measurements will result in false test results.

## 3. M1A1 Tanks with Sabot AMMO SUBDES 5.

M1A1 tanks that have completed the M829A1 SABOT modification to the computer electronics unit (CEU) require updated solution inputs for Checks 4 and 5.

Crews will notice that the order of performance of Check 4 (Special Input) and Check 5 (Ballistic Input) have been reversed in FM 17-12-1, Change 3 AFD.

Check 4 (Special Input) tests the ability of the CEU to correct for individual values given by either the cant sensor, crosswind sensor, or the lead angle sensor. Check 5 (Ballistic Input) tests the ability of the CEU to correct for multiple inputs from all automatic and manual inputs simultaneously.

Crews will now conduct Check 4 (Special Input) prior to conducting the Check 5 (Ballistic Input). This ensures that the CEU is correcting for the individual components (cant, crosswind, lead) prior to conducting full ballistic solution inputs check.

**Note.** Remember 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 that given round.

With this CEU modification applied to the M1A1 tank, an alternate and more effective means of completing Checks 4 and 5 of the AACs can be conducted. The following procedures explain the use of the maintenance data function in combination with normal AACs procedures for Checks 4 and 5. It will now be possible to determine if the problem is with the CEU or whether the gun/turret drive (GTD) portion of the fire control system needs troubleshooting. Read and follow the instructions carefully and ensure all steps for the AACs are performed in sequence.

## CHECK 4 (Special Input M1A1).

### 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 special gunnery checks described in Appendix F, TM 9-2350-264-10-3.

### CONDITIONS

1. The tank is on level ground with the solution board 100 meters ( $\pm 3$  meters) from the front edge of the tank.
2. The horizontal reference line on the solution board is level with the gun trunnion. An easy way to check this is to move MRS lever to IN. Squeeze 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. (The illustration, *M1/M1A1 Combined Solution Board*, is a scale drawing of the solution board to be used.)
3. An MBD is required.
4. The engine is off, VEHICLE MASTER POWER and TURRET POWER are on, auxiliary hydraulic power and CCP power are on, and the FIRE CONTROL MODE switch is at NORMAL.

**Note.** Checks 4 and 5 must be performed with 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 through the CCP data key during Checks 4 and 5. Do not use the LRF. The LRF may expose unprotected personnel to injury.

1. Record the zero data (CCF), MRS update and MRS boresight numbers from the CCP before conducting Check 4. Set zero data for 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.)
2. Press the RANGE key and index 1,200 meters. Squeeze the power control handles and press the ENTER key, hold power control handles for five seconds.
3. Put the fire control system in the boresight mode by pressing the BORESIGHT key on the CCP.

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

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. (To minimize backlash, the gunner should use a "G" pattern while moving the main gun.)
5. 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.
6. Store the boresight data by pressing the ENTER key on the CCP.
7. Check the boresight solution by gripping the palm switches for five seconds and releasing. Press the BORESIGHT key and re-lay the sight in the GPS target. The MBD aiming dot reticle should be pointing to the original aiming point on the GUN target on the solution board. Cancel the boresight mode by pressing the ENTER key.
8. Range values must be entered last when conducting the special input check. Grip palm switches first then enter range value into CCP. Hold the palm switches for five seconds then release. (Failure to enter range after the palm switches are pressed will result in a failure of Check 4.)
9. Use the fire control inputs described in the table, *MLA1 Computer Inputs for Check 4*.

**Note.** The basic solution has all manual and automatic inputs set to neutral values.

10. Enter the fire control inputs from the appropriate column.
11. Index range, squeeze the power control handles, and press the ENTER key. Hold the power control handles for five seconds.
12. Using the manual controls, lay the GPS aiming dot back on the aiming point.
13. Crewman on the outside views through the MBD and confirms that the gun is on the correct block.
14. Push the MAINT DATA key, index 88, and ENTER.
15. Record the readings in the CCP display under the CCP column on the Check 4 Results form.
16. Push MAINT DATA, index 89, and ENTER.
17. Record the readings in the CCP display under the CCP column on the Check 4 Results form.
18. Push MAINT DATA, index 90, and ENTER. (This takes you out of the MAINT DATA mode.)
19. Compare the readings entered in the CCP column with the readings in the Actual column on the Check 4 Results form. If the difference is greater than  $\pm 0.02$  for either 88 or 89, the tank fails.

## Tank Gunnery Lessons Learned

---

**Notes.** Evaluate each column individually. If the difference for 88 is 0.02 and the difference for 89 is 0.02, the tank will pass.

The crewman by the MBD should ensure that the aiming dot is on the appropriate block; if it is *not*, note that the MBD was not on the correct block.

Failure due to differences of 0.03 or greater indicates problems with the CEU. If the difference is 0.02 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 as was taken during boresighting.
- CCP not zeroed (for example, CCF).
- Incorrect entry of check data into the CCP.
- Problems with the fire control system other than the CEU.

Indicated faults with the CEU could be caused by--

- CCP not zeroed (for example, CCF).
- Incorrect entry of check data into the CCP.
- A bad CEU.

20. Repeat steps 10 through 19 for each solution.

21. Enter cant solution. (If it fails, the cant value is incorrectly set or the cant function is not being processed by the computer.)

22. Enter the crosswind solution. (If it fails, the crosswind value is incorrectly set or the crosswind function is not being processed by the computer.)

23. Enter the lead solution. (If it fails, the lead value is incorrectly set or the lead function is not being processed by the computer.)

**Note.** If a solution fails, check for errors in boresighting and perform the failed solution a second time, paying close attention to the values that are input to the computer. (Do *not* try the other solutions if the basic solution fails; notify organizational maintenance.)

24. After completing Check 4 and after all faults have been corrected, proceed to Check 5.

**MIA1 COMPUTER INPUTS FOR CHECK 4**

MAINT DATA	EL 88			
	AZ 89			
AMMO:	HEAT			
SUBDES:	1			
Wind	0.0	0.9	44.9	0.1
Cant	0.0	10.4	0.0	0.0
Lead	0.1	0.0	0.0	5.43
Ammo Temp	69.8	69.8	69.8	69.8
Air Pressure	29.92	29.92	33.00	29.92
Air Temp	59.0	59.0	59.0	59.0
*Range	1,030	1,855	1,780	1,835
Solution on Board	Basic	Cant	Crosswind	Lead

\*Range is the last input placed into the computer.

**MIA1 CHECK 4 RESULTS**

SUBDES	BASIC		CANT		CROSSWIND		LEAD	
MAINT DATA	88	89	88	89	88	89	88	89
Actual	4.82	0.0	9.87	-1.50	9.87	6.02	9.87	11.55
CCP								
Difference								
Pass/Fail								

## CHECK 5 (Ballistic Solution M1A1)

### PURPOSE

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

### CONDITIONS

1. The special input solution board is shown in the illustration, *M1/M1A1 Combined Solution Board*.
2. The engine is off, VEHICLE MASTER POWER and TURRET POWER are on, the auxiliary hydraulic pump is on, and the FIRE CONTROL MODE switch is set to NORMAL.

### 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. Press the RANGE key and index 1,200 meters. Squeeze the power control handles and press the ENTER key. Hold the power control handles for five seconds, then release.

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

2. Put the fire control system in the boresight mode by pressing the BORESIGHT key 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. To minimize backlash, the gunner should use a "G" pattern while moving the main gun.
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 key on the CCP.
6. Check the boresight solution by gripping the palm switches for five seconds and releasing. Press the BORESIGHT key and re-lay the sight on the GPS target. The MBD aiming dot/reticle should be pointing to the original aiming point on the GUN target on the solution board. Cancel the boresight mode by pressing the ENTER key.
7. Nine separate main gun solutions will be checked. To check each of the nine solutions, perform the following procedures:

- Note.** If the tank failed Check 4 or maintenance was performed, ensure the zero data (CCF) for each AMMO SUBDES is set to 0.0 and 0.0, and MRS update and MRS boresight numbers to 0.0 and 0.0 before conducting Check 5. (Failure to do so will result in a failure of Check 5.)
- a. Manually index the data inputs (except for range) into the CCP for a given solution as provided in the table, *MIA1 Computer Inputs for Check 5*.
  - b. Grip the palm switches and enter the range value into the CCP. Hold the palm switches for five seconds and release. (Range values must be entered last when conducting special input checks; failure to enter range after the palm switches are pressed will result in a failure of Check 5.)
  - c. Enter fire control inputs from the computer inputs column for Check 5.
  - d. Index range, squeeze the power control handles and press the enter key. Hold the power control handles for five seconds.
  - e. Using the manual controls lay the GPS aiming dot back on the aiming point.
  - f. Crewman on the outside views through the MBD and confirms that the gun is on the correct block.
  - g. Push MAINT DATA key, index 88, and ENTER.
  - h. Record the readings in the CCP display under the CCP column on the Check 5 Results form.
  - i. Push MAINT DATA, index 89, and ENTER.
  - j. Record the readings in the CCP display column on the Check 5 Results form.
  - k. Push MAINT DATA, index 90, and ENTER. (This takes you out of the MAINT DATA mode.)
  - l. Compare the readings entered in the CCP column with the readings in the Actual column on the Check 5 Results form. (If the difference is greater than  $\pm 0.02$  for either 88 or 89, the tank fails.)

**Notes.** Evaluate each column individually. If the difference for 88 is 0.02 and the difference for 89 is 0.02, the tank will pass.

The crewman by the MBD should ensure that the aiming dot is on the appropriate block; if it is *not*, note that the MBD was not on the correct block.

Failure due to differences of 0.03 or greater indicates problems with the CEU. If the difference is 0.02 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 as was taken during boresighting.
- CCP not zeroed. (for example, CCF).

## Tank Gunnery Lessons Learned

---

- Incorrect entry of check data into the CCP.
- Problems with the fire control system other than the CEU.

Indicated faults with the CEU could be caused by--

- CCP not zeroed (for example, CCF).
- Incorrect entry of check data into the CCP.
- A bad CEU.

m. Repeat steps 7d through 7l for each solution.

**Notes.** The solution is correctly implemented if the MBD aiming dot/reticle is within the solution square identified in the table, *MLA1 Computer Inputs for Check 5*.

If a solution is failed, the crew should rerun the check a second time. Close attention must be paid to correct procedures used and data put into the computer. (If a second try produces the same results, record on DA Form 2404 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.

**M1A1 COMPUTER INPUTS FOR CHECK 5**

MAINT DATA		EL 88 AZ 89									
AMMO	SABOT						HEAT				
SUBDES	0	1	2	3	4	5	0	1	2	3	
Wind	10.5	5.5	-22	34.6	-44.9	10.5	38.6	-9.1	-4.9	-4.8	
Cant	0	0	0	0	0	0	5	10	0	0	
Lead	-0.60	16.3	-10.7	3.08	-2.68	-0.64	-4.6	5.1	-5.13	-5.14	
Ammo Temp	75	100	25	50	25	75	100	100	0	0	
Air Pressure	30	30	24	28	30	30	25	26	24	24	
Air Temp	75	100	25	50	25	75	100	100	0	0	
Range	3,531	815	1,578	3,982	1,970	3,116	1,800	1,385	1,908	1,903	
Solution Number on Board	1	2	3	4	5	1	6	7	8	8	

**M1A1 RESULTS FOR CHECK 5 (SABOT)**

SUBDES	0		1		2		3		4		5	
MAINT DATA	88	89	88	89	88	89	88	89	88	89	88	89
Actual	6.58	-0.75	1.76	8.29	3.04	-10.79	8.11	9.54	5.07	-8.03	6.58	-0.75
CCP Difference												
Pass/Fail												

**M1A1 RESULTS FOR CHECK 5 (HEAT)**

SUBDES	0		1		2		3	
MAINT DATA	88	89	88	89	88	89	88	89
Actual	8.10	-6.02	7.35	5.52	10.63	-11.54	10.60	11.52
CCP								
Difference								
Pass/Fail								

**M26A1/M27A1 (LENZAR) MUZZLE BORESIGHT DEVICE**

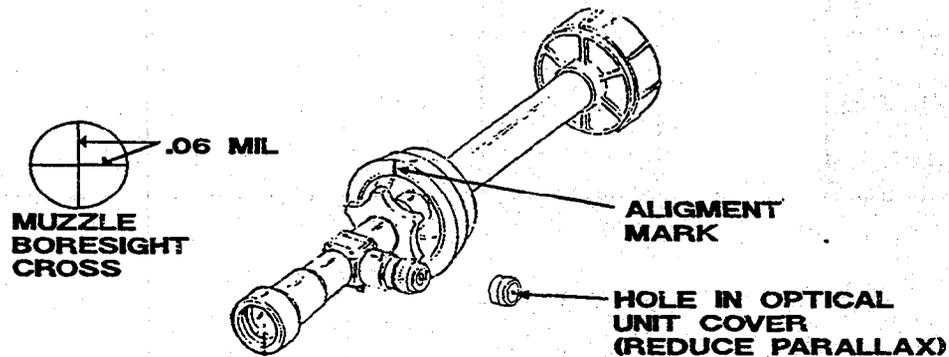
The Army has applied an accuracy improvement program to the M26A1/M27A1 muzzle boresight devices (MBD). These devices can be identified by the serial number. All M26A1/M27A1 with a serial number above 9000 have had the accuracy improvement program applied to them. The following are characteristics of the improved devices:

- When rotated 180 degrees, the MBD should not have an error that exceeds .2 mils in azimuth or elevation. (The vertical and horizontal lines that make up the aiming cross on the M26A1/M27A1 are .06 mil in width.)
- An alignment mark located on the tapered muzzle cone helps the crew to insert the MBD in the 12 and 6 o'clock positions.

There is now a hole in the optical unit cover (eye piece) to reduce parallax when viewing through the eye piece. This cover should be left on the optical unit during boresight procedures.

Other modifications or tighter tolerance changes have been made to the draw bar, optical head, reticle mount, objective lens and prism housing to increase accuracy.

Units who still have M26A1/M27A1 MBDs with a serial number under 9000 can turn these devices in through the supply system to receive an upgraded M26A1/M27A1 MBD.



## ENGAGING DISMOUNTED TROOPS WITH THE M240 COAX MACHINE GUN

When engaging troops with the M240 coax machine gun, crews should employ the following techniques for both offensive and defensive engagements.

### 1. LRF Return Selection.

- **ARM LAST RETURN** is the return used in most combat situations as described in the TM 9-2350-255-10-1/-2/-3 and TM 9-2350-264-10-1/-2/-3/TM 9-2350-264-10-1/-2 (September 1990), under principles of operation.
- **ARM 1ST RETURN** is used primarily for training ranges where targets will have holes in them or be on stilts that place the target above the ground and allow spill over of the laser beam to cause multiple returns.

This is true for both main gun and troop type engagements. When engaging troops, it is critical that the initial killing burst have a lethal effect. When engaging troops in ARM 1ST RETURN, the probability of the laser beam being interrupted by foliage, dust, smoke, or other environmental factors between tank and target is reasonably high. When this happens, the range display appears with a multiple return bar. The CEU will accept the first return; if it is not the true range to the target, there could be enough range difference to cause the initial burst to miss the troops but still warn them to go to the ground.

When using ARM LAST RETURN laser at the base of the target. This will prevent spill over from the laser beam from going beyond the target. By using this technique, even when a multiple return bar is received due to vegetation, rain, fog, or dust between the tank and target, there is a higher probability it will be correct.

### 2. Engagement Technique.

Immediately after ranging, the gunner should dump lead. The rationale for this is based upon the slow ballistic characteristics of the 7.62-mm round which causes the ballistic computer to apply a large amount of lead. With the sweeping firing patterns (back and forth) used in these types of engagements, lead may make it difficult to place effective fire on the target.

After having ranged and dumped lead, the gunner will bring the reticle up to the center of the target area and fire a killing burst. A killing burst is a continuous burst fired through the target area and designed to kill as many troops as possible before they hit the ground or find cover.

Once the troops have gone to the ground, the gunner will switch to suppressive fire using 20- to 30-round bursts.

## BORESIGHTING PROCEDURE GTAs

In the field today, there are numerous references that list a boresight procedure for M1/M1A1 tanks. Among the sources are the vehicle TM -10, FM 17-12-1, GTA 17-6-40 (M1), and GTA 17-6-45 (M1A1). The Armor School position is that crews should only use the boresight procedure

listed in FM 17-12-1, Change 3 AFD. The other references have discrepancies which increase the chance of error while boresighting.

### **M1/M1A1 OPERATOR'S MANUAL CHANGES**

All units receiving the M1/M1A1 series tanks need to ensure that the TMs -10 have all the up-to-date changes. Recent changes to the TMs incorporate some very important safety and emergency procedures.

For TM 9-2350-255-10-1/-2/-3, order changes 1 through 11 through unit publications; ensure changes are ordered for each volume. TM 9-2350-264-10-1/-2/-3 has been combined into two volumes (TM 9-2350-264-10-1/-2). Changes 1 through 10 for TM 9-2350-264-10-1/-2/-3 have been incorporated into these volumes. This Lessons Learned publication provides page references for both the three-volume set (TM 9-2350-264-10-1/-2/-3) and the two-volume set (TM 9-2350-264-10-1/-2).

### **COAX BATTLESIGHT UPDATE**

On M1 tanks, the minimum range the crew can set for coax battlesight is 200 meters. All engagements under 200 meters require the TC to use the battlesight add/drop toggle switch to index ranges under 200 meters.

On M1A1 tanks, coax battlesight ranges can be preset down to 25 meters.

### **THERMAL TARGETS**

The following is a list of Blane thermal targets now available to units in the field. The NSN for each is included and the cost is available on the AMDF.

#### **National Stock Numbers Items Received July 10, 1990--July 23, 1990**

<b>Military Item Description</b>	<b>Blane Item #</b>	<b>NSN</b>
Thermal Target Integrated, Frontal	B-T72-FT	6920-01-323-0776
Thermal Target Integrated, Flank	B-T72-FK	6920-01-323-0774
Tank Thermal Target Harness, Frontal	B-TTH-FT	6920-01-321-6899
Tank Thermal Target Harness, Flank	B-TTH-FK	6920-01-321-6900
Thermal Target Integrated, Frontal	B-BMP-FT	6920-01-322-1074
Thermal Target Integrated, Flank	B-BMP-FK	6920-01-321-5910
Thermal Target Integrated, Frontal	B-BRDM-FT	6920-01-321-5911
Thermal Target Integrated, Flank	B-BRDM-FK	6920-01-323-0775
Thermal Target Integrated, Frontal	B-BTR-70-FT	6920-01-321-5912
Thermal Target Integrated, Flank	B-BTR-70-FK	6920-01-321-5913
Infantry Target Harness	B-ITH	6920-01-321-6901
Integrated Infantry Target, E-Type	B-E	6920-01-321-5914
Integrated Infantry Target, F-Type	B-F	6920-01-321-5915
J-Bolts	B-JB	5306-01-322-2453