

AD-A156 802

DTIC FILE COPY

Research Product 84-12

M1 Tank Degraded Mode Gunnery

ARI Field Unit at Fort Knox, Kentucky
Training Research Laboratory

May 1984

DTIC
ELECTE
JUL 24 1985
S D



U. S. Army Research Institute for the Behavioral and Social Sciences

Approved for public release; distribution unlimited.

85 7 24 078

U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the
Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Technical Director

L. NEALE COSBY
Colonel, IN
Commander

Technical review by

Scott E. Graham
Donald R. Lampton

SFC Blair, SFC Jacqueth, SFC Middleton, and SFC Coswell
USAARMC, Weapons Department, Fort Knox, KY

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
Distribution/	
Availability Codes	
Dist	Special
A-1	

NOTICES

FINAL DISPOSITION: This Research Product may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: This Research Product is not to be construed as an official Department of the Army document in its present form.

RE: For Research Purpose Only, Not For
Distribution

The above statement no longer applies. The
information on pages having that statement
is now in the public domain.
Per Mr. Bill Harlow, ARIBSS

RE: Meaning of Key Word, ENCOG
Basic NCO Course

Research Product 84-12

M1 Tank Degraded Mode Gunnery

Ronald E. Kraemer

**Submitted by
Donald F. Haggard, Chief
ARI Field Unit at Fort Knox, Kentucky**

**Approved as technically adequate
and submitted for publication by
Harold F. O'Neil, Jr., Director
Training Research Laboratory**

**U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333**

**Office, Deputy Chief of Staff for Personnel
Department of the Army**

May 1984

**Army Project Number
2Q263743A794**

Education and Training

Approved for public release; distribution unlimited.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARI Research Product 84-12	2. GOVT ACCESSION NO. AD-A156802	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) M1 Tank Degraded Mode Gunnery	5. TYPE OF REPORT & PERIOD COVERED Final Report	
7. AUTHOR(s) Kraemer, Ronald E.	6. PERFORMING ORG. REPORT NUMBER --	
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Research Institute for the Behavioral and Social Sciences, 5001 Eisenhower Avenue Alexandria, VA 22333-5600	8. CONTRACT OR GRANT NUMBER(s) --	
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Research Institute for the Behavioral and Social Sciences, 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 2Q263743A794 Task 3.314 (FY 84) Work Unit 100	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) --	12. REPORT DATE May 1984	
	13. NUMBER OF PAGES 194	
	15. SECURITY CLASS. (of this report) Unclassified	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) --		
18. SUPPLEMENTARY NOTES --		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Armor training; Tank gunnery; Cross training. M1 (Abrams) tank; Fire commands; Unit training Sustainment training; Tank commander; Battlefield scenarios Individual skills training; Tank gunner; Self-study guides Skills sustainment; BNCOC		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Research was conducted to develop tank gunnery sustainment training materials for M1 Abrams tank crewmembers. The research product developed consists of three booklets for use by tank commanders and gunners in maintaining their knowledge and skills in degraded mode operation. The first booklet presents a knowledge of specific gunnery systems and operator responses during malfunction, while the two remaining booklets provide pictorial battlefield situations wherein the tank commander/gunner must apply the acquired knowledges during immediate and non-immediate engagement conditions.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

M1 TANK DEGRADED MODE GUNNERY

CONTENTS

	Page
BOOKLET 1: M1 GUNNERY SYSTEMS	vii
BOOKLET 2: NON-IMMEDIATE ENGAGEMENTS	53
BOOKLET 3: IMMEDIATE ENGAGEMENTS	133

M1 TANK
DEGRADED MODE GUNNERY

BOOKLET
1

M1 GUNNERY
SYSTEMS



FOR RESEARCH PURPOSE ONLY

NOT FOR DISTRIBUTION

US ARMY RESEARCH INSTITUTE

FOR THE BEHAVIORAL AND SOCIAL SCIENCES

RP 84-12-A

TABLE OF CONTENTS

TANK COMMANDER TRAINING NOTES	1
USER'S GUIDE	3
SECTION I: CROSSWIND SENSOR	6
SECTION II: CANT SENSOR	10
SECTION III: LEAD ANGLE SENSOR	15
SECTION IV: LASER RANGEFINDER	20
SECTION V: STABILIZATION SYSTEM	25
SECTION VI: GUNNER'S PRIMARY SIGHT (DAY CHANNEL)	29
SECTION VII: GUNNER'S PRIMARY SIGHT RETICLE	34
SECTION VIII: THERMAL IMAGING SYSTEM (TIS)	38
SECTION IX: IMAGE CONTROL UNIT/ ELECTRONICS UNIT	43
SECTION X: TURRET POWER	47

TANK COMMANDER TRAINING NOTES

GENERAL INFORMATION

This set of booklets deals with degraded mode gunnery systems on the M1 tank. There are 3 booklets in the set. When a crewmember has finished the complete set, he will be able to:

TAKE THE CORRECT ACTIONS IF AN M1
GUNNERY SYSTEM FAILS DURING A NON-
IMMEDIATE OR IMMEDIATE ENGAGEMENT

OVERVIEW OF THE BOOKLETS

The set of booklets has been organized from simple to complex. That is, the first booklet provides general information on M1 gunnery systems. The rest of the booklets provide increasingly difficult degraded gunnery problems which require solution. The booklets are as follows:

BOOKLET 1 - M1 Gunnery Systems
BOOKLET 2 - Degraded Mode Gunnery -
Non-Immediate Engagements
BOOKLET 3 - Degraded Mode Gunnery -
Immediate Engagements

PURPOSE OF THE BOOKLETS

The set of booklets has been designed to help you train gunners. The booklets may be used to:

- SUSTAIN THE SKILLS OF YOUR GUNNER
- CROSS-TRAIN OTHER PERSONNEL TO THE GUNNER POSITION

The booklets have not been designed as initial training. In other words, crewmen using the set of booklets must have certain skills. These skills are:

- SET UP THE GUNNER'S STATION ON THE M1 TANK
- DEAL WITH NORMAL MODE GUNNERY

When a crewmember has these existing skills, he will be ready to use this set of booklets.

USING THE BOOKLETS

The information within the booklets is based upon non-immediate and immediate engagements. These terms are defined in the front of each booklet.

- BEFORE THEY BEGIN, BE SURE THAT CREWMEMBERS USING THESE BOOKLETS UNDERSTAND THE DIFFERENCE BETWEEN:
- NON-IMMEDIATE ENGAGEMENTS
 - IMMEDIATE ENGAGEMENTS

BOOKLET NUMBER 1
M1 GUNNERY SYSTEMS
USER'S GUIDE

This is booklet number 1 in a set of 3 booklets. The set deals with degraded mode gunnery systems on the M1 tank. When you have finished the complete set, you will be able to:

- TAKE THE CORRECT ACTIONS IF AN M1 GUNNERY SYSTEM FAILS DURING A NON-IMMEDIATE OR IMMEDIATE ENGAGEMENT

DEFINITION OF NON-IMMEDIATE AND IMMEDIATE ENGAGEMENTS

The terms non-immediate engagement and immediate engagement may be new to you. They will be used in all of the booklets. They are defined as follows:

NON-IMMEDIATE ENGAGEMENT

- The threat has not seen you or cannot kill you
- Before you engage, you have time to identify and correct for unknown gunnery system failures

IMMEDIATE ENGAGEMENT

- The threat has seen you or can kill you
- Before you engage, you do not have time to identify and correct for unknown gunnery system failures

The actions you take in this set of booklets, and in battle, will depend on whether the engagement is non-immediate or immediate.

BE SURE YOU CAN DEFINE EACH TYPE OF ENGAGEMENT!

THIS BOOKLET

This booklet contains descriptions of the following gunnery systems on the M1 tank:

- CROSSWIND SENSOR
- CANT SENSOR
- LEAD ANGLE SENSOR
- LASER RANGEFINDER
- STABILIZATION SYSTEM
- GUNNER'S PRIMARY SIGHT (DAY CHANNEL)
- GUNNER'S PRIMARY SIGHT RETICLE
- THERMAL IMAGING SYSTEM
- IMAGE CONTROL UNIT/ELECTRONICS UNIT
- TURRET POWER

Each description includes:

- FUNCTION
- INDICATION OF POSSIBLE FAILURE
- RESPONSE TO A POSSIBLE FAILURE
 - Non-Immediate Engagements
 - Immediate Engagements

This booklet provides the foundation for all other booklets in the set.

BE SURE TO PAY ATTENTION TO EACH DESCRIPTION!

HOW TO USE THIS BOOKLET

1. Read the description of each gunnery system (starting with CROSSWIND SENSOR on page 6).
2. Answer the review questions following the system description.
3. Check your answers with the Answer Key that is provided at the bottom of the page.
4. If you need further information, refer to:
 - The M1 Technical Manual (TM 9-2350-255-10, Volumes 1, 2, and 3) and
 - FM-17-12-1
5. Proceed to the next gunnery system description.

BEFORE YOU USE THIS BOOKLET

Before using this booklet, be sure you can do the following:

- | |
|---|
| <ul style="list-style-type: none">● SET UP THE GUNNER'S STATION● DEAL WITH NORMAL MODE GUNNERY |
|---|

SECTION I CROSSWIND SENSOR

FUNCTION

The CROSSWIND SENSOR determines the cross-wind speed and direction at the vehicle. The computer then uses that information to provide a ballistic solution.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - "F" appears in GPS
- During computer self-test:
 - "3" appears in display window
 - NO GO lamp lights
 - CROSSWIND button flashes

Remember: Many other system failures will also produce an "F" in GPS.

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

When an "F" appears in the GPS the gunner will not know which particular system has failed. In non-immediate engagements situations, he should:

- Report: MALFUNCTION
- Check:
 - Laser RANGE switch is in SAFE
 - CB 22, CB 25, CB 27 are ON
- Perform a computer self-test

If the malfunction is corrected during the CHECK procedure, notify the TC immediately. If the crosswind sensor fails during the COMPUTER SELF-TEST, he should:

report CROSSWIND SENSOR IS OUT, then

respond to TC command. For example:

DEGRADED - ENTER ZERO - FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply the gunner's standard adjustment.

B: Immediate Engagements

With only an "F" in the GPS, the gunner will not know which particular system has failed. For immediate engagements, he should:

report MALFUNCTION, then

respond to TC command. For example:

DEGRADED - FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply the gunner's standard adjustment.

REMEMBER: When an "F" appears in the GPS it will remain there until the failed system is corrected.

CROSSWIND SENSOR
QUESTIONS

1. What is the function of the crosswind sensor?
 - A. Determine the tilt of the tank.
 - B. Determine crosswind speed and direction at vehicle.
 - C. Determine range from you to the target.
 - D. Determine crosswind speed at the target.

2. What is one indication of a known sensor failure?
 - A. Computer shows FAIL.
 - B. Rounds hit right of the target.
 - C. "3" appears in CCP display window.
 - D. An "F" symbol appears in the GPS.

3. In a non-immediate and immediate engagement, what is the first thing the gunner should do when an "F" appears in the GPS?
 - A. Perform a computer self test.
 - B. Report "MALFUNCTION" and situation, if known.
 - C. Ensure laser RANGE switch is in SAFE.
 - D. Check out Circuit Breakers 22, 25, and 27 are ON.

4. Which of the following checks should the gunner make when an "F" appears in GPS?
- A. Laser RANGE switch is in SAFE.
 - B. Turret lock is in UNLOCKED.
 - C. CB 22, 25, and 27 are ON.
 - D. THERMAL MODE switch in in STBY.
5. During a non-immediate engagement, what is the TC's command when the gunner reports MALFUNCTION-CROSSWIND SENSOR OUT?
- A. DEGRADED-FIRE
 - B. FIRE-DEGRADED
 - C. ENTER ZERO-FIRE
 - D. DEGRADED-ENTER ZERO-FIRE
6. During an immediate engagement, what is the TC's command when the gunner reports MALFUNCTION?
- A. DEGRADED-FIRE
 - B. FIRE-DEGRADED
 - C. ENTER ZERO-FIRE
 - D. DEGRADED-ENTER ZERO-FIRE

Answers: 1.B 2.C 3.B 4.A,C 5.D 6.A

SECTION II CANT SENSOR

FUNCTION

The CANT SENSOR determines the degree of cant when the gun trunnions are not horizontal (tilted). The computer then uses that information to provide a ballistic solution, when tank is stationary.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - "F" appears in GPS
- During computer self-test:
 - "2" appears in display window
 - NO GO lamp lights
 - CANT button flashes

Remember: Many other system failures will produce an "F" in the GPS.

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

With only an "F" in the GPS, the gunner will not know which particular system has failed. In non-immediate engagements situations, he should:

- Report: MALFUNCTION
- Check:
 - Laser RANGE switch is in SAFE
 - CB 22, CB 25, CB 27 are ON
 - Perform a computer self-test

If the malfunction is corrected during the CHECK procedure, notify the TC immediately. If the cant sensor fails during the COMPUTER SELF-TEST,

report **CANT SENSOR IS OUT**, then
respond to TC command. For example:

DEGRADED-APPLY CANT CORRECTION-FIRE

or

**DEGRADED-DRIVER MOVE TO
LEVEL FIRING POSITION-FIRE**

Note: If round misses and impact is observed, keep palm switches depressed and apply gunner's standard adjustment.

IMPORTANT: Corrections for cant cannot be made on the move. Also, when you apply a correction, aim 1 mil higher and in opposite direction of cant for each 1,000 meters:

B: Immediate Engagements

With only an "F" in the GPS, the gunner will not know which particular system has failed. For immediate engagements, he should:

report **MALFUNCTION**, then
respond to TC command. For example:

DEGRADED-FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply the gunner's standard adjustment.

REMEMBER: When an "F" appears in the GPS it will remain there until the failed system is corrected.

CANT SENSOR

QUESTIONS

1. What is the function of the cant sensor?
 - A. Determine the windspeed at end of gun tube.
 - B. Determine the lead for manual tracking.
 - C. Determine the distance to a target.
 - D. Determine the degree of cant when the gun trunnions are not horizontal.
2. What is one indication of a known cant sensor failure?
 - A. "2" appears in CCP display window.
 - B. "3" appears in CCP display window.
 - C. An "F" symbol appears in the GPS.
 - D. The computer panel displays FAIL.
3. In a non-immediate engagement, what two things should the gunner check after reporting MALFUNCTION?
 - A. CB 22, CB 25, and CB 27.
 - B. Laser RANGE switch is in SAFE.
 - C. CCP display window.
 - D. CANT button on CCP.

4. How should the gunner fire at a target in an immediate engagement situation when an "F" appears in the GPS?
 - A. Fire using the GPS and cant correction.
 - B. Fire using the GAS and cant correction.
 - C. Fire using the GPS without any correction for cant.
 - D. Fire using the GAS without any correction for cant.
5. If the round misses and is observed, what adjustment should you use?
 - A. Cant adjustment.
 - B. Gunner's standard adjustment.
 - C. BOT
 - D. Target Form
6. What is the cant correction when firing at a target at 2,000 meters?
 - A. None
 - B. 1 mil
 - C. 2 mils
 - D. 3 mils

Answers: 1.D 2.A 3.A,B 4.C 5.B 6.C

SECTION III LEAD ANGLE SENSOR

FUNCTION

The lead angle sensor determines the amount of lead required to hit a moving target. The computer then uses that information to provide a ballistic solution.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - "F" appears in GPS
 - Aiming point does not automatically follow the target after lasing
- During computer self-test:
 - "4" appears in CCP display
 - NO GO lamp lights
 - LEAD button flashes

Remember: Many other system failures will produce an "F" in GPS.

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

When the aiming point does not automatically follow the target after lasing, the lead angle sensor system has probably failed. In non-immediate engagement situations, the gunner should:

- Report: MAJUNCTION-NO LEAD
- Check:
 - Laser RANGE switch is in SAFE
 - CB 22, CB 25, CB 27 are ON
 - Perform a computer self-test

If the malfunction is corrected during the CHECK procedure, notify the TC immediately. If the lead angle sensor fails during the COMPUTER SELF-TEST, the gunner should:

report LEAD ANGLE SENSOR IS OUT, then

respond to TC command. For example:

DEGRADED-APPLY MANUAL LEAD-FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply gunner's standard adjustment.

IMPORTANT: The suggested standard lead for SABOT is 2-1/2 mils and 5 mils for HEAT, regardless of target speed.

B: Immediate Engagements

When the aiming point does not automatically follow the target after lasing, the gunner can be fairly certain that the lead angle sensor has failed. In immediate engagement situations, where there is no time to trouble-shoot, the gunner should:

report **MALFUNCTION-NO LEAD**, then
respond to TC command. For example:

DEGRADED-APPLY MANUAL LEAD-FIRE

Note: If round misses and impact is observed,
keep palm switches depressed and apply gunner's
standard adjustment.

REMEMBER: When an "F" appears in the GPS it
will remain there until the failed system is
corrected.

LEAD ANGLE SENSOR

QUESTIONS

1. What is the function of the lead angle sensor?
 - A. Determine how much lead is needed to hit a moving target.
 - B. Determine the range to a moving target.
 - C. Determine how much range correction is needed to hit a target.
 - D. Determine how much lead is required to engage a stationary target.
2. What is one indication of a probably lead angle sensor failure?
 - A. An "F" symbol appears in the GPS.
 - B. Aiming point does not follow target after lasing.
 - C. Lead lines illuminate on GPS reticle.
 - D. Target speed appears in the GPS.
3. In a non-immediate engagement, what is the last check the gunner should perform when an "F" appears in the GPS?
 - A. Check the Circuit Breakers.
 - B. Check the laser RANGE switch.
 - C. Check spent case ejection guard.
 - D. Perform a computer self-test.

4. What is the suggested standard lead when firing SABOT at a target moving 16-20 mph?
 - A. 2-1/2 mils
 - B. 5 mils
 - C. 7-1/2 mils
 - D. 10 mils
5. What is the gunner's crew response when an "F" appears in the GPS during a moving target engagement?
 - A. MALFUNCTION
 - B. DEGRADED
 - C. NO LEAD
 - D. MALFUNCTION-NO LEAD
6. How should the gunner engage a moving target with SABOT once it has been determined that the lead angle sensor has failed?
 - A. Fire using the GAS and SABOT reticle.
 - B. Fire using the GPS without any correction for lead.
 - C. Fire using the GAS without any correction for lead.
 - D. Fire using the GPS and standard lead.

ANSWERS: 1.A 2.B 3.D 4.A 5.D 6.D

SECTION IV LASER RANGEFINDER

FUNCTION

The laser rangefinder (LRF) quickly and accurately determines the range to the target. That information is then used by the computer to provide a ballistic solution.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - "F" appears in GPS
 - Range data in GPS does not change after lasing
- During computer self-test:
 - "8" appears in CCP display
 - NO GO lamp lights
 - RANGE button flashes

Remember: Many other system failures will produce an "F" in GPS. Also, effective use of LRF can be lost due to environment (fog, rain, smoke, etc.), vehicle failure, targets smaller than LRF beam width.

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

When range data does not change after lasing, the laser rangefinder has probably failed. In non-immediate engagement situations, the gunner should:

• Report:

MALFUNCTION-NO RANGE

• Check:

- Laser RANGE switch is in ARM 1ST RTN or ARM LAST RTN
- FIRE CONTROL MODE switch is in NORMAL or EMERGENCY
- AUTO RANGE light on CCP is off
- THERMAL TEST switch is in OFF
- CB 25 is in ON
- Perform a computer self-test

If the malfunction is corrected during the CHECK procedure, notify the TC immediately. If the LRF fails during the COMPUTER SELF-TEST, the gunner should:

report LRF IS OUT, then

respond to TC command. For example:

DEGRADED-FIRE

Note: If the round misses and impact is observed, keep the palm switches depressed and apply gunner's standard adjustment.

IMPORTANT: When the LRF fails during a non-immediate engagement, the TC can fire using the previous range shown in the GPS display (if correct), the range shown on the CCP, a battlesight range solution, an estimated range to be indexed into the computer, or an estimated range and the GAS.

B: Immediate Engagements

When range data does not change after lasing, the gunner cannot be fairly certain that the LRF has failed without troubleshooting the system. In immediate engagement situations, troubleshooting is impossible. Therefore, the gunner should:

report MALFUNCTION-NO RANGE, then

respond to TC command. For example:

DEGRADED-TWO ZERO FOUR ZERO-FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply gunner's standard adjustment.

IMPORTANT: When the LRF fails during an immediate engagement, the TC can fire using the previous range shown in the GPS display (if correct), a battlesight range solution, or an estimated range and the GAS.

LASER RANGEFINDER

QUESTIONS

1. What is the function of the laser rangefinder?
 - A. Determine battlesight range.
 - B. Determine the range from tank to target.
 - C. Determine how much lead is required to obtain a target kill.
 - D. Determine how much cant correction to apply when firing HEAT ammunition.
2. What is one indication of a probable laser rangefinder failure?
 - A. "F" appears in the GPS.
 - B. Laser RANGE switch is in ARM 1ST RTN.
 - C. FIRE CONTROL MODE switch is in NORMAL.
 - D. Range data does not change after lasing.
3. Which of the following numbers indicates an LRF failure during computer self-test?
 - A. "2"
 - B. "3"
 - C. "4"
 - D. "8"

4. When the LRF fails during an immediate engagement situation, which fire command(s) could the gunner expect to hear?
- A. DEGRADED-FIRE
 - B. DEGRADED-INDEX ONE TWO HUNDRED-FIRE
 - C. DEGRADED-TWO ZERO ONE HUNDRED-FIRE
 - D. All of the above
5. When a laser rangefinder malfunction occurs during a non-immediate engagement, which switch(s) should the gunner check?
- A. Laser RANGE switch
 - B. FIRE CONTROL MODE switch
 - C. THERMAL TEST switch
 - D. All of the above

Answers: 1.B 2.D 3.D 4.A,C 5.D

SECTION V STABILIZATION SYSTEM

FUNCTION

The stabilization system automatically slaves the sights to the main gun and where the gun tube moves, the sights follow. This enables the gunner to keep his aiming point on target and fire without having to come to a brief halt.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - View in GPS/TIS jumps around
 - Unable to keep aiming point on target

RESPONSE TO A POSSIBLE FAILURE

Non-Immediate and Immediate Engagements

When the stabilization system fails during any type of engagement, the gunner should:

- Report:

MALFUNCTION-STAB OUT

- Switch FIRE CONTROL MODE to EMERGENCY
- Respond to TC command. For example:

DEGRADED-DRIVER STOP...FIRE

Note: If round misses and impact is observed, keep the palm switches depressed and apply reengage method of direct fire adjustment.

IMPORTANT: When the FIRE CONTROL MODE switch is placed in EMERGENCY, automatic lead is cancelled. Therefore, when engaging a moving target, the gunner must apply the suggested standard lead for the ammunition announced in initial fire command.

The suggested standard leads are:

- | | | |
|---------|---------|------------|
| ● SABOT | - - - - | 2-1/2 mils |
| ● HEAT | - - - - | 5 mils |

STABILIZATION SYSTEM

QUESTIONS

1. What is the function of the stabilization system?
 - A. Track targets automatically while moving.
 - B. Slave the sights to the main gun.
 - C. Slave the main gun to the sights.
 - D. Provide automatic lead inputs to computer.
2. When the stabilization system fails, what position should the gunner place the FIRE CONTROL MODE switch?
 - A. NORMAL
 - B. MANUAL
 - C. EMERGENCY
 - D. SAFE
3. What command should the gunner expect to hear after he notifies the TC of a stabilization system failure?
 - A. DEGRADED-FIRE
 - B. DEGRADED-DRIVER STOP-FIRE
 - C. DRIVER STOP-FIRE
 - D. FIRE

4. What is one indication of a stabilization system failure?
- A. "0000" appears in GPS.
 - B. "F" appears in GPS.
 - C. Unable to keep aiming point on target.
 - D. "8" appears in CCP display.
5. When the stabilization system fails, how should the gunner engage a 20 mph moving target with HEAT ammo?
- A. Fire using the GPS and auto lead.
 - B. Fire using the GPS and 5 mil lead.
 - C. Fire using the GPS and 10 mil lead.
 - D. Fire using GAS and HEAT reticle.

Answers: 1.B 2.C 3.B 4.C 5.B

SECTION VI
GUNNER'S PRIMARY SIGHT (GPS)
(DAY CHANNEL)

FUNCTION

The GPS (day channel) provides daylight optics for close-in (Unity) and area (3X) surveillance, and for target identification and engagement (10X). In NORMAL mode, it is stabilized in elevation, and contains a projected reticle that is maintained on target center of mass by corrections from the ballistic computer. It also displays current range symbols, a multiple return indicator, a ready-to-fire indicator, and a fire control fault symbol.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - No view of outside area in 3X or 10X magnification

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

When the GPS (day channel) fails during a non-immediate engagement situation, the gunner should:

- Report: MALFUNCTION-NO GPS
- Check:
 - ✓ CB 21 is ON

If the malfunction is corrected during the CHECK procedure notify the TC immediately. If not corrected, the gunner should:

report **GPS IS OUT** , then

respond to TC command. For example:

DEGRADED-USE TIS-FIRE

Note: If round misses and impact is observed, keep the palm switches depressed and apply reengage method of direct fire adjustment.

B: Immediate Engagements

When the GPS (day channel) fails during an immediate engagement situation, the gunner should:

report **MALFUNCTION-GPS OUT** , then

respond to TC command. For example:

DEGRADED-USE TIS-FIRE

Note: If round misses, keep palm switches depressed and apply reengage method of direct fire adjustment.

IMPORTANT: If the TIS is not in the STBY mode, about 5 to 15 minutes will be needed to get the system ready for use. In that situation, the gunner must notify the TC and prepare to engage the target using the GAS.

GPS (DAY CHANNEL)

QUESTIONS

1. What is the function of the GPS (day channel)?
 - A. Provide daylight optics for target surveillance, identification, and engagement.
 - B. Provide target intensification during daylight.
 - C. Provide for stabilized operation in NORMAL mode.
 - D. Provide solutions for fire control fault indications.
2. What should the gunner report when a GPS (day channel) malfunction occurs during a non-immediate engagement?
 - A. DEGRADED-GPS OUT
 - B. MALFUNCTION-TIS
 - C. MALFUNCTION-NO GPS
 - D. DEGRADED-NO GPS
3. If the GPS (day channel) failure is not corrected during a non-immediate engagement, how should a tank target at 2300 meters be engaged?
 - A. Use TIS and precision gunnery.
 - B. Use GAS and announced range.
 - C. Use GPS and degraded gunnery.
 - D. Use TIS and fire battlesight.

4. If the GPS (day channel) fails during an immediate engagement, and the TIS is OFF, what should the gunner do before engaging the target?

- A. Turn TIS to ON.
- B. Index announced range.
- C. Switch to GAS.
- D. Depress BATTLESIGHT RNG button.

Answers: 1.A 2.C 3.A 4.C

SECTION VII
GUNNER'S PRIMARY SIGHT (GPS) RETICLE

FUNCTION

The GPS reticle provides the aiming reference for engaging targets using a fire control system solution. It is marked in mils to also assist in range and manual lead determination.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
- No reticle image in GPS

ACTIONS FOR GPS RETICLE FAILURE

A: Non-Immediate Engagements

When the GPS reticle is not present in the GPS during a non-immediate engagement, the gunner should:

- Report: MALFUNCTION-NO RETICLE
- Check:
 - CB 21 and CB 30 are ON
 - GPS RETICLE control is fully clockwise

If malfunction is corrected, notify the TC immediately. If it is not corrected, the gunner should:

report **RETICLE IS OUT**, then
respond to TC command. For example:

DEGRADED-USE TIS-FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply reengage method of direct fire adjustment.

B: Immediate Engagements

When the GPS reticle is not present (fails) during an immediate engagement situation, the gunner should:

report **MALFUNCTION-RETICLE IS OUT**, then
respond to TC command. For example:

DEGRADED-USE TIS-FIRE

Note: If round misses, keep palm switches depressed and apply reengage method of direct fire adjustment.

IMPORTANT: If the TIS is not in STBY or ON mode, about 5 to 15 minutes will be needed to get the system ready for use. In that situation, the gunner must notify the TC and prepare to engage the target using the GAS.

GPS RETICLE

QUESTIONS

1. What is the function of the GPS reticle?
 - A. Provide sight stabilization during vehicle movement.
 - B. Provide an aiming reference for GPS target engagement.
 - C. Provide for estimated range to distant targets.
 - D. Provide fire control solutions for ballistic computer.
2. What should the gunner report when the GPS reticle goes out during a non-immediate engagement?
 - A. DEGRADED-RETICLE OUT
 - B. MALFUNCTION-TROUBLESHOOTING
 - C. MALFUNCTION-RETICLE OUT
 - D. DEGRADED-USE TIS
3. What should the TC command when he's informed that the GPS reticle went out during an immediate engagement situation?
 - A. MALFUNCTION-USE TIS-FIRE
 - B. DEGRADED-USE TIS-FIRE
 - C. DEGRADED-USE GPS-FIRE
 - D. MALFUNCTION-FIRE

4. To be able to use the TIS in an immediate engagement situation, what position should the THERMAL MODE switch be in?
- A. OPEN or ON
 - B. SHTR or STBY
 - C. ON or SHTR
 - D. STBY or ON

Answers: 1.B 2.C 3.D 4.D

SECTION VIII
THERMAL IMAGING SYSTEM (TIS)

FUNCTION

The GPS (thermal channel) is referred to as the TIS (thermal imaging system) and is primarily a night sight. Like the GPS (day channel) it provides for target surveillance, identification, and engagement. The TIS uses thermal (heat) radiation rather than visible light, and depends on the electronic control unit for its reticle and display symbols.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
- No thermal images present in sight

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

When thermal images are not present in the sight, the TIS has probably failed. In a non-immediate engagement situation, the gunner should:

- Report:
MALFUNCTION-NO THERMAL IMAGES
- Check (adjust):
 - FLTR/CLEAR/SHTR switch in SHTR
 - Thermal ballistic door is open
 - UNIT TEST PATTERN switch is OFF
 - FAULT light is not lit
 - CB 22 is ON
 - Adjust CONTRAST and SENSITIVITY controls

If malfunction is corrected during the CHECK (ADJUST) procedure, notify the TC immediately. If not corrected, the gunner should:

report **TIS IS OUT**, then
respond to TC command. For example:

DEGRADED-TWO EIGHT HUNDRED-FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply gunner's standard adjustment.

IMPORTANT: If the TIS was used during daylight, the TC could switch to GPS (daylight channel) or fire using the GAS. At night, the TC has to use artificial light (searchlight, flares, etc.) to engage the target or fire from a sketch card.

B: Immediate Engagements

When thermal images are not present in the sight, the TIS has probably failed. In an immediate engagement situation, the gunner should:

report **MALFUNCTION-TIS OUT**, then
respond to TC command. For example:

DEGRADED-TWO EIGHT HUNDRED-FIRE

Note: If the round misses and impact is observed, keep palm switches depressed and apply gunner's standard adjustment.

IMPORTANT: In this situation, it's assumed that there is sufficient light (moonlight) to see the target. If not, it would be wise to seek a hull down position without delay.

THERMAL IMAGING SYSTEM (TIS)

QUESTIONS

1. What is the function of the TIS?
 - A. Provide sight stabilization at night.
 - B. Provide an aiming point for night engagements.
 - C. Provide the TC with a secondary sighting system.
 - D. Provide night optics for target surveillance, identification, and engagement.
2. Which of the following errors would cause the TIS to malfunction?
 - A. FLTR/CLEAR/SHTR switch in SHTR
 - B. Thermal ballistic door open
 - C. UNIT TEST PATTERN switch is ON
 - D. CB 22 set to ON
3. What should the gunner do when a TIS (or any other) malfunction is corrected during a non-immediate engagement situation?
 - A. Lay, lase and fire
 - B. Use the GAS
 - C. Notify the TC immediately
 - D. Announce "REENGAGING"

4. Which of the following conditions would prevent the TC from using the GPS (day channel) when the TIS fails at night?
- A. No searchlight
 - B. No moonlight/starlight
 - C. No sketch card
 - D. All of the above

Answers: 1.D 2.C 3.C 4.D

SECTION IX
IMAGE CONTROL UNIT (ICU)/ELECTRONIC UNIT (EU)

FUNCTION

The Image Control Unit/Electronic Units provide the symbols displayed in the GPS/TIS sights. These symbols are the:

- Ready-to-fire symbol (green square)
- Range symbols (numbers)
- Fire-control fault symbol ("F")
- Multiple return symbol (bar or line over range data)

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - No Range (numbers) after lasing
 - No Ready-to-fire symbol after lasing

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

When the range symbols and ready-to-fire symbol fails to appear in the GPS/TIS after lasing, the ICU/EU has probably failed. In a non-immediate engagement situation, the gunner should:

report MALFUNCTION-NO SYMBOLS, then

respond to TC command. For example:

DEGRADED-CHECK RANGE IN CCP...FIRE

Note: If the round misses and impact is observed, keep the palm switches depressed and apply reengage method of direct fire adjustment.

IMPORTANT: The accuracy of the LRF, combined with the choice of first or last return logic, should provide crew members with enough confidence to fire even though the range is not shown. However, if the crew has the time and is uncertain, the TC may have the gunner check the range displayed in the CCP.

B: Immediate Engagements

When the range symbols and ready-to-fire symbol fails to appear in the GPS/TIS after lasing, the ICU/EU has probably failed. In an immediate engagement situation, the gunner should:

report **MALFUNCTION-NO SYMBOLS**, then

respond to TC command. For example:

DEGRADED-FIRE

Note: If round misses and impact is observed, keep palm switches depressed and apply re-engage method of direct fire adjustment.

IMAGE CONTROL UNIT/ELECTRONICS UNIT

QUESTIONS

1. Which of the following symbols is not provided by the ICU/EU?
 - A. Ready-to-fire
 - B. PASS
 - C. Range
 - D. Fire control fault

2. What are two indications of ICU/EU failure?
 - A. No multiple return bar
 - B. No range symbol
 - C. No ready-to-fire symbol
 - D. No "F" symbol

3. If you are in a non-immediate engagement and lose GPS symbology, what action may the TC take?
 - A. Have gunner check range displayed in TCF.
 - B. Have gunner index an estimated range.
 - C. Have gunner use the GAS and announced range.
 - D. Have gunner fire battlesight.

4. If you are in an immediate engagement situation and lose GPS symbology, what should the TC command?

- A. DEGRADER-USE BATTLESIGHT-FIRE
- B. DEGRADED-INDEX(RANGE)-FIRE
- C. DEGRADED-USE GAS-FIRE
- D. DEGRADED-FIRE

Answers: 1.B 2.B,C 3.A 4.D

SECTION X
TURRET POWER

FUNCTION

Turret power provides the gunner or TC with the capability to quickly traverse the turret and elevate or depress the main gun and coax using the gunner's power control handles or TC's override.

INDICATION OF POSSIBLE FAILURE

- During an engagement:
 - Turret or gun fails to move or stops

RESPONSE TO A POSSIBLE FAILURE

A: Non-Immediate Engagements

When the turret or gun fails to move or stops, power to the turret has probably failed. In a non-immediate engagement, the gunner should:

- Report:

MALFUNCTION-NO TURRET POWER
- Check:
 - CB 17, CB 30, and CB 31 are ON
 - Turret Traverse Lock is UNLOCKED
 - Main gun elevation travel lock is unlocked
 - GUN/TURRET DRIVE switch is in POWERED
 - FIRE CONTROL MALF light is not lit
 - Engine running or AUX HYDR POWER is in ON
 - Hydraulic pressure gauge above 1550 psi
 - Turret/Hull/Gun Shield for obstructions

If the malfunction is corrected during the CHECK procedure, notify the TC immediately. If not corrected, the gunner should:

report **TURRET POWER IS OUT** ,

switch FIRE CONTROL MODE to MANUAL, then respond to TC command. For example:

DEGRADED-ONE EIGHT HUNDRED-FIRE

Note: If round misses and impact is observed, apply the gunner's standard adjustment.

IMPORTANT: When the turret power fails, the TC issues fire commands using GAS and degraded mode gunnery techniques. The gunner must switch to MANUAL mode and use the manual handles to traverse and elevate.

B: Immediate Engagements

When the turret or gun fails to move or stops, power to the turret has probably failed. In an immediate engagement situation, the gunner should:

report **MALFUNCTION-NO TURRET POWER** ,

switch FIRE CONTROL MODE to MANUAL, then respond to TC command. For example:

DEGRADED-ONE EIGHT HUNDRED-FIRE

Note: If round misses and impact is observed, apply the gunner's standard adjustment.

REMEMBER: The TC may use GAS and degraded mode gunnery techniques, if applicable. The gunner must switch to MANUAL mode and use the manual handles to traverse and elevate.

TURRET POWER

QUESTIONS

1. In a Non-Immediate Engagement, which of the following errors would cause the turret power to malfunction?
 - A. CB 11, CB 12, CB 13 are ON
 - B. GUN/TURRET DRIVE switch in MANUAL
 - C. Turret Traverse Lock is UNLOCKED
 - D. Hydraulic pressure above 1550 psi
2. In a Non-Immediate Engagement, which of the following fire commands could the TC issue when the turret power has failed?
 - A. MALFUNCTION-FIRE-BATTLESIGHT
 - B. DEGRADED-FIRE
 - C. DEGRADED-INDEX ONE EIGHT HUNDRED-FIRE
 - D. DEGRADED-ONE EIGHT HUNDRED-FIRE
3. What fire control mode should the gunner use when the turret power fails?
 - A. MANUAL
 - B. EMERGENCY
 - C. NORMAL
 - D. Any of the above

4. In an Immediate Engagement, which of the following fire commands could the TC issue when the turret power has failed?
- A. MALFUNCTION-FIRE-BATTLESIGHT
 - B. DEGRADED-FIRE
 - C. DEGRADED-INDEX ONE EIGHT HUNDRED-FIRE
 - D. DEGRADED-ONE EIGHT HUNDRED-FIRE

Answers: 1.B 2.D 3.A 4.D

This M1 Degraded Mode Gunnery booklet
is a prototype training document. For
comments or questions contact:

Mr. Ronald E. Kraemer
ARI Field Unit- Ft Knox
ATTN: PERI-IK
Steele Hall
Fort Knox, KY 40121

Autovon: 464-4932
Commercial: (502) 624-4932

M1 TANK
DEGRADED MODE GUNNERY
NON-IMMEDIATE
ENGAGEMENTS

BOOKLET

2



FOR RESEARCH PURPOSE ONLY

NOT FOR DISTRIBUTION

US ARMY RESEARCH INSTITUTE

FOR THE BEHAVIORAL AND SOCIAL SCIENCES

RP 84-12-B

BOOKLET NUMBER 2

DEGRADED MODE GUNNERY - NON-IMMEDIATE ENGAGEMENTS

USER'S GUIDE

1

BOOKLET NUMBER 2
DEGRADED MODE GUNNERY - NON-IMMEDIATE ENGAGEMENTS
USER'S GUIDE

This is booklet number 2 in a set of 4 booklets. The set deals with degraded mode gunnery on the M1 tank. When you have finished the complete set, you will be able to:

TAKE THE CORRECT ACTIONS IF AN M1 GUNNERY SYSTEM FAILS DURING A NON-IMMEDIATE OR IMMEDIATE ENGAGEMENT

DEFINITION OF NON-IMMEDIATE AND IMMEDIATE ENGAGEMENTS

The terms non-immediate engagement and immediate engagement may be new to you. They will be used in all of the booklets. They are defined as follows:

NON-IMMEDIATE ENGAGEMENT -

- The threat has not seen you or cannot kill you
- Before you engage, you have time to identify and correct for unknown gunnery system failures

2

IMMEDIATE ENGAGEMENT -

- The threat has seen you or can kill you
- Before you engage, you do not have time to identify and correct for unknown gunnery system failures

The actions you take in this set of booklets, and in battle, will depend on whether the engagement is non-immediate or immediate.

BE SURE YOU CAN DEFINE EACH TYPE OF ENGAGEMENT!

THIS BOOKLET

This booklet will give you practice in dealing with degraded mode gunnery during non-immediate engagements.

3

The booklet contains a number of battlefield scenarios. Each scenario contains:

- A PICTURE OF THE BATTLEFIELD SITUATION
- A SHORT WRITTEN DESCRIPTION OF THE BATTLEFIELD SITUATION AND THE STATUS OF YOUR TANK
- A QUESTION FOR YOU TO ANSWER

HOW TO USE THIS BOOKLET

1. Look at the scenario picture.
2. Read the short written description.
3. Read and answer the scenario question.

SOME QUESTIONS ARE FOLLOWED BY A LIST OF POSSIBLE ANSWERS. FOR THESE QUESTIONS, YOU SHOULD SELECT THE CORRECT ANSWER.

SOME QUESTIONS DO NOT HAVE A LIST OF POSSIBLE ANSWERS. FOR THESE QUESTIONS, YOU MUST PROVIDE YOUR OWN ANSWER.

4. Check your answer with the Answer Key on the page following the scenario.
5. Complete the rest of the scenarios.

BEFORE YOU USE THIS BOOKLET

Before you use this booklet, be sure you have completed Booklet 1 of the set.

SCENARIO 1



THE SITUATION

- M1 is located among trees, undetected.
- A T-72 appears at 1800 meters.
- "F" appears in GPS.

What should you do, immediately?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Report MALFUNCTION	Perform a computer self-test	Apply manual lead and engage target	Use GAS and engage target

SCENARIO 1 ANSWER

You should have selected A: Report MALFUNCTION

When an "F" appears in GPS during a Non-Immediate Engagement, any one of many systems could have failed. Your immediate action is to notify the TC by reporting MALFUNCTION.

WRONG ANSWERS

B. This is done AFTER you check the laser RANGE switch and CB 22, 25, and 27.

C. With only an "F" indication, you cannot know for sure if the lead angle sensor has failed.

D. In a non-immediate engagement, you have time to identify and correct for unknown gunnery system failures.

SCENARIO 2



10

THE SITUATION (Continued)

- Your M1 is located among trees, undetected.
- Target is a T-72 at 1800 meters.
- "F" is displayed in GPS.
- You reported MALFUNCTION and checked switches.
- Laser RANGE switch is in SAFE; CBs 22, 25, 27 are ON

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Apply cross-wind aim-off	Engage the target using the GAS	Apply manual lead and engage target	Perform a computer self-test

11

SCENARIO 2 ANSWER

The correct answer is D: Perform a computer self-test.

When you perform a computer self-test, the self-test will stop when it reaches a failed system. When this occurs, you must cancel the failed system by pushing its flashing input key. This will allow the test to continue.

WRONG ANSWERS

- A. Wait a minute! You do not know if the crosswind sensor has failed.
- B. Not so fast! Perform a computer self-test first to possibly identify the failed system.
- C. Same as B.

SCENARIO 3



14

THE SITUATION (Continued)

- Your M1 is located among trees, undetected.
- Target is a T-72 at 1800 meters.
- "F" is displayed in GPS.
- You reported MALFUNCTION and checked switches.
- Switches are OK so you performed a computer self-test.
- CROSSWIND sensor fails the self-test.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Apply cross-wind aim-off and engage target	Notify the TC of specific failure	Perform computer self-test	Engage the target without corrections

15

61

SCENARIO 3 ANSWER

The correct answer is B: Notify the TC of specific failure.

If the crosswind sensor (or any other system) fails during the computer self-test, the gunner should notify the TC immediately and then respond to the TC's command. For example:

GUNNER: CROSSWIND SENSOR IS OUT.

TC: DEGRADED, ENTER ZERO, FIRE.

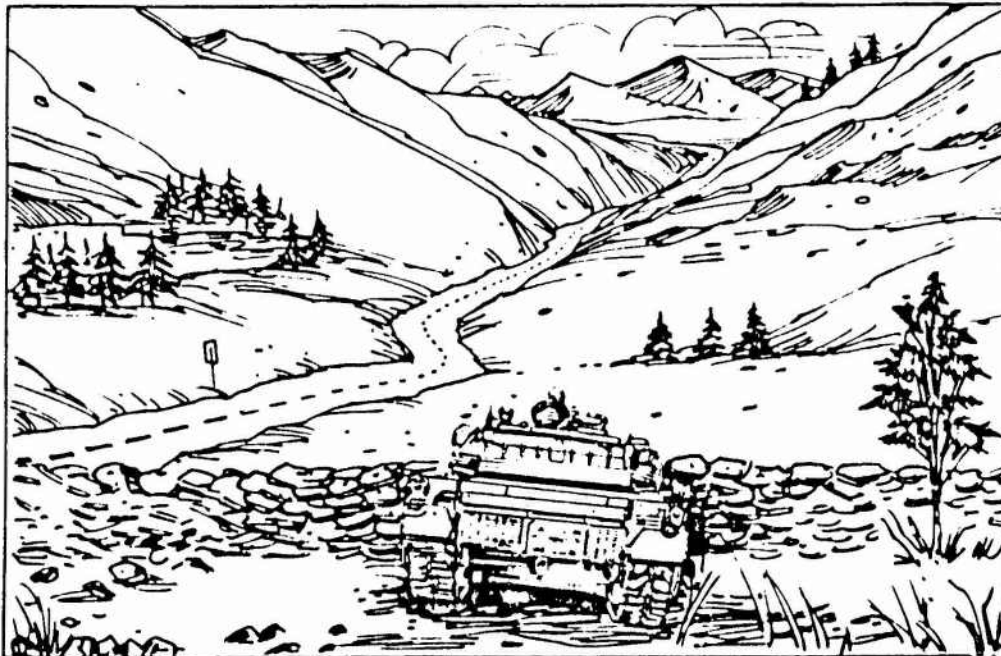
16

WRONG ANSWERS

- A. No corrections are applied for crosswind sensor failures.
- C. Not necessary. Would only confirm the failure and waste time.
- D. No. Must not engage without informing TC of known failure.

17

SCENARIO 4



18

THE SITUATION

- M1 is canted in a hull-down conducting surveillance.
- You are watching the area by traversing the turret.
- Targets traveling on the road ahead are to be engaged.
- No targets have been detected.
- "F" appears in GPS.

What should you do?

A

Cancel
CROSSWIND
input

B

Perform
computer
self test

C

Cancel
CANT
input

D

Notify the TC.

19

SCENARIO 4 ANSWER

The correct answer is D: Notify the TC

When an "F" appears in the GPS, you should always notify the TC. The way to do that is to announce MALFUNCTION and the situation, if known.

20

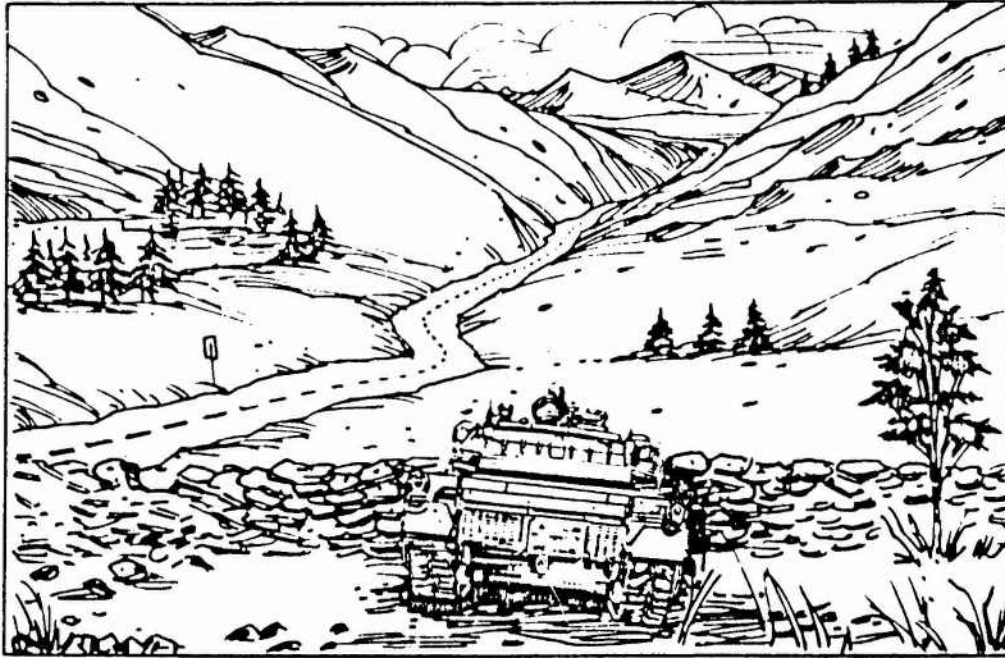
WRONG ANSWERS

- A. No. Don't "cancel" a gunnery systems unless it has failed.
- B. Not yet. Check out the switches first.
- C. Same as A.

21

64

SCENARIO 5



22

THE SITUATION (Continued)

- M1 is canted in a hull-down position conducting surveillance.
- Targets on road ahead are to be engaged.
- No targets have been detected.
- "F" appeared in GPS and you announced MALFUNCTION.

What should your next action be?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Engage target cant correction	Respond to TC command	Perform computer self-test	Check laser RANGE switch and CBs

23

65

SCENARIO 5 ANSWER

You should have selected D: Check laser RANGE switch and CBs.

An "F" displayed in the GPS could mean any number of things. In a non-immediate engagement situation (time is available), you should check to ensure that:

- Laser RANGE switch is in SAFE.
- CB 22, 25, and 27 are ON.

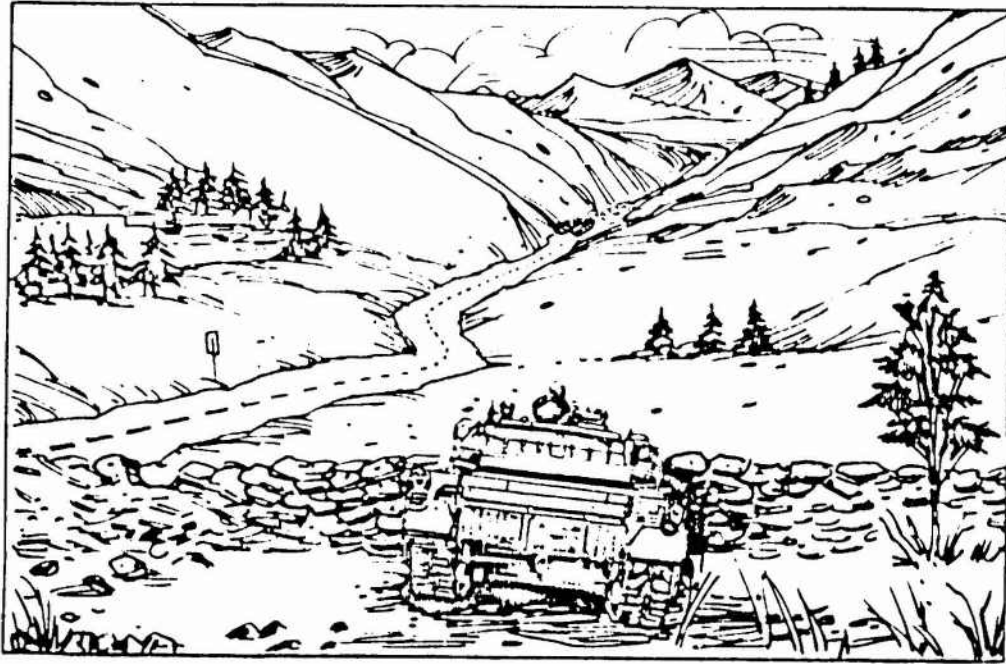
WRONG ANSWERS

- A. No. Attempt to identify the failed system.

B. No. TC is waiting to hear from you on what caused the failure.

C. Not yet. Check out the RANGE switch and CBs first.

SCENARIO 6



26

THE SITUATION (Continued)

- M1 is canted in a hull-down position conducting surveillance.
- Targets on road ahead are to be engaged.
- No targets had been detected.
- "F" appeared in GPS; you announced MALFUNCTION.
- You checked switches and performed a computer self-test.
- Cant sensor failed and you notified the TC.
- T-72 suddenly appears at 2100 meters.

How should you expect to engage the target?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Fire precision using GPS and adjust	Fire degraded using GAS and cant correction	Fire degraded using GPS and battlesight	Fire precision using GPS and cant correction

27

SCENARIO 6 ANSWER

You should have selected D: Fire precision using GPS and cant corrections.

When a CANT SENSOR failure occurs during a non-immediate engagement situation, the TC can move the tank to a level-firing position or have the gunner apply an aim-off correction. The correction for CANT is to aim 1-mil higher and in the opposite direction for each 1000 meters.

WRONG ANSWERS

- A. This is the solution for an IMMEDIATE ENGAGEMENT when the threat is most dangerous.
- B. No. GAS is used when GPS and TIS become non-operational.
- C. No. Battlesight gunnery is used when LRF fails.

SCENARIO 7



30

THE SITUATION

- M1 is in a hull-down position, undetected.
- An armored scout car is detected moving across open ground.
- TC commands GUNNER, HEAT, MOVING APC...ON.
- You announce IDENTIFIED and lase to target.
- "F" appears in GPS.
- Aiming point fails to follow the target.

What should you do?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Report DEGRADED NO LEAD	Report MALFUNCTION	Report MALFUNCTION NO LEAD	Report DEGRADED and "cancel" LEAD sensor

31

SCENARIO 7 ANSWER

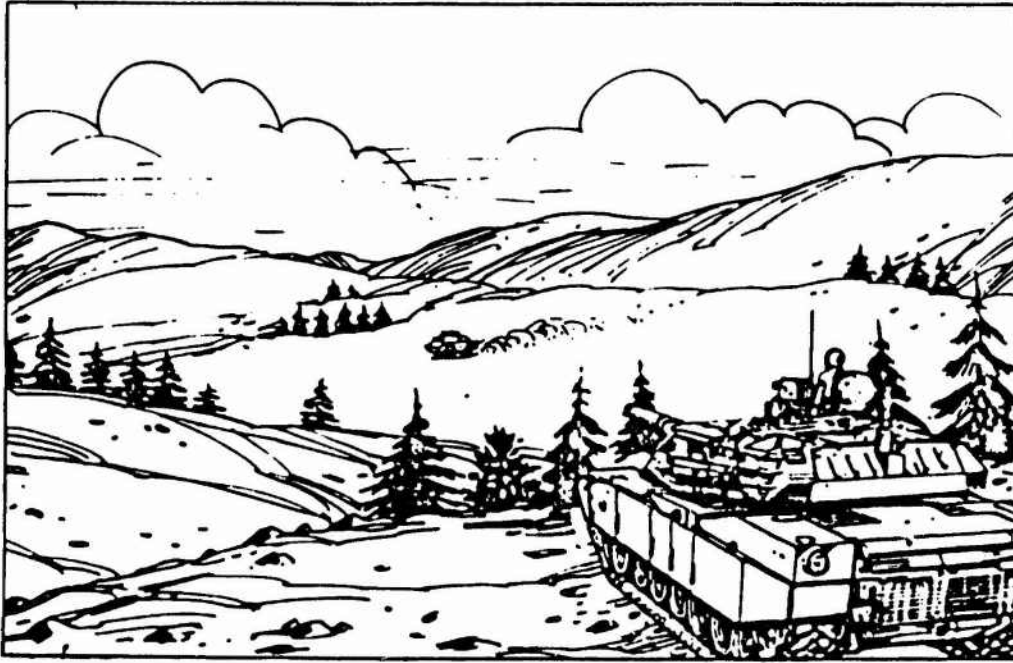
The correct answer is C: Report MALFUNCTION - NO LEAD

When only an "F" is displayed in the GPS, it could mean one of many things. However, if an "F" and the aiming point fails to follow after lasing, you know that the lead angle system is malfunctioning. Why remains to be determined.

WRONG ANSWERS

- A. No such report for gunner.
- B. Partially correct, but since you know lead angle sensor is malfunctioning, you should report it.
- D. No such command and too early to "cancel" auto lead angle sensor system.

SCENARIO 8



34

THE SITUATION (Continued)

- M1 is in a hull-down position, undetected.
- An armored scout car is detected moving across open ground.
- During target engagement, you report MALFUNCTION - NO LEAD.
- Check of switch and CBs fails to identify cause of malfunctions.
- Computer self-test identifies a lead angle sensor failure.
- You notify the TC: LEAD ANGLE SENSOR IS OUT.

How should you expect to engage the target?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Use GPS and manual lead	Use GPS without lead	Use GAS without lead	Use GAS manual lead

35

71

SCENARIO 8 ANSWER

The correct answer is A: Use GPS and manual lead.

When the lead angle sensor has failed and you are engaging a moving target, manual lead must be applied.

36

WRONG ANSWERS

B. No. Lead must be applied when engaging a moving target.

C. No. GPS is still working and should be used with manual lead.

D. Same as C.

37

72

SCENARIO 9



38

THE SITUATION (Continued)

- M1 is in a hull-down position, undetected.
- Armored scout car is detected moving across open ground.
- HEAT ammo is loaded and ready to fire.
- You reported MALFUNCTION - LEAD ANGLE SENSOR IS OUT.
- TC commands DEGRADED - APPLY MANUAL LEAD - FIRE.

What is the standard lead to apply in this situation?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
10 mils	2-1/2 mils	7-1/2 mils	5 mils

39

73

SCENARIO 9 ANSWER

You should have selected D: 5 mils

When the lead angle sensor fails, manual lead must be applied when engaging a moving target. The suggested standard leads, regardless of target speed, are:

- 2-1/2 mils for SABOT
- 5 mils for HEAT

40

WRONG ANSWERS

- A. No. The suggested standard lead for HEAT is 5 mils, regardless of target speed.

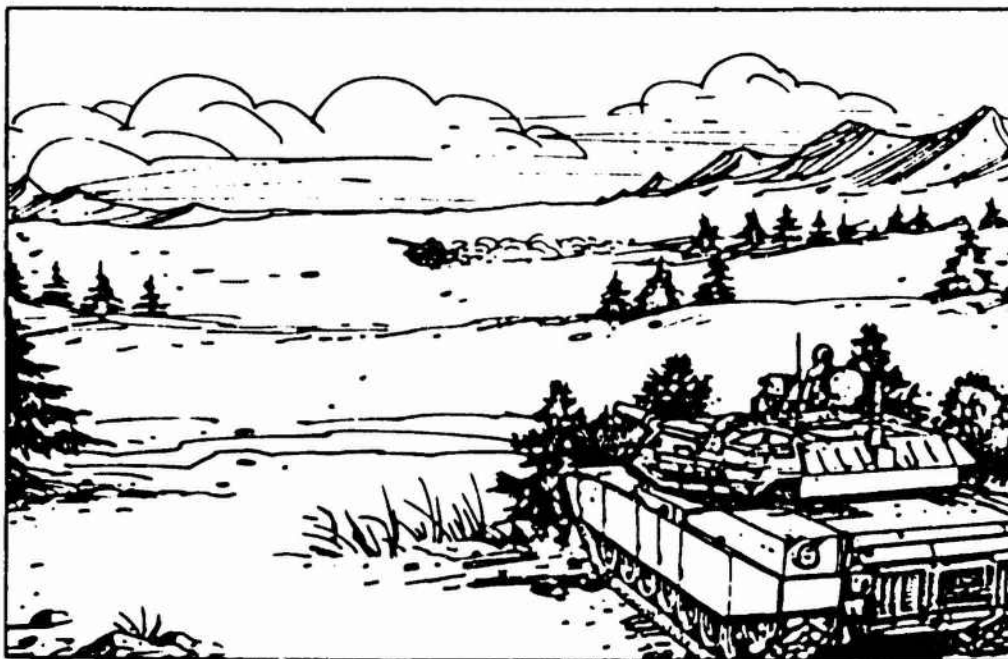
B. No. This is the standard lead for SABOT ammunition.

C. No. This is the standard lead for HEP, which is no longer in the M1 ammo inventory.

41

74

SCENARIO 10



42

THE SITUATION

- M1 is in a hull-down position, undetected.
- A T-55 is detected at about 2500 meters.
- TC issues a fire command.
- You lase to target while continuing to track.
- "F" appears in GPS and range display remains unchanged.
- You announce MALFUNCTION.

What system has most likely failed?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Cant sensor	Lead angle sensor	Laser rangefinder	Turret power

43

SCENARIO 10 ANSWER

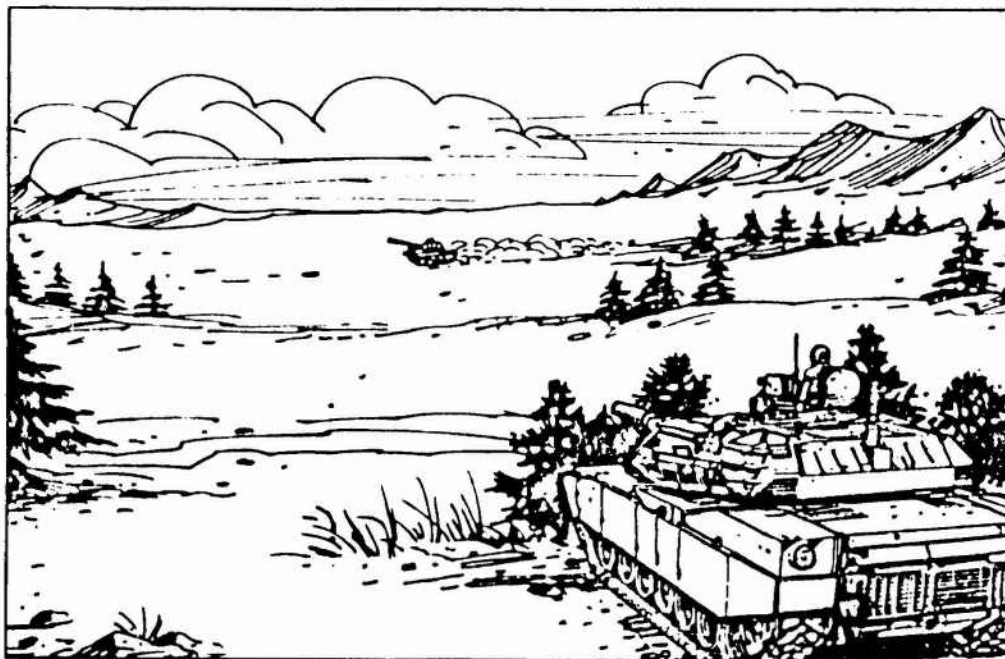
You should have selected C: Laser rangefinder

In this situation, the laser rangefinder has most likely failed. Remember, the indications are:

- "F" appears in GPS.
- Range data does not change after lasing.

WRONG ANSWERS

- A. When CANT sensor fails, only an "F" will appear in GPS.
- B. When lead angle sensor fails, an "F" will appear and the aiming point will not automatically follow the target after lasing.
- D. If the power to the turret fails, the turret or gun cannot be moved.



46

THE SITUATION

- M1 is in a hull-down position, undetected.
- A T-55 is detected at about 2500 meters.
- TC issued a fire command.
- You lased to target while continuing to track.
- "F" appeared in GPS and range display remains unchanged.
- You announced MALFUNCTION - NO RANGE.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Check switches and CB	Fire using GAS with estimated range	Perform a computer self-test	Fire using GAS with estimated range input to computer

47

77

SCENARIO 11 ANSWER

You should have selected A: Check switches and CBs.

Remember. This is a Non-Immediate Engagement situation. After announcing MALFUNCTION and the situation, if known--NO RANGE, the gunner should check appropriate switches and CBs (circuit breakers). For the LRF these are:

- Laser RANGE switch is in ARM 1ST RTN or ARM LAST RTN.
- FIRE CONTROL MODE switch is in NORMAL or EMERGENCY.
- AUTO RANGE light on CCP is off.
- THERMAL TEST switch is OFF.
- CB 25 is ON.

48

WRONG ANSWERS

B. Not yet. In a Non-Immediate Engagement situation, quickly attempt to identify what caused the malfunction before going to a degraded mode of gunnery.

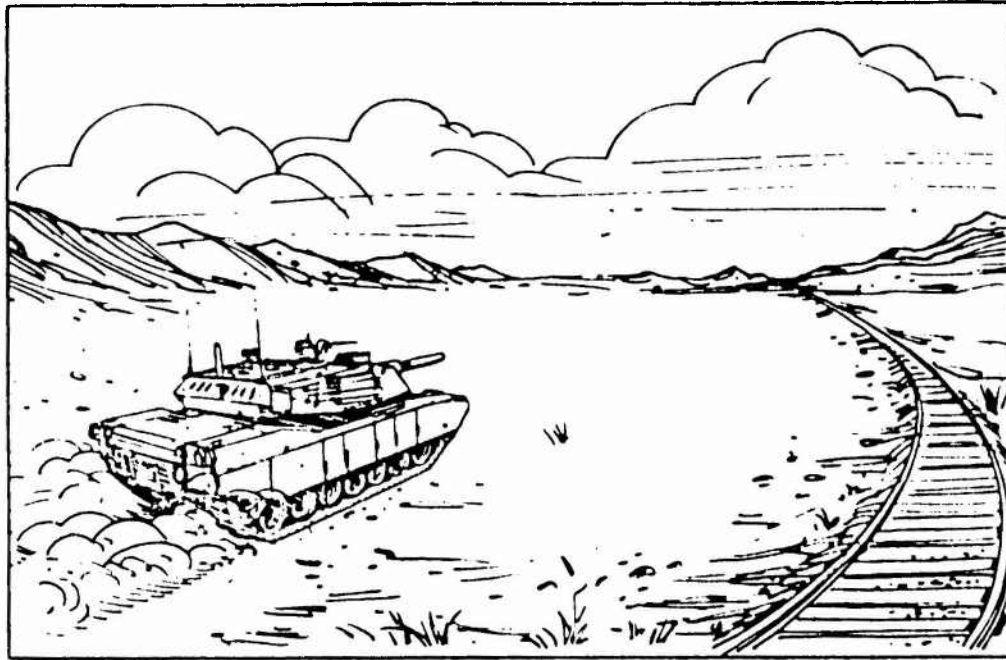
C. Check out the switches and circuit breakers first. If they are okay, then perform a computer check.

D. Same as B.

49

78

SCENARIO 12



THE SITUATION

- M1 is traveling cross country at about 20-25 mph.
- No targets are expected in immediate area.
- View in GPS starts to jump around.
- You are unable to keep a fixed aiming point.
- You announce MALFUNCTION.

What system has most likely failed?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Cant sensor	Laser rangefinder	Lead angle sensor	Stabilization system

SCENARIO 12 ANSWER

You should have selected D: Stabilization system

When the stabilization system fails:

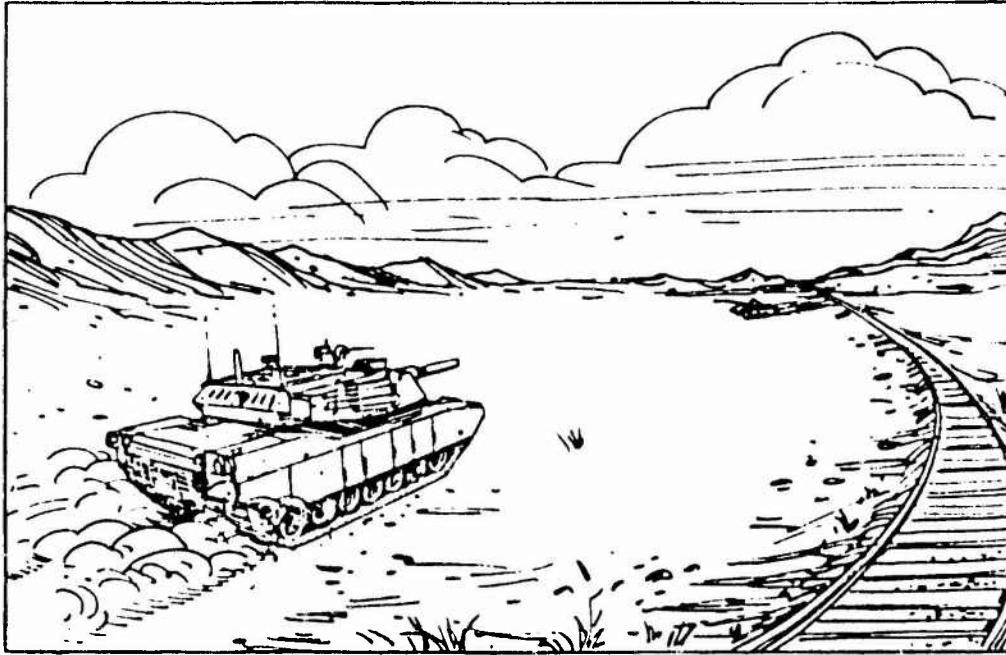
- The view in GPS will jump around
- You are unable to keep aiming point fixed on a target.

--

WRONG ANSWERS

- A. When the cant sensor fails, only an "F" will appear in GPS.
- B. When the LRF fails an "F" will appear in GPS, also, range will remain unchanged (the same) after lasing.
- C. When the lead angle sensor fails, an "F" will appear in GPS. Also the aiming point will not automatically follow the target after lasing.

SCENARIO 13



THE SITUATION (Continued)

- M1 is traveling cross country at about 20-25 mph.
- Aiming point in GPS is jumping and cannot be controlled.
- You announced MALFUNCTION-STAB OUT.
- A tank-like target suddenly appears at 1400 meters.
- TC commands DEGRADED-DRIVER STOP, and issues a fire command.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Cancel STAB on CCP	Switch to GAS	Switch FIRE CONTROL MODE to EMERGENCY	Switch to TIS

SCENARIO 13 ANSWER

You should have selected C: Switch FIRE CONTROL MODE to EMERGENCY

When the stabilization system fails:

- Report MALFUNCTION-STAB OUT
- Switch FIRE CONTROL MODE to EMERGENCY
- Respond to TC command. For example, DEGRADED-DRIVER STOP... GUNNER-SABOT-TANK...FIRE

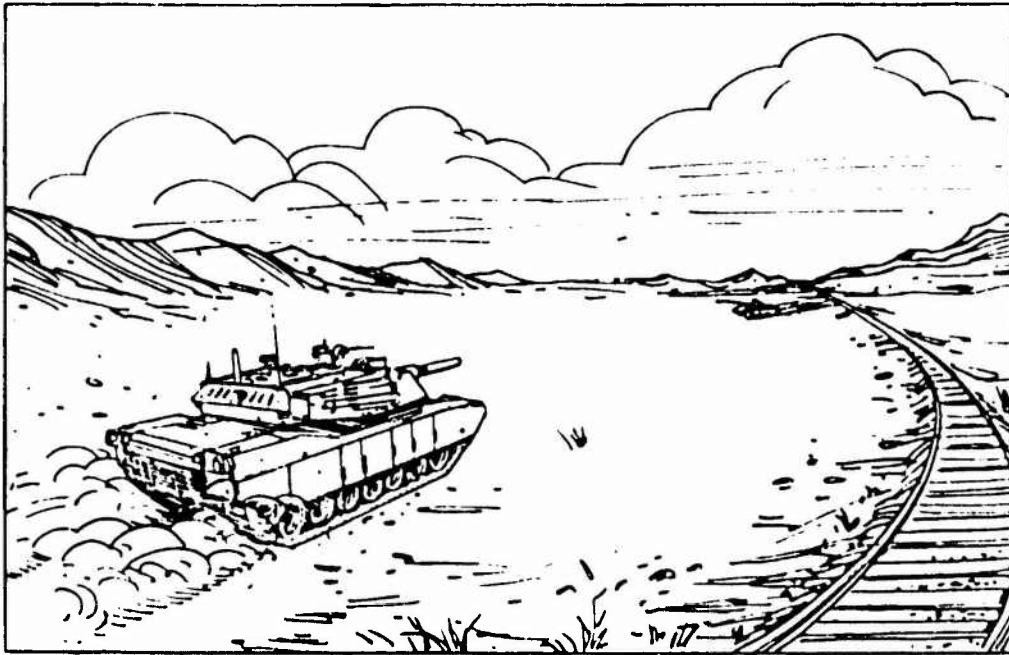
WRONG ANSWERS

- A. No such position on CCP.

B. Since there is nothing wrong with the GPS, there is no reason to use another sight.

D. Same as B.

SCENARIO 14



THE SITUATION (Continued)

- M1 is traveling cross country at about 20-25 mph.
- Stabilization system goes out.
- Tank-like target appears at 1400 meters moving 30-35 mph.
- TC commands driver to stop and issues a fire command.
- Loader loads HEAT. TC commands FIRE.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lay center of mass and fire	Lay, lase, and fire	Lay, lase, apply lead, and fire	Index 1400, lay center of mass, and fire.

SCENARIO 14 ANSWER

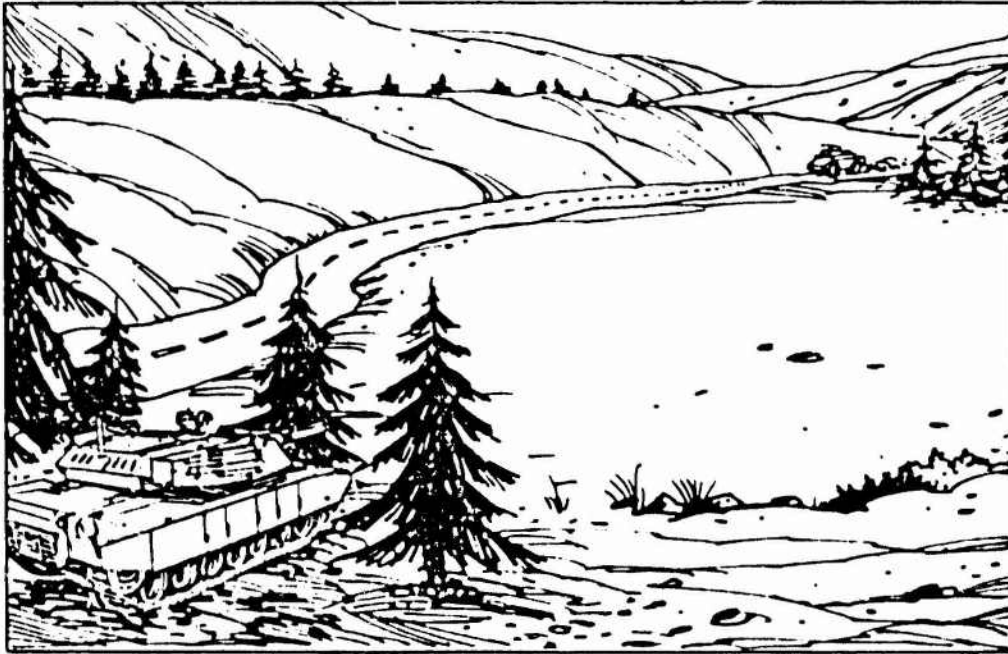
You should have selected C: Lay, lase, apply lead, and fire

Remember. When you switch to EMERGENCY mode, automatic lead is cancelled. Therefore, when engaging a moving target the gunner must apply the suggested standard lead for the ammunition announced in the fire command. In this situation, the lead is 5 mils.

WRONG ANSWERS

- A. Must apply a standard lead when FIRE CONTROL MODE is switched to EMERGENCY.
- B. Same as A.
- C. Same as A.

SCENARIO 15



THE SITUATION

- You are undetected and tracking a BRDM at 3000 meters.
- As the BRDM moves closer, the GPS goes out.
- You report MALFUNCTION-NO GPS.

What should you do next?

A

Switch to
the TIS

B

Perform a
computer self-
test

C

Check CB21

D

Switch to the GAS

SCENARIO 15 ANSWER

The correct answer is C: Check CB21

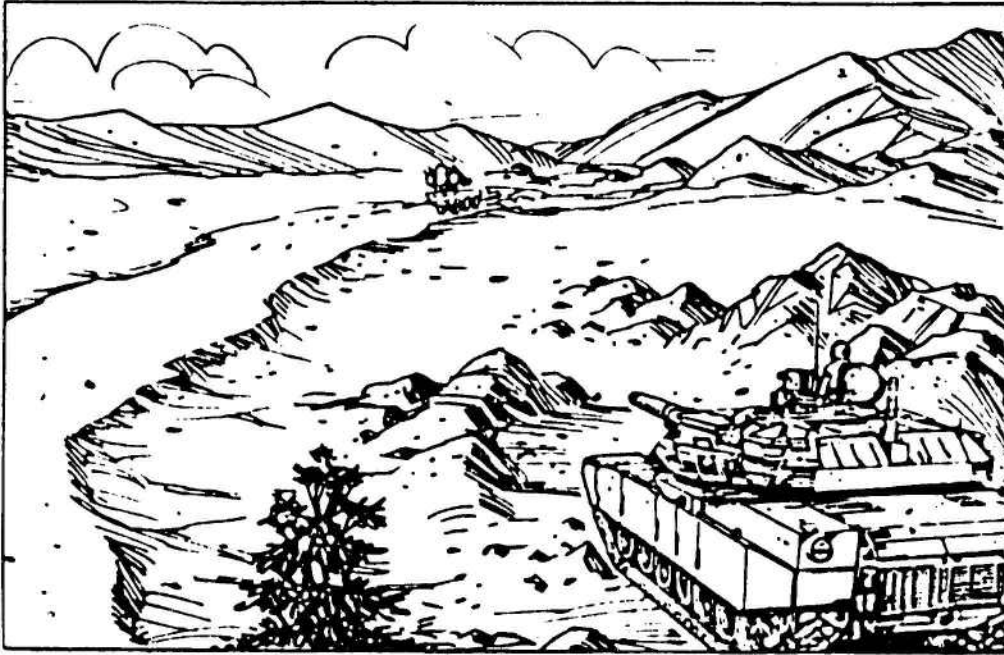
In a Non-Immediate Engagement situation, you have time to conduct a quick check of switches that might cause the malfunction. For a GPS malfunction, you should:

- Report MALFUNCTION-NO GPS
- Check CB21 is ON

WRONG ANSWERS

- A. Not yet. Try to identify fault first.
- B. Computer self-test cannot identify why GPS failed.
- D. Same as A.

SCENARIO 16



THE SITUATION

- M1 is halted among rocks, undetected.
- TIS is on STBY.
- A TEL vehicle carrying GECKO missiles is detected at 1200 meters.
- TC issues fire command.
- M1 hits a large bump.
- The reticle in the GPS goes out.
- You report MALFUNCTION-NO RETICLE.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Switch to TIS	Check CB21, IO, and reticle control	Switch to GAS	Perform computer self-test

SCENARIO 16 ANSWER

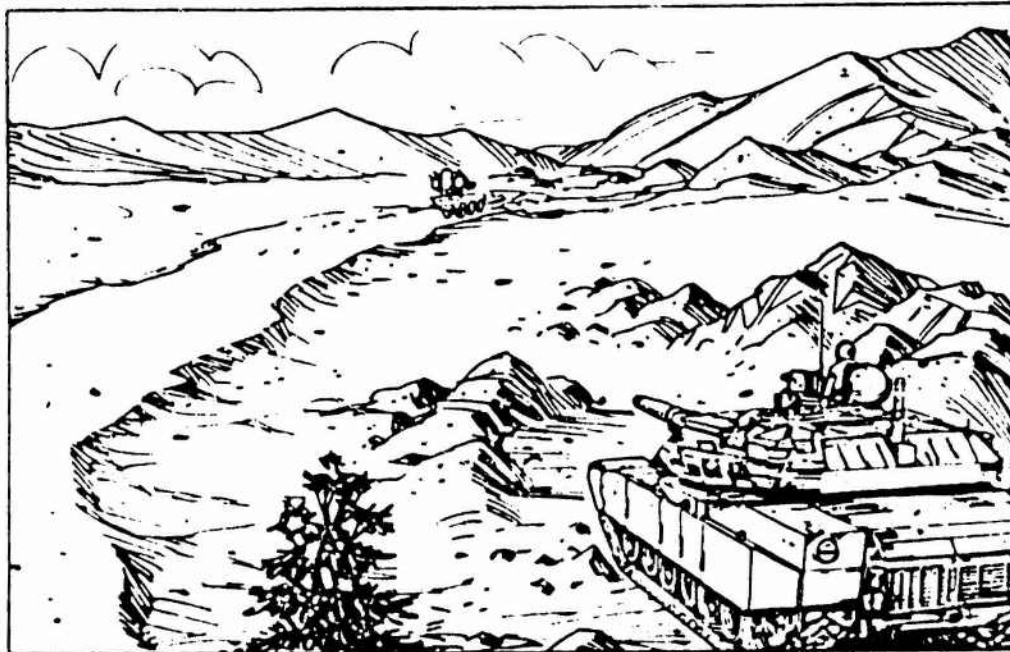
The correct answer is B: Check CB 21 and 30 and reticle control.

If Circuit Breaker 21 and 30 are not ON, a reticle will not be displayed in the GPS. Also, the GPS RETICLE control must be fully clockwise.

WRONG ANSWERS

- A. Not yet. Check out the CBs and reticle control first.
- C. Same as A.
- D. Computer self-test cannot identify a GPS reticle failure.

SCENARIO 17



THE SITUATION (Continued)

- M1 is halted among rocks.
- TIS is in STBY mode.
- TEL carrying GECKO missiles is detected at 1200 meters.
- TIS commands: GUNNER, SABOT, AITITANK.
- GPS vehicle goes out.
- You report MALFUNCTION--NO RETICLE.
- You check CB 21 and 30 and reticle control; they are OK.
- You notify TC that GPS reticle is out.

How should you expect to engage the target?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Use GPS and battlesight technique	Use GAS and 1200 range line	Use TIS and precision fire	Index 1200 and fire using TIS

SCENARIO 17 ANSWER

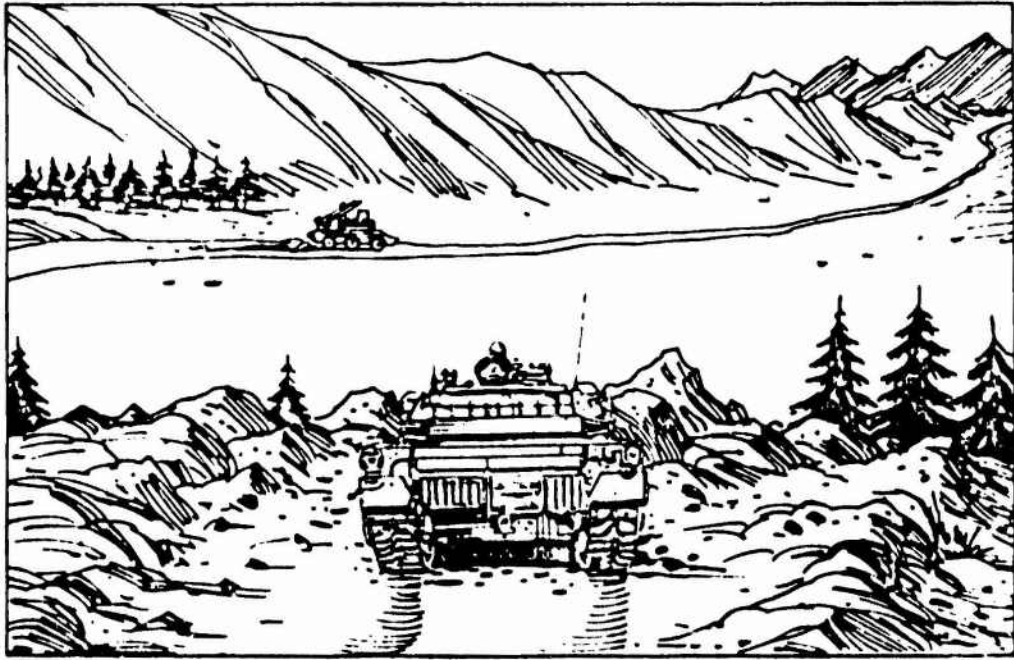
You should have selected C: Use TIS and precision fire.

The TIS is in STBY and can be quickly switched to ON to engage the target. If it was not in STBY, some 5 to 15 minutes would be required before it becomes operational. In that situation, the TC would have the gunner use the GAS and estimated range.

WRONG ANSWERS

- A. Not possible without a reticle.
- B. Only IF the TIS was not in STBY.
- D. No need to index range as long as LRF is operational.

SCENARIO 18



THE SITUATION

- M1 is in a hull-down position, undetected.
- TEL carrying GECKO missile is detected at 1200 meters.
- GPS reticle has failed; you switch to the TIS.
- No thermal images appear in view.
- You report MALFUNCTION-NO TIS.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Check/adjust controls	Perform computer self-test	Switch UNIT TEST PATTERN to TEST	Get into GAS

SCENARIO 18 ANSWER

You should have selected A: Check/adjust controls.

When the TIS has possibly malfunctioned, the gunner should perform the following checks/adjustments:

- FLTR/CLEAR/SHTR switch is in SHTR.
- Thermal Ballistic door is open.
- UIIT TEST PATTERN switch is in OFF.
- FAULT light is off.
- CB 22 is ON.
- Adjust CONTRAST and SENSITIVITY controls.

WRONG ANSWERS

- B. Computer self-test cannot identify a TIS malfunction.
- C. No. This would be an internal check of the TIS system. To operate it must be in the OFF position.
- D. NOT YET. Check/adjust appropriate controls first.

SCENARIO 19



THE SITUATION

- GPS reticle was knocked out during your last engagement.
- You prepared the TIS for use as the GPS backup system, but the TIS is not working.
- While you were preparing the TIS, the TC spotted a truck convoy at 2200 meters.
- You switch THERMAL MODE to OFF.

How should you expect to engage the target?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Use GPS precision	Use GPS battlesight	Use GAS and announced range	Use TIS battlesight

SCENARIO 19 ANSWER

You should have selected C: Use GAS and announced range.

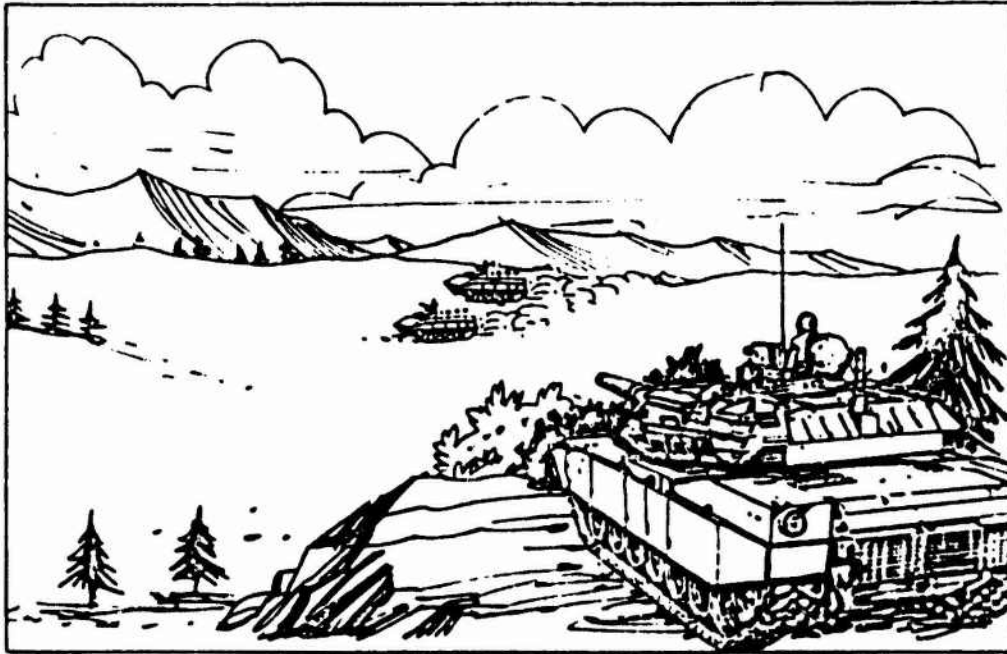
The GPS cannot be used because there is a GPS reticle failure. You just found out that the TIS cannot be used either because it has gone out. The only sight left is the GAS.

RN

WRONG ANSWERS

- A. No. The GPS does not have a reticle.
- B. Same as A.
- D. The TIS is not working.

SCENARIO 20



THE SITUATION

- M1 is in a stationary position behind trees, undetected.
- TC spots two APCs at about 1200 meters.
- You lay the GPS reticle on the APCs and lase.
- No range is displayed in the GPS.

What is the most likely failure?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
GPS reticle	GPS	ICU/EU	Laser rangefinder

SCENARIO 20 ANSWER

You should have selected C: ICU/EU

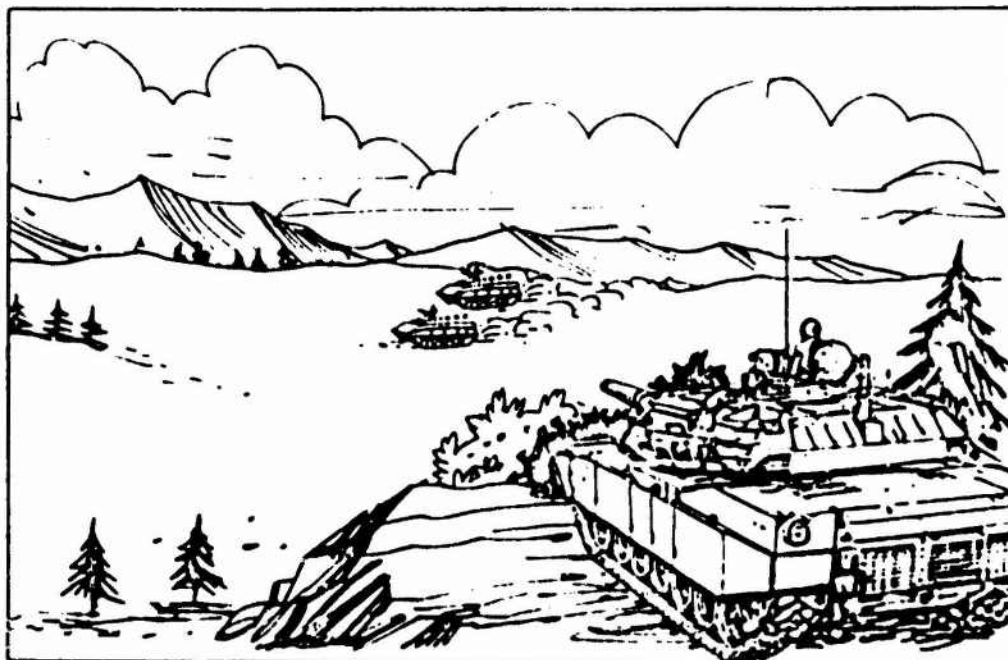
The ICU/EU has probably failed when, after lasing:

- There is no range displayed in the GPS.
- There is no ready-to-fire symbol.

WRONG ANSWERS

- A. GPS and reticle are present, otherwise you could not have lased the target.
- B. Same as A.
- D. If the LRF fails, an "F" will appear in GPS and range display will show flashing zeros.

SCENARIO 21



THE SITUATION (Continued)

- M1 is in a stationary position behind trees, undetected.
- TC detected two APCs at about 1200 meters.
- You lased to the target but range was not displayed.
- You reported MALFUNCTION-NO SYMBOLS.
- TC issues fire command using HEAT.

How should you expect to engage the target?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Use GPS precision	Use GPS battlesight	Use GAS precision	Use TIS precision

SCENARIO 21 ANSWER

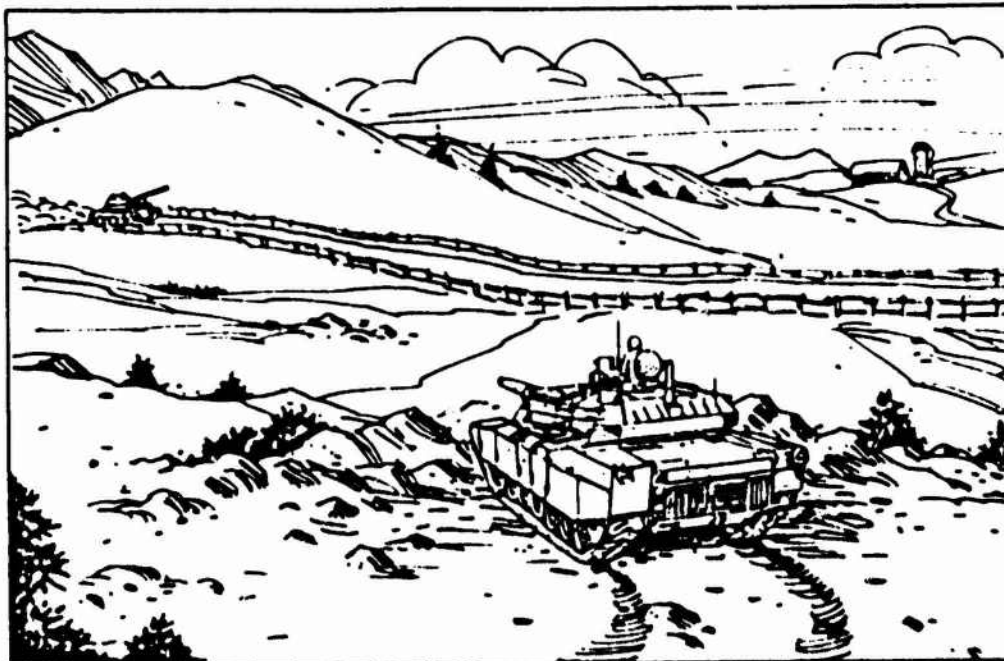
You should have selected A: Use GPS precision

The accuracy of the LRF, combined with the choice of 1ST or LAST RTN logic, should provide the confidence needed to fire even though the range is not displayed. However, if time is available and you want to be more certain, you could check the range on CCP.

WRONG ANSWERS

- B. Not necessary. Better to check range displayed on CCP.
- C. No. GAS is used if both GPS/TIS are not operational.
- D. Not necessary to change sights. Only the range is not displayed in GPS.

SCENARIO 22



THE SITUATION

- You have identified an ICU/EU (GPS symbology) failure.
- A moving T-72 is detected at about 2800 meters.
- You have not been seen yet.

How should you expect to engage the T-72?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Use GPS and estimated range	Use GAS and estimated range	Use GPS and precision	Use GPS battlesight

SCENARIO 22 ANSWER

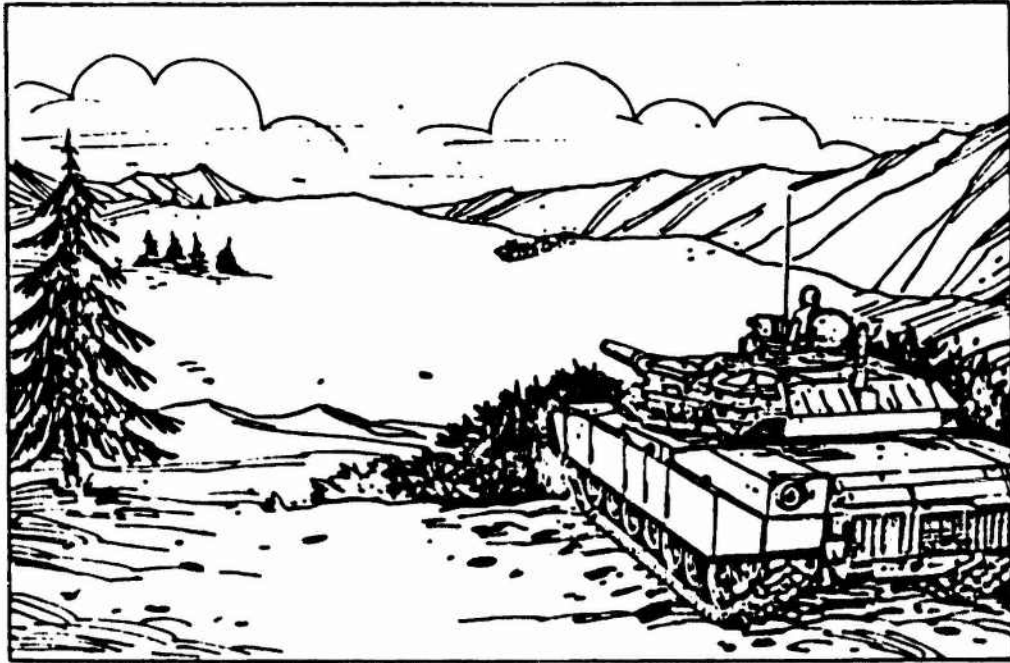
The correct answer is C: Use GPS and precision

Remember. The LRF is working and the range obtained after lasing to the target should be accurate. If you have time and want to eliminate any doubts you have, check the range display in CCP.

WRONG ANSWERS

- A. No need for estimated range; LRF is working.
- B. No. GAS is a backup sight; GPS is working.
- D. No. Target is way beyond battlesight range.

SCENARIO 23



THE SITUATION

- M1 is on a hill, hidden behind bushes.
- BTR is detected moving across battlefield below you.
- You try to engage the BTR, but the turret won't traverse.

What should you do immediately?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Activate manual controls	Notify the TC	Check controls and CBs	Switch to MANUAL mode

SCENARIO 23 ANSWER

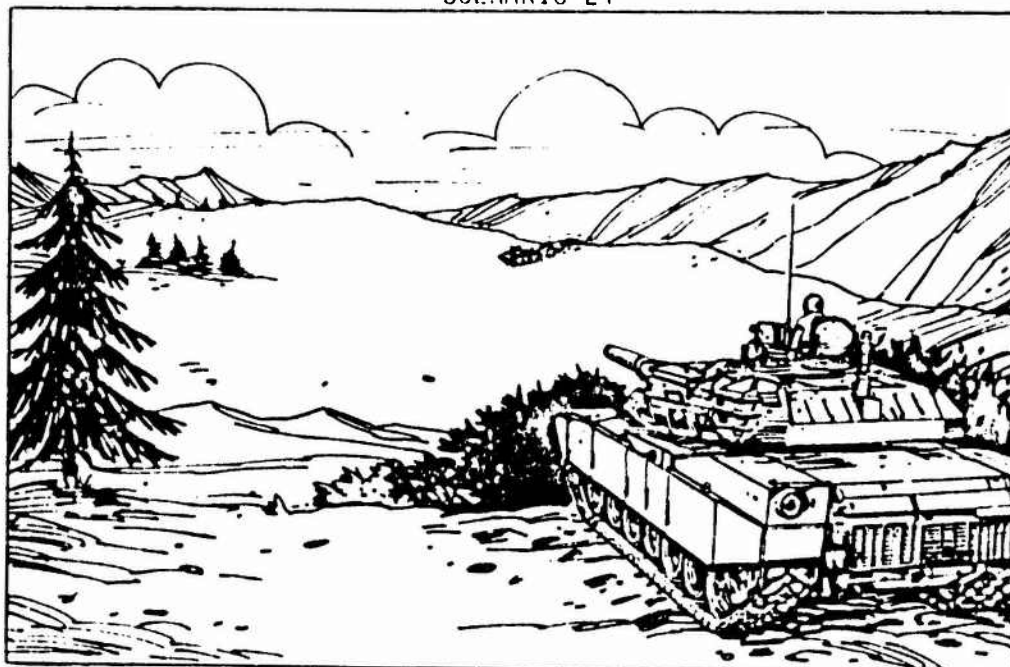
You should have selected B: Notify the TC.

When any malfunction occurs, in this case the gunner's power control handles, notify the TC immediately by reporting MALFUNCTION (and situation, if known) NO TURRET POWER.

WRONG ANSWERS

- A. Not yet. May be unnecessary.
- C. Yes, but notify TC of malfunction, first.
- D. Same as A.

SCENARIO 24



THE SITUATION (Continued)

- M1 is on a hill, hidden behind bushes.
- BTR is detected moving across battlefield below you.
- You attempt engagement, but turret won't traverse.
- You announce MALFUNCTION-NO TURRET POWER.
- You begin checking controls and CBs.

Which one of the following checks would cause the malfunction?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
GUN/TURRET DRIVE switch is in MANUAL	Hydraulic pressure above 1550 psi	CB 17, 30 and 31 are ON	Turret traverse lock is in UNLOCKED

SCENARIO 24 ANSWERS

You should have selected A: GUN/TURRET/DRIVE switch is in MANUAL.

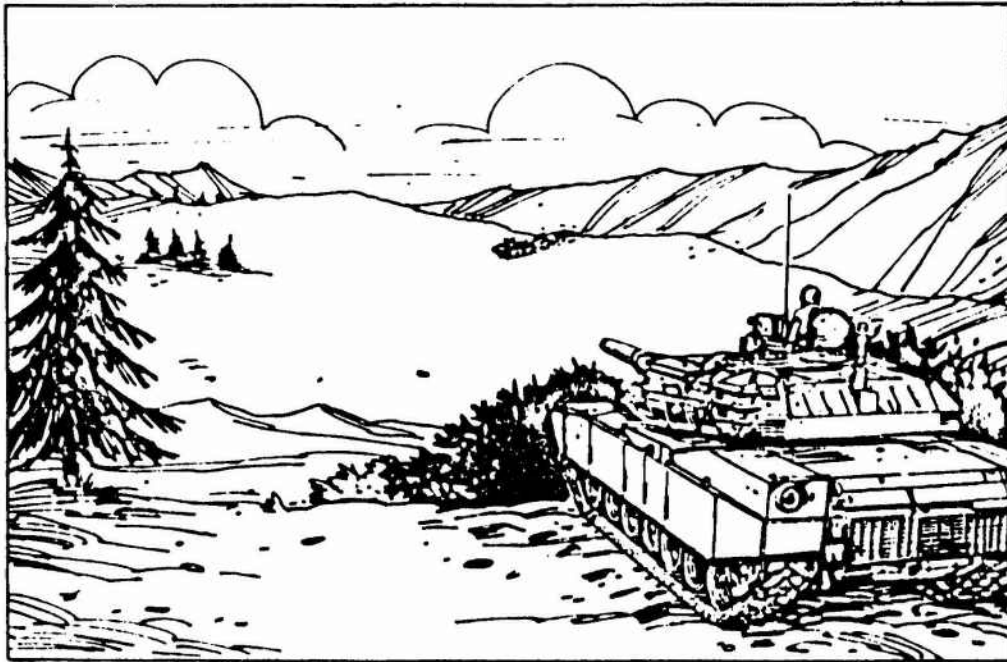
When a malfunction occurs with the turret power system during a Non-Immediate Engagement, the gunner should quickly conduct the following checks:

- CB 17, 30, and 31 are ON.
- Turret traverse lock is UNLOCKED.
- Main gun elevation lock is unlocked.
- GUN/TURRET DRIVE switch is in POWERED.
- FIRE CONTROL MALF light is off.
- Engine is running or AUX HYDR POWER is ON.
- Hydraulic pressure gauge is above 1550 psi.
- Turret/Hull/Gun Shield for obstructions.

WRONG ANSWERS

- B. These checks would NOT cause a malfunction.
- C. Same as B.
- D. Same as B.

SCENARIO 25



THE SITUATION (Continued)

- M1 is on a hill, hidden behind bushes.
- BTR is detected moving across the battlefield below you.
- You attempt to engage, but turret won't traverse.
- You announce MALFUNCTION-NO TURRET POWER.
- You check out controls and CBs and cannot locate the cause.
- You report that TURRET POWER IS OUT.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Switch to GAS	Switch GUN/TURRET DRIVE to MANUAL	Switch FIRE CONTROL MODE to MANUAL	Switch to TIS

SCENARIO 25 ANSWERS

You should have selected C: Switch FIRE CONTROL MODE to MANUAL

Unless this step is performed by the gunner, the turret will not traverse and the main gun will not elevate or depress when using the manual controls.

104

WRONG ANSWERS

- A. Not yet. Switch over to MANUAL mode, first.
- B. NOT performed by the gunner.
- D. No. Requires turret power for operation.

105

106

SCENARIO 26



THE SITUATION

- M1 is hidden in treeline, undetected.
- Three T-72s are detected at 2700 meters.
- A stiff wind is blowing from your left.
- When traversing the turret, you notice an "F" in GPS.

What steps should you take? (Sorry, but from now on out you are on your own. Write down your answers first, then turn the page to check them out. Good luck.)



110

THE SITUATION (Continued)

- Your I11 is hidden in treeline, undetected.
- A stiff wind is blowing from your left.
- Three T-72s are coming down the road at 2700 meters.
- "F" has appeared in GPS; you report MALFUNCTION.
- You conduct checks and computer self-test.
- You report CROSSWIND SENSOR IS OUT.

What should you expect to do next before engaging the target?
(Write down your answer, then turn the page.)

111

SCENARIO 27 ANSWER

You should have said: Enter ZERO

112

NOTE: It is permissible for the TC to command you to enter a crosswind correction rather than ZERO. Therefore, do not assume or automatically enter ZERO when the crosswind sensor fails.

113

109

SCENARIO 27 ANSWER

You should have said: Enter ZERO

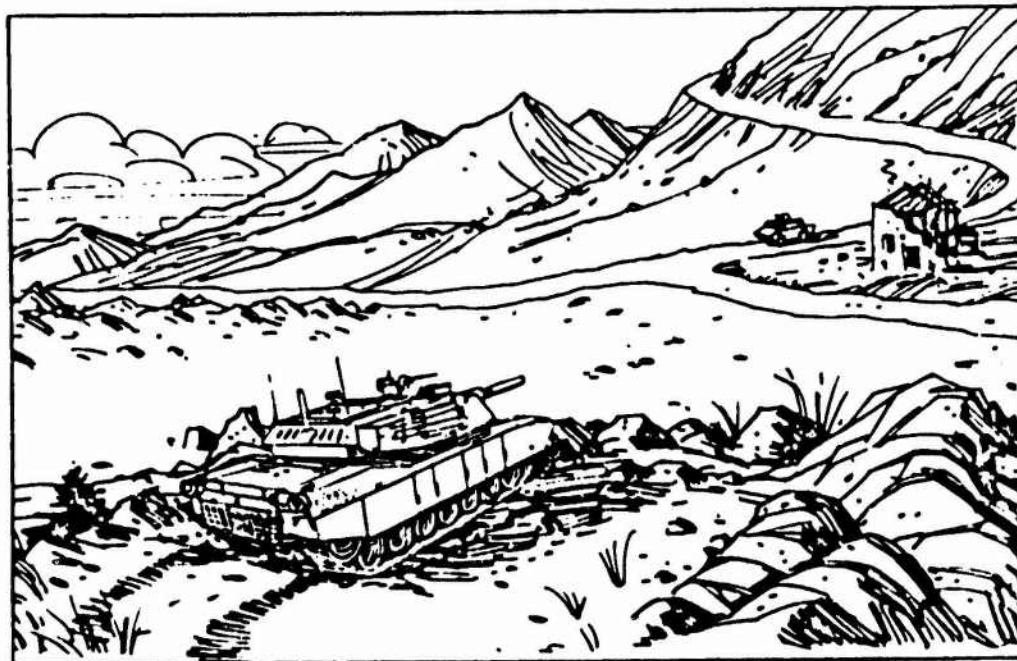
112

NOTE: It is permissible for the TC to command you to enter a crosswind correction rather than ZERO. Therefore, do not assume or automatically enter ZERO when the crosswind sensor fails.

113

110

SCENARIO 28



114

THE SITUATION

- M1 is positioned behind rocks, slightly canted.
- An armored scout car is spotted at about 2200 meters.
- "F" appears in GPS during main gun lay.
- You notify the TC by reporting MALFUNCTION.
- You check controls, CBs and perform a computer self-test to identify the malfunction.

What do you suspect is the malfunction? (Write down your answer, then turn the page.)

115

111

SCENARIO 28 ANSWER

Your guess is as good as any. From the appearance of the tank, it might be a cant sensor malfunction. However, in FM 17-12-1 you will be informed that there are 57 electrical circuits that do not pertain to the fire control system, but will produce an "F" in the GPS. The only way to determine if it is a primary direct fire control system failure is to conduct a computer self-test.

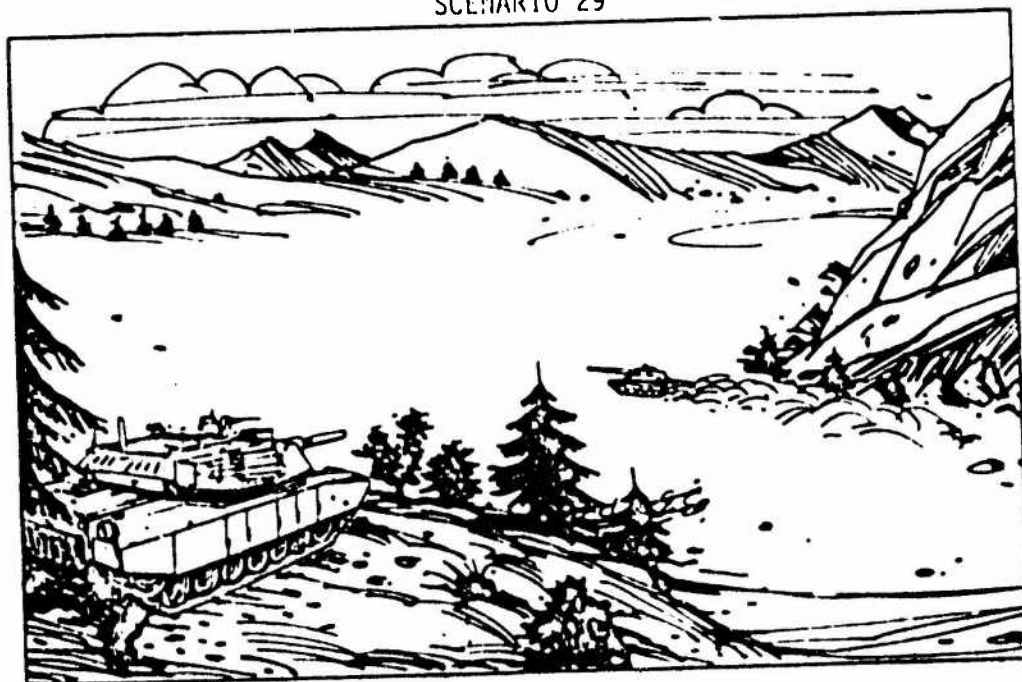
116

If the number "2", NO GO, and CANT button on CCP are observed, then you know that the cant sensor has failed. The "F" will remain in the GPS however, until the system is corrected.

117

112

SCENARIO 29



118

THE SITUATION

- M1 is hull-down, undetected.
- TC spots a tank and issues a fire command.
- You identify and lose to target.
- "F" suddenly appears in GPS and reticle aiming point fails to automatically follow the target.

What steps should you take? (Write down your answer, then turn the page.)

119

113

SCENARIO 29 ANSWER

You should have answered:

1. Report MALFUNCTION-NO LEAD.
2. Check controls and CBs:
 - Laser RANGE switch is in SAFE
 - CB 22, 25, 27 are ON.
3. Perform a computer self-test.
4. If malfunction is corrected, notify the TC and continue with the engagement.
5. If malfunction is not corrected, inform TC of computer self-test results then respond to his commands.

120

In this situation, the computer self-test should display a "4", NO GO, and a flashing LEAD button to indicate a lead angle sensor failure. If so, report LEAD ANGLE SENSOR IS OUT, then respond to TC command. For example: DEGRADED-APPLY MANUAL LEAD-FIRE.

121

114

SCENARIO 30



122

THE SITUATION (Continued)

- M1 is hull-down, undetected.
- Tank target is moving across open ground.
- TC announces GUNNER-HEAT-TANK...
- "F" appears in GPS after lasing; you report MALFUNCTION-NO LEAD.
- Checks and computer self-test have been performed.
- There is a lead angle sensor failure; LEAD input is cancelled.
- TC announces DEGRADED-APPLY MANUAL LEAD-FIRE.

What is the standard manual lead for this engagement?
(Write down your answer, then turn the page.)

123

115

SCENARIO 30 ANSWER

You should have answered: 5 mils

When the lead angle sensor has failed and you are engaging a moving target with the main gun, manual lead must be applied. The suggested standard manual leads are:

- SABOT 2-1/2 mils
- HEAT 5 mils

124

NOTE: The suggested standard manual leads are used where applicable regardless of target speed. For example, if the target speed is estimated at 30-35 mph you would apply either 2-1/2 or 5 mil lead depending on ammo being fired. If the target speed is just 5-10 mph you would still apply either a 2-1/2 or 5 mil lead.

125

116

SCENARIO 31



126

THE SITUATION

- M1 is positioned next to an old building, undetected.
- A HIND-D chopper is detected hovering about 900 meters straight ahead.
- TC issues fire command; you lay on target and lase.
- "F" appears in GPS and range display remains unchanged.

What is your report and what actions do you take? (Write down your answers, then turn the page.)

127

117

SCENARIO 31 ANSWER

Your answers should be something like this:

1. Report MALFUNCTION-NO RANGE.
2. Check controls and CBs:
 - Laser RANGE switch is in ARM 1ST RTN or ARM LAST RTN.
 - FIRE CONTROL MODE is in NORMAL or EMERGENCY.
 - RANGE light on CCP is not lit.
 - THERMAL TEST switch is in OFF.
 - CB 25 is in ON.
3. Perform a computer self-test.
4. If malfunction is corrected, notify the TC and continue with the engagement.
5. If malfunction is not corrected, inform TC of computer self-test results, then respond to his command.

SCENARIO 32



130

THE SITUATION (Continued)

- M1 is positioned next to an old building, undetected.
- A HIND-D chopper is detected hovering about 900 meters straight ahead.
- TC issues a fire command; you lay on target and lose.
- "F" appears in GPS while range data remains unchanged.
- You report MALFUNCTION-NO LEAD, conduct checks, and perform computer self-test.
- You report LRF IS OUT and await TC command.

What commands could you expect to hear? (Write down your answers, then turn the page.)

131

119

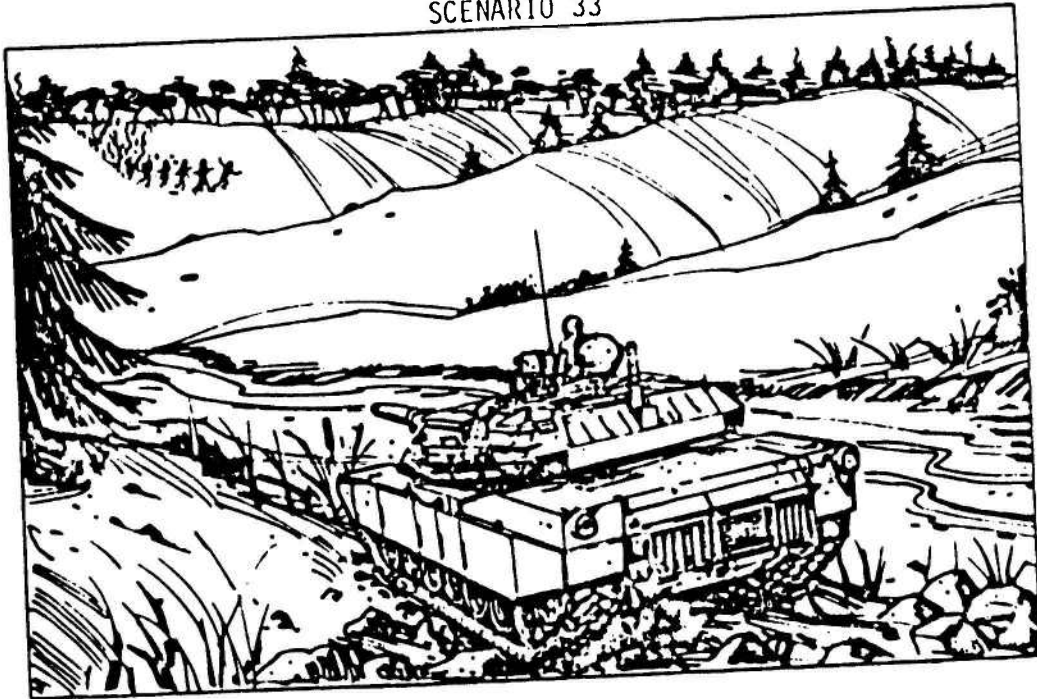
SCENARIO 32 ANSWER

Your answer should be something like this:

When the LRF has failed, the TC can command the gunner to fire using:

- The range shown in the CCP range display.
- An indexed range and GPS.
- A 900 meter battlerange solution and GPS.
- An announced range and GAS.

SCENARIO 33



134

THE SITUATION

- M1 is moving over rough ground along a river, undetected.
- Small group of troops is detected at 2000 meters.
- View in GPS suddenly begins to jump and cannot be controlled.

What is the most likely failure and what should you report to TC? (Write down your answers, then turn the page.)

135

121

SCEANARIO 33 ANSWER

Your answers should be something like this:

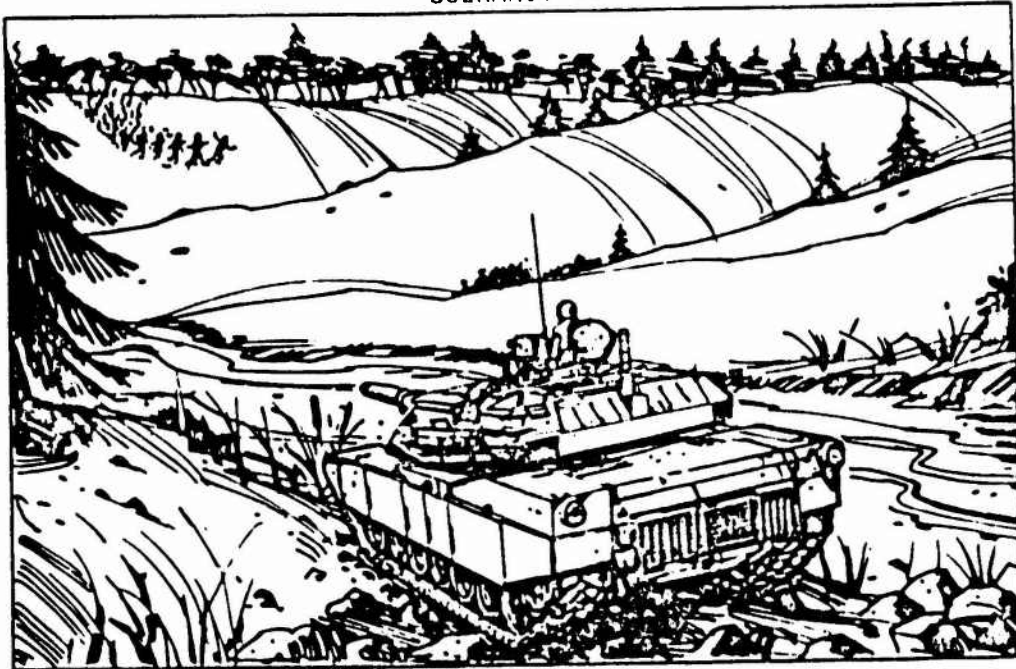
The most likely failure is the stabilization system and that you would immediately report MALFUNCTION-NO STAB.

136

137

122

SCENARIO 34



138

THE SITUATION (Continued)

- M1 is moving over rough ground along a river, undetected.
- A small group of troops is detected at 2000 meters.
- You have notified the TC of a stabilization malfunction.

What should you do next? (Write down your answers, then turn the page.)

139

123

SCENARIO 34 ANSWER

You should have answered: Switch FIRE CONTROL MODE to EMERGENCY.

Whenever there is a stabilization failure, three things must be done before the target is engaged:

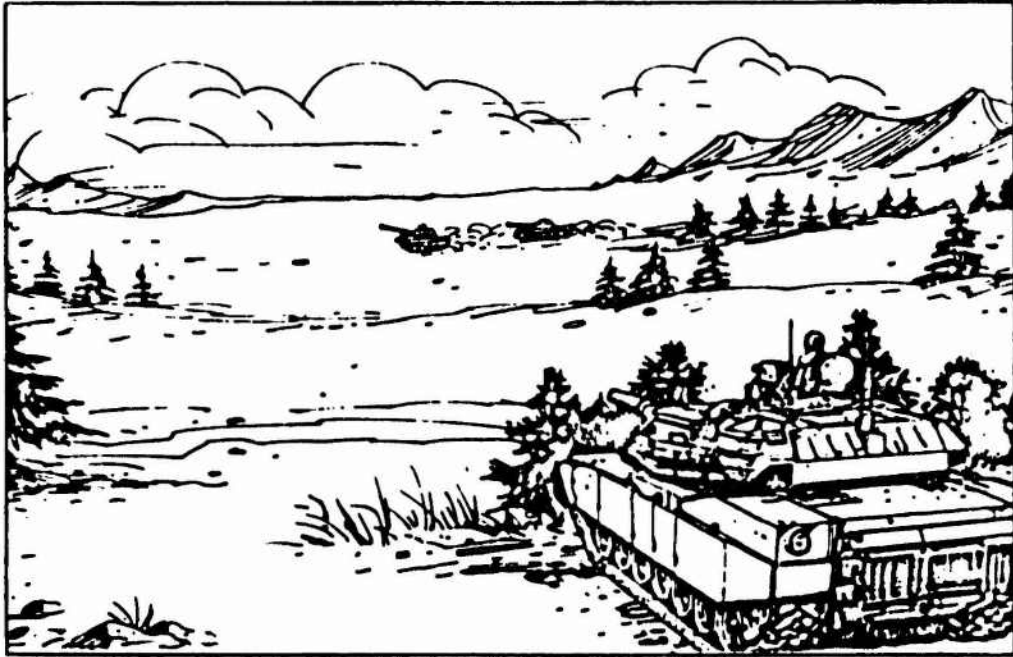
GUNNER

- Notify the TC of the stabilization failure, i.e., MALFUNCTION-NO STAB.
- Switch FIRE CONTROL MODE to EMERGENCY.

TANK COMMANDER

- Have driver come to a brief halt before issuing a fire command or announcing FIRE.

SCENARIO 35



142

THE SITUATION

- M1 is in a hull-down position, undetected.
- Two T-55s are detected at about 2800 meters.
- TC announces GUNNER, SABOT, TWO TANKS, LEAD TANK...
- Right before you lose, the GPS reticle disappears.

What do you do now? (Write down your answers, then turn the page.)

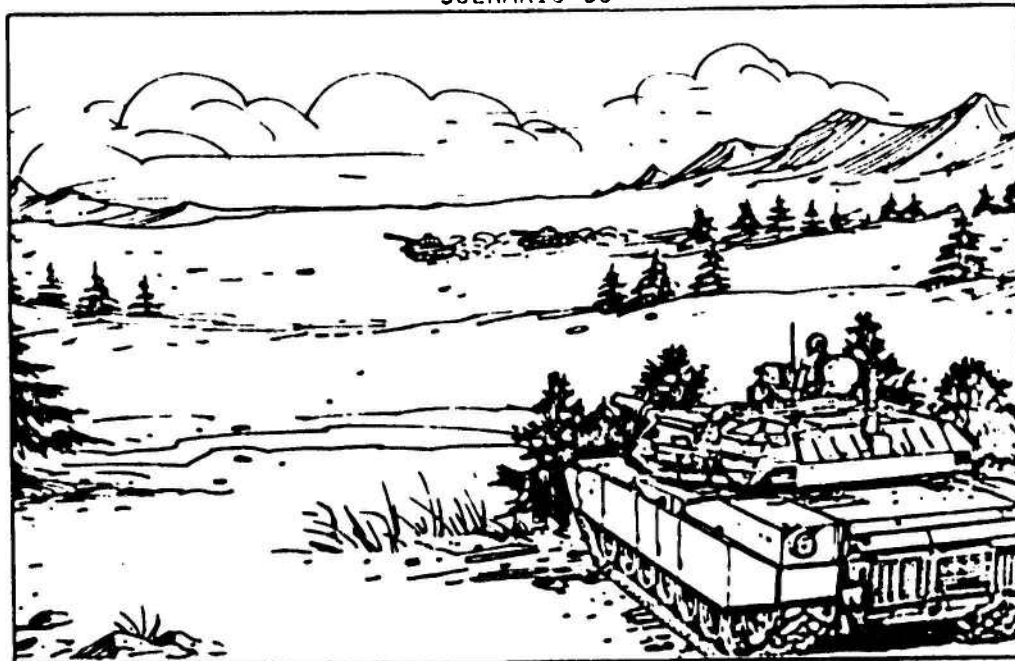
143

125

SCENARIO 35 ANSWER

Your answers should be something like this:

1. Report MALFUNCTION-NO RETICLE.
2. Check controls and CBs:
 - CB 21 and CB 30 are ON.
 - GPS RETICLE control is fully clockwise.
3. If malfunction is corrected, notify the TC and continue with the engagement.
4. If malfunction is not corrected, report RETICLE IS OUT then respond to TC commands.



146

THE SITUATION (Continued)

- M1 is hull-down, undetected.
- Two T-55s are detected at about 2800 meters.
- The GPS reticle has failed.
- TC commands DEGRADED-USE TIS-FIRE.
- You switch THERMAL MODE to ON from STBY, place FLTR/CLEAR/SHTR switch in SHTR, open thermal ballistic cover and adjust CONTRAST and SENSITIVITY controls.
- Suddenly, thermal images in TIS VIEW disappear.

What should you report and what actions should you take?
(Write down your answers, then turn the page.)

147

127

SCENARIO 36 ANSWER

Your answers should be something like this:

1. Report MALFUNCTION, NO THERMAL IMAGES.
2. Check controls and CBs:
 - FLTR/CLEAR/SHTR is in SHTR.
 - Thermal ballistic door is open.
 - UNIT TEST PATTERN is in OFF.
 - FAULT light is not lit.
 - CB 22 is ON.
3. If malfunction is corrected, notify the TC and continue with engagement.
4. If malfunction is not corrected, report TIS IS OUT then respond to TC command.

148

NOTE: If the TIS is used during daylight conditions, the TC could switch to the GPS (day channel) or fire using the GAS. At night, the TC would have to use artificial light (searchlight, flares, etc) to engage the target or employ indirect fire from a sketch card.

149

128

SCENARIO 37



150

THE SITUATION

- M1 is positioned among trees, undetected.
- A moving self-propelled howitzer is observed at about 3000 meters.
- TC issues a fire command.
- You laser to the howitzer, but the range display is blank.

What should you report and what actions should you take?
(Write down your answers, then turn the page.)

151

129

SCENARIO 37 ANSWER

Your answers should be something like this:

Report MALFUNCTION-NO SYMBOLS, then respond to TC command.
For example, DEGRADED-CHECK RANGE IN COMPUTER...FIRE.

152

NOTE: The accuracy of the LRF, combined with the choice of TST or LAST RTN logic, should provide crew members with enough confidence to fire even through the range data is not displayed in the GPS. If the crew has the time (Non-Immediate Engagement), the TC may have the gunner check the range displayed in the computer.

153

130

SCENARIO 38



TCA

THE SITUATION (Continued)

- M1 is positioned among trees, undetected.
- A moving self-propelled howitzer is observed at about 3000 meters.
- TC issues fire command.
- You lase to the target but range data does not show up in GPS.
- You report MALFUNCTION-NO SYMBOLS.
- TC commands DEGRADED-FIRE.
- Suddenly, the turret stops moving. You report MALFUNCTION-NO TURRET POWER.

What action should you take next? How should you expect to engage the target? (Write down your answers, then turn the page.)

This M1 Degraded Mode Gunnery booklet
is a prototype training document. For
comments or questions contact:

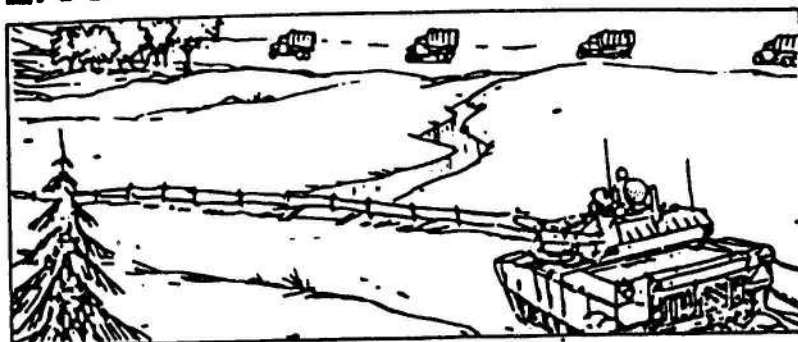
Mr. Ronald E. Kraemer
ARI Field Unit-Ft Knox
ATTN: PERI-IK
Fort Knox, KY 40121

Autovon: 464-4932
Commercial: (502) 634-4932

M1 TANK
DEGRADED MODE GUNNERY
IMMEDIATE
ENGAGEMENTS

BOOKLET

3



FOR RESEARCH PURPOSE ONLY

NOT FOR DISTRIBUTION

US ARMY RESEARCH INSTITUTE

FOR THE BEHAVIORAL AND SOCIAL SCIENCES

RP 84-12-C

BOOKLET NUMBER 3

DEGRADED MODE GUNNERY - IMMEDIATE ENGAGEMENTS USER'S GUIDE

This is booklet number 3 in a set of 4 booklets. The set deals with degraded mode gunnery on the M1 tank. When you have finished the complete set, you will be able to:

TAKE THE CORRECT ACTIONS IF AN M1 GUNNERY SYSTEM FAILS
DURING A NON-IMMEDIATE OR IMMEDIATE ENGAGEMENT

DEFINITION OF NON-IMMEDIATE AND IMMEDIATE ENGAGEMENTS

The terms non-immediate engagement and immediate engagement may be new to you. They will be used in all of the booklets. They are defined as follows:

NON-IMMEDIATE ENGAGEMENT -

- The threat has not seen you or cannot kill you
- Before you engage, you have time to identify and correct for unknown gunnery system failures

2

IMMEDIATE ENGAGEMENT -

- The threat has seen you or can kill you
- Before you engage, you do not have time to identify and correct for unknown gunnery system failures

The actions you take in this set of booklets, and in battle, will depend on whether the engagement is non-immediate or immediate.

BE SURE YOU CAN DEFINE EACH TYPE OF ENGAGEMENT!

THIS BOOKLET

This booklet will give you practice in dealing with degraded mode gunnery during immediate engagements.

3

The booklet contains a number of battlefield scenarios. Each scenario contains:

- A PICTURE OF THE BATTLEFIELD SITUATION
- A SHORT WRITTEN DESCRIPTION OF THE BATTLEFIELD SITUATION AND THE STATUS OF YOUR TANK
- A QUESTION FOR YOU TO ANSWER

HOW TO USE THIS BOOKLET

1. Look at the scenario picture.
2. Read the short written description.
3. Read and answer the scenario question.

SOME QUESTIONS ARE FOLLOWED BY A LIST OF POSSIBLE ANSWERS. FOR THESE QUESTIONS, YOU SHOULD SELECT THE CORRECT ANSWER.

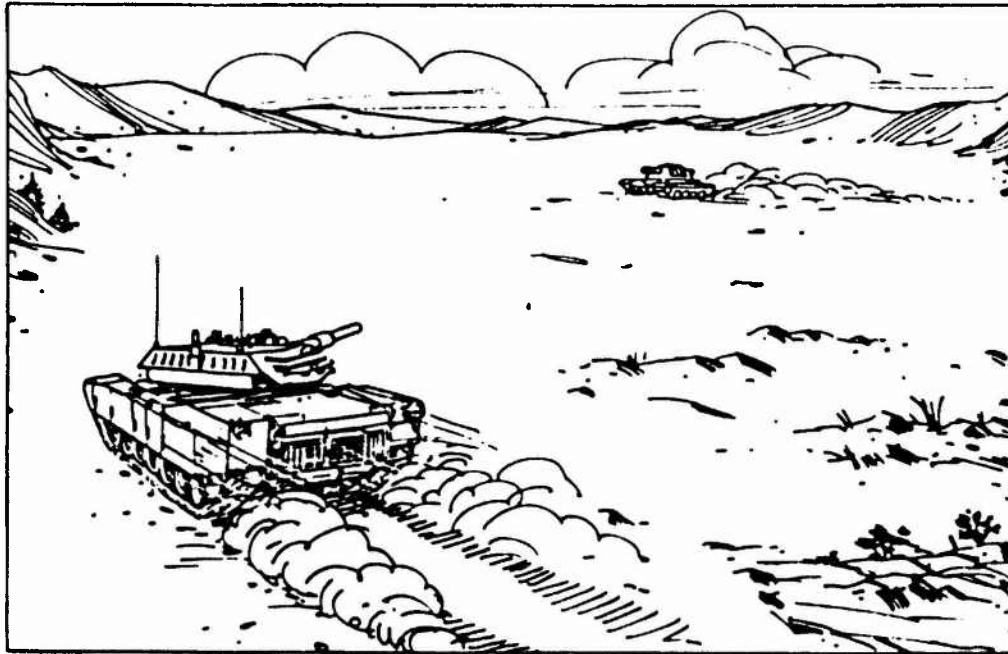
SOME QUESTIONS DO NOT HAVE A LIST OF POSSIBLE ANSWERS. FOR THESE QUESTIONS, YOU MUST PROVIDE YOUR OWN ANSWER.

4. Check your answer with the Answer Key on the page following the scenario.
5. Complete the rest of the scenarios.

BEFORE YOU USE THIS BOOKLET

Before you use this booklet, be sure you have completed Booklet 1 of the set.

SCENARIO 1



6

THE SITUATION

- M1 is moving across open terrain, unprotected.
- T-72 is detected at about 1800 meters.
- You have been detected; TC issues fire command.
- "F" symbol appears in GPS.

What should you do?

A

Perform a
self-test

B

Apply cant
correction
and fire

C

Report
MALFUNCTION

D

Fire using
GPS

7

SCENARIO 1 ANSWER

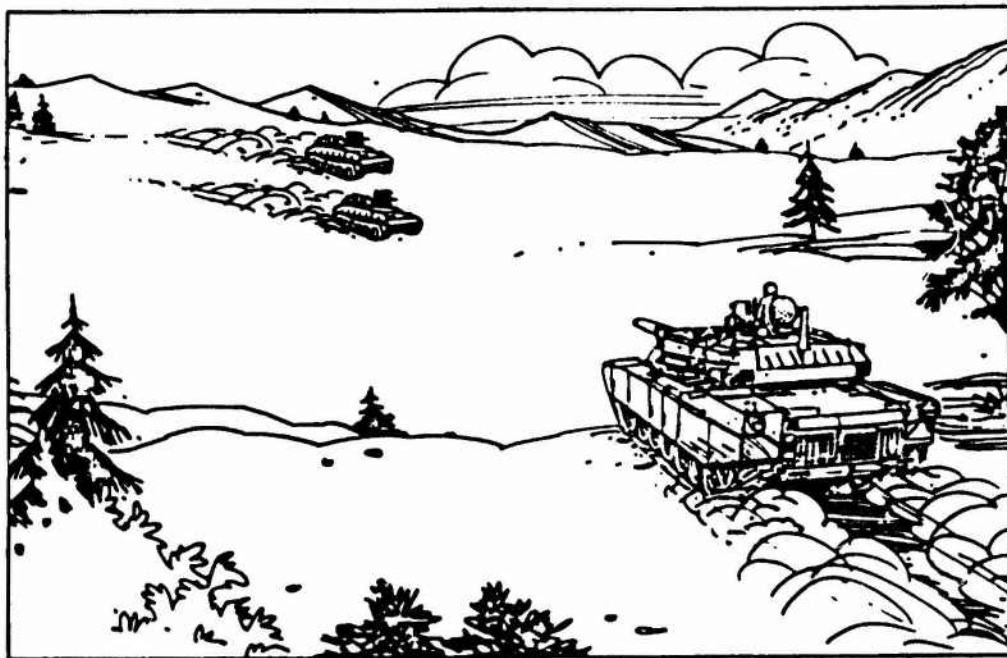
You should have selected C: Report MALFUNCTION

Any one of many systems can cause an "F" to appear in GPS. When an "F" appears in the GPS, without any other indications or clues to what caused the "F", your first action is to notify the TC by reporting MALFUNCTION. What you do next during an Immediate Engagement situation depends on the TC's decision-making skills. Since he does not know what caused the malfunction, his command would be DEGRADED-FIRE. If no major fire control system has failed, the target should be hit and destroyed with the first round.

WRONG ANSWERS

- A. No. You do not have time to perform a computer self-test when you are about to be engaged by an armor defeating target.
- B. No. There are no indications that the cant sensor has failed.
- D. NOT YET. In this situation, the TC must command DEGRADED-FIRE first.

SCENARIO 2



10

THE SITUATION

- M1 is moving across open ground, unprotected.
- There is a 35-45 mph crosswind. Two T-72's are detected at about 2000 meters.
- TC issues fire command for the multiple moving target engagement.
- "F" appears in GPS after lasing the left tank.
- You report MALFUNCTION.

What should you do now?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Apply cross-wind correction and fire on command	Switch to GAS and fire on command	Apply manual lead and fire on command	Respond to TC command

11

SCENARIO 2 ANSWER

You should have selected D: Respond to TC's command

When a malfunction occurs you must report it to the TC by announcing MALFUNCTION. If you know what system has probably malfunctioned report it as well, i.e., NO LEAD, NO RETICLE, NO STAB, etc. During Immediate Engagement situations there is no time to identify and correct for unknown gunnery system failures. In this scenario, the TC will announce DEGRADED-FIRE immediately.

WRONG ANSWERS

- A. No. This is not known! Many things can cause an "F" to appear in GPS.
- B. No. There is neither the time nor a reason for switching to the GAS.
- C. Same as A.

SCENARIO 3



14

THE SITUATION

- M1 is positioned along a hillside, unprotected.
- An RPG is detected at about 1100 meters, preparing to engage you.
- TC issues a fire command.
- "F" appears in GPS after lasing.

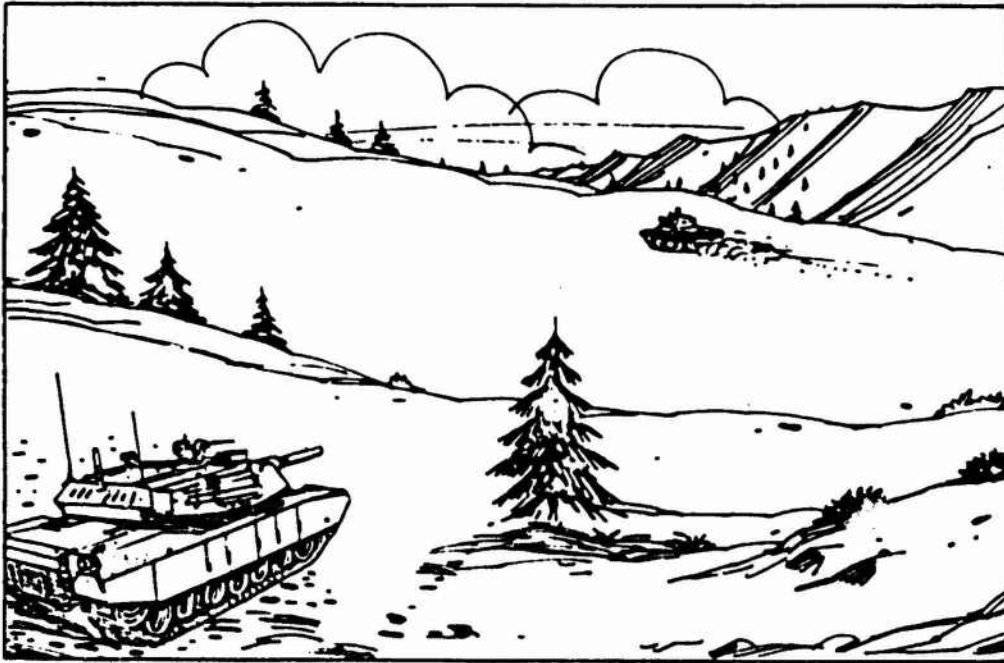
What should you do?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Aim 1 mil high and in opposite direction, then fire on command	Report MALFUNCTION NO CANT SENSOR, then respond to TC command	Aim 1 mil high and in same direction, then fire on command	Report MALFUNCTION, then respond to TC command

15

140

SCENARIO 4



18

THE SITUATION

- A T-62 is detected moving at about 20 mph.
- Estimated target range is 1430 meters.
- TC commands GUNNER, SABOT, MOVING TANK.
- "F" appears in GPS after lasing.
- Aiming point does not follow the target, automatically.

What should you do?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Report MALFUNCTION, then respond to TC command	Report MALFUNCTION- NO LEAD, then respond to TC command	Report MALFUNCTION then apply standard lead and fire	Report MALFUNCTION- NO LEAD, then fire using standard lead

19

SCENARIO 4 ANSWER

The correct answer is B? Report MALFUNCTION-NO LEAD, then respond to TC command.

In this scenario you not only had an "F" appear in the GPS, but the aiming point failed to automatically follow the target after you lased. This indicates a LEAD ANGLE sensor malfunction and should be reported to the TC. The TC can then use that information to issue the correct fire command, i.e., DEGRADED-APPLY MANUAL LEAD-FIRE.

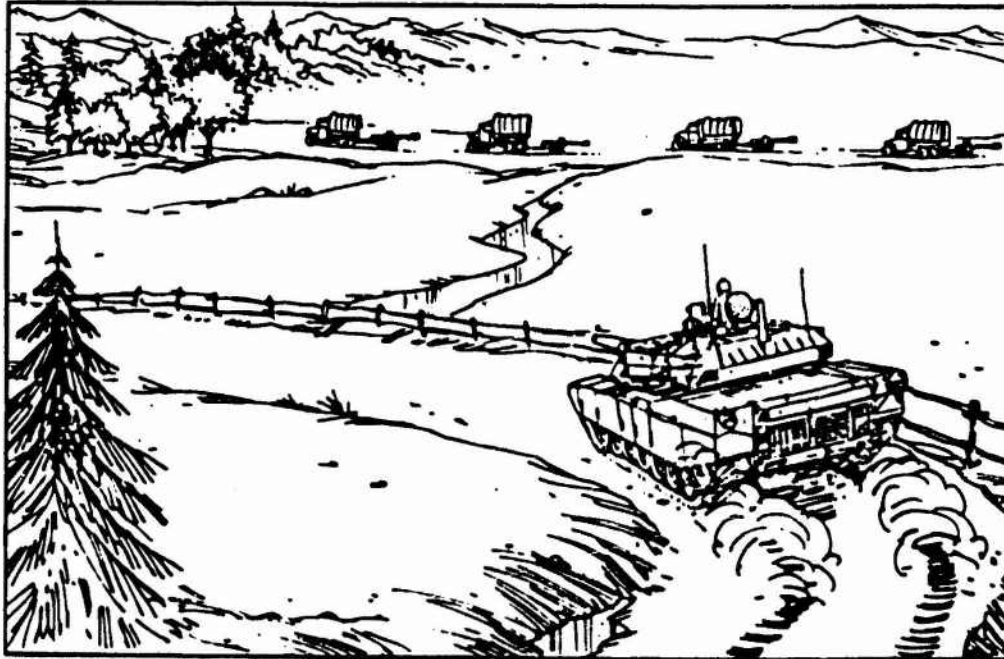
20

WRONG ANSWERS

- A. Partially correct, but since you know that the Lead Angle sensor has malfunctioned, you should report it.
- C. No. You must not fire until directed by the TC, regardless of whether you reported the lead angle sensor malfunction or not.
- D. Same as C.

21

SCENARIO 5



22

THE SITUATION (Continued)

- "F" remains in GFS because of a failed lead angle sensor system.
- You turn the corner on a mountain road.
- Across the valley you see 4 trucks towing SD-44 antitank guns.
- They have detected you and are moving for cover.
- The trucks are 2100 meters away and moving about 40 mph.
- TC issues fire command using HEAT.

How much lead should you apply?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
None	5 mils	10 mils	20 mils

23

SCENARIO 5 ANSWER

You should have selected B: 5 mils

This is the correct answer because:

- You must apply a standard lead when there is a lead angle sensor failure.
- 5 mils is the suggested standard lead for a HEAT round regardless of target speed.

24

WRONG ANSWERS

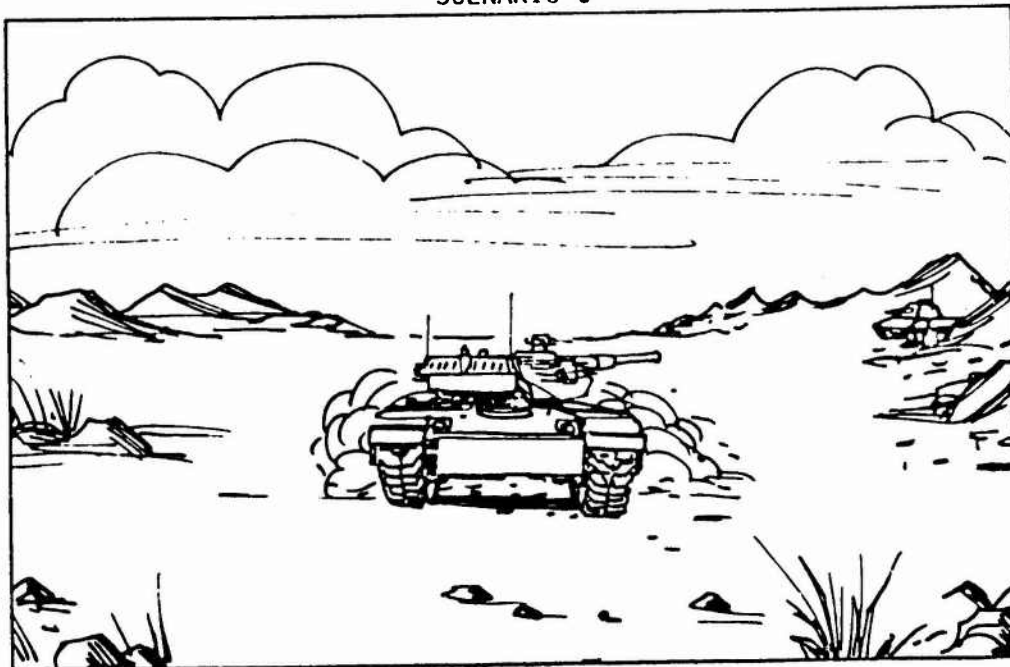
- A. When lead angle sensor fails you must apply a manual lead when engaging moving targets.

C. The speed of target is difficult to estimate. For that reason, the suggested standard leads for SABOT and HEAT are applied regardless of target speed.

D. Same as C.

25

SCENARIO 6



26

THE SITUATION

- A T-55 is detected at about 3000 meters.
- You have been detected; T-55 is preparing to engage.
- TC issues fire command using SABOT.
- You lase to the target; "F" appears in GPS.
- Range display shows flashing zeros.

What is your report?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
MALFUNCTION	MALFUNCTION- LRF OUT	MALFUNCTION- COMPUTER OUT	DEGRADED

27

SCENARIO 6 ANSWER

The answer is B: MALFUNCTION-LRF OUT

Indications of an LRF malfunction are:

- "F" appears in GPS.
- Flashing "0000" appears in range display after lasing.
- Range in GPS range display do not change.

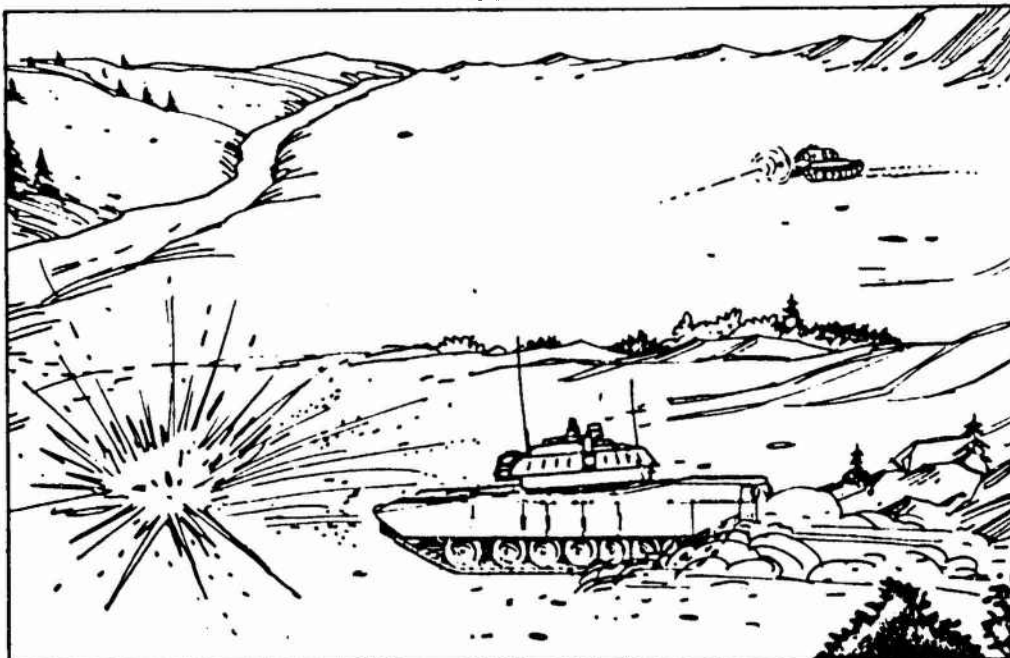
WRONG ANSWERS

- A. Partially correct, but since you know the LRF is out you should report it.

C. No. These are not indications of a computer failure.

D. No. The gunner cannot give such a report.

SCENARIO 7



30

THE SITUATION

- There is an "F" in GPS; LRF is out.
- 1000 meters is displayed in GPS and CCP.
- A T-72 at about 1000 meters fires and misses.
- TC issues a precision mode fire command.

How should you expect to engage the target?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Fire using GAS battle- sight	Fire using GPS battle- sight	Fire using GAS preci- sion	Fire using GPS precision

31

SCENARIO 7 ANSWER

You should have selected B: Fire using GPS battlesight

When the LRF is out of operation, the TC can fire using the range shown in the GPS or CCP range display or issue a corrected or new fire command using either a battlesight range or estimated range and the GAS. In the above situation, since the target is within battlesight range, the TC should command: GUNNER, BATTLE-SIGHT, MOVING TANK and fire immediately.

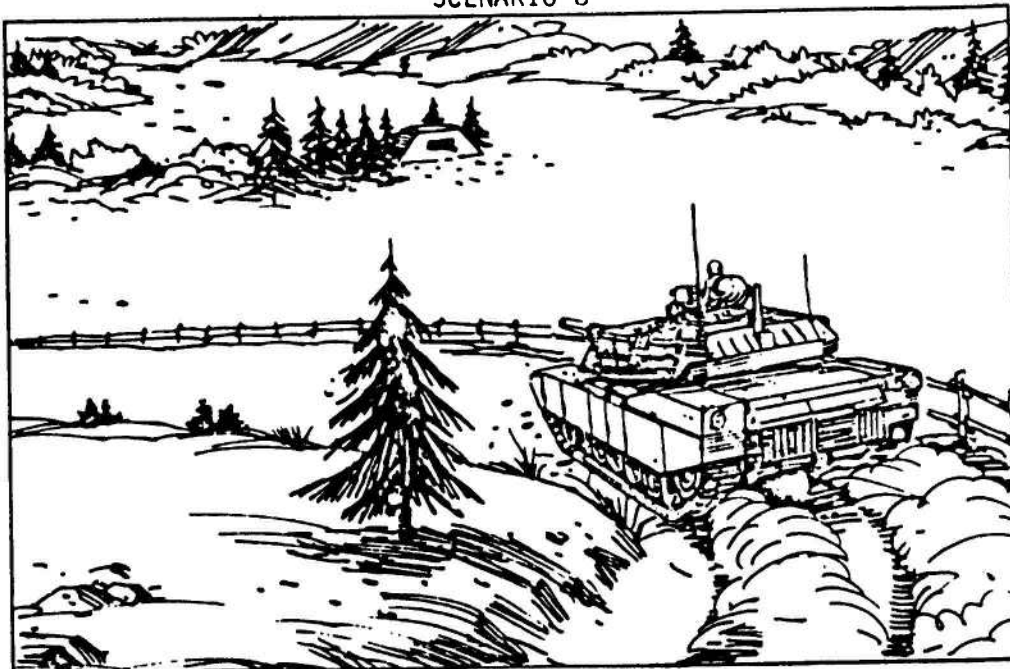
32

WRONG ANSWERS

- A. No. Would take some additional few seconds that are not there. Also, crew would lose the benefits of a computerized ballistic solution.
- C. Same as A.
- D. Not possible. LRF is not operational.

33

SCENARIO 8



34

THE SITUATION

- You just turn a curve in a road.
- A bunker is spotted at about 750 meters.
- SAGGER team in bunker is ready to fire at you.
- TC issues fire command.
- View in GPS starts jumping around.

What should you do now?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Report MALFUNCTION- STAB OUT and switch to NORMAL	Report MALFUNCTION- DRIVER STOP and fire	Report MALFUNCTION- STAB OUT and switch to EMERGENCY	Report MALFUNCTION-NO SYMBOLS and switch to TIS

35

149

SCENARIO 8 ANSWER

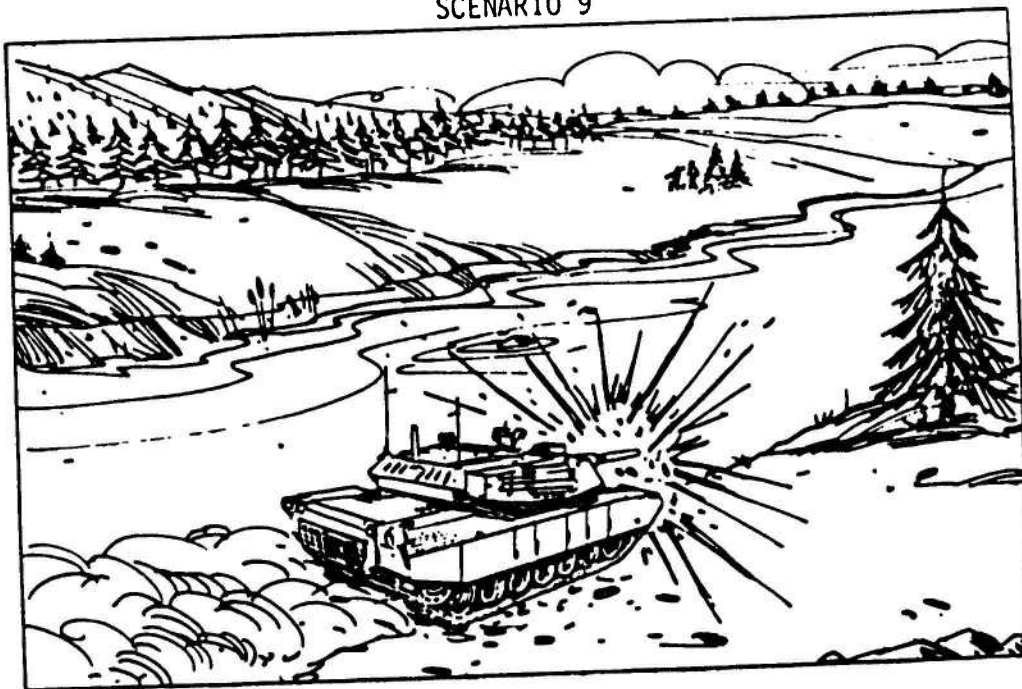
The correct answer is C: Report MALFUNCTION-STAB OUT and switch to EMERGENCY.

You should know that the stabilization system has failed when the view in the GPS starts jumping around and you are unable to keep the aiming point on target. When this occurs the TC should command the driver to stop and for you to fire. For example: DEGRADED-DRIVER STOP...FIRE.

WRONG ANSWERS

- A. No. You should be in NORMAL mode already.
- B. No. The TC would command the driver to stop and when the gunner is to fire.
- D. No. If GPS symbology is lost the GPS view and aiming point will not be affected.

SCENARIO 9



38

THE SITUATION

- M1 is moving along a river.
- RPG team is spotted at about 1200 meters across the river.
- The RPG team fires at you and misses.
- Round hits very near and damages the GPS ballistic doors.
- You have lost your GPS view. TIS is in off.
- You announce MALFUNCTION-GPS OUT.

What should you do next?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Insure CB21 is ON	Switch to GAS	Perform a computer self-test	Switch TIS to ON

39

151

SCENARIO 9 ANSWER

You should have selected B: Switch to GAS

The GAS is used as the backup sighting system when the GPS view fails and the TIS is OFF or non-operational. Remember, about 5 to 15 minutes are required to get the TIS ready for use when it is not in the STBY mode.

40

WRONG ANSWERS

- A. No. There is no time for troubleshooting. Need to return fire immediately.
- C. Same as A.
- D. If TIS is off, 5 to 15 minutes are needed before system is ready for use.

41

SCENARIO 10



42

THE SITUATION

- M1 is hull-down, behind rocks.
- TIS is in STBY mode; GAS is operational.
- TC spots a HIND chopper at about 1000 meters.
- The chopper has detected you; TC issues main gun fire command.
- The GPS reticle goes out after lasing.

What should be your next action?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Check CB 21 and CB 30 are ON	Switch to GAS	Announce MALFUNCTION- RETICLE	Switch TIS to ON

43

SCENARIO 10 ANSWER

You should have selected C: Announce MALFUNCTION-NO RETICLE

Whenever there is a system failure the gunner must notify the TC immediately by reporting MALFUNCTION and the situation, if known.

44

WRONG ANSWERS

- A. No. In an Immediate Engagement situation there is no time to identify what caused a system failure.
- B. No. GAS is used when both GPS/TIS are inoperable.
- D. No. Must inform TC of failed system before doing anything else.

45

SCENARIO 11



46

THE SITUATION (Continued)

- M1 is hull-down, behind rocks.
- TIS is in STBY mode; GAS is operational.
- TC spots a HIND chopper at about 1000 meters.
- The chopper has detected you; TC issues main gun fire command.
- The GPS reticle is out; you reported it to the TC

What should be your next action?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Check CB 21 and CB 30 are ON	Switch to GAS	Check GPS- RETICLE control	Switch TIS to ON

47

SCENARIO 11 ANSWER

You should have selected D: Switch TIS to ON

When the TIS is in the STBY mode, it is the preferred sighting system when the GPS cannot be used. GPS cannot be used without a reticle for aiming..

48

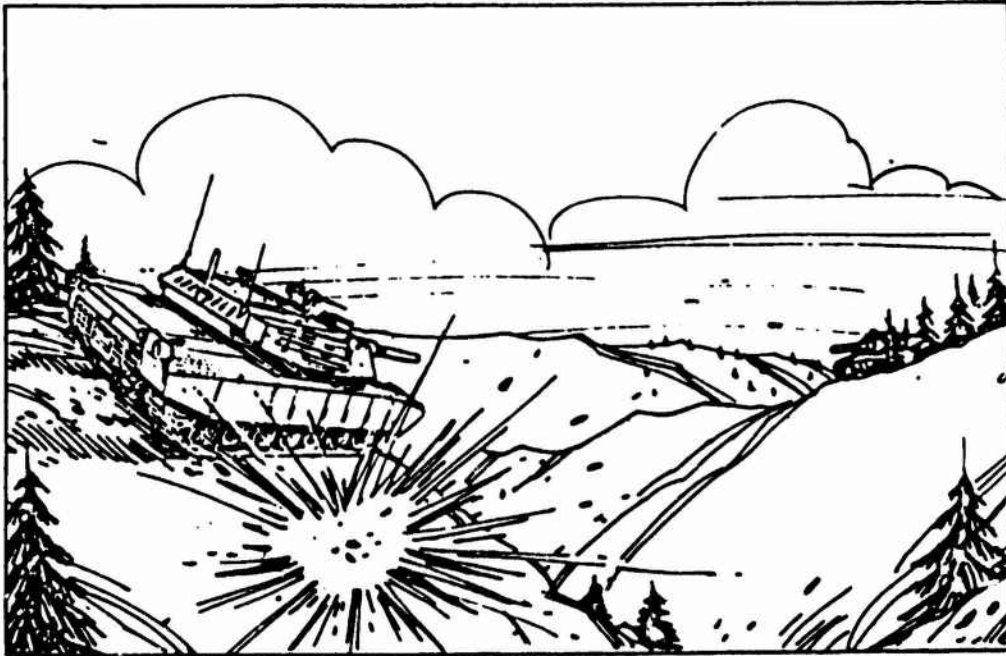
WRONG ANSWERS

- A. No. Do not have enough time to troubleshoot the GPS reticle when you are in an immediate situation.
- B. No. When the TIS is in STBY mode it is the preferred sighting system when the GPS reticle fails.
- C. Same as A.

49

156

SCENARIO 12



50

THE SITUATION

- M1 moves over a hill.
- After a few minutes, a T-80 hidden in some trees at about 800 meters opens fire on you.
- You are using the TIS because the GPS failed.
- A round from the T-80 hits close; TIS goes out.
- You report MALFUNCTION-NO TIS.

What should you do now?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Switch to GPS	Check CB 22 is ON	Switch to GAS	Perform a computer self-test

51

SCENARIO 12 ANSWER

The correct answer is C: Switch to GAS

If the TIS fails when it is being used as the backup sight, you must switch to the GAS. Since the target is within battlesight range, the gunner should anticipate firing battlesight for ammo loaded.

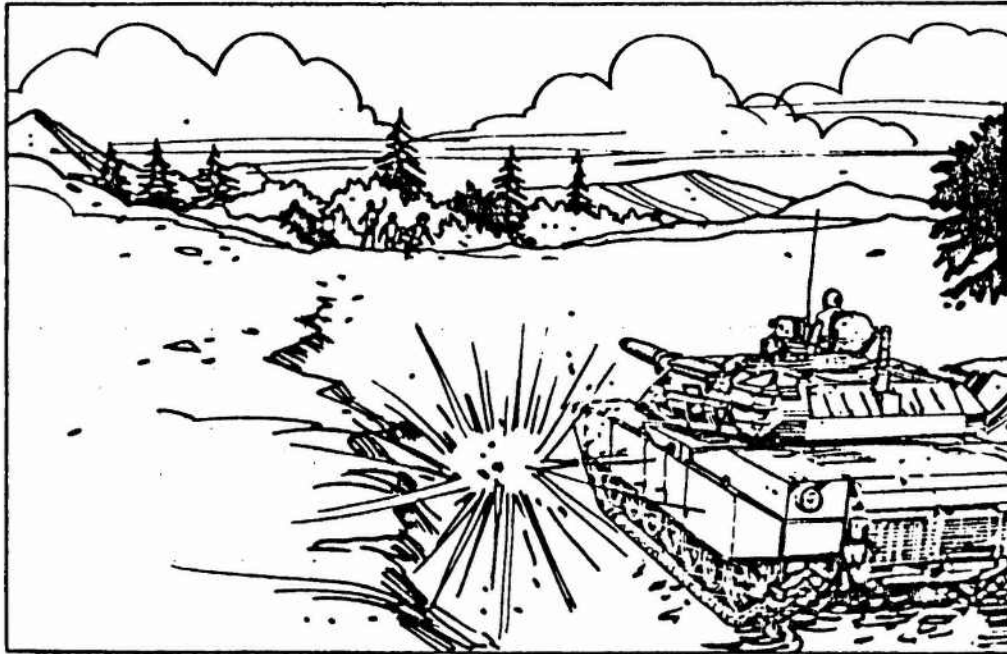
52

WRONG ANSWERS

- A. No. GPS has failed.
- B. No. There is no time to waste. Besides, a computer self-test will not indicate why the TIS failed.
- D. Same as B.

53

SCENARIO 13



54

THE SITUATION

- M1 is moving over rough terrain.
- A SAGGER team is detected in some trees at about 2400 meters.
- An ATGM is launched at you; M1 suddenly hits an obstacle.
- TC issues fire command.
- You lose to the target; range and ready-to-fire symbols fail to appear.

What should be your report to TC?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
MALFUNCTION- NO GPS	MALFUNCTION- NO RANGE	MALFUNCTION- NO SYMBOLS	MALFUNCTION- NO TIS

55

SCENARIO 13 ANSWER

You should have selected C: MALFUNCTION-NO SYMBOLS

When you lose GPS symbology both the range and ready-to-fire symbols will not appear after lasing. This is a failure in the Image Control Unit (ICU) when using the GPS. It is a failure in the Electronics Unit (EU) when using the TIS.

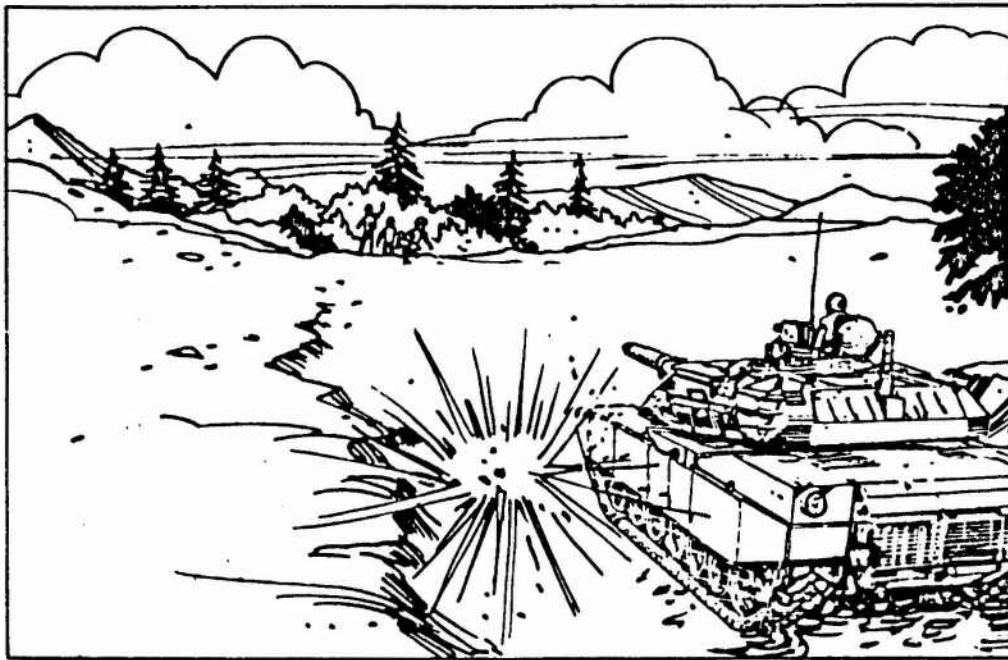
56

WRONG ANSWERS

- A. No. If GPS or TIS fails you will not be able to see anything using it.
- B. No. If the LRF fails, you will get an "F" and flashing zeros in GPS.
- D. Same as A.

57

SCENARIO 14



58

THE SITUATION (Continued)

- M1 is moving over rough terrain.
- A SAGGER team is detected in some trees at about 2400 meters.
- An ATGM is launched at you. M1 suddenly hits an obstacle.
- TC issues fire command.
- You lose to target; GPS symbology is lost.
- You report MALFUNCTION-NO SYMBOLS.

How should you expect to engage the target?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Fire using GAS and announced range	Fire using GPS precision	Fire using GPS and battlesight range technique	Fire using GPS and indexed range

59

SCENARIO 14 ANSWER

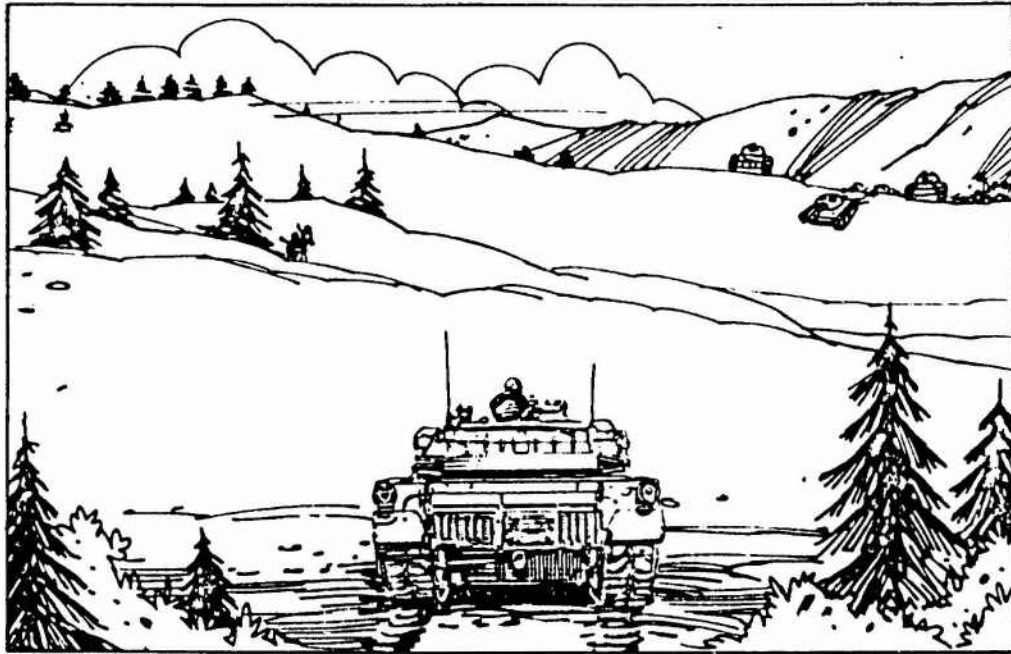
You should have selected B: Fire using precision

When there is a GPS or TIS symbology failure, the TC will command DEGRADED-FIRE during on Immediate Engagement situation. Remember. The accuracy of the LRF, combined with the choice of first or last return logic, should provide crew members with enough confidence to fire even though the range is not shown.

WRONG ANSWERS

- A. No. The GAS is used when GPS/TIS are inoperable.
- C. No. It could be done but it would not be as accurate as firing precision.
- D. No. It is not as accurate as firing precision and would require more time than what's available in this situation.

SCENARIO 15



62

THE SITUATION

- You are detected by three T-62s 2500 meters to your right.
- An RPG team at 1100 meters to your left is set up to fire.
- TC issues a fire command for you to engage the T-62s with SABOT while he engages the RPG team.
- TC lays main gun for direction.
- When you try to place reticle on target, the turret won't move.

What should you do now?

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Report MALFUNCTION- NO TURRET POWER	Check CB 17, 30, and 31 are ON	Report MALFUNCTION- COMPUTER OUT	Check hydraulic pressure gauge is above 1550 psi

63

SCENARIO 15 ANSWER

You should have selected A: Report MALFUNCTION-NO TURRET POWER

Obviously, something has caused the turret power to fail. If there was available time to check it out, it probably could be resolved and turret power restored to the system. Since there is no time to waste, the gunner must report the malfunction and be prepared to operate using manual controls immediately.

WRONG ANSWERS

- B. This is an Immediate Engagement situation. There is no time to troubleshoot the failed system.
- C. No. A computer failure will not prevent the turret from moving.
- D. Same as B.

SCENARIO 16



66

THE SITUATION

- Your M1 is stationary and canted along a hillside.
- A T-55 is detected at about 1800 meters.
- You have been detected; T-55 is preparing to engage.
- TC announces GUNNER, SABOT, TANK and lays gun at target...
- "F" appears in GPS after lasing.

What is your immediate response?

(No choices this time. Write down your answer, then turn the page.)

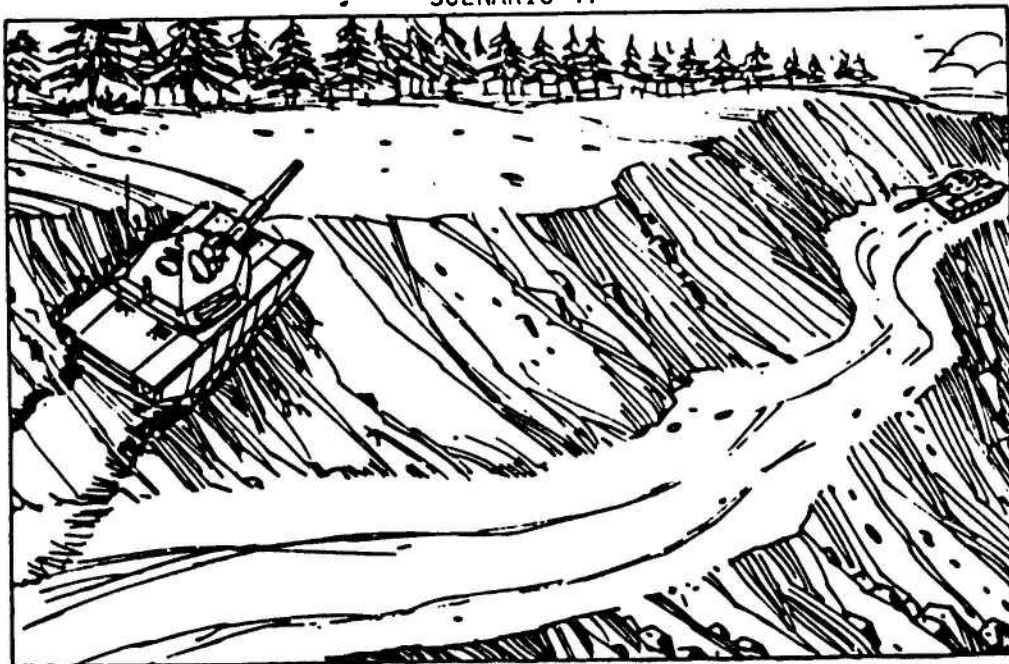
67

SCENARIO 16 ANSWER

Your answer should have been something like this:

Since you are detected by a T-55 tank that can kill you, you need to get off that first round right away. In this situation, the TC will announce DEGRADED-FIRE. It would just take too long to do anything else.

SCENARIO 17



70

THE SITUATION (Continued)

- Your M1 is stationary and canted along a hillside.
- A T-55 is detected at about 1800 meters.
- You have been detected; T-55 is preparing to engage.
- TC announces GUNNER, SABOT, TANK and lays gun at target...
- "F" appears in GPS after lasing.
- You announce MALFUNCTION.
- TC announces DEGRADED-FIRE.

How should you engage the target? If you miss and observe round impact, what should you do?

(Write down your answer, then turn the page.)

71

SCENARIO 17 ANSWER

You should have said something like this:

Fire target center of mass and attempt to observe the impact of the round. If the round misses and is observed, keep the palm switches depressed and apply REENGAGE method of direct fire adjustment.

Remember: When it is determined that there is a cant sensor failure, the gunner's correction is to aim 1 mil high and in the opposite direction for every 1000 meters.

SCENARIO 18



74

THE SITUATION

- Your M1 is hidden among trees, without cover.
- A stiff wind is blowing from your left.
- Three T-72s are detected on the road at 2700 meters.
- You are detected; TC issues fire command: GUNNER-HEAT-TANK.
- "F" appears in GPS.

What is your immediate response? How should you expect to engage the target? If you miss and observe round impact, what should you do?

(Write down your answer, then turn the page.)

75

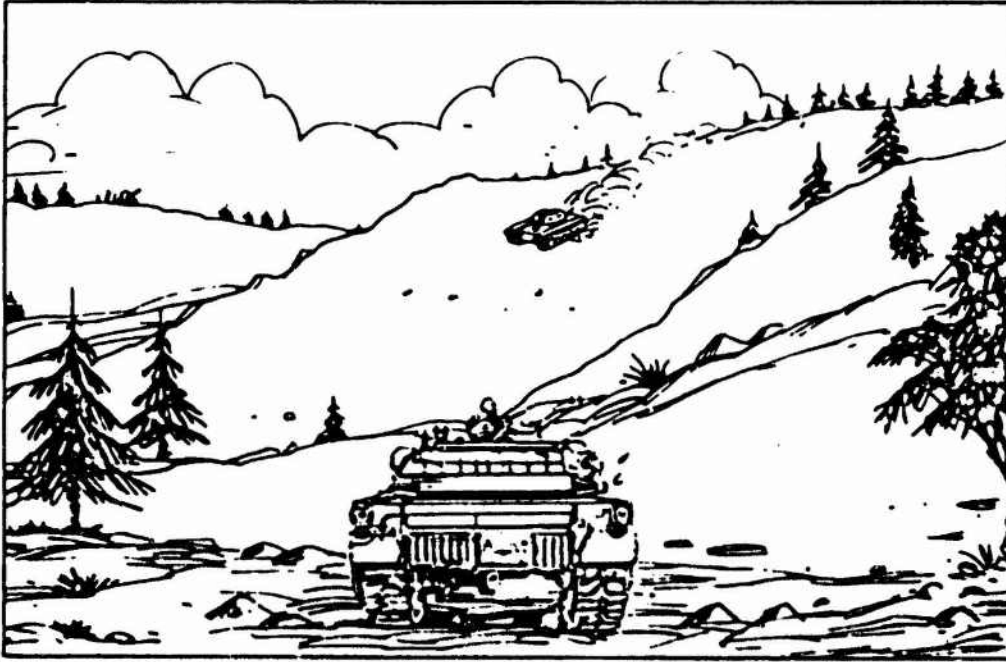
SCENARIO 18 ANSWER

You should have said something like this:

Fire using the GPS without apply any correction for crosswind and attempt to observe the impact of the round. If the round misses and is observed, keep the palm switches depressed and apply the gunner's standard adjustment (1 mil).

Remember. When an "F" appears in the GPS, one of several systems could have malfunctioned or failed. Simply because there is a strong crosswind does not mean the crosswind sensor has malfunctioned.

SCENARIO 19



78

THE SITUATION

- You have just come over a hill.
- You see a T-62 tank traveling at 30-35 mph at 2100 meters.
- He spots you; TC issues a fire command using SABOT ammo.
- "F" appears in GPS after lasing; reticle does not follow target automatically.

What is your immediate response? How should you expect to engage the target? If you miss and observe round impact, what should you do?

(Write down your answers, then turn the page.)

79

171

SCENARIO 19 ANSWER

You should have said something like this:

Announce MALFUNCTION-NO LEAD and expect to engage the target using 2-1/2 mil standard lead from center of mass and direction of turret movement. If round misses and impact is observed, apply REENGAGE method of direct fire adjustment.

Remember. The suggested standard manual leads is based on type of round fired and range to target. Since the speed of a distant target is difficult to estimate, the suggested lead adjustment is 2-1/2 mils for SABOT and 5 mils for HEAT.

SCENARIO 20



82

THE SITUATION

- M1 is partially hidden behind rocks.
- A T-62 is detected ready to fire at 1250 meters.
- TC issues fire command: GUNNER, SABOT, TANK.
- You lay on target and lase; flashing zeros are displayed in GPS along with an "F" symbol.

What is your immediate response? How should you expect to engage the target? If you miss and observe round impact, what should you do?

(Write down your answers, then turn the page.)

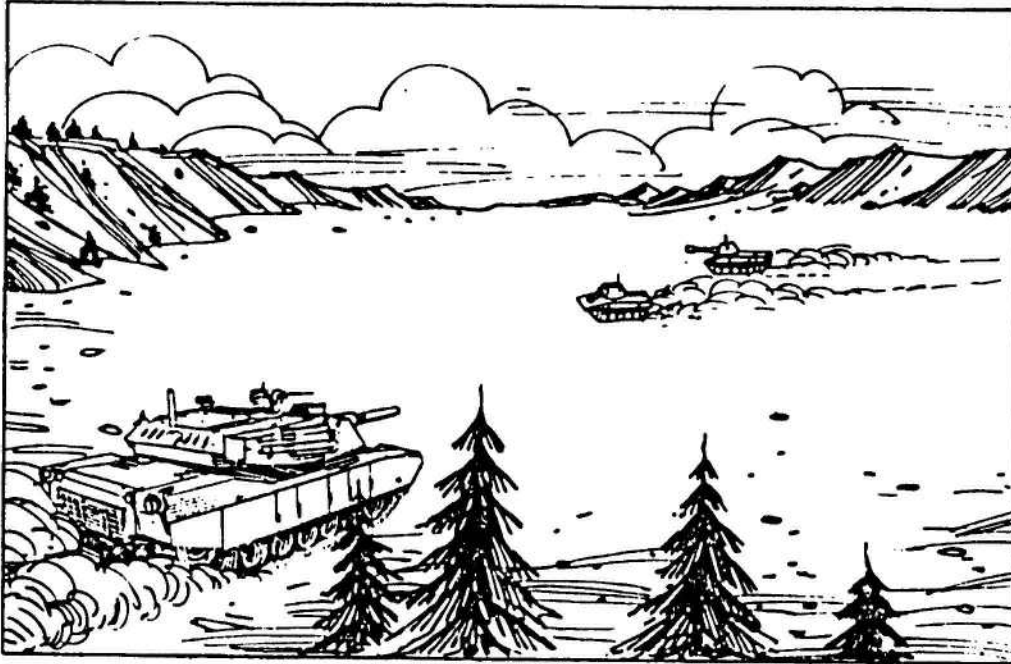
83

SCENARIO 20 ANSWER

You should have said something like this:

Announce MALFUNCTION-NO RANGE and expect to engage the target using the previous range shown in GPS display (if known), a battlesight range solution, or an estimated range and the GAS. If round misses and impact is observed, keep palm switches depressed and apply gunner's standard adjustment.

SCENARIO 21



86

THE SITUATION

- M1 is moving cross-country; TIS is in STBY.
- Two PT-76 tanks are detected moving towards you at 1650 meters.
- One PT-76 has its gun pointed at you.
- TC issues fire command using SABOT.
- M1 hits a big bump and the GPS view start to jump around; cannot keep reticle on target.

What is your immediate response? How should you expect to engage the target? If round misses and impact is observed, what should you do?

(Write down your answers, then turn the page.)

87

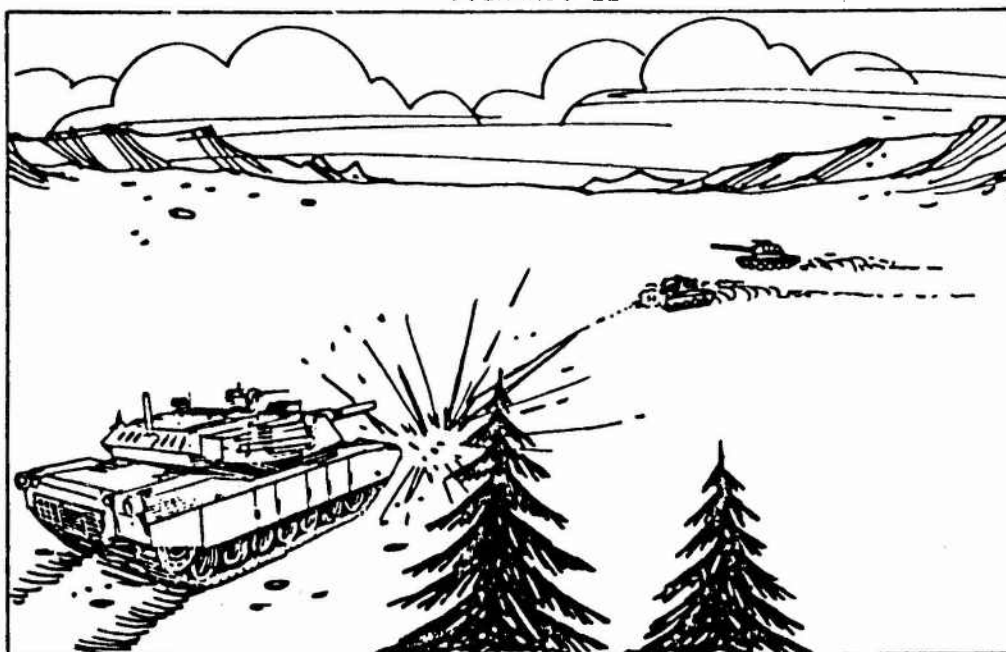
SCENARIO 21 ANSWER

You should have said something like this:

Announce MALFUNCTION-NO STAB, switch to EMERGENCY mode and engage the target from a brief halt using 2-1/2 mil lead. If round misses and impact is observed, apply reengage method of direct fire adjustment.

Remember. When the FIRE CONTROL MODE is switched to EMERGENCY, automatic lead is cancelled. Therefore, when engaging a moving target, the gunner must apply the suggested standard lead for the announced ammo, i.e., 2-1/2 mils for SABOT, 5 mils for HEAT.

SCENARIO 22



90

THE SITUATION (Continued)

- You are engaging two PT-76s at 1640 meters.
- M1 has come to a stop because of stabilization failure; TIS is in STBY.
- Before you can fire, one PT-76 fires a round at you and
- GPS view is lost.

What is your immediate response? How should you expect to engage the target? If round misses and impact is observed, what should you do?

(Write down your answers, then turn the page.)

91

177

SCENARIO 22 ANSWER

You should have said something like this:

Announce MALFUNCTION-GPS IS OUT and engage the target using the TIS and 2-1/2 mil lead. If round misses and impact is observed, keep palm switches depressed and apply reengage method of direct fire adjustment with modified lead.

Remember. To use the TIS, the gunner should:

- Place FLTR/CLEAR/SHTR switch to SHTR.
- Switch THERMAL MODE to ON.
- Open THERMAL ballistic door.

SCENARIO 23



94

THE SITUATION

- M1 is traveling along a tree line.
- A towed antitank gun, hidden behind some rocks, opens fire on you.
- Antitank gun is at about 2700 meters.
- TC issues fire command.
- As he lays the gun for direction you notice that the GPS reticle is missing.

What is your immediate response? How should you expect to engage the target? What should you do if the round misses and impact is observed?

(Write down your answers, then turn the page.)

95

SCENARIO 23 ANSWER

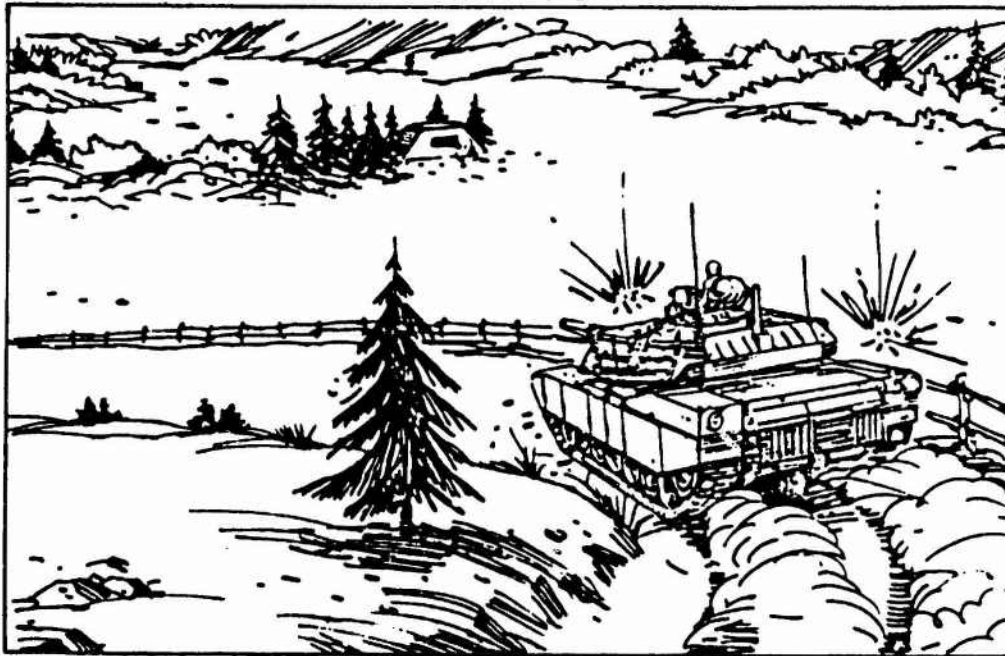
Your answer should have been something like:

Announce MALFUNCTION-NO GPS RETICLE and expect to engage the target using the TIS. If round misses and impact is observed, apply reengage method of direct fire adjustment.

06

Remember. TIS must be in STBY mode, otherwise 5 to 15 minutes are required before it becomes operational. If it is not in STBY, be prepared to engage the target using the GAS and announced range...immediately.

SCENARIO 24



98

THE SITUATION

- M1 is in an offensive attack.
- Antitank gun in a bunker about 700 meters to the left; it opens fire.
- TC issues fire command using HEAT; lays gun on target.
- You lase but the range does not appear in display.

What is your immediate response? How should you expect to engage the target? What should you do if round misses and impact is observed?

(Write down your answers, then turn the page.)

99

SCENARIO 24 ANSWER

You should have said something like this:

Announce MALFUNCTION-NO SYMBOLS and expect to engage the target without correction. If round misses, apply reengage method of direct fire adjustment.

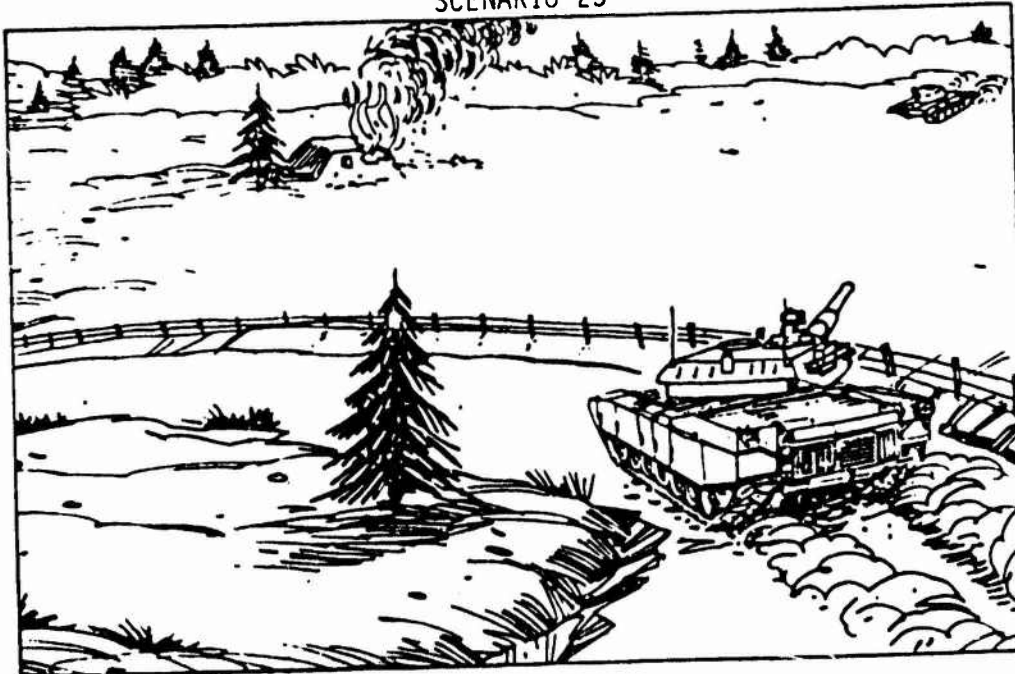
100

Remember. The accuracy of the LRF, combined with the choice of first or last return logic, should provide crew members with sufficient confidence to fire even though the range is not shown in GPS display.

101

102

SCENARIO 25



102

THE SITUATION (Continued)

- You have just destroyed the antitank gun in a bunker at 700 meters.
- You engaged the target without range numbers in GPS range display.
- A T-55 is detected on the right at about 2400 meters.
- He is stationary and preparing to fire.
- TC lays gun for direction while issuing a fire command.
- You attempt to aim but turret won't move.

What is your immediate response? How should you expect to engage the target? What should you do if round misses and impact is observed?

(Write down your answers, then turn the page.)

103

103

SCENARIO 25 ANSWER

You should have said something like this:

Announce MALFUNCTION-TURRET POWER IS OUT, switch FIRE CONTROL MODE to MANUAL, and expect to engage the target using the GAS and manual controls. If round misses and impact is observed, apply the gunner's standard adjustment.

104

This M1 Degraded Mode Gunnery booklet
is a prototype training document. For
comments or questions contact:

Mr. Ronald E. Kraemer
ARI Field Unit-Ft Knox
ATTN: PERI-IK
Fort Knox, KY 40121

Autovon: 464-4932
Commercial: (502) 634-4932