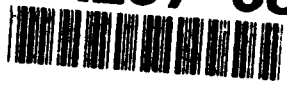AD-A257 680

Trainer's Guide: Multipurpose Arcade Combat Simulator: Moving Target Training

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Litton Computer Services

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U.S. Army Research Institute

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Research Institute for the Behavioral and Social Sciences

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The Multipurpose Arcade Combat Simulator (MACS) is an inexpensive, computer-based rifle trainer that helps soldiers master perceptual/motor and cognitive shooting skills. To date, more than a thousand MACS devices are being used for basic and unit rifle marksmanship training throughout the Army. This Moving Target Trainer's Guide details a MACS cartridge that provides instruction on engagement of moving targets and gives several levels of practice that gradually increase skill and knowledge requirements. The guide also offers helpful instructor recommendations to assist trainers. The program cartridge and the accompanying copy of the Trainer's Guide for the Commodore computer version of Moving Target MACS are available through the Fort Benning Training Support Center.

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FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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Distribution /		
Availability Codes		
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MULTIPURPOSE ARCADE COMBAT SIMULATOR

(MACS-M16 RIFLE)
BASIC RIFLE MARKSMANSHIP
and
MOVING TARGET TRAINING

TABLE OF CONTENTS

MACS SYSTEM ASSEMBLY INSTRUCTIONS

NOTE:

The MACS system can be easily assembled using the instructions found in this section. The instructions should be read before attempting to assemble the system to prevent damage to the system. Particular care must be taken to **NEVER** insert or remove the program cartridge while the keyboard power is **ON**.

MACS SYSTEM ASSEMBLY INSTRUCTIONS

PLEASE READ ALL INSTRUCTIONS BEFORE ATTEMPTING TO ASSEMBLE THE MACS SYSTEM.

CAUTION:

· MAKE SURE **ALL** EQUIPMENT IS TURNED **OFF** BEFORE PROCEEDING OR DAMAGE TO EQUIPMENT WILL RESULT.

MONITOR

KEYBOARD

FRONT

RIGHT SIDE

REAR

POWER
SWITCH

FRONT

POWER
SWITCH
OUT=OFF
IN=ON
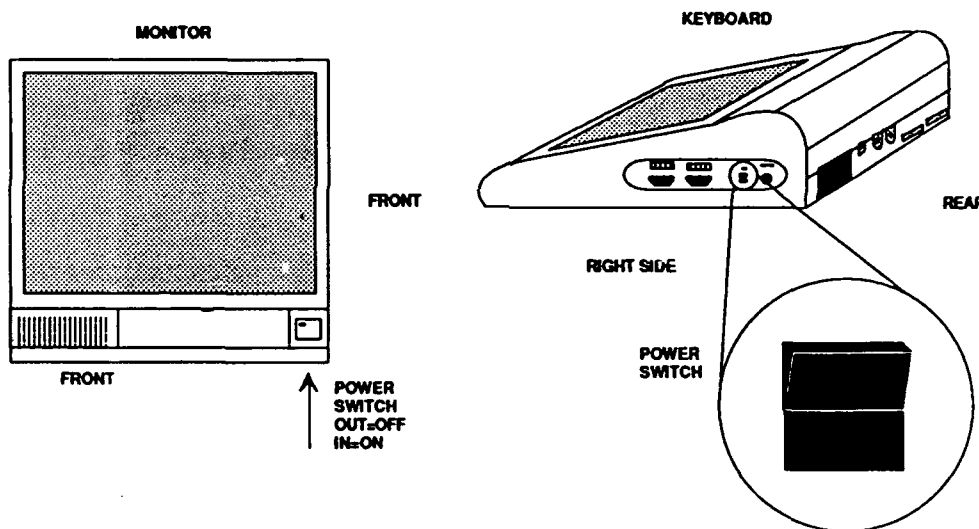
NOTE:

If your system contains a switched power supply box, please note that the power switch is on the front. If there is no power when the switch is in the ON position, check the fuse found in the back of the box.

POWER SUPPLY BOX

FRONT

ON
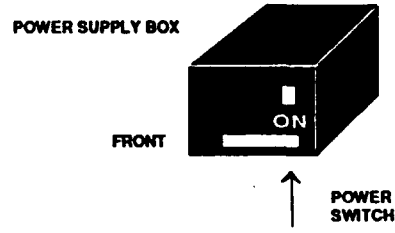
POWER
SWITCH

· Unpack the equipment carefully.
· Each system should have the following components:
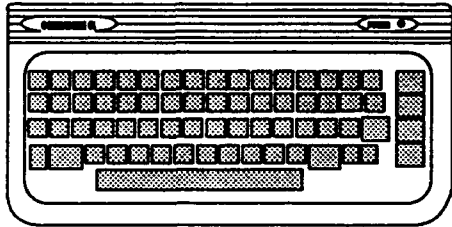
· Keyboard/computer
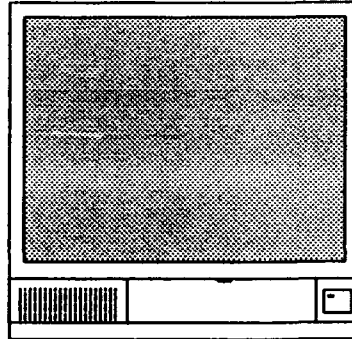
· 13" color monitor
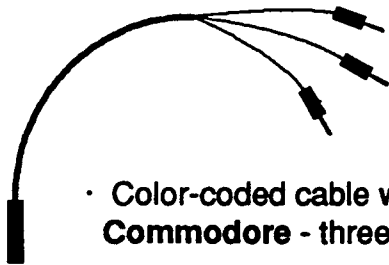
· Color-coded cable with jacks.
Commodore - three jacks used.

MACS

· MACS cartridge

TO KEYBOARD

· Power supply box

TO OUTLET
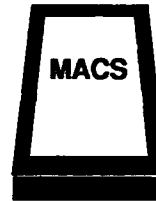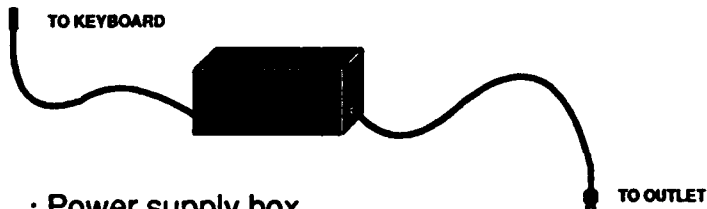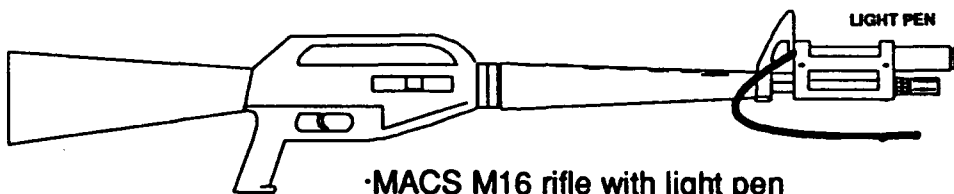
LIGHT PEN

·MACS M16 rifle with light pen

· All equipment should be placed on a firm, steady surface.
· Sandbags are required for supported position.
· Computer equipment should be located near a three-pronged receptacle.
· MACS M16 rifle should be aimed at monitor.
· Place monitor exactly **7'6"** from light pen.
· **NOTE:** Mark distance on connector cord.

7'6"
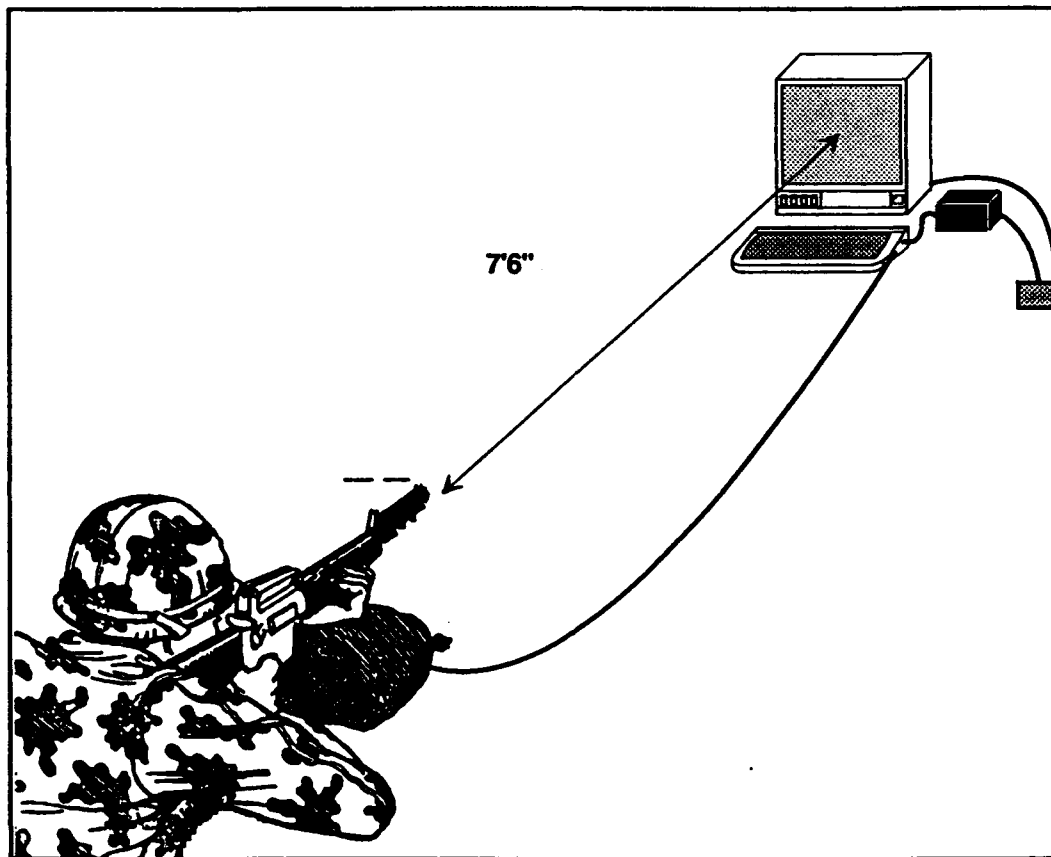
STEP 3   MACS CARTRIDGE

CAUTION:

· **MAKE SURE <u>ALL</u> EQUIPMENT IS TURNED <u>OFF</u> BEFORE PROCEEDING OR DAMAGE TO EQUIPMENT WILL RESULT.**

· Insert MACS cartridge (label up) into slot in back of keyboard.
    · **Use firm steady pressure, gently rocking cartridge left and right.**
    · Cartridge is firmly seated when it can no longer be rocked.

KEYBOARD

REAR

MACS

MACS CARTRIDGE

COMMODORE MONITOR (1802)

- · Plug cable jacks into rear of monitor.
  - · Sockets and cable jacks are color-coded
  - · Jacks must be plugged in correct sockets for program to run correctly.
- · With notch in twelve o'clock position, plug other end of color-coded cable into left-hand port as you face rear of keyboard.
- · Set position of controls on front of monitor:
  - · Brightness and tint to detent
  - · Color and contrast to maximum

COMMODORE MODEL 1802

MONITOR REAR

1 2 3

COLOR-CODED CABLE WITH JACKS

NOTCH

KEYBOARD
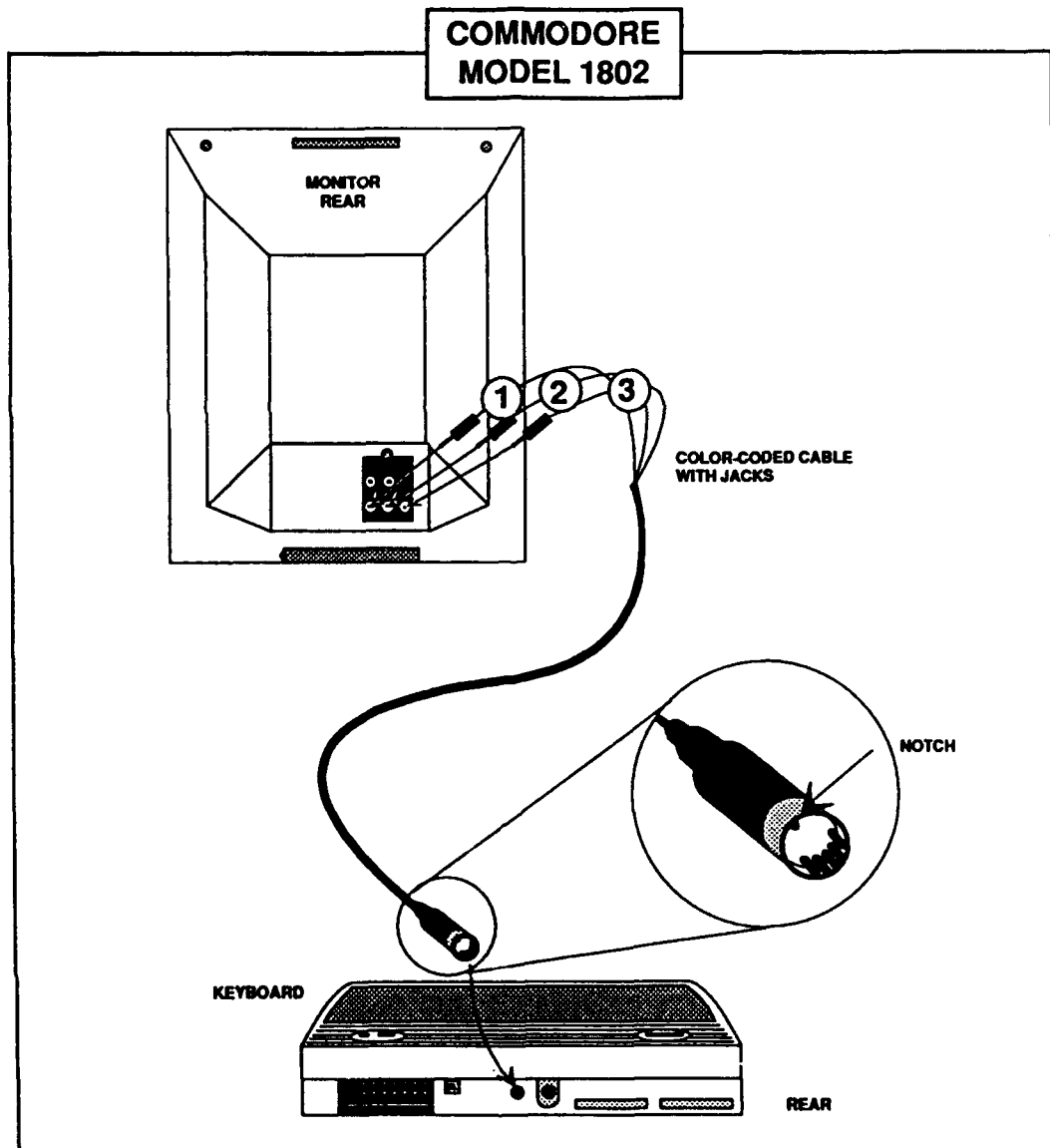
REAR

HITACHI MONITOR

· Plug cable jacks into rear of monitor.
  · Sockets and cable jacks are designated **1** and **2**.
  · IGNORE COLOR OF SOCKETS and JACKS!
  · IGNORE EXTRA JACKS!
  · Jacks must be plugged in correct sockets for program to run correctly.
· Set rear switch to **NTSC**.
· With notch in twelve o'clock position, plug other end of color-coded cable into left-hand port, as you face the rear of keyboard.

1-8
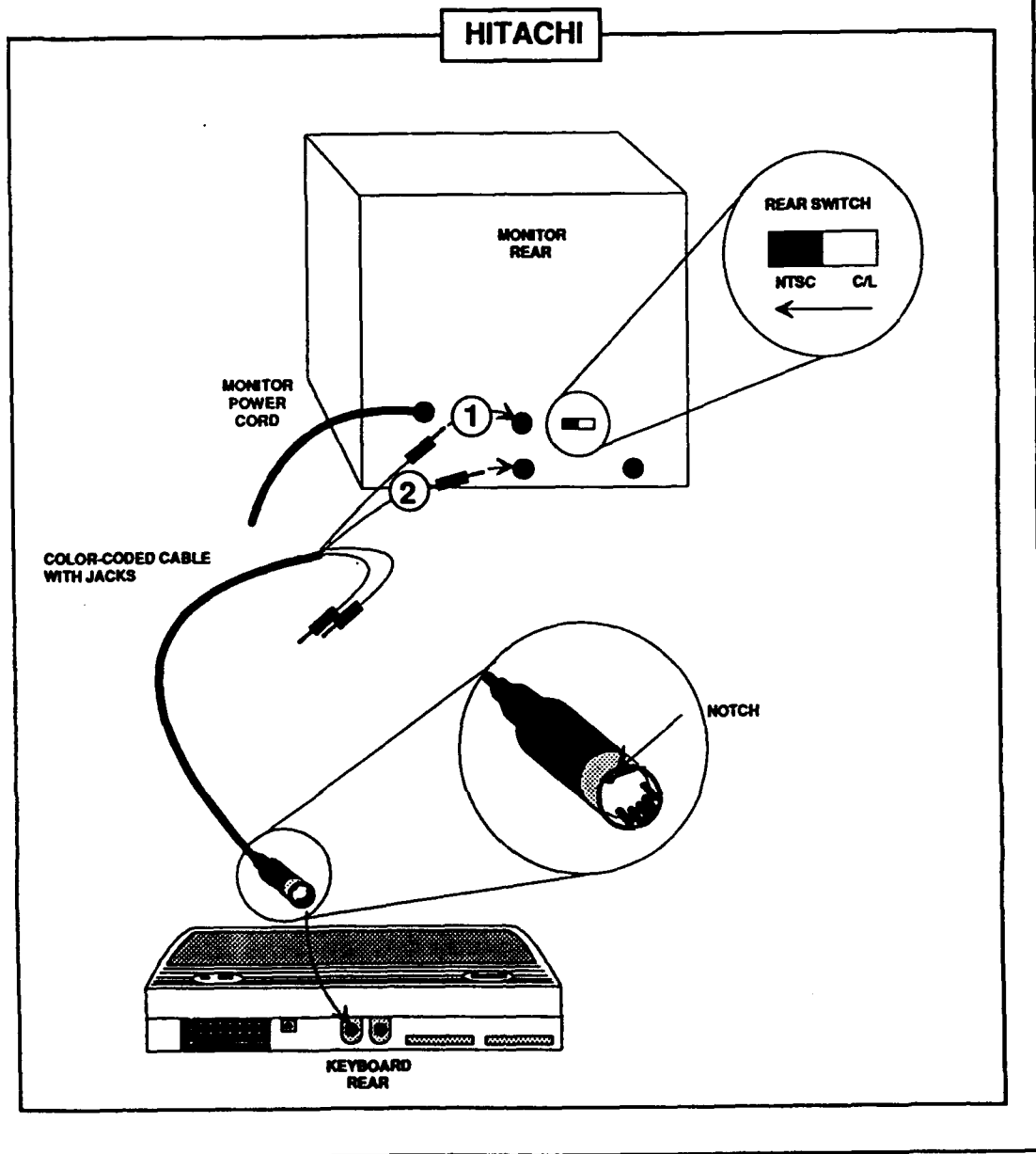
STEP 5 TERMINAL CONNECTION

· Plug terminal connection (from power supply box) into keyboard power socket.
  · As you face the keyboard, socket is found on right hand side next
    to the off-on switch.

KEYBOARD

FRONT

REAR

POWER SUPPLY BOX   RIGHT SIDE

ON   POWER
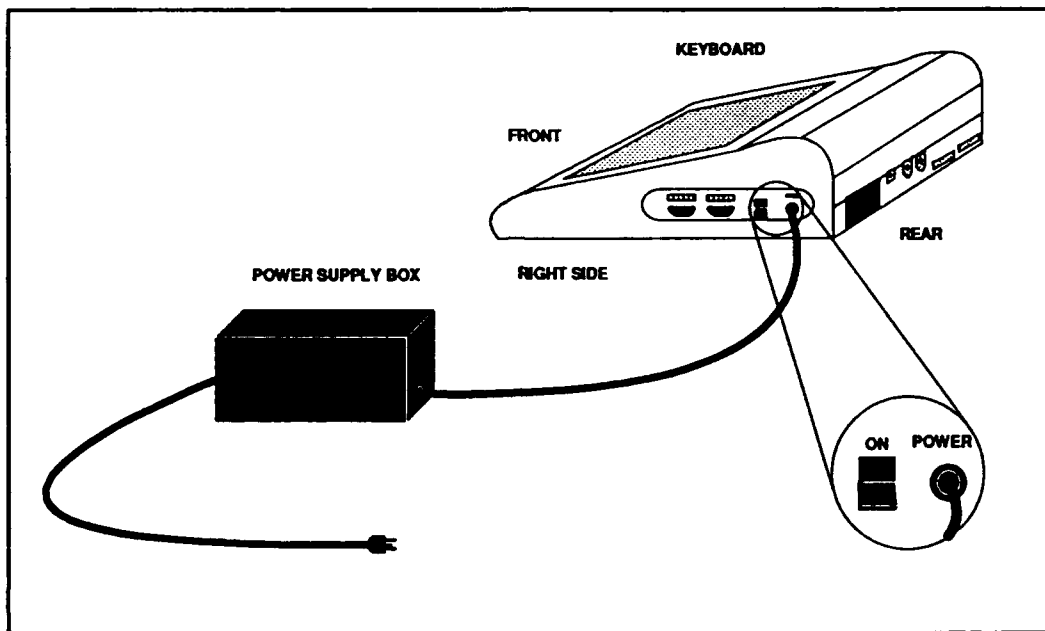
STEP 6 M16 CABLE PLUG

· Plug MACS M16 rifle light pen cable into control port 1 slot found on right-hand side of keyboard.

CAUTION:

PLUG ONLY FITS ONE WAY!

MACS M16 Rifle

KEYBOARD

FRONT

REAR

RIGHT SIDE

CONTROL PORT 1
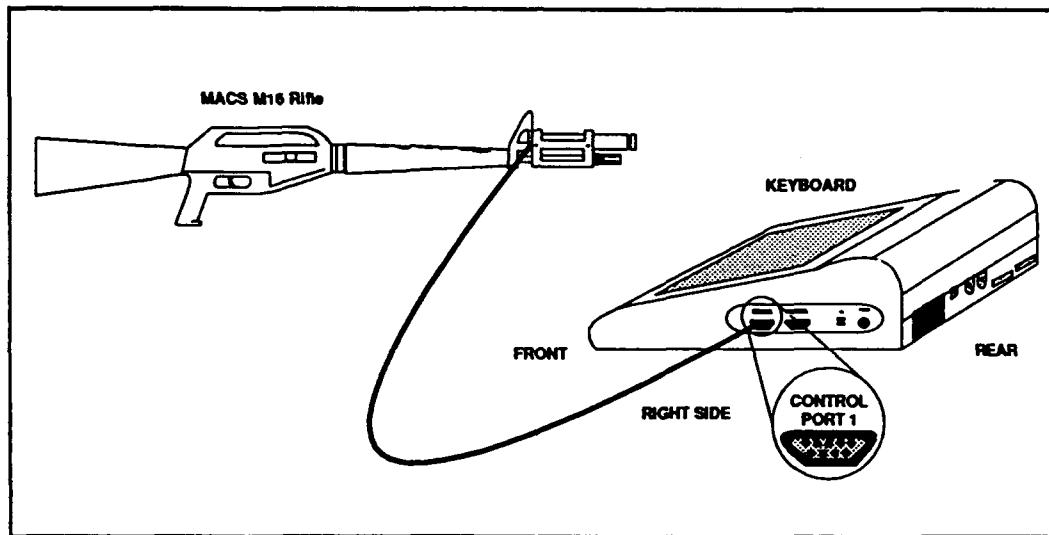
STEP 7   PLUG POWER CORDS INTO OUTLET

· Plug in three-pronged AC power cord from power supply box.
· Use of a surge protector power strip is strongly recommended.
· Plug in monitor power cord.
· Monitor power cord is found on bottom rear of monitor.

MONITOR
REAR

Monitor
Power Cord

POWER STRIP

POWER SUPPLY BOX
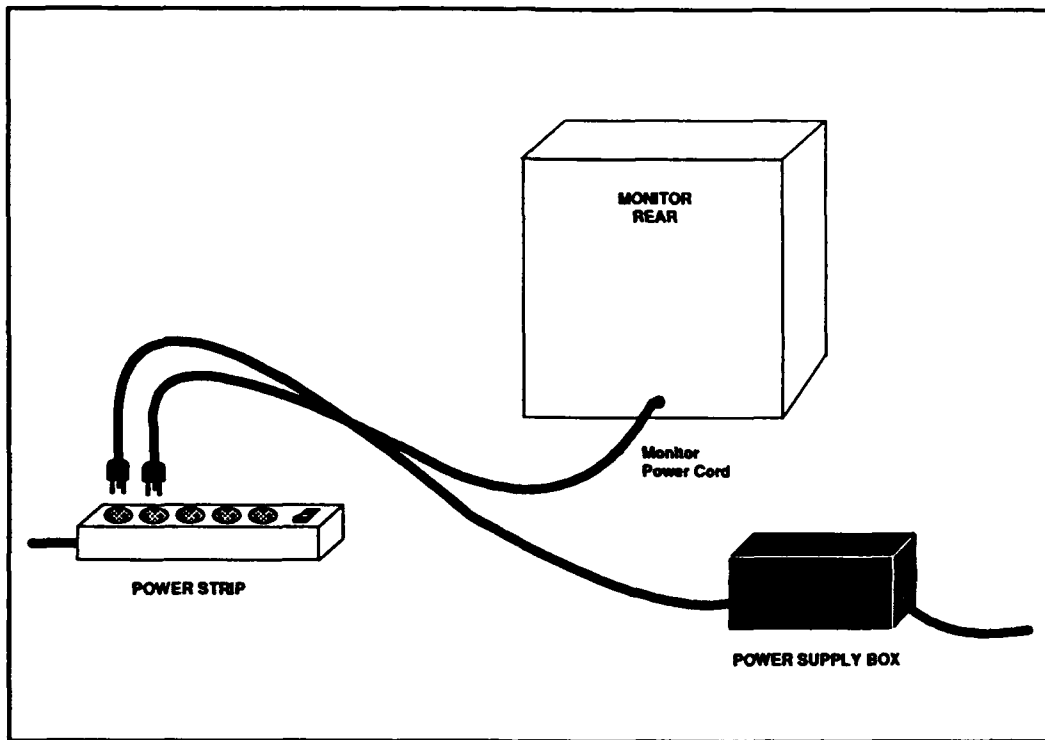
STEP 8 TURN ON THE SYSTEM

Turn **on** components of system in following order.

1. **Computer**: switch located on right side of keyboard
2. **Monitor**: switch located on bottom right front

Commodore (Model 1802)
- Adjust BRIGHT and TINT to halfway between maximum and minimum (detent).
- Adjust COLOR and CONTRAST to maximum.
- Adjust VOLUME to halfway.

Hitachi
- Adjust BRIGHT and CONTRAST to maximum (clockwise).
- Adjust VOLUME and COLOR to detent.
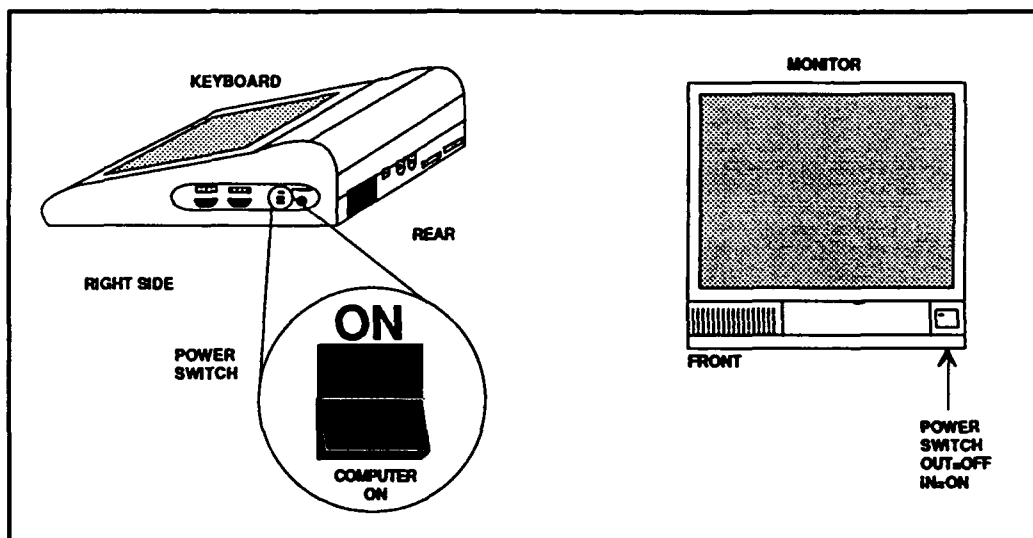
The MACS Welcome Screen should appear in color and with sound.

IF NOT REFER TO TROUBLESHOOTING TIPS IN SECTION 5.

WELCOME TO THE

M ultipurpose

A rcade

C ombat

S
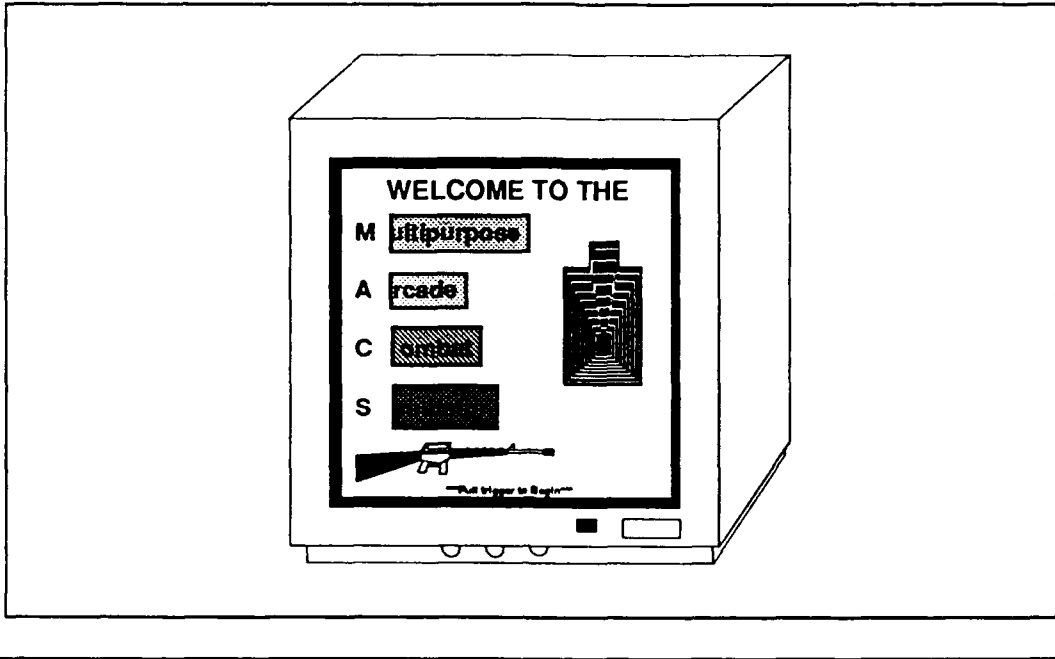
LIGHT PEN MOUNT ALIGNMENT

NOTE:

The MACS system light pen mount occasionally may need to be realigned. The only tool needed is an allen wrench (9/64" for demilitarized rifle or 7/64" for M16 replica rifle).

Older MACS systems have an adjustable focal ring on the light pen. An incorrect gap is the most frequent and easily corrected problem if the light pen is not reading the computer screen (detected by a purple border). On these systems, always check to ensure the gap between the focal ring and light pen barrel is approximately 5/8", before attempting to adjust the light pen mount.

Detailed instructions for adjusting the light pen mount are provided in section 2 of this guide.

LIGHT PEN MOUNT ALIGNMENT

NOTE:

BEFORE PROCEEDING WITH ALIGNMENT OF LIGHT PEN MOUNT
- **Place rifle 7'6" from screen.**
- **Turn on computer.**
- **The MACS Welcome Screen will appear.**

7'6"
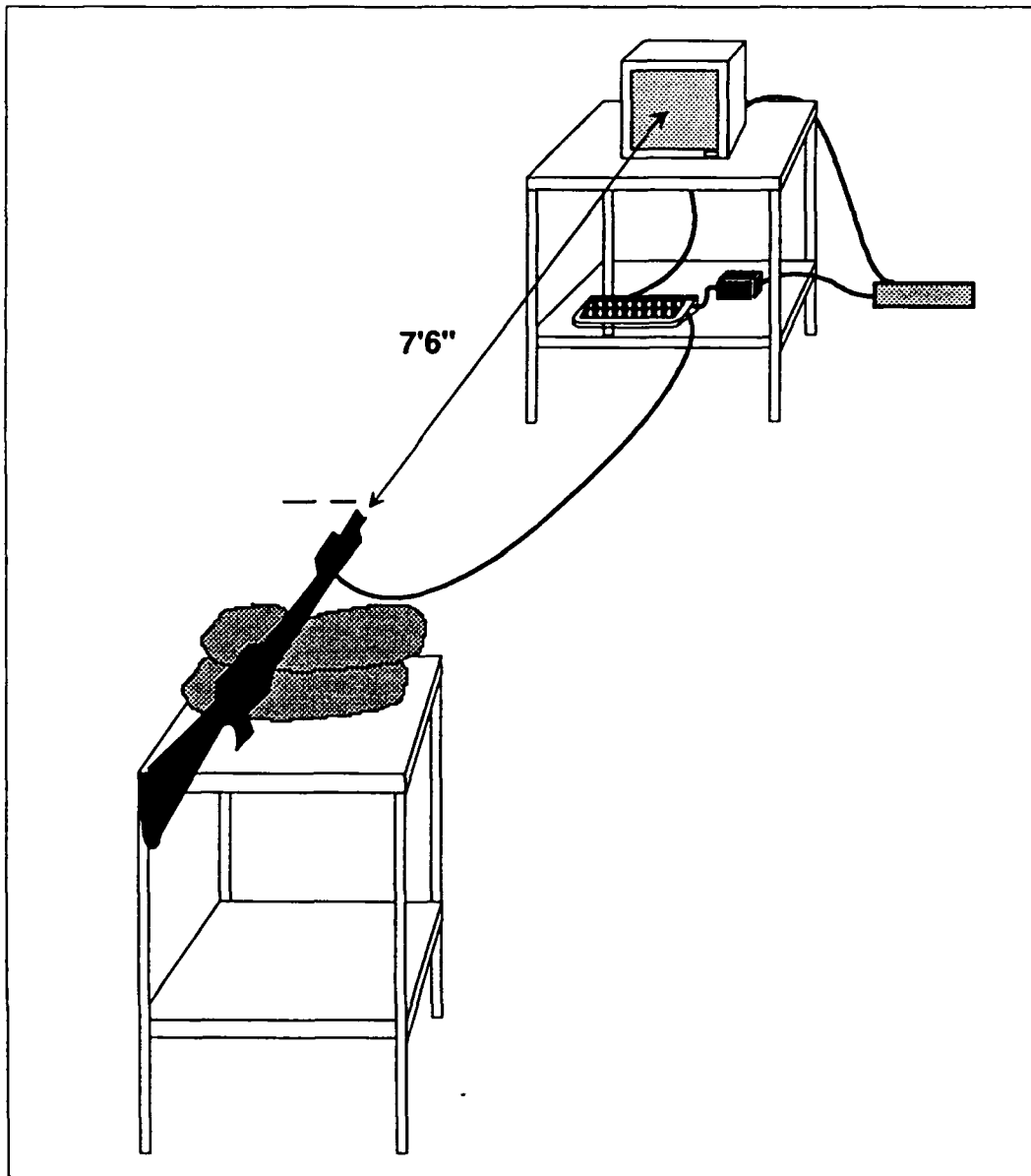
STEP 1 CHECK ALIGNMENT OF THE LIGHT PEN MOUNT

· Type LP at MACS welcome screen or;
· Press [RUN STOP] to enter MACS menu.

· Type letters **LP** then RETURN to start light pen mount alignment program.
· Aim at center of blue cross and pull trigger.
· **While holding rifle steady look over sight.**
    · If light pen mount alignment is correct, **O.K.** will appear on the screen
       and black dot will appear in rectangle.
· Go to **STEP 3.**

LIGHT PEN MOUNT ALIGNMENT
SCREEN FOR MACS SYSTEM

AIM AT BLUE CROSS
PULL TRIGGER WHEN READY
O.K.

BLUE CROSS

LIGHT PEN MOUNT
ALIGNMENT RECTANGLE
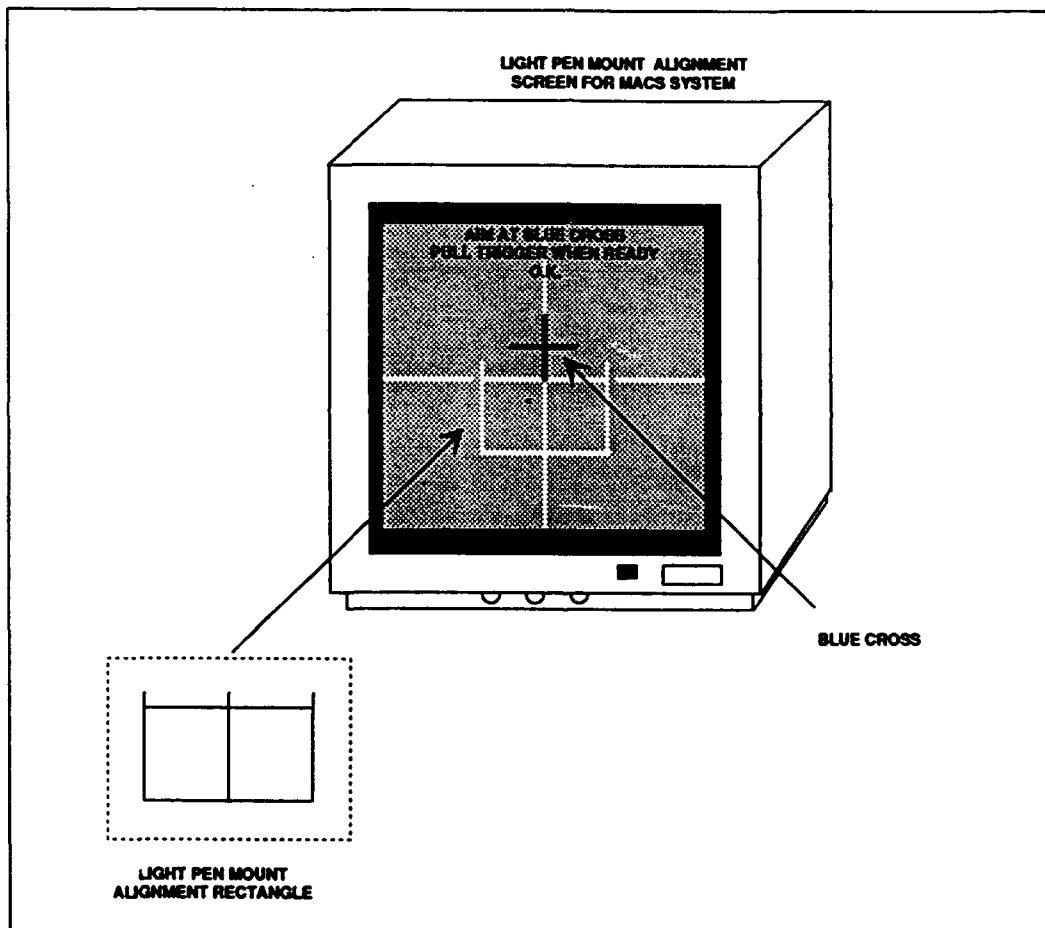
IF BLACK DOT IS NOT IN ALIGNMENT RECTANGLE AND O.K. DOES NOT APPEAR LIGHT PEN MOUNT NEEDS ADJUSTMENT. GO TO STEP 2.

LIGHT PEN MOUNT ALIGNMENT
SCREEN FOR MACS SYSTEM

AIM AT BLUE CROSS
PULL TRIGGER WHEN READY
RIGHT/DOWN
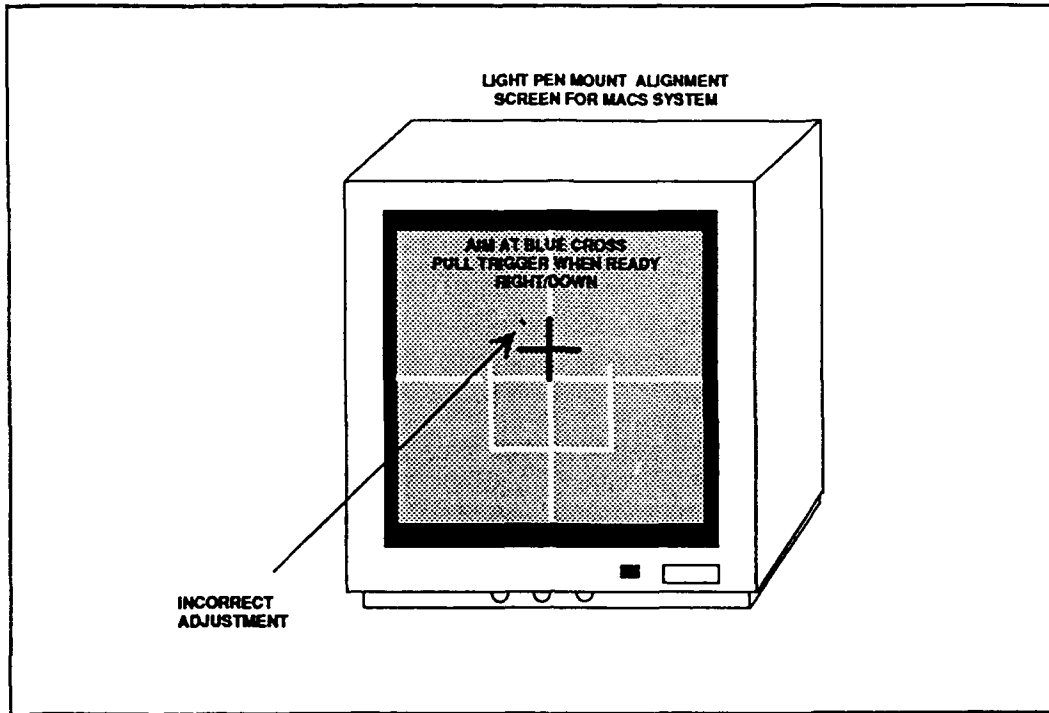
INCORRECT
ADJUSTMENT

LIGHT PEN MOUNT ADJUSTMENT IS REQUIRED ONLY IF THE BLACK DOT DOES NOT APPEAR WITHIN THE ALIGNMENT RECTANGLE WHEN RIFLE IS AIMED AT CENTER OF BLUE CROSS.

NOTE:

For light pen mount adjustment two people are recommended unless a vise is available to hold rifle securely.

- For light pens with adjustable focal rings:
  - Ensure gap between focal ring and light pen barrel is 5/8".
- Loosen screws on light pen mount.
  - 9/64" for demilitarized M16 rifle.
  - 7/64" for replica M16 rifle.
- Holding rifle securely, aim rifle at center of blue cross.
- Adjust light pen mount to move black dot into rectangle.
- When **O.K.** appears, tighten screws on light pen mount.
- If this does not work; see trouble shooting in section 5.
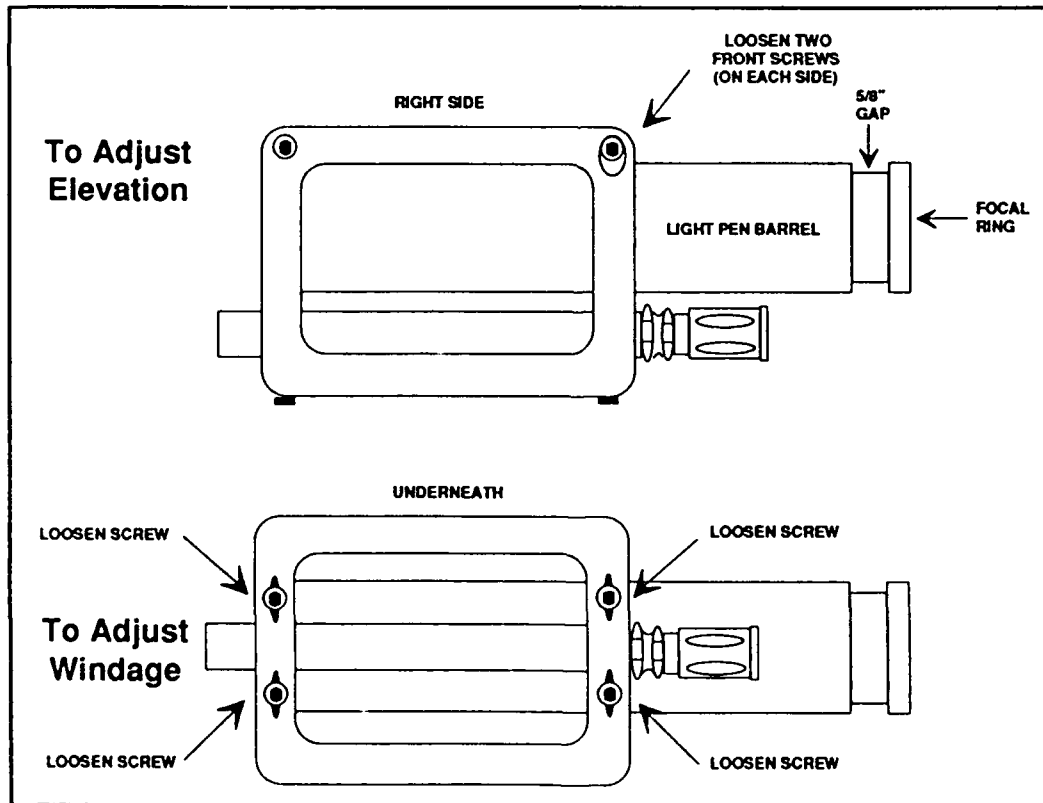
· Look over the rifle sights at the monitor screen.
· Aim rifle toward different points on screen.

AIM AT BLUE CROSS
PULL TRIGGER WHEN READY
RIGHT/DOWN

**BLACK DOT FOLLOWING
RIFLE LIGHT PEN MOVEMENT**

AIM AT BLUE CROSS
PULL TRIGGER WHEN READY
LEFT/DOWN

**BLACK DOT FOLLOWING
RIFLE LIGHT PEN**

AIM AT BLUE CROSS
PULL TRIGGER WHEN READY
RIGHT/DOWN

**BLACK DOT FOLLOWING
RIFLE LIGHT PEN MOVEMENT**
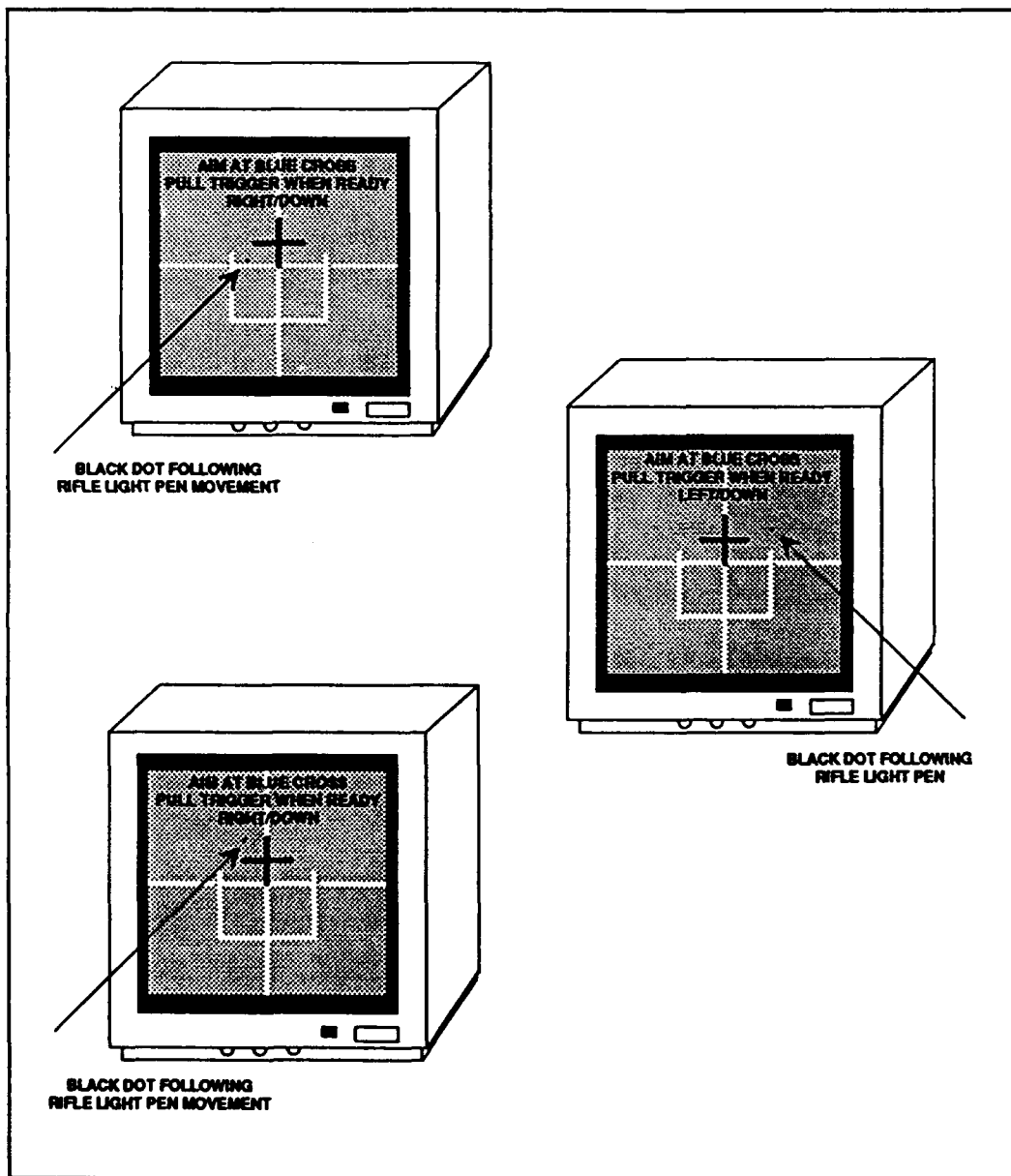
IF BLACK DOT SMOOTHLY FOLLOWS MOVEMENT OF RIFLE, LIGHT PEN MOUNT ALIGNMENT PROCEDURE IS COMPLETE!

LIGHT PEN MOUNT ALIGNMENT IS CORRECT WHEN:
· O.K. APPEARS ON SCREEN
· BLACK DOT APPEARS IN RECTANGLE

AIM AT BLUE CROSS
PULL TRIGGER WHEN READY
O.K.

CORRECT
ADJUSTMENT
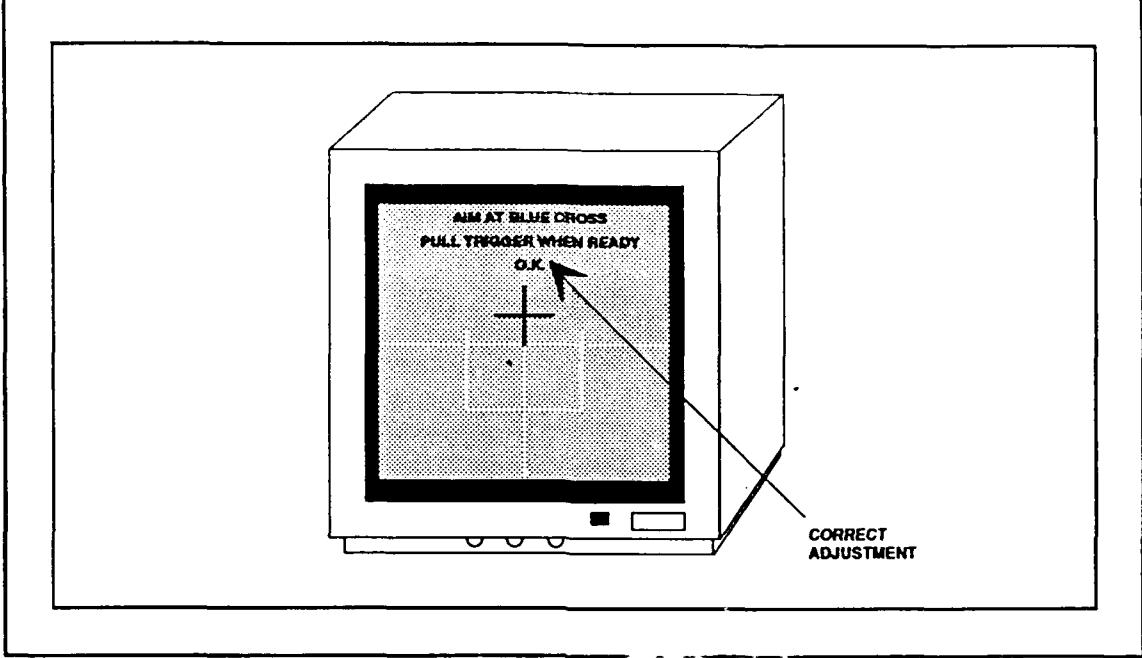
Pull trigger to return to MACS Welcome Screen

WELCOME TO THE

M ltipurpose

A rcade

C

S

THE BASIC RIFLE MARKSMANSHIP PROGRAM

OVERVIEW OF MACS SYSTEM AND BRM PROGRAM

MACS system is a low-cost, part-task weapons trainer that has been validated as a teaching device with entry-level soldiers. The system may be used for basic, preparatory, sustainment, and remedial training.

The MACS system has four parts:

1. **An M16 demilitarized or replica rifle with a light pen attached to the barrel;**
2. **A Commodore 64 computer;**
3. **A computer monitor; and**
4. **The BRM software cartridge designed for use with the M16 rifle.**

MACS allows soldiers to practice Basic Rifle Marksmanship (BRM) skills by firing at targets at scaled ranges displayed on a computer screen. Diagnostic feedback is provided on the screen.

The program written for the MACS system provides part-task training in BRM. A skill test is followed by a main program which has nine increasingly more difficult levels of training. Stationary targets at ranges between 50 and 300 meters are presented at varying time intervals depending on the level being practiced. Specific performance standards are se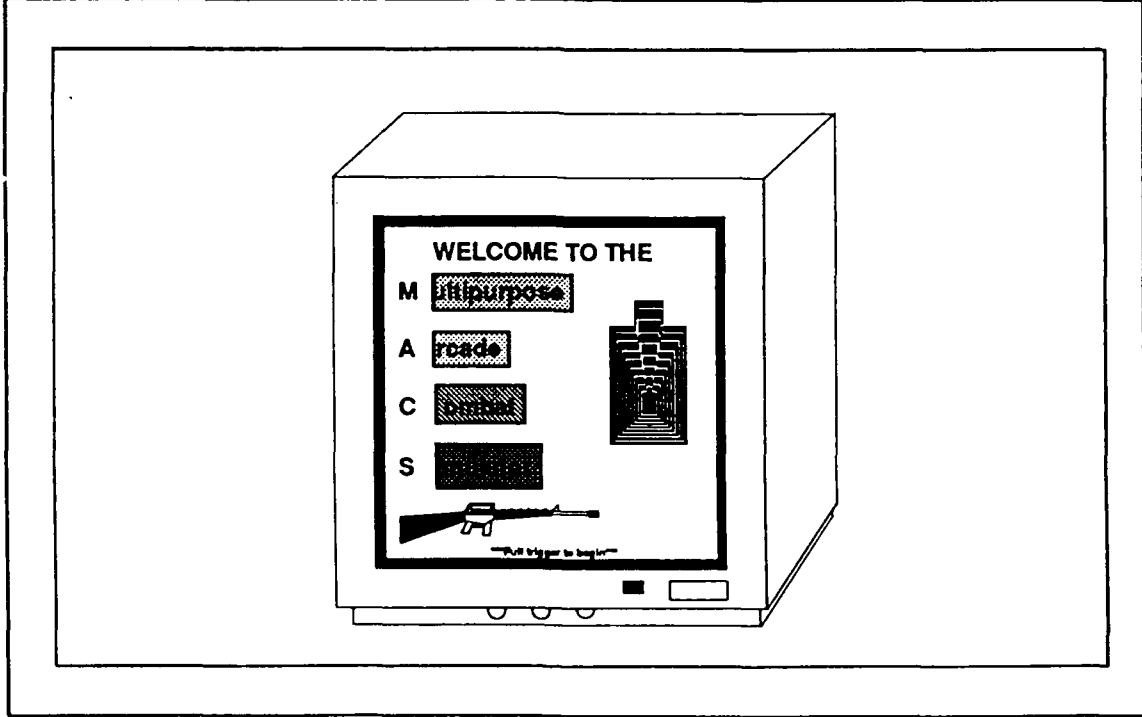t for each level, and are incorporated into the program. Upon completion of a level, the shooter's performance is evaluated against these standards.

Depending on performance the shooter may:

1. **Advance to the next level;**
2. **Stay at the same level; or**
3. **Be sent back one level.**

The MACS BRM program is specifically designed to help the average and below average shooter, and does this in two ways:

· **First, it provides the shooter with more feedback than can be obtained from live fire on a range.**

· **Second, because the rifle has no flash, recoil, or cartridge ejection system, it allows the shooter to develop the psycho-motor skills needed to achieve steady position, correct aiming, breath control, and control of the weapon at trigger closure, without having to overcome the instinct to flinch or blink when a weapon is fired.**

MACS provides additional flexibility, allowing the instructor to go directly to any level using the MENU. Other OPTIONS include introducing wind of different speeds and directions into any of the nine levels, and a "call your shot" routine. A list of options and menu instructions are found in section 4.

The MACS system software is largely self-explanatory, but assumes the presence of an instructor. It is designed to enable a sergeant to train a squad. On-screen diagnostic feedback is provided to the shooter, which helps the instructor in identifying problems, and recommending corrective action.

At the first four levels, shot-by-shot feedback is provided:

- Steady position
- Breath control
- Aiming
- Trigger squeeze
- Shot location
- Replay of sight picture

At all levels summary feedback is provided:

- Single target shot groups for each range.
- Average diagnostic scores or a summary of shots is presented at the end of each level.

The type of feedback provided at each level of difficulty is summarized beginning on page 3-17.

The MACS BRM program has incorporated features to enable a single instructor to monitor the progress of several soldiers at the same time (with multiple systems). Standards embedded in the program determine the shooter's progress from level to level.

The color of the screen border changes to draw the instructor's attention to any soldier having difficulty. The colors of the borders indicate the soldier's status:

- BLACK - Making satisfactory progress.
- RED - Refiring some targets at a particular range, or a part of a level.
- BLUE - Refiring an entire level.
- YELLOW - Has been sent back one level.
- PURPLE - Aiming off the screen, or light pen not reading.

Information on the soldier's progress is included in the upper left corner of the screen.

- L - Level being shot.
- T - Target being shot within a level.
- R - Number of refires within a level.

Before using the MACS system as a teaching device with soldiers, the instructor should read the MACS Trainer's Guide and shoot the entire program several times.

WELCOME TO THE

M █████████ ···—

A █████

C █████

S █████

Pull trigger to begin

MACS
BASIC RIFLE
MARKSMANSHIP
Training

4 fundamentals of
rifle marksmanship

· Steady Position
· Aiming
· Breath Control
· Trigger Squeeze

(Pull trigger to continue)
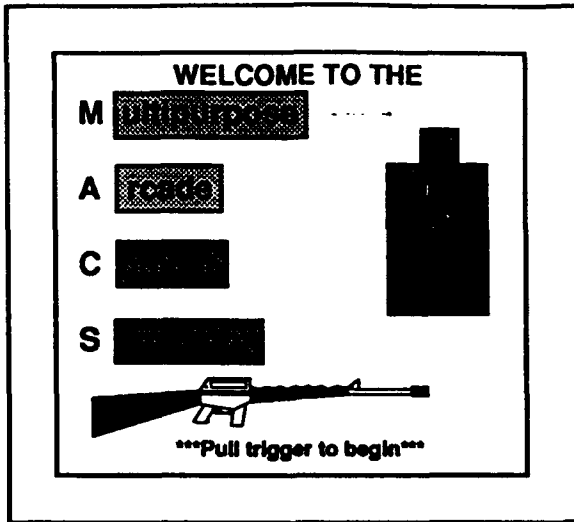
MACS WELCOME SCREEN

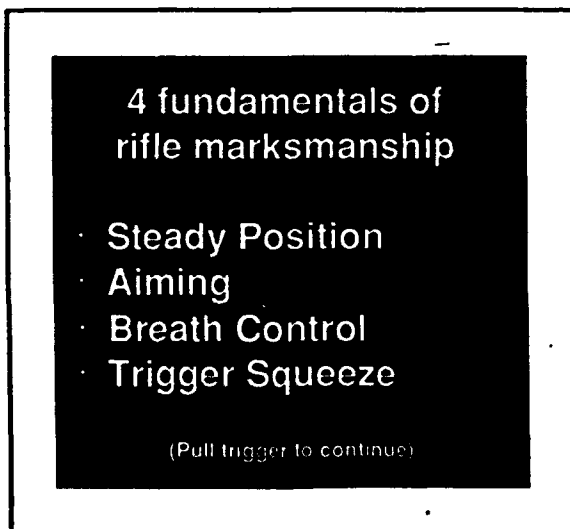· First screen of MACS BRM program.

· Adjust volume.

· Pull trigger to begin program.

or

Press [RUN STOP] key to access

MACS program menu (see section 4).
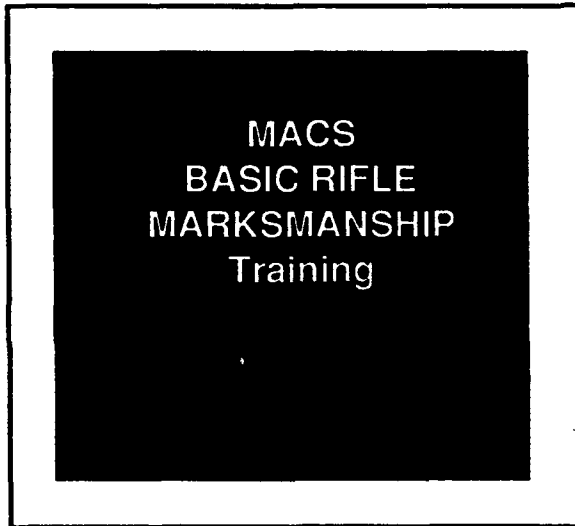
NOTE: [2] on keyboard will

substitute for trigger pull on screens not
showing targets.

First 3 shots
establish shot group.
Aim center of mass.

White dot shows
center.
(Pull trigger to continue)
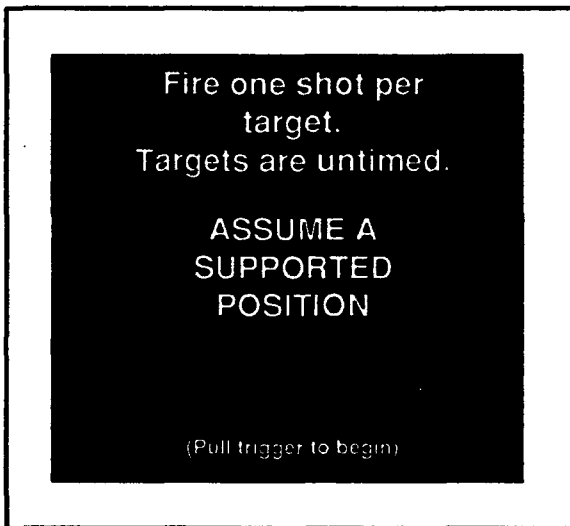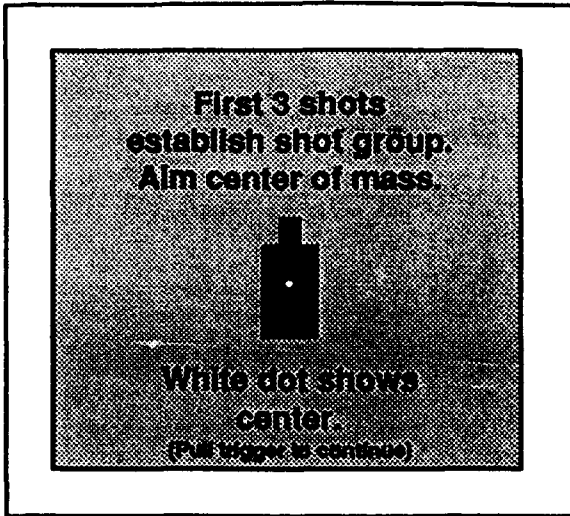
ESTABLISH SHOT GROUP

· It is important to get a good shot group.

· Targets are at 250 m.

NOTE: Adjustment of brightness or contrast after establishing shot group changes system calibration (firer must rezero).

Fire one shot per
target.
Targets are untimed.

ASSUME A
SUPPORTED
POSITION

(Pull trigger to begin)

SHOOTING INSTRUCTIONS

: The next three shots establish shot group.

NOTE: Pulling rifle trigger sends signal to computer to continue.
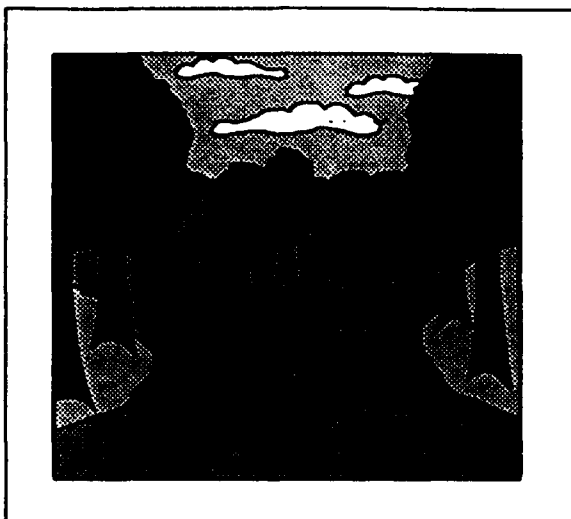
FIRE SHOT GROUP

- Soldier fires one shot at each of three targets.

NOTE: Purple border appears when light pen is not aimed at screen.
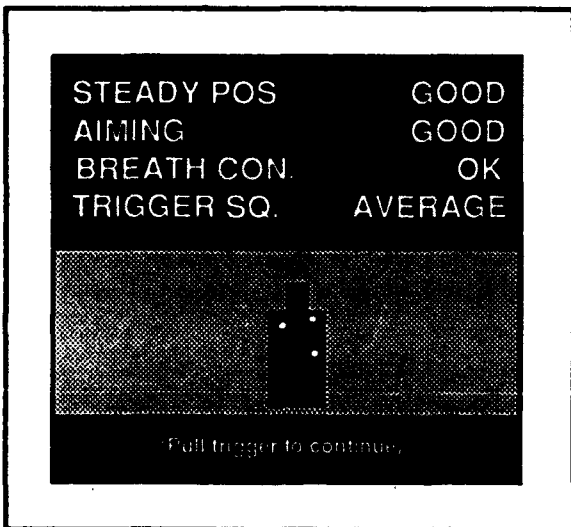
SHOT GROUP SUMMARY SCREEN

```
STEADY POS      GOOD
AIMING          GOOD
BREATH CON.       OK
TRIGGER SQ.   AVERAGE
```

Pull trigger to continue.

- Shot locations pictured on target.
- Feedback for three shots summarized.
- Good shot group calibrates system.

IF SHOT GROUP IS INVALID:

Invalid shot group

Try again

- An invalid shot group is one in which one or more shots hit outside a rectangular area (not seen by the shooter) which is the same size as the light pen mount alignment rectangle shown on the next page.

IF SECOND SHOT GROUP IS INVALID:
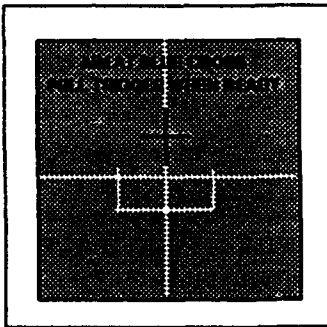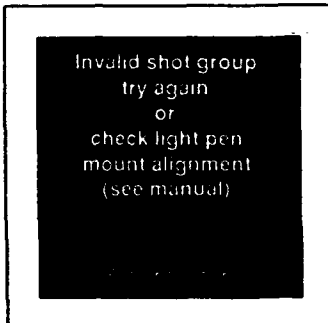
Invalid shot group
try again
or
check light pen
mount alignment
(see manual)

If second shot group is invalid:

· Press [RUN STOP] on Keyboard to start light pen mount alignment program.

NOTE: See section 2 for instructions on aligning the light pen mount.

· Follow directions for alignment.

· Following alignment the program will return to WELCOME TO MACS screen.

IF SHOT GROUP IS VALID:

SHOT GROUP   GOOD
Would you like to
try for a
tighter group?

Yes   No
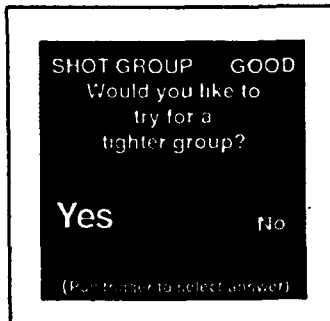
· Pull trigger when selected answer (YES or NO) is enlarged.

· If YES:
Refire shot group.

· If NO:
Initial skill test criteria determine starting level.

INITIAL SKILL TEST CRITERIA

To pass each skill test two GOOD ratings and two EXCELLENT ratings must be earned on measures of shot location, steady position, aiming, and trigger squeeze.

IF CRITERIA ARE NOT MET:

LEVEL
1

Introduction Supported
Position

(Push mouse to continue)
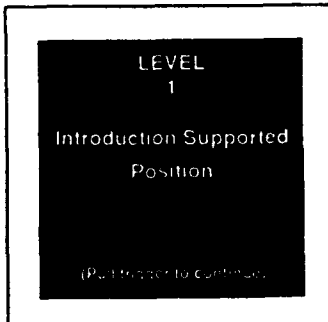
· Program starts at Level 1.
· See page 3-12.

IF CRITERIA ARE MET:

Next three shots help
decide start level.

ASSUME AN
UNSUPPORTED

POSITION

(Pull trigger to continue)

STEADY POS   GOOD
AIMING   GOOD
BREATH CON.   OK
TRIGGER SQ.   GOOD

(Pull trigger to continue)

- Skill test is continued.
- Soldier fires one shot as each of three targets is presented from an unsupported firing position.
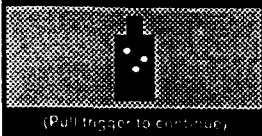
IF CRITERIA ARE NOT MET:

LEVEL
2

Introduction Unsupported
Position

- Program starts at Level 2.

IF CRITERIA ARE MET:

You have done well!
Now try
timed targets.

ASSUME A
SUPPORTED

POSITION

(Pull trigger to begin.)

- Skill test is continued.
- 3 shots fired at timed targets in supported position to determine starting level for better shooters.

- Timed targets at 100, 250, and 300 m are presented.

You will start at...

IF CRITERIA ARE NOT MET:

LEVEL
3

Timed Targets Supported
Position

(Pull trigger to continue.)

- Program starts at Level 3.

NOTE: If criteria are met, three shots are then fired from the unsupported position. Program can begin at Level 4 or Level 5 depending on results of this skill test.
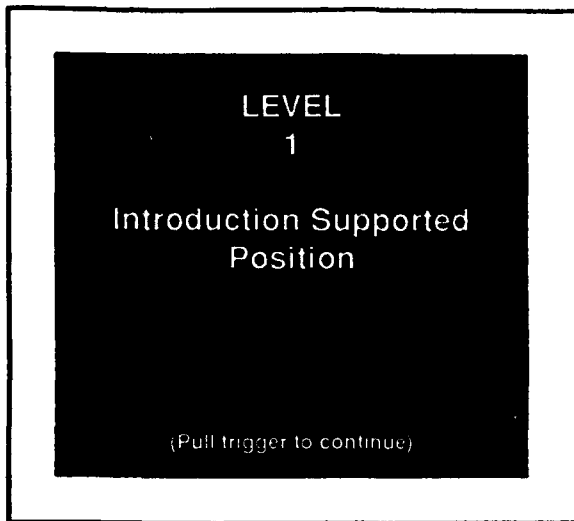
LEVEL 1

· First firing level in BRM program.
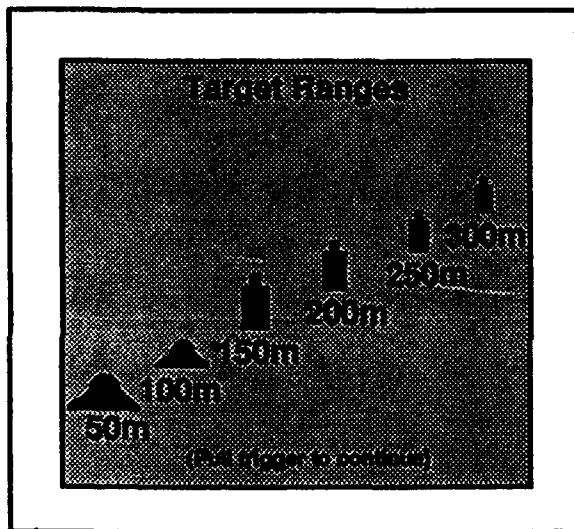
TARGET RANGES

· Targets at each range are illustrated.
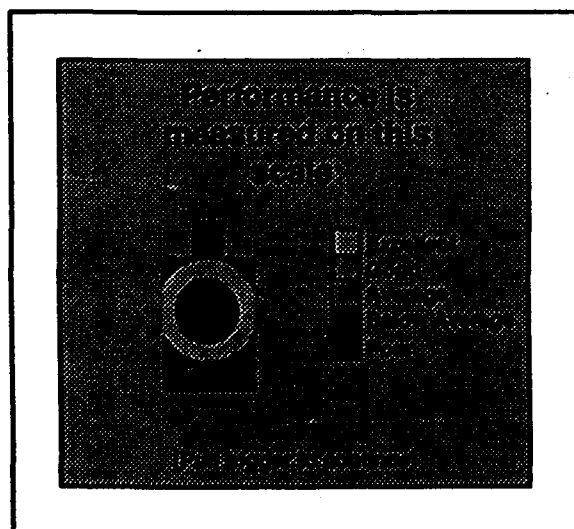
SHOT LOCATION STANDARDS

· The shooter must hit center of mass for shot location to be graded excellent.

Targets are untimed
Standard: Hit 2 of 3
at each distance

ASSUME A
SUPPORTED
POSITION

(Pull trigger to begin)

L=1 T=1 R=0

HIT
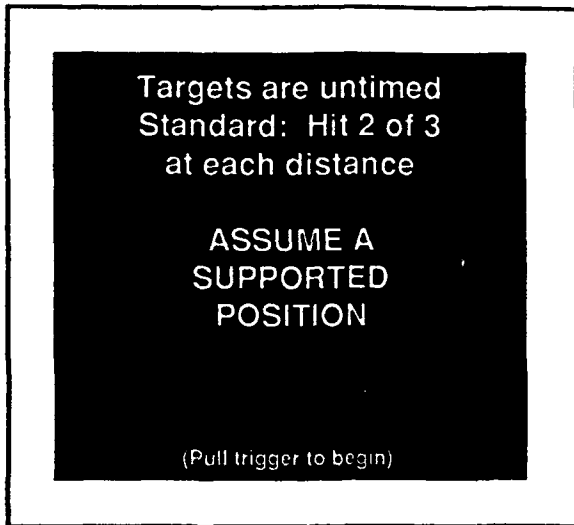
SHOOTING INSTRUCTIONS

· Untimed targets.
· Hit 2 of 3 at each distance.
· Supported position.
· First three targets are at 50 meters.
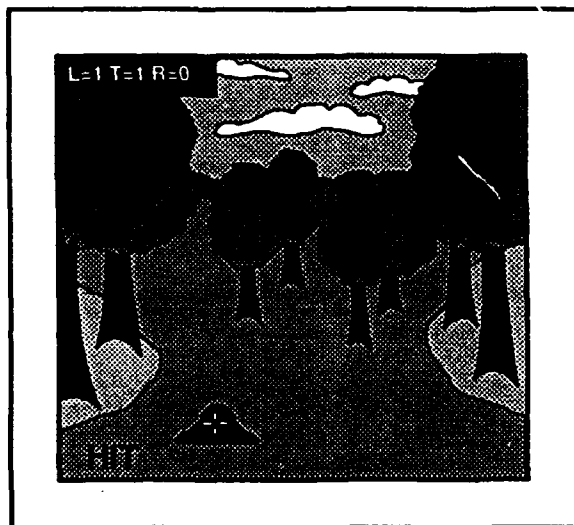
TARGET SCREENS

· Three target screens are presented.

· Feedback screens follow each target presentation.

$-\!\!\mid\!\!-$ indicates bullet strike.

· HIT or MISS appears in lower left corner of screen.

NOTE: In the upper left corner of the screen:
· L=Level being shot.
· T=Target being shot within a level.
· R=Number of refires within a level.

FEEDBACK SCREEN SEQUENCE

```
STEADY POS      GOOD
AIMING          GOOD
BREATH CON.       OK
TRIGGER SQ   AVERAGE

REPLAY
```

```
STEADY POS      GOOD
AIMING          GOOD
BREATH CON.       OK
TRIGGER SQ   AVERAGE
SHOT LOC     AVERAGE
```

```
STEADY POS      GOOD
AIMING          GOOD
BREATH CON        OK
TRIGGER SQ   AVERAGE
SHOT LOC     AVERAGE
```
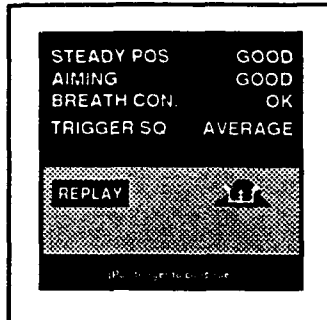
correct sight placement (black).

your sight placement (white).
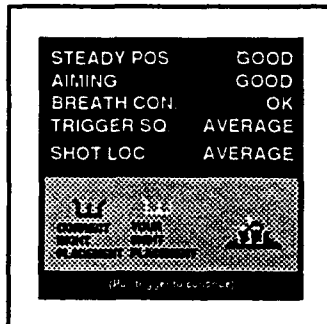
- Each shot is followed by a replay of the sight placement of the shooter compared to the correct sight placement, and bullet strike.
- Shooter's sight placement in moments before bullet strike (white) is superimposed over correct sight placement (black).
- The shot can be replayed as many times as necessary.
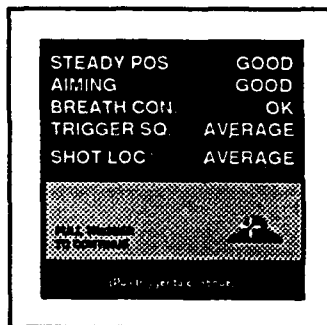
- PULL TRIGGER TO CONTINUE to next target screen.
- Bullet strike is displayed on target.
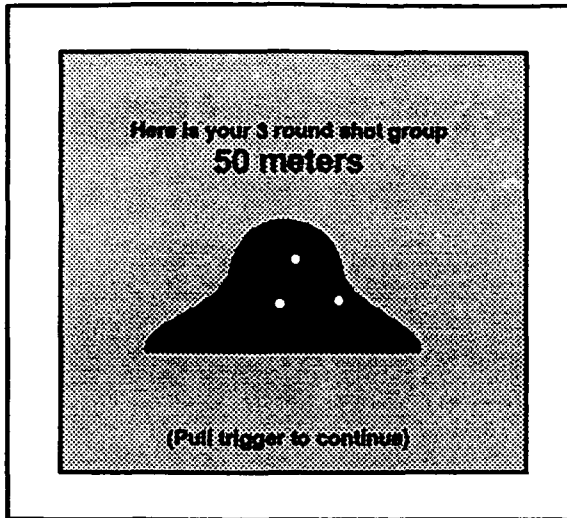
3 ROUND SHOT GROUP

- · Target and feedback screens repeated for 100, 150, 200, 250, and 300 m targets.
- · Shot group displayed on target at each range.
- · These screens can be analyzed as if shots were fired at a known distance (KD) range.
- · Must hit 2 of 3 targets to meet standard.

TRAINER'S TIP

Trainer should assist the soldier by performing a shot group analysis, & give corrective action.

For example, the soldier's shot group at 100m is centered horizontally, but is too high.
Corrective action: explain adjusted aiming point.

FAILURE TO MEET STANDARD
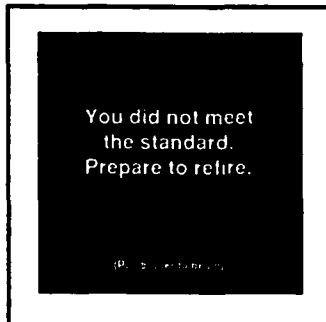
- · Repeats presentation of target and feedback screens for each of the 3 shots.
- · 3 round shot group is displayed for the range.

NOTE: Red border appears during refire of a range.
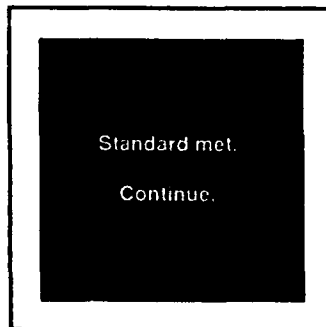
- · This screen appears following refire at a specified range.
- · Border color will return to black as program continues.

```
SUMMARY : LEVEL 1

Steady Pos          GOOD
Aiming           AVERAGE
BREATH CON            OK
Trigger Sq       AVERAGE
Shot Loc         AVERAGE




(Pull trigger to continue)
```

· If standard is met the shooter goes on to Level 2.

STANDARD FOR LEVEL 1 NOT MET

```
You are being sent back
     to Level 1
   because one of
your SUMMARY Scores
   was poor or below
      average.
```

```
4 fundamentals of
rifle marksmanship

  Steady Position
  Aiming
  Breath Control
  Trigger Squeeze

(Pull trigger to continue)
```

· Blue border will appear during refire of a level.

· Yellow border will appear if shooter has regressed from a higher level.

Summary Description of Levels

Level 1. Introduction to Supported Position

Summary description

- No time limit.
- Supported position.
- Single-target presentations.
- Eighteen targets presented, three targets at each of six ranges.
- Targets engaged in order of range: 50, 100, 150, 200, 250, and 300 m.

Feedback

- Words **HIT** or **MISS** appear on screen for each shot.
- Cross hair appears on screen to show bullet strike.
- Diagnostics and replay are shown after each shot.
- Screen shows 3 rounds on single target after each group of three shots.
- Summary screen at end of level shows average diagnostic scores.

Standards

- Two hits out of three shots at each range within level. Failure to meet standard at a given range results in immediate refire of 3 more targets at that range. Refires continue until standard is met.
- Refire of level is required if any score on summary screen is **BELOW AVERAGE** or **POOR.**
- Breath control is rated **OK** or **CHECK.** These ratings are tied to the steady position score.

Level 2. Introduction to Unsupported Position

Identical to Level 1, with these exceptions:

- It is fired in the unsupported position.

- Shooter is regressed a level if any 2 scores on summary screen are **POOR.**

Level 3. Timed Targets in Supported Position

Summary description

- Time limit approximately 1 1/3 times that of record fire.
- Supported position.
- Single target presentations.
- Twenty-four targets in random sequence (four presentations per range).

Feedback

- Cross hair appears on screen to show bullet strike.
- For a hit, target disappears immediately after bullet strike is shown.
- Diagnostics and replay are shown after bad shots only. Criteria for bad shot is a POOR for any score or a BELOW AVERAGE for shot location.
- Audible tone when target exposure time limit has expired.
- Summary screen at end of level showing average diagnostic scores.
- Summary screens showing four shots at each range on single targets.

Standards

- Three hits out of four shots at each range within level. For each range at which this standard is not met, a refire of four targets at each of those ranges is required. Refires continue until standard is met.
- Refire of level is required if any score on summary screen is BELOW AVERAGE or POOR.
- Shooter is regressed a level if any two scores on summary screen are POOR.

Level 4. Timed Targets in Unsupported Position

Identical to Level 3, with these exceptions:

- Level 4 is fired in the unsupported position.
- Standard is lower. Three hits out of four shots at 50, 100, 150, and 200 m, and two hits out of four shots at 250 m and 300 m.

Level 5. Practice Record Fire I

Summary description

- Time limit same as for record fire.
- Supported and unsupported positions.
- Single or double presentations.
- Targets presented in random sequence.
- 20 targets fired supported, then 20 fired unsupported.

Feedback

- Cross hair appears on screen to show bullet strike.
- For a hit, target disappears after bullet strike is shown.
- Audible tone when target exposure time limit has expired.
- OUT OF AMMO appears on screen when 20 shots have been fired.
- Interim summary of performance (hits, misses, and no fires) and shot location score given at end of each position and final summary at end of course of fire.
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position.
- Overall performance is graded Expert (36-40), Sharpshooter (30-35), Marksman (23-29), or Unqualified (0-22).

Standards

- Fifteen hits out of 20 shots in both supported and unsupported positions. Refire of position if standard not met.
- On double target exposures, a penalty is recorded if furthest target is engaged first (a penalty indicates a tactical error, but does not reduce the total number of hits).
- Regress one level for shot location score of POOR. Stay at same level for mean shot location score of BELOW AVERAGE. Otherwise pass.

Level 6. Practice Record Fire II

Identical to Level 5, with the exception that the cross hair showing bullet strike appears only after misses. Target disappears when hit.

Level 7. Record Fire

Summary description

- Time limit same as actual live-fire qualification course.
- Supported and unsupported positions.
- Single or double presentations.
- Targets presented in random sequence.
- 20 targets fired supported, then 20 fired unsupported.

Feedback

- Targets disappear when hit.
- OUT OF AMMO appears on screen when 20 shots have been fired.
- Audible tone when target exposure time limit has expired.
- Cross hairs showing bullet strike for misses on refires only.
- Interim summary of performance (hits, misses, and no fires) and shot location score given at end of each position and final summary at end of course of fire.
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position.
- Overall performance is graded Expert (36-40), Sharpshooter (30-35), Marksman (23-29), or Unqualified (0-22).

Standards

- Fifteen hits out of 20 shots in both supported and unsupported positions. Refire of position if standard not met.
- On double target exposures, a penalty is recorded if furthest target is engaged first.
- Regress one level for average shot location score of POOR. Stay at same level for mean shot location score of BELOW AVERAGE. Otherwise pass.

Level 8. Rapid Record Fire

Identical with Level 7, except that the exposure times of targets are 2/3 of those used in record fire.

Level 9. Combat Fire

Summary description

- Time limits variable, dependent on number of targets presented.
- Supported and unsupported positions..
- Single, double, and multiple presentations.
- Eighty targets in two attack/retreat scenarios each of 40 targets. First scenario is fired supported and second unsupported.

Feedback

- Targets disappear when hit.
- **OUT OF AMMO** appears on screen when 40 shots have been fired.
- Cross hairs showing bullet strike for misses on refires only.
- Summary of shot location (hits, misses, and no fires) given at end of supported position and at end of unsupported position.
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position.
- Performance graded as Expert (36-40), Sharpshooter (30-35), Marksman (23-29), or Unqualified (0-22).

Standard

- Twenty-three hits out of 40 shots in both supported and unsupported positions. Refire of position if standard not met.

A	B	C	D	E	F	G
H	I	J	K	L	M	N
O	P	Q	R	S	T	U
V	W	X	Y	Z		

Enter your
initials

- At the end of Level 9, combat fire, high scorers may enter initials for display on high score screen. The high score screen will alternate with the MACS welcome screen until computer is turned off.

Level 9 High Scores

1. JMB   2. WWG
3. MAC   4. ARI
5. LCS   6. WWG
7. JMB   8. JWP
9. RFM   10. EWW

- Alternates with MACS welcome screen
- Activated after shooter fires high score on Level 9.

CONGRATULATIONS

You are finished
with this program.
Call instructor.

NOTE:

The following charts provide a summary of the MACS BRM Cartridge.

MACS FEEDBACK FOR BRM CARTRIDGE

	SHOT-BY-SHOT DIAGNOSTIC FEEDBACK			ON-SCREEN FEEDBACK DURING SHOOTING						SUMMARY FOLLOWING SHOOTING SEQUENCE	
LEVEL											
1	X		X		X			X			
2	X		X		X			X			
3		X	X	X	X			X			
4		X	X	X	X			X			
5			X	X	X	X	X	X		X	X
6			X*	X	X	X	X	X	X	X	X
7			X**	X	X	X	X	X	X	X	X
8			X**	X	X	X	X	X	X	X	X
9			X**	X	X	X	X		X		X

*FOR MISSES ONLY
**FOR MISSES ON REFIRES ONLY

MACS BRM CARTRIDGE

LEVEL	TITLE	TIME LIMIT	POSITION	TARGET PRESENTATION	TARGET SEQUENCE	NUMBER OF TARGETS	STANDARDS
1	INTRODUCTION TO SUPPORTED POSITION	NONE	SUPPORTED	SINGLE	IN ORDER 50-100-150-200-250-300	18 (3 PER RANGE)	HIT 2 OF 3 TARGETS AT EACH DISTANCE
2	INTRODUCTION TO UNSUPPORTED POSITION	NONE	UNSUPPORTED	SINGLE	IN ORDER 50-100-150-200-250-300	18 (3 PER RANGE)	HIT 2 OF 3 TARGETS AT EACH DISTANCE
3	TIMED TARGETS IN SUPPORTED POSITION	1 1/3 TIMES GREATER THAN TIME ALLOWED FOR RECORD FIRE	SUPPORTED	SINGLE	RANDOM	24 (4 PER RANGE)	HIT 3 OF 4 TARGETS AT EACH DISTANCE
4	TIMED TARGETS IN UNSUPPORTED POSITION	1 1/3 TIMES GREATER THAN TIME ALLOWED FOR RECORD FIRE	UNSUPPORTED	SINGLE	RANDOM	24 (4 PER RANGE)	HIT 3 OF 4 TARGETS AT 50-100-150-200 HIT 2 OF 4 TARGETS AT 250-300
5	PRACTICE RECORD FIRE I	SAME AS RECORD FIRE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
6	PRACTICE RECORD FIRE II	SAME AS RECORD FIRE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
7	RECORD FIRE	SAME AS ACTUAL LIVE-FIRE QUALIFICATION COURSE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
8	RAPID RECORD FIRE	1/3 LESS THAN TIME ALLOWED FOR RECORD FIRE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
9	COMBAT FIRE	VARIES	SUPPORTED/ UNSUPPORTED	MULTIPLE	ATTACK/ RETREAT	80	HIT 23 OF 40 TARGETS IN EACH POSITION

DESCRIPTION OF THE MACS MENU

DESCRIPTION OF THE MACS MENU

The MACS Menu provides flexibility for the instructor using the MACS program.

To access the MACS program menu, press the [RUN STOP] key:

- · At the Welcome to MACS screen.
- · At any Level screen.
- · Repeatedly during a level when a target is on the screen.

DESCRIPTION OF THE MACS MENU

Instructions for using the MACS menu options are on the pages listed below.

```
Start Level:  1
Final Level:  9
Wind Speed: 0 mph


 1:  Introduction Supported Position
 2:  Introduction Unsupported Position
 3:  Timed Targets Supported Position
 4:  Timed Targets Unsupported Position
 5:  Practice Record Fire I
 6:  Practice Record Fire II
 7:  Record Fire
 8:  Rapid Record Fire
 9:  Combat Fire
                                                     Page
 L:  Select Start Final Level   ............................................. 4-4
 N:  New Firer  ...................................................................... 4-4
 W:  Set Wind Speed  .......................................................... 4-6
 CS:  Turn on "Call your shot" option  ............................... 4-5
 LP:  Light pen mount adjustment  ........................................ 2-1
 SG:  Sight and grouping program  .......................................... 4-8
 EZ:  Set Level 1 targets for 250 meters  ............................ 4-4
  G:  Go to start  ................................................................... 4-4


 Select number or letter & press RETURN
 ? __
```

LEVEL OPTION

· Permits instructor to set levels before students arrive.

Choose level option	⟶	Select letter & press RETURN ? L
Enter starting level	⟶	Select number & press RETURN Start level (1-9)? 4
Enter final level	⟶	Select number & press RETURN Final level (4-9)? 9
Begin program	⟶	Select letter & press RETURN ? G

NEW FIRER OPTION

· Program returns to Establish Shot Group screen.
· Used when one firer has completed firing and a new firer takes over.

⟶ Select letter & press RETURN
? N

EZ OPTION

· Sets all targets in Level 1 to 250m.

⟶ Select letter & press RETURN
? EZ

G OPTION

· Returns user to starting or previous level.
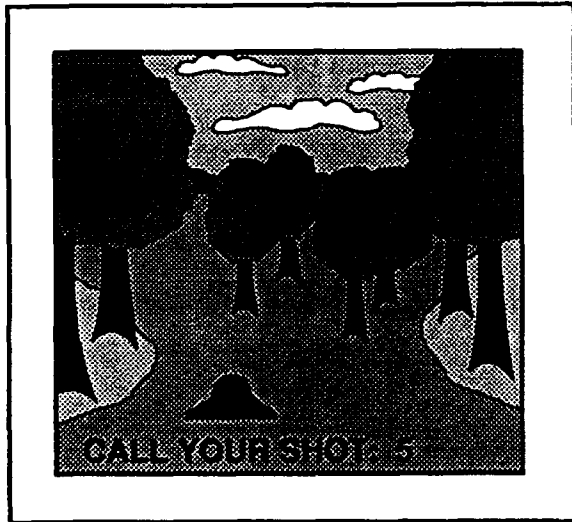
⟶ Select letter & press RETURN
?G

```
Start Level  1
Final Level  9
Wind Speed  0 mph

1  Introduction Supported Position
2  Introduction Unsupported Position
3  Timed Targets Supported Position
4  Timed Targets Unsupported Position
5  Practice Record Fire I
6  Practice Record Fire II
7  Record Fire
8  Rapid Record Fire
9  Combat Fire

L  Select Start Final Level
N  New Firer
W  Set Wind Speed
CS  Turn on Call your shot option
LP  Light pen mount adjustment
SG  Sight and grouping program
E2  Set Level 1 targets for 200 meters
G  Go to start

Select number or letter & press RETURN
? CS
```

USING THE CALL YOUR SHOT OPTION

Enter: [C] [S]

NOTE: The "Call Your Shot" option works with Levels 1 and 2 only.
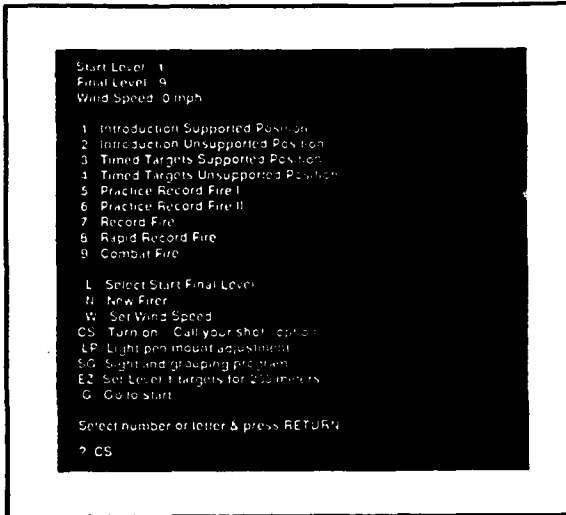
CALL YOUR SHOT

· Firer has 5 seconds to call out shot location after the trigger is pulled.
· CALL YOUR SHOT appears on the bottom of the screen.

· When time expires crosshairs appear on target showing shot location.

```
Start Level  1
Final Level  9
Wind Speed  0 mph

1   Introduction Supported Position
2   Introduction Unsupported Position
3   Timed Targets Supported Position
4   Timed Targets Unsupported Position
5   Practice Record Fire I
6   Practice Record Fire II
7   Record Fire
8   Rapid Record Fire
9   Combat Fire

L   Select Start Final Level
N   New Firer
W   Set Wind Speed
CS  Turn on  Call your shot  option
LP  Light pen mount adjustment
SG  Sight and grouping program
E2  Set Level 3 targets for 250 meters
G   Go to start

Select number or letter & press RETURN

? W
```

· Enter [W] to select wind.

WIND EFFECTS

```
Wind Effects:

Type a number (1-3) for wind speed:
1.:  0 MPH
2:  10 MPH
3:  20 MPH

? 2
```

· Enter [1] [2] or [3]

to select wind speed.

NOTE: There is no wind effect at 0 mph.

WIND DIRECTION

```
Wind Effects:

Type a number (1-8) for  wind direction:

1:   ↑    (No value)

2:   ↗    (Half value)

3:   →    (Full value)

4:   ↘    (Half value)

5:   ↓    (No value)

6:   ↙    (Half value)

7:   ←    (Full value)

8:   ↖    (Half value)

? 3
```
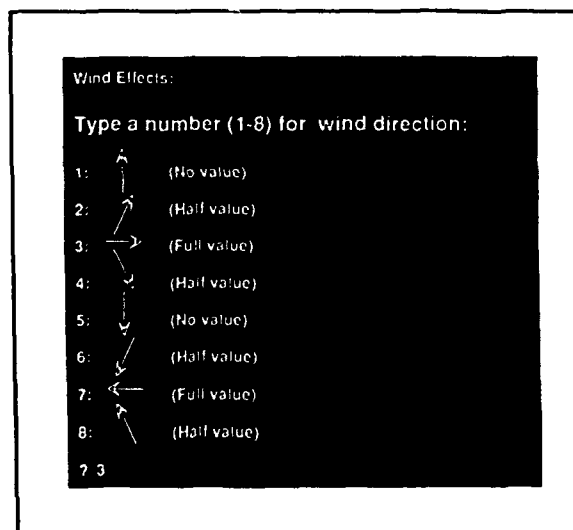
· Enter [1] to [8]

to select wind direction.

↑	1: Directly behind shooter
↗	2: Behind shooter from left to right
→	3: Directly from left to right
↘	4: Toward shooter from left to right
↓	5: Directly at shooter
↙	6: Toward shooter from right to left
←	7: Directly from right to left
↖	8: Behind shooter from right to left
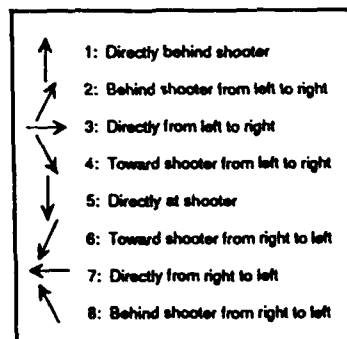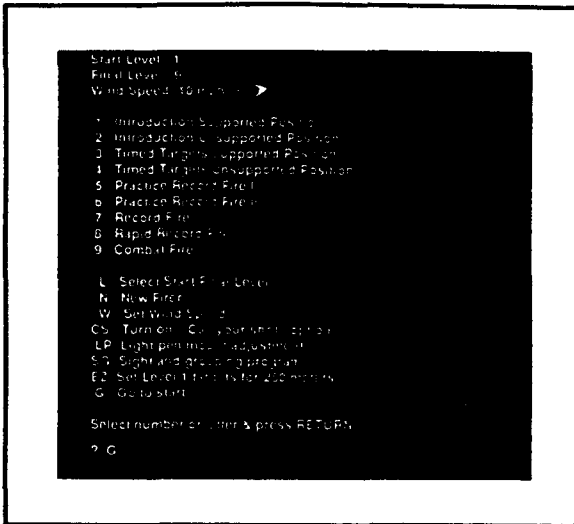
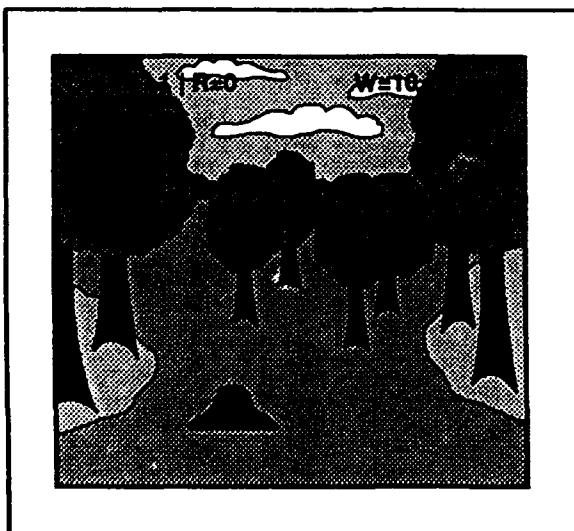- Now return to skill level.

- Enter [G] to return to skill level.

- Title screen for selected level will appear next.
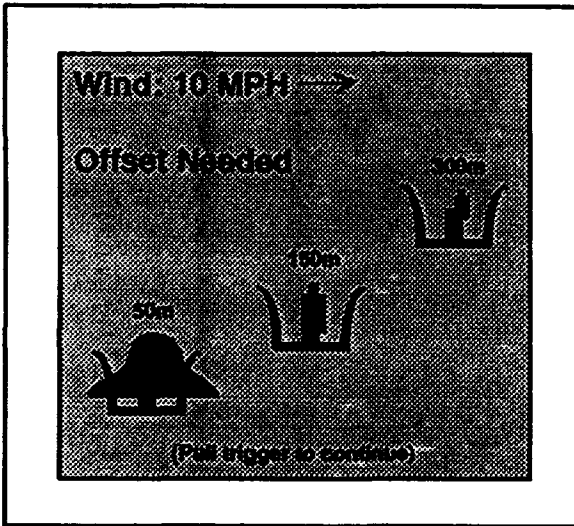
WIND

- The correct offset is illustrated for targets at three distances.
- The offset changes with each wind effect.

NOTE: Wind speed and direction will remain in effect unless program is restarted, or new wind speed and direction are entered using the menu.

TARGET SCREEN

- Wind speed and direction are shown in upper right-hand corner of screen.

MACS
Basics of
Aiming

(Pull TRIGGER to begin)

Correct Application
of Sight Alignment
and Aiming Improves
Marksmanship Skills

(Pull TRIGGER to continue)

MACS
Sight Alignment
and
Aiming
Program

(Pull TRIGGER to continue)

· The sight and grouping program is designed to teach and test the basic skills of sight alignment, aiming, and shot grouping to the novice marksman.
· The sight and grouping program has three parts:
     1. Sight alignment program.
     2. Aiming program.
     3. Grouping program.

(Pull TRIGGER to continue)
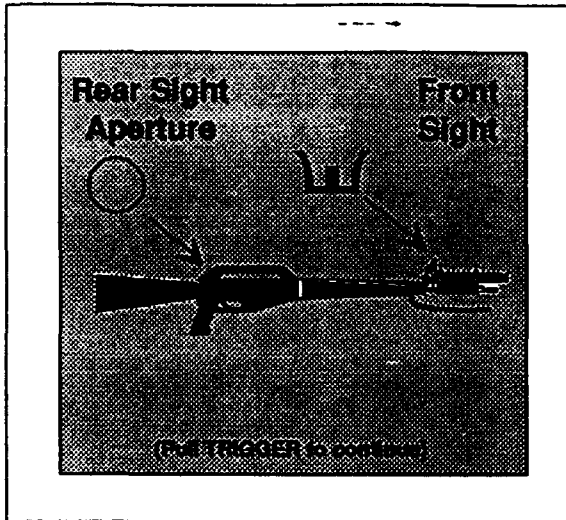
LOCATION OF SIGHTS

· Front sight.
· Rear sight aperture.

(Pull TRIGGER to continue)
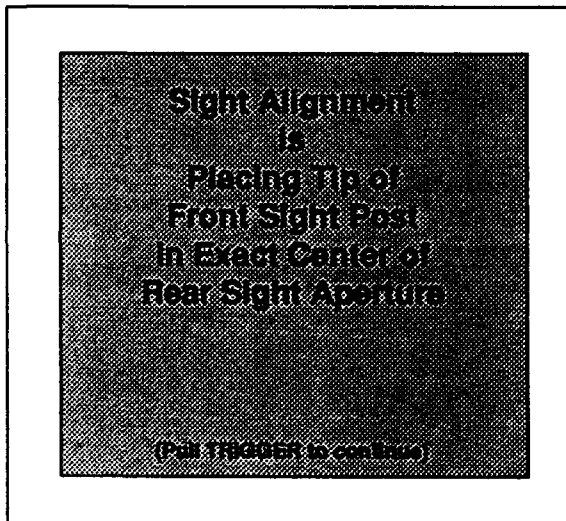
DEFINITION OF SIGHT ALIGNMENT

DEMONSTRATION OF SIGHT ALIGNMENT
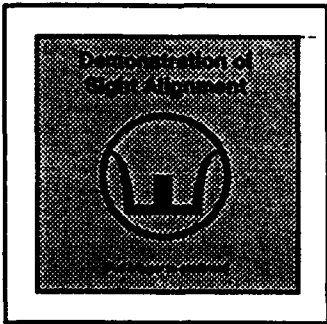
SIGHT ALIGNMENT

Part 1:
· Tip of front sight post
is placed in center of rear sight aperture.
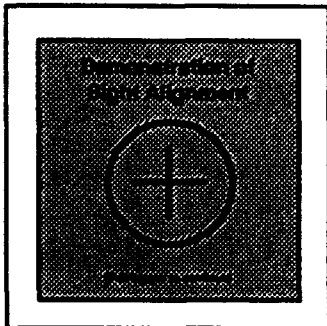
Part 2:
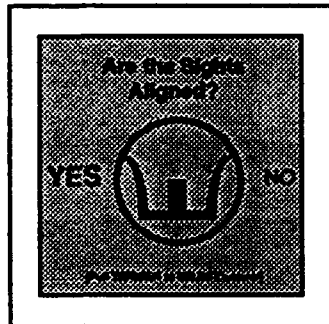· Center of rear sight aperture is designated by red cross.
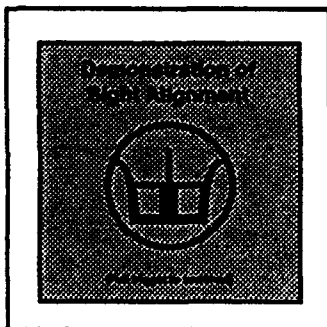
Part 3:
· Complete demonstration screen.
· Sequence returns to Part 1 unless trigger is pulled.

SIGHT ALIGNMENT TEST
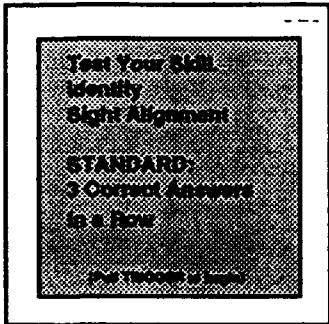
TEST INFORMATION SCREEN

- Tests ability to identify correct sight alignment.
- Must correctly identify three sight pictures in a row to pass test.

TEST SCREEN

- Front and rear sights pictured.
- YES and NO alternately appear in large (boldface) type.
- Select answer by pulling trigger when choice appears in large (boldface) type.
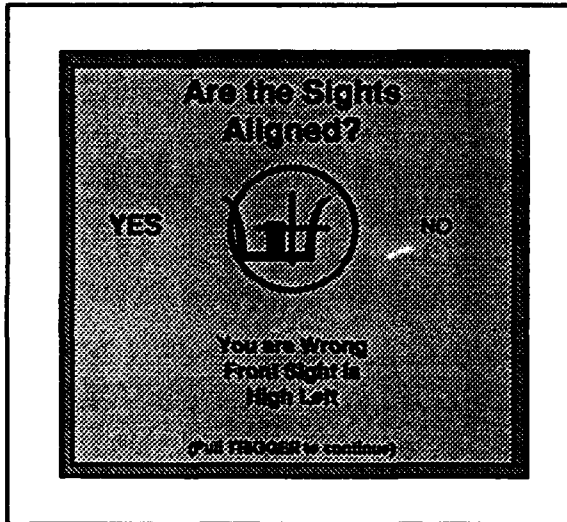
SIGHT ALIGNMENT TEST FEEDBACK SCREENS

INCORRECT RESPONSE FEEDBACK

- · Red border appears.
- · Red cross designates correct placement of front sight in rear aperture.
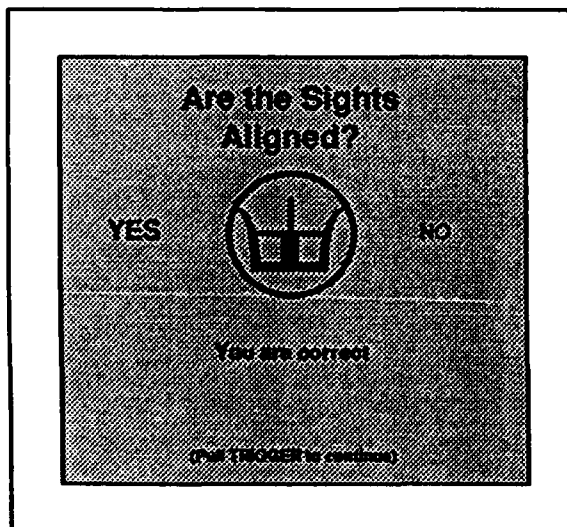- · Error is described.
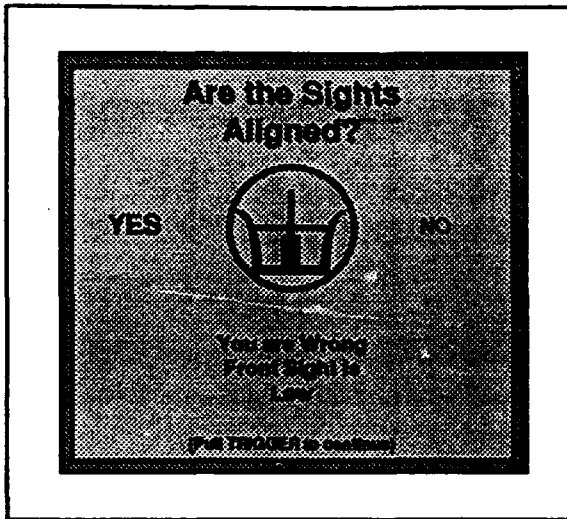
EXAMPLE

- · Red border appears.
- · Red cross designates correct placement of front sight in rear aperture.
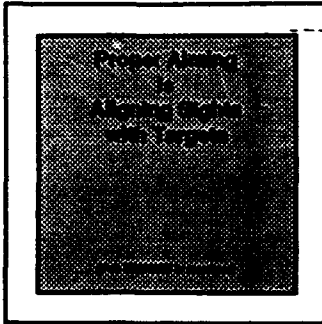- · Error is described.

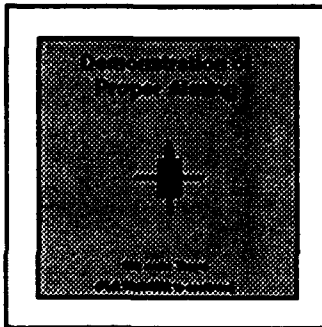### CORRECT RESPONSE FEEDBACK

· You are correct.

AIMING PROGRAM

Definition

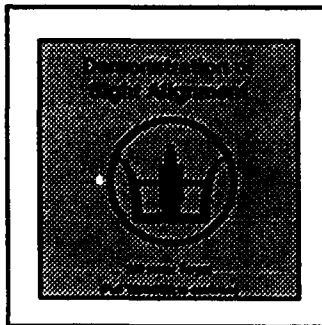· Proper aiming is aligning sights with target.
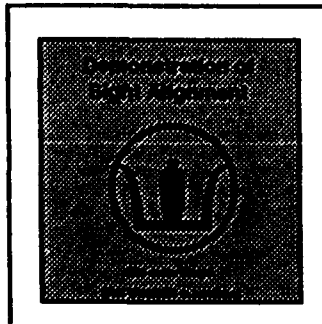
DEMONSTRATION OF AIMING

EXPLANATION

Part 1:
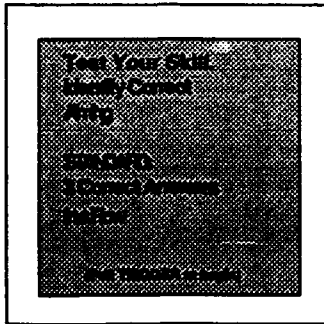· Cross hairs designate center of mass of target.

Part 2:
· Correct sight alignment is placed at center of mass.

Part 3:
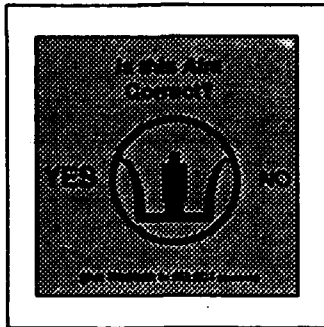· Cross hairs are removed.
· Correct sight alignment shown at center of mass.
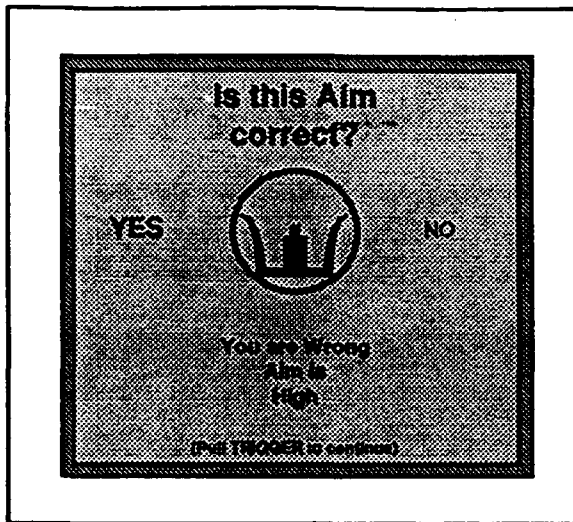· Sequence returns to Part 1 unless trigger is pulled.

AIMING SKILL TEST

· Tests ability to identify correct sight picture.
· Must correctly identify three sight
  pictures in a row to pass test.

TEST SCREEN

· YES and NO alternately appear in large (boldface)
  type.
· Select answer by pulling trigger when choice appears
  in large (boldface) type.

AIMING TEST
FEEDBACK SCREENS

INCORRECT RESPONSE
FEEDBACK

- Red border appears.
- Red cross designates center of mass of the target.
- Error is described.

CORRECT RESPONSE
FEEDBACK

- You are correct.

AFTER THREE CORRECT
RESPONSES IN A ROW:

- Next set of screens test ability to identify correct sight alignment and sight picture.

ADVANCED AIMING TEST

ADVANCED AIMING SKILL TEST

· Tests ability to identify correct sight alignment and sight picture.
· YES and NO alternately appear in large (boldface) type.
· Select answer by pulling trigger when choice appears in large (boldface) type.
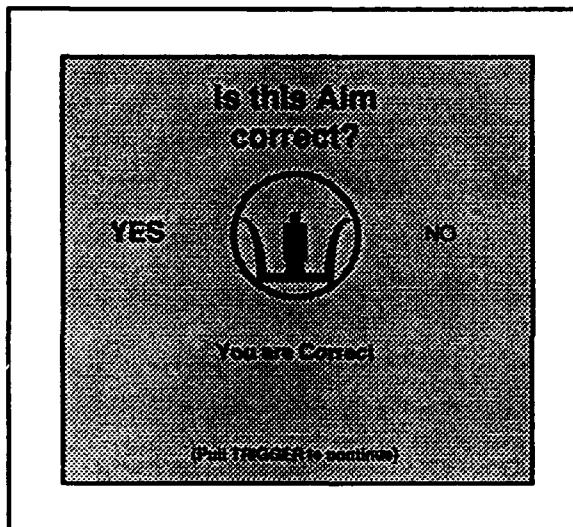· Must correctly identify three in a row to exit test.
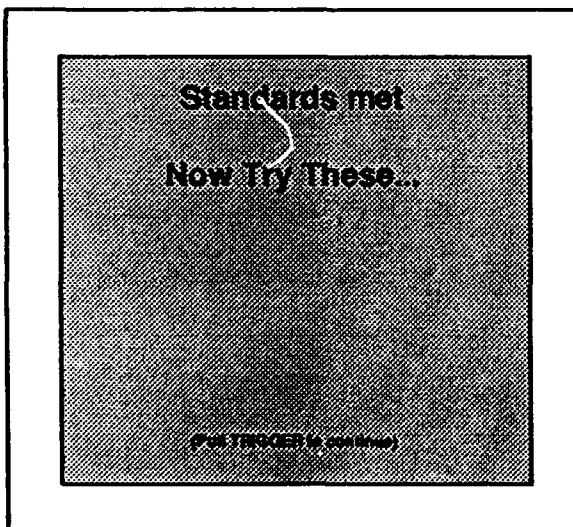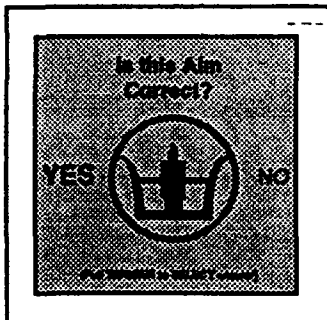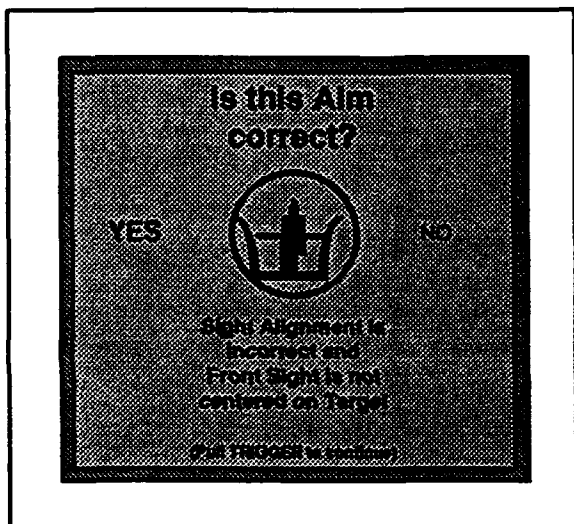
ADVANCED AIMING TEST FEEDBACK SCREENS

INCORRECT RESPONSE FEEDBACK

· Red border appears.
· Red cross designates center of mass of the target.
· Error is described.
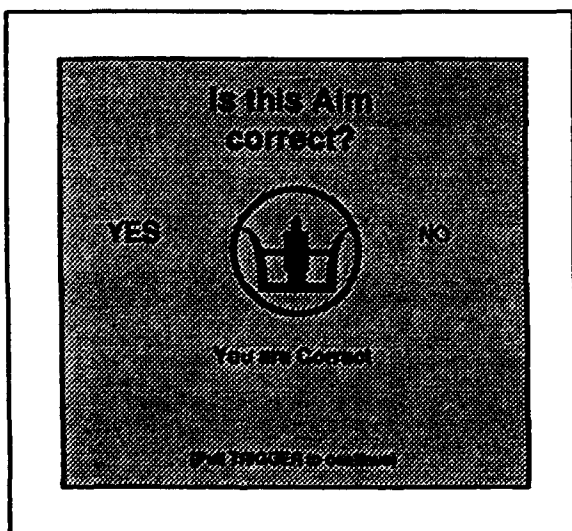
CORRECT RESPONSE FEEDBACK

· You are correct.
· Front and rear sights are aligned correctly.
· Front sight is placed on center of mass of target.
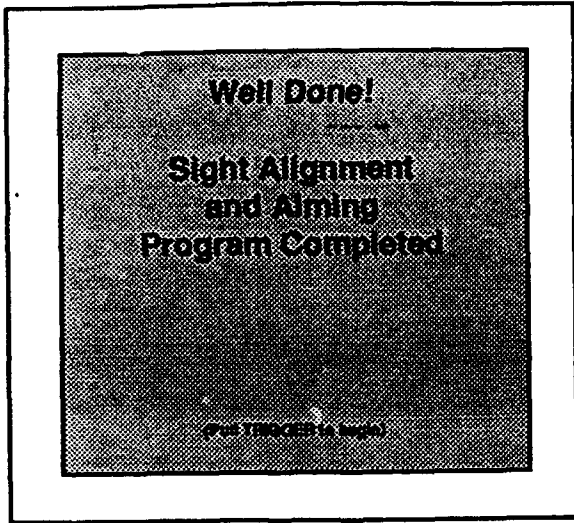
AFTER THREE CORRECT RESPONSES IN A ROW:

· End of Aiming Program.
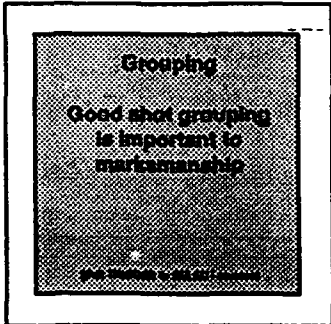
STATEMENT OF IMPORTANCE

· Tight shot groups indicate correct application of the four fundamentals of marksmanship.
  · Steady position
  · Aiming
  · Breath control
  · Trigger squeeze

Grouping

Good shot grouping is important to marksmanship

Tight Shot group: shots hit close together

TIGHT

(Pull TRIGGER to continue)
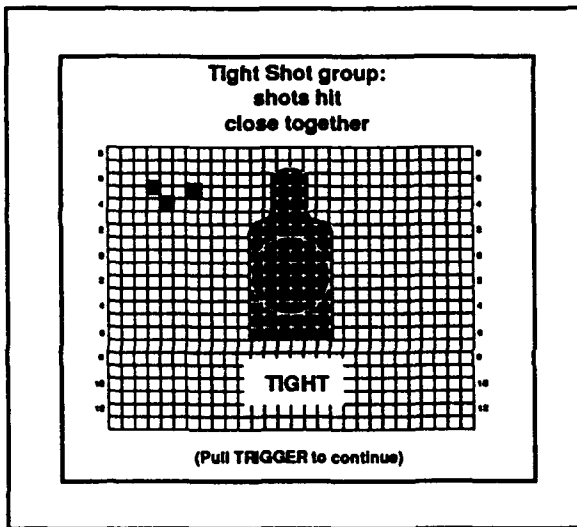
TIGHT SHOT GROUP

· Shots fit in 4 cm circle.
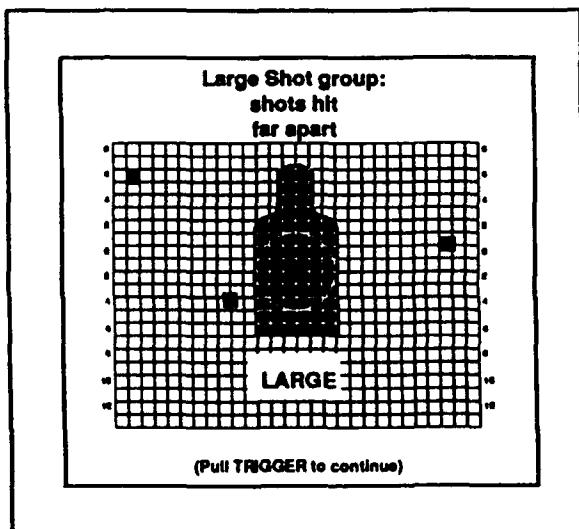
LARGE SHOT GROUP

· Shots do not fit in 4 cm circle.

Large Shot group: shots hit far apart

LARGE

(Pull TRIGGER to continue)

TIGHT SHOT GROUP

Tight Shot Group
Fits in 4cm circle

(Pull TRIGGER to continue)
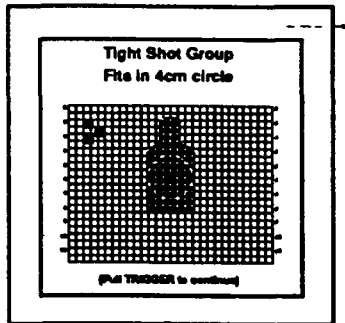
Part 1:
· 3 shots hit close together.

Tight Shot Group
Fits in 4cm circle

(Pull TRIGGER to continue)
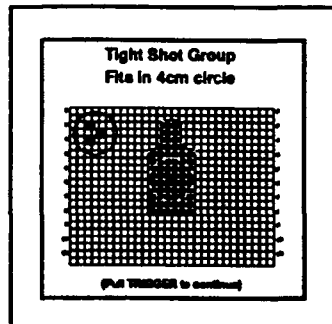
Part 2:
· Circle appears around shot group.

Tight Shot Group
Fits in 4cm circle

(Pull TRIGGER to continue)
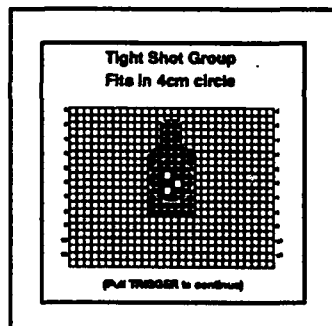
Part3:
· Shot group moves to center of target.

TWO SHOT GROUP

If only 2 shots
can be seen, fire
another shot group

(Pull TRIGGER to continue)
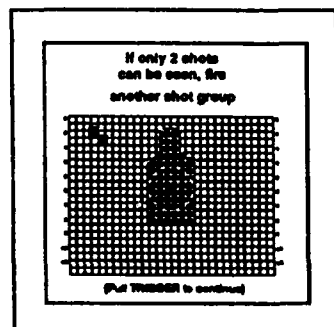
· One shot missed target.
· Fire another shot group.

Is this a tight
shot group?

YES   NO
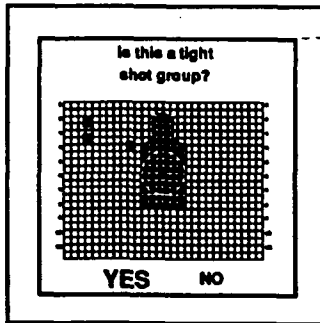
SHOT GROUP SKILL TEST

· Tests recognition of tight shot group.
· YES and NO alternately appear in large (boldface) type.
· Select answer by pulling trigger when choice appears in large (boldface) type.
· Must correctly identify three in a row to pass test.

WRONG

Group does not
fit in circle

(Pull TRIGGER to continue)
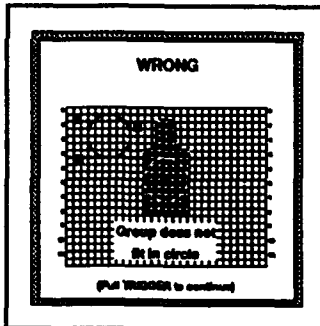
INCORRECT RESPONSE

· Red border appears.
· Scaled, 4 cm circle moves to middle of shot group.
· Error is described.

YES   Correct
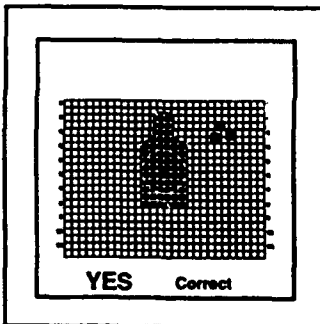
CORRECT RESPONSE

· You are correct.

4-20
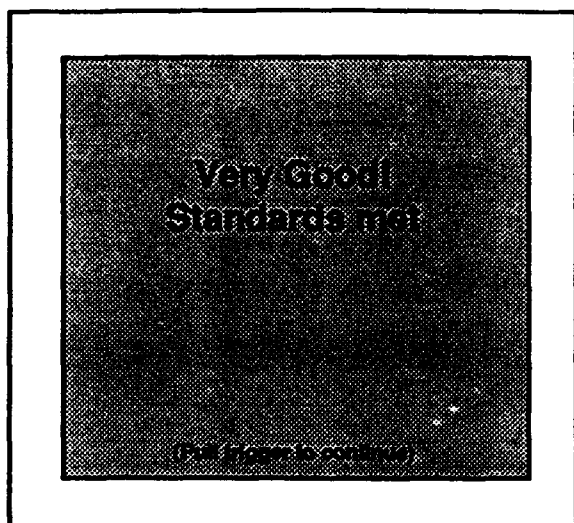
AFTER THREE CORRECT RESPONSES IN A ROW

· Standards met.
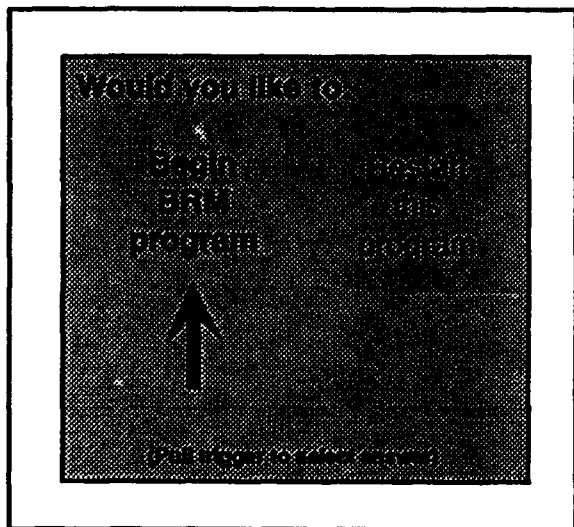
END OF PROGRAM

· Select choice by pulling trigger when arrow points to desired response.

TROUBLESHOOTING TIPS

TROUBLESHOOTING TIPS

PROBLEM	SOLUTION
Computer will not come on.	Ensure power cords are plugged in.
	Ensure all power switches are turned on.
	Use a different outlet.

PROBLEM	SOLUTION
Program does not start.	**Turn off all power switches.** Take out and reinsert BRM cartridge.
	Turn on all power switches.
	Ensure shift lock key on keyboard is in UP position.

PROBLEM	SOLUTION
No sound.	Adjust volume control on monitor.
	Recheck cable connections.

PROBLEM	SOLUTION
Light pen does not work (purple border appears or light pen fails tracking test as described on page 2-7).	Check 5/8" gap on focal ring, if applicable.
	Recheck cable connections.
	Check distance to monitor screen. (Should be 7'6").
	Increase monitor brightness and/or contrast.
	Turn off computer. Restart system.
	Let monitor warm up.

COMMODORE (Model 1802)

| No picture. | Adjust BRIGHT to maximum (clockwise). (BRIGHT knob is located behind the panel at the front of the monitor). |
| | Turn off all power switches. Recheck cable connections. |
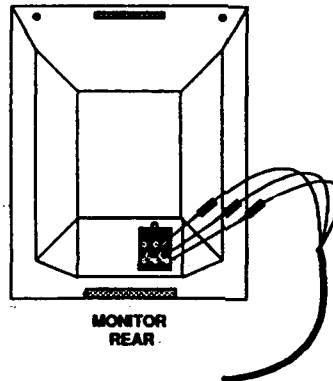
MONITOR
REAR

HITACHI

No picture.	Adjust BRIGHT to maximum (clockwise). (BRT knob is located along the lower edge of the monitor at the front.)
	Turn off all power switches. Recheck cable connections.
	Ensure rear switch on back of monitor is set to NTSC.

REAR SWITCH

NTSC   C/L

MONITOR
REAR

FOR FURTHER INFORMATION

Broom, J. M., Champion, D. F., Greene, W. H., Martere, R. F., Purvis, J. W. ,& Sills, E. G. (1989). Multipurpose arcade combat simulator (MACS) basic rifle marksmanship (BRM) program. (ARI Research Report 90-01). Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

This research report provides a more detailed discussion of the rationale behind the instructional design, standards, and feedback contained in the MACS BRM program.

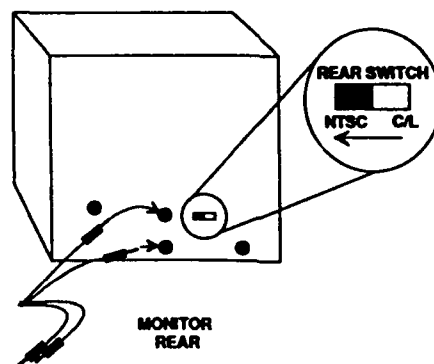Evans, K. L. (1988). Development and evaluation of the multipurpose arcade combat simulator: A research summary (ARI Research Report 1488). Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

Available from the Defense Technical Information Center order no. AD-B 130 099.

This research report summarizes the results of over 20 developmental hardware tests, training and cost effectiveness evaluations, and informal field investigations conducted since 1982. Benefits associated with MACS training used in conjunction with standard training appear to be increased performance, fewer failures to meet performance standards, significantly lower expenditures of ammunition, improved performance feedback, and greater soldier interest.

Heller, F. H. & Evans, K. L. (1989). Joint service multipurpose arcade combat simulator (JMACS) user guide (ARI Research Product 89-23). Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

This research product presents information on system assembly, operation, and troubleshooting of the JMACS hardware. Features of the JMACS training software and associated performance standards are also described. The MACS BRM software described in the Trainer's Guide and the report by Broom and associates (1989) has replaced the JMACS training software throughout the services. The updated software is available from the Training Support Center, Fort Benning, Georgia.

MACS MOVING TARGET PROGRAM

MOVING TARGET TRAINING

The ability to hit moving targets on the battlefield is recognized as a high-priority combat task. During the past 100 years, several attempts have been made to conduct moving target training, but many complicating factors have always prevented it from becoming a formal part of the Army's rifle marksmanship program. During the past few years, limited training on the engagement of moving targets has been presented to 11B and 11M Infantry soldiers undergoing One Station Unit Training at Fort Benning, Georgia, using the Army's only operational moving target ranges. Most leaders and trainers have not received instruction or practice on the engagement of moving targets.

The MACS Moving Target Program has been developed so that all soldiers who have access to a Commodore MACS system may receive training and practice on the engagement of moving targets. While every attempt should be made to practice on a live fire range, extensive use of the MACS Moving Target Program will improve the ability of most soldiers to hit moving combat targets.

Guidance on moving target training is contained in FM 23-9, <u>M16A1 and M16A2 Rifle Marksmanship</u>. A somewhat more detailed discussion of moving target training is contained in FC 23-11, <u>Unit Rifle Marksmanship Training Guide</u>. Given the current state of moving target training, the MACS Moving Target Program includes detailed instructional material which will allow a soldier to learn with minimum supervision. The MACS Moving Target instruction is compatible with the above references but it represents a refinement and enhancement of previously available instructional material.

The Weaponeer Marksmanship Trainer and Firearms Training System are devices with moving target capabilities. These are very effective; however, they are currently available in limited numbers. The ranges throughout the Army which include moving rifle targets are very limited in numbers and will normally not be available for the conduct of effective moving target training. Accordingly, the only moving target training available to most soldiers will be the MACS Moving Target Program. For any existing Commodore MACS system, all that is needed is a moving target cartridge which may be obtained from the Training Support Center at Fort Benning.

Moving Target Training should be an integral part of every marksmanship program. The instructional portion of MACS may be presented to several soldiers at once, but each soldier should be provided at least one hour to progress through the entire program, with opportunities to repeat the training as often as possible.

OVERVIEW OF MACS MOVING TARGET PROGRAM

The MACS Moving Target Program is designed for a soldier who has completed Basic Rifle Marksmanship (BRM) training. As a minimum, anyone firing the moving target program should first complete the BRM MACS program.

The initial requirement is to zero the rifle. This procedure electronically zeros the rifle by taking an average of three shots fired and placing the center of the shot group at target center. If less than an excellent shot group is obtained, the soldier will be given an option to shoot for a better zero.

Following zero, the soldier is given an option to view moving target instruction or move directly to firing exercises. All soldiers who are new to moving target training should view the instruction. The instruction is designed to provide an understanding of why lead is required on moving targets. Several examples of correct target leads are presented and the soldier is taught how to use a single lead rule which will hit most high-priority combat targets.

The MACS Moving Target Program is organized in 10 levels of training and practice as follows:

Level 1 is a Tracking Exercise. Tracking is explained and demonstrated and the soldier is required to demonstrate good tracking techniques before advancing.

Level 2 is a Trapping Exercise. The trapping technique is explained and demonstrated and the soldier is required to use good trapping techniques before advancing.

Level 3 provides practice on a 60-meter target at lateral speeds of 1.5, 3, and 6 miles per hour. On this and following levels, the soldier may use tracking or trapping to engage targets. Soldiers will be provided a separate evaluation on each technique and will be able to determine which method works best. As with all levels, standards must be met before advancing to the next level.

Levels 4, 5 and 6 are similar to Level 3, but provide practice at ranges of 75, 125, and 185 meters. A detailed performance feedback review is provided for each shot.

Level 7 is a free moving scenario of single targets, but it incorporates stationary targets with moving targets. Detailed feedback is provided each time a target is missed and a crosshair shows the location of all hits and misses.

Level 8 is an advanced scenario in that it includes multiple exposures of stationary and moving targets which are more difficult to engage. Additionally, this level provides more bullets than targets, so targets that are missed may be engaged a second time. On this level, no detailed feedback is provided and a crosshair is shown for misses only.

Level 9 is a good primer for the Fort Benning Moving Target Range because the target speeds, distance, and exposure times are similar. As on the range, no feedback is provided on shot performance.

Level 10 is the most complex scenario in that it includes short-exposure stationary targets and unpredictable moving targets.

A soldier who successfully completes all ten levels of the MACS program is ready for the experience of a live-fire range.

At any time the MACS program is being used, the instructor or student may return to the menu screen by pressing the RUN/STOP key one or more times. The menu screen allows for movement directly to any level or the selection of several options.

The feedback provided allows an instructor to monitor several shooters and determine their progress. The color of the screen border changes to draw the instructor's attention to any soldier having difficulty. The colors of the border indicate the soldier's status:

- BLACK - Making satisfactory progress.
- RED - Refiring targets at a particular range.
- PURPLE - Aiming off the screen or light pen not reading.

Information on the soldier's progress is included in the upper left corner of the screen.
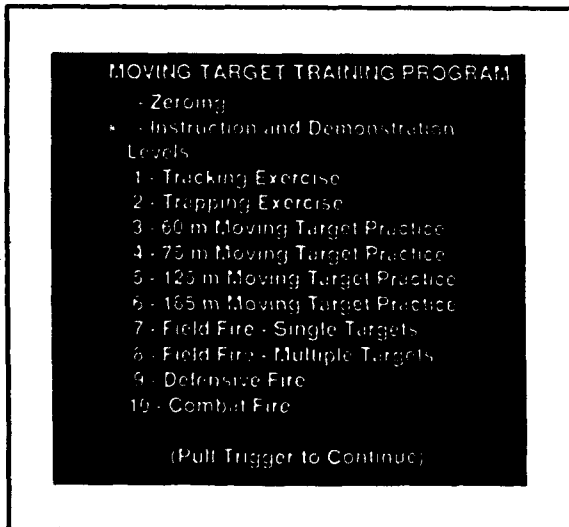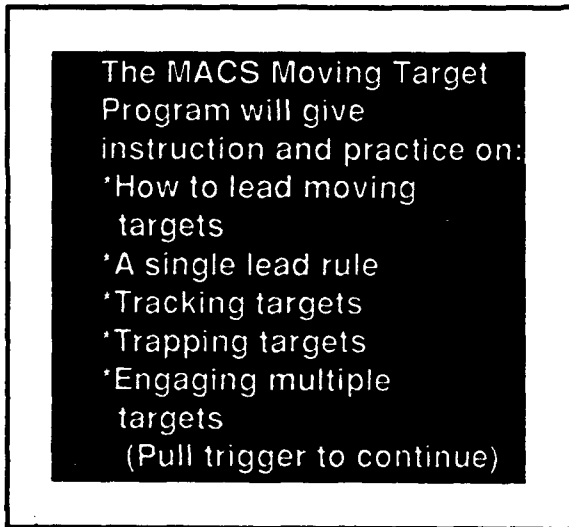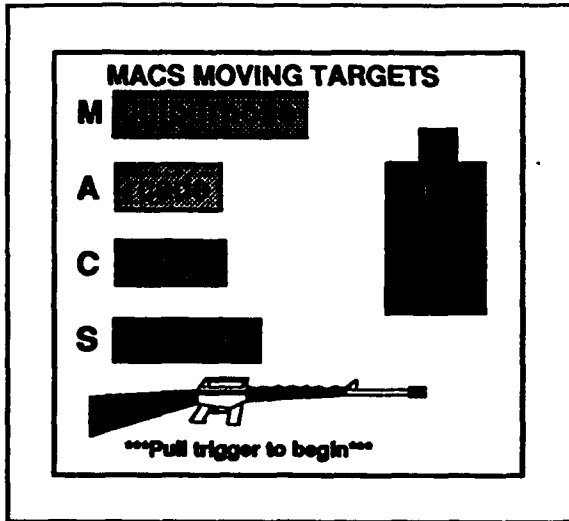
L - Level being shot.
T - Target being shot within a level.
R - Number of refires within a level.

Fundamentals

Stationary	Moving (Track)	Moving (Trap)
Steady Position	Smooth Track	Steady Position
Aiming	Lead	Lead
Breath Control	Breath Control	Breath Control
Trigger Squeeze	Trigger Squeeze	Trigger Pull

It should be noted that the four fundamentals of marksmanship learned during the engagement of stationary targets have been retained, in so far as possible, for the engagement of moving targets. When tracking moving targets, it is important to develop a smooth track, the ability to move the rifle smoothly in concert with the target movement. The MACS evaluation measures the consistency of the aiming point relative to target movement prior to firing. The proper lead must be established and maintained. The lead score is a function of how close the aiming point was to the proper lead point prior to firing. As with stationary targets, breathing must be momentarily stopped before firing. The MACS system cannot measure breathing; therefore, if the soldier maintains a smooth track on the target, it is assumed that breathing is okay. If a smooth track is not maintained, MACS feedback will indicate that breathing should be checked as a possible problem, along with other factors. Trigger squeeze continues to be the most important fundamental for the successful engagement of targets. One advantage of tracking is that the trigger is squeezed, similar to a stationary target engagement, so that the exact moment of firing cannot be anticipated. A good trigger squeeze should begin with pressure on the trigger so that final pressure can be applied rapidly. It may take only a fraction of a second to squeeze the trigger, but that is enough time to prevent a flinch, which will probably result in a target miss. The trigger squeeze rating is taken at the moment of firing, so a flinch will be reflected in a low rating. When trapping targets, a steady position should be established in front of the target. This measure is similar to the measurement of a steady position for the engagement of stationary targets. The same target lead must be applied. The MACS rating indicates how close the aiming point was to the proper lead spot when the weapon was fired. Breath control is measured the same for all firings. Trigger pull is very important for a successful trap. The trigger cannot be squeezed, but it must be pulled so the soldier knows precisely when the rifle is going to shoot. This is a disadvantage of the trapping technique because many soldiers will unconsciously react (flinch) when they know the weapon is going to fire. The rifle must be held somewhat more firmly and the trigger must be pulled without disturbing the lay of the weapon. The MACS rating will reflect any excessive movement during trigger pull.

MACS MOVING TARGET PROGRAM SEQUENCE

SCREENS

MACS MOVING TARGETS

M

A

C

S

Pull trigger to begin

The MACS Moving Target
Program will give
instruction and practice on:
'How to lead moving
 targets
'A single lead rule
'Tracking targets
'Trapping targets
'Engaging multiple
 targets
 (Pull trigger to continue)

MOVING TARGET TRAINING PROGRAM

- Zeroing
- Instruction and Demonstration
Levels
1 - Tracking Exercise
2 - Trapping Exercise
3 - 60 m Moving Target Practice
4 - 75 m Moving Target Practice
5 - 125 m Moving Target Practice
6 - 185 m Moving Target Practice
7 - Field Fire - Single Targets
8 - Field Fire - Multiple Targets
9 - Defensive Fire
10 - Combat Fire

(Pull Trigger to Continue)

NOTES TO TRAINER

· Introductory Screen of MACS
  Moving Target Program.

· Adjust volume so the rifle shot is at
  the desired level.

· Make final adjustments to bright-
  ness and contrast.
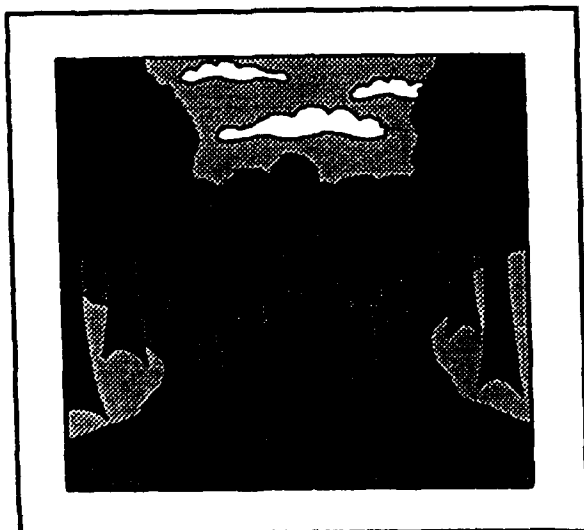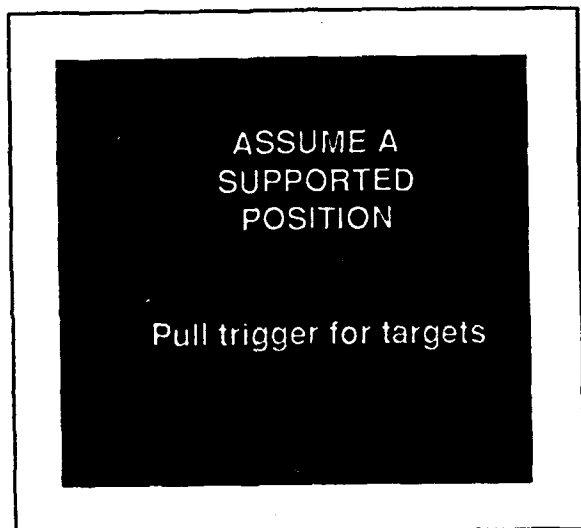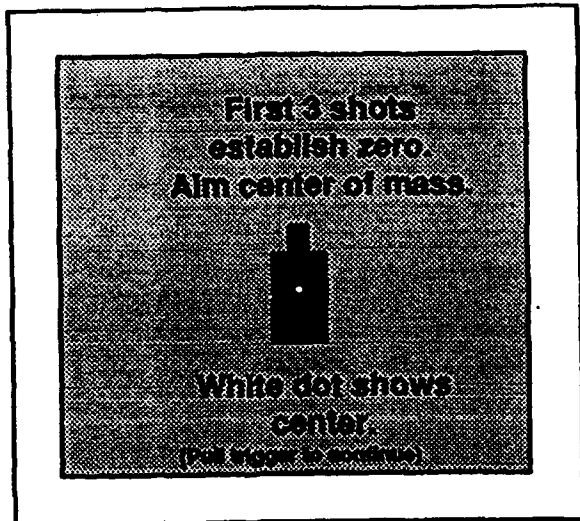
· General overview of instruction.

· This is an information screen for the
  shooter.

· The instructor or shooter may
  access the program menu (page 6-
  35) at any time by pressing
  the [RUN STOP] key one or more

  times.

First 3 shots
establish zero.
Aim center of mass.

White dot shows
center.
(red trigger to continue)

ASSUME A
SUPPORTED
POSITION

Pull trigger for targets
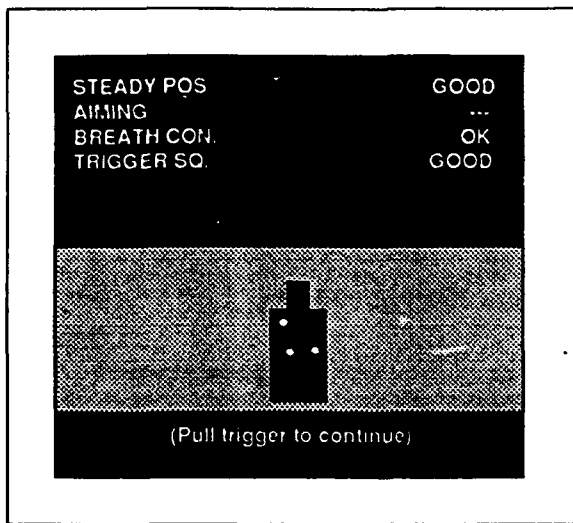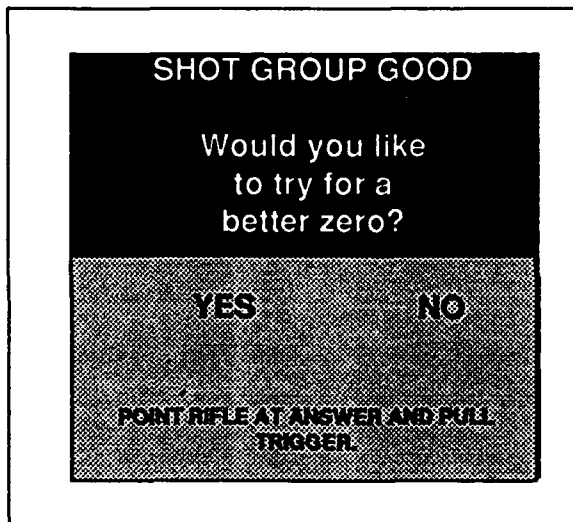

- Each new shooter should fire the zero program. This electronically zeros the rifle to the shooter's personal zero.

- The zero target is a scaled 250-meter target, which is the zero range for the M16A1 rifle. The M16A2 rifle is zeroed for 300 meters, which means it will hit farther above the point of aim at ranges out to 250 meters. For example, shooting a 185-meter target, the M16A1 will hit about 2.9 inches above point of aim and the M16A2 will hit about 5.6 inches above point of aim. However, this small difference in the vertical placement of bullets should not limit the benefit of this Moving Target Program for soldiers armed with the M16A2, because the lead requirements are the same for both weapons.

- The position used for zeroing should be the same position the shooter expects to use while firing the program.

- No position requirements are stated during the program, so available support should be used to maximum advantage. Trainers may eliminate support or require firing from a prone position to vary training.

- To establish zero, three, stationary, untimed targets are presented.

- The shooter should fire one well-aimed shot at each target.

```
STEADY POS            GOOD
AIMING                ...
BREATH CON.           OK
TRIGGER SQ.           GOOD



          (Pull trigger to continue)
```

- The Zero Summary Screen evaluates the zero performance and locates the shot group at target center.

- Note that "aiming" is not evaluated, but for the rest of the program the evaluation of aiming is based on the zero obtained.

- A good zero is important. If the shot group is rated excellent, the shooter will advance.

```
         SHOT GROUP GOOD

          Would you like
           to try for a
           better zero?


        YES            NO


     POINT RIFLE AT ANSWER AND PULL
              TRIGGER.
```

- If the shot group is rated less than excellent, the shooter is given a choice to improve his zero by shooting a tighter shot group.

- If **YES** is selected, the zero will be repeated.

- If **NO** is selected, the shooter will advance.

IF FIRST SHOT GROUP IS INVALID:
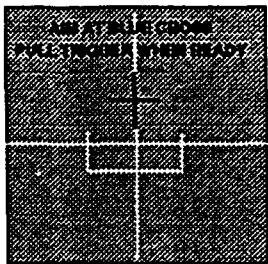
```
    Invalid shot
       group

     Try again

    (Pull trigger
    to continue)
```

- An invalid shot group is one in which one or more shots hit outside a rectangular area (not seen by the shooter).

IF SECOND SHOT GROUP IS INVALID:

Invalid shot group
try again
or
check light pen
mount alignment
(see manual)

If second shot group is Invalid:

· Press [**RUN** / **STOP**] on Keyboard to start light pen mount alignment program.
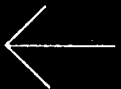
NOTE: See section 2 for instructions on aligning the light pen mount.

· Follow directions for alignment.

· Following alignment the program will return to MACS MOVING TARGET Introductory Screen.
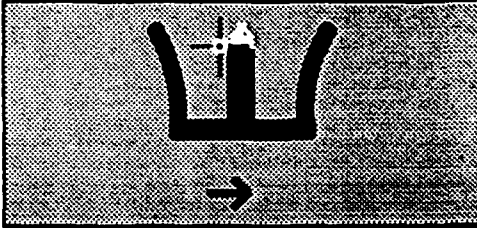
MOVING TARGET
INSTRUCTION &
DEMONSTRATION

START
FIRING
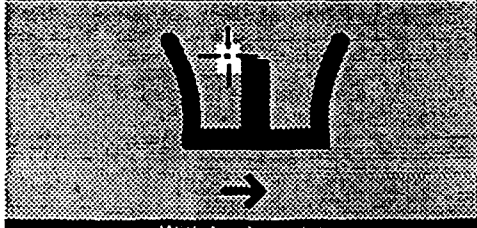EXERCISES

POINT RIFLE AT ANSWER
AND PULL TRIGGER

· After zeroing, the shooter has the option of beginning the firing exercises immediately or receiving moving target instruction and demonstration.

· The only personnel who should go directly to firing exercises are those who have previously demonstrated proficiency on the program.

You may miss moving targets by aiming at center mass, because the target is still moving as the bullet travels down range.

Without lead you miss
185 meters
6 mph lateral speed

(Pull Trigger to Continue)

To hit a target that is moving laterally across your front, you must aim ahead of target center. This is called LEAD.

With lead you hit
185 meters
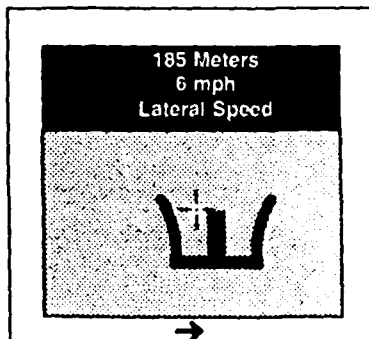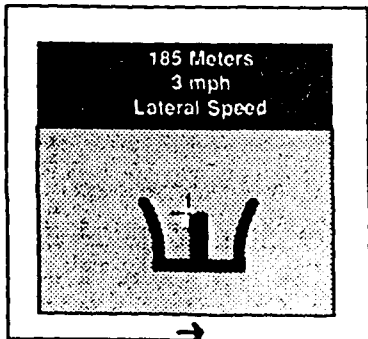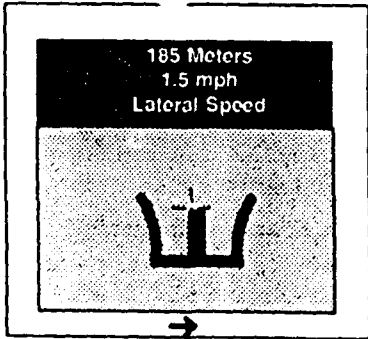6 mph lateral speed
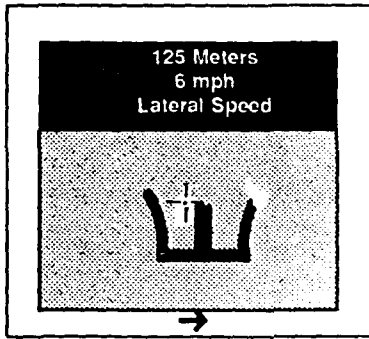
(Pull Trigger to Continue)

The amount of lead needed to hit target center will increase when the target is farther away and/or is moving faster laterally across your front.
12 examples follow

(Pull Trigger for 12 examples)

· When a football receiver goes out for a pass and makes a 90-degree cut across the field, it is very obvious that the quarterback must aim the ball in front of the receiver so the ball can be caught. The same principle must be applied when shooting a bullet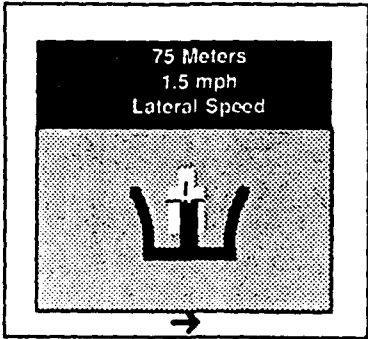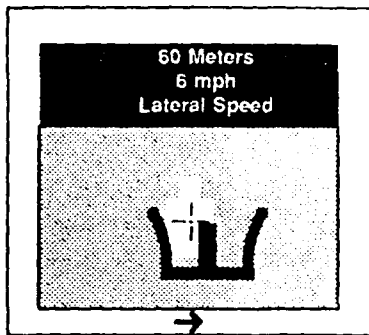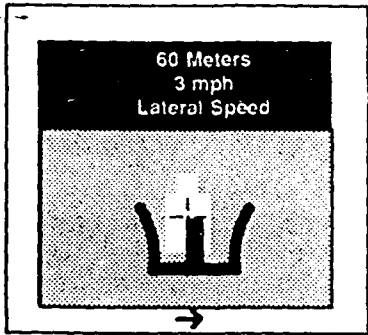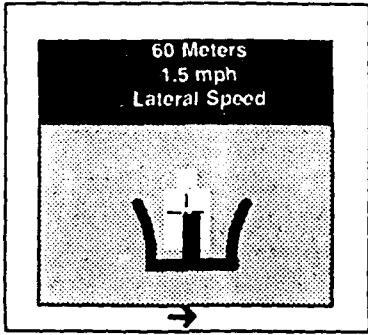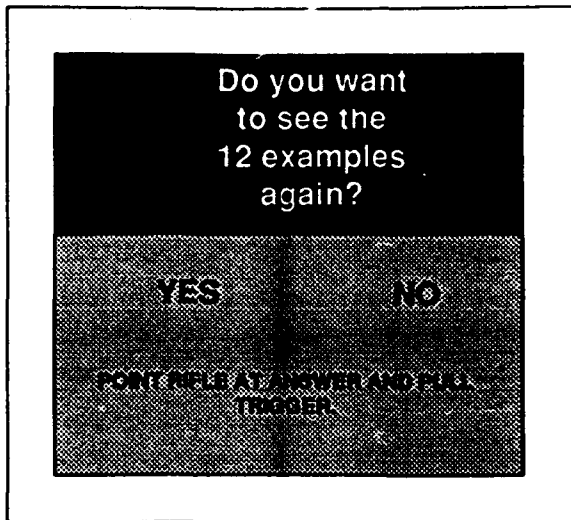 at a running target. Even though the bullet leaves the rifle at over 2,000 miles per hour, a target moving at 6 miles per hour will travel over 6 inches while the bullet travels 60 meters, over 8 inches while the bullet travels 75 meters, 14 inches while the bullet travels 125 meters, and over 22 inches while the bullet travels 185 meters. Therefore, the rifle must be aimed in front of a moving target to ensure good target hits.

· You will note that all targets on the MACS Moving Target Program are moving at 90 degrees and a lateral speed of 1.5, 3, or 6 mph. If a target is moving at 90 degrees to the shooter, its lateral speed and its true speed are the same. However, if a target is running directly at the shooter, its lateral speed will be zero and it should be engaged as if it were a stationary target. If the target is at an angle of less than 90 degrees, the lead required will be reduced. For example, a 7 mile per hour target at a 35-degree angle covers the same space, from the shooter's point of view, as a 4 mile per hour target at 90 degrees. In other words, the three speeds used on MACS represent a wide range of possible speed and angle combinations. To illustrate, the lead requirements are the same for a 1.5 mile per hour target at 90 degrees, a 3 mile per hour target at 30 degrees, a 4 mile per hour target at 20 degrees, a 6 mile per hour target at 15 degrees, and an 8 mile per hour target at 10 degrees.

· Note that to obtain a dead center hit, a different aiming point must be used for each speed and range.

DIFFERENT LEAD REQUIREMENTS FOR DEAD-CENTER HITS

60 Meters 1.5 mph Lateral Speed	60 Meters 3 mph Lateral Speed	60 Meters 6 mph Lateral Speed
75 Meters 1.5 mph Lateral Speed	75 Meters 3 mph Lateral Speed	75 Meters 6 mph Lateral Speed
125 Meters 1.5 mph Lateral Speed	125 Meters 3 mph Lateral Speed	125 Meters 6 mph Lateral Speed
185 Meters 1.5 mph Lateral Speed	185 Meters 3 mph Lateral Speed	185 Meters 6 mph Lateral Speed

Do you want
to see the
12 examples
again?

YES   NO

POINT RIFLE AT ANSWER AND PULL
TRIGGER

- Since the examples move quickly,
the shooter is provided an option of
seeing them again.

- Selecting YES will rerun the 12
examples, and selecting NO will
continue with the program.
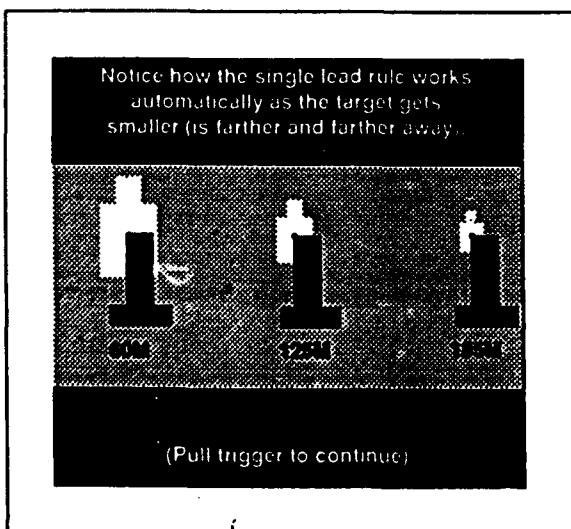
To simplify target leads put the trail-
ing tip of the front sight post at center
of mass. This is the SINGLE LEAD RULE

CENTER MASS

75 meters
3 mph for this shot

(Pull trigger to continue)
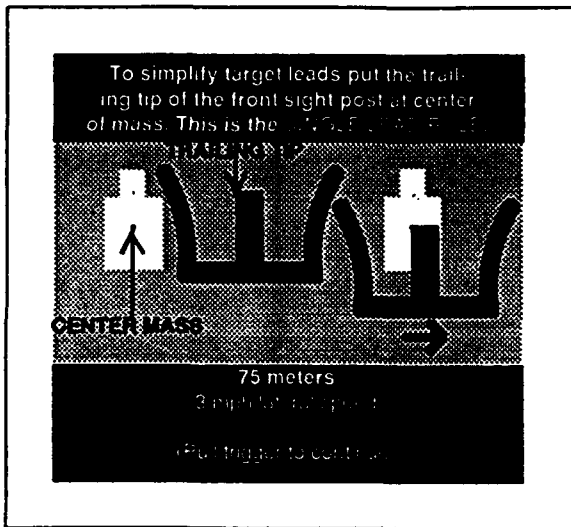
- Given that it is impossible to remem-
ber all of the various leads required
to obtain a dead center hit even if
the speed, angle, and range of the
target could be determined, the
single lead rule will result in hitting
most high-priority combat targets.

- For soldiers being introduced to the
engagement of moving targets, the
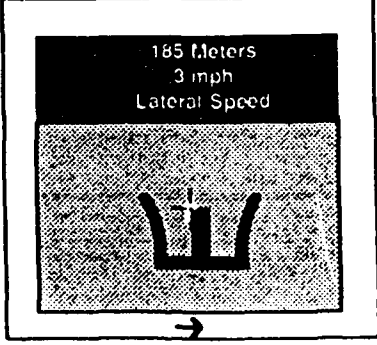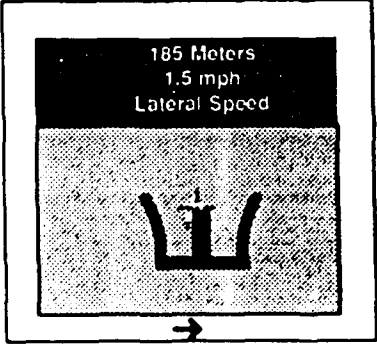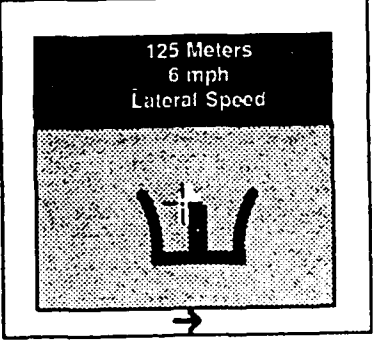single lead rule should be taught.

Notice how the single lead rule works
automatically as the target gets
smaller (is farther and farther away).

(Pull trigger to continue)

- A good zero results in the average
bullet strike being at the center of
the front sight post. Therefore,
when the trailing edge of the sight
is placed at target center, the
perceived distance from the edge of
the sight to the center results in
lead.

- Since the sight is perceived to cover
a very small portion of the target at
close range and a large portion at
more distant ranges, using this rule
results in the small amount of lead
needed for close targets and a
greater amount of lead which is
needed for more distant targets.

6-12

Following are eleven
examples of the
single lead rule.
showing where the
bullet will hit the
target. Remember to
put the trailing tip
of the sight post at
center mass.

(Pull trigger to see 11 examples)

- Eleven examples of the single lead
  rule are graphically shown (one after
  another without a break) each show-
  ing where the bullet hits for the
  given range and target speed.

- Note that the trailing edge of the
  sight is placed at target center on all
  targets but that bullet strike varies
  somewhat from the center of the
  target.

HIT LOCATIONS USING SINGLE LEAD RULE:

60 Meters 1.5 mph Lateral Speed	60 Meters 3 mph Lateral Speed	60 Meters 6 mph Lateral Speed
75 Meters 1.5 mph Lateral Speed	75 Meters 3 mph Lateral Speed	75 Meters 6 mph Lateral Speed
125 Meters 1.5 mph Lateral Speed	125 Meters 3 mph Lateral Speed	125 Meters 6 mph Lateral Speed
185 Meters 1.5 mph Lateral Speed	185 Meters 3 mph Lateral Speed	

Do you want to see
the 11 examples of
the single lead rule
again?

YES   NO

Point rifle at answer
and pull trigger

- The lead rule examples in this Guide have been placed on one page so they may be reproduced for closer study.

- While the single lead rule is the appropriate starting point, as soldiers become more skilled, they should modify the rule to put all bullets as close to target center as possible.

The single lead rule will hit most combat
targets. To hit fast lateral targets at
more than 100 meters you need more lead.

Insufficient lead causes a miss
165 meters
6 mph lateral speed

(Pull trigger to continue)

- The single lead rule will not work on distant targets with fast lateral speed. These targets require more lead.

The single lead rule will hit most combat
targets. To hit fast lateral targets at
more than 100 meters you need more lead.

Increased lead - a hit
165 meters
6 mph lateral speed

(Pull trigger to continue)

- Moving the trailing edge of the front sight out to the leading edge of the target provided the additional lead needed for this category of target.

> Two ways to engage
> moving targets are
> tracking & trapping.
> You will get to try
> both methods to see
> how they work.
>
> (Pull trigger to continue)

- Instructional Levels 1 and 2 are devoted to tracking and trapping.

Level 1. Tracking Exercise

PURPOSE

- Explanation of tracking.
- How to track.
- Tracking practice.

SUMMARY DESCRIPTION

- 75 meter target at 3 miles per hour.
- Ten targets presented - Five moving from left to right and five moving right to left.

FEEDBACK

- Words HIT or MISS appear on screen for each shot.
- Cross hair appears on screen to show bullet strike.
- Replay after each shot.
- Shooter will be corrected if trapping technique is used to engage targets.

STANDARDS

- Smooth track and proper lead (EXCELLENT or GOOD ratings) on 3 of 5 targets in each direction.
- Refire is required if a standard is not met.

LEVEL
1

Tracking Exercise

(Pull trigger to continue)
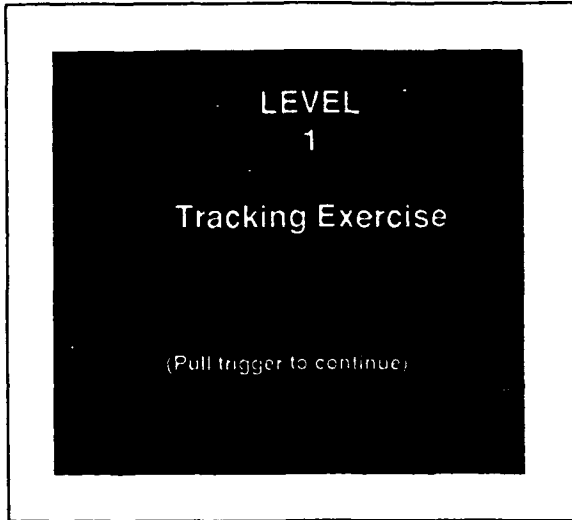
- On this level, the soldier is required to use the tracking technique of moving target engagement.

To track, get the correct lead and move your rifle with the target as you squeeze the trigger.
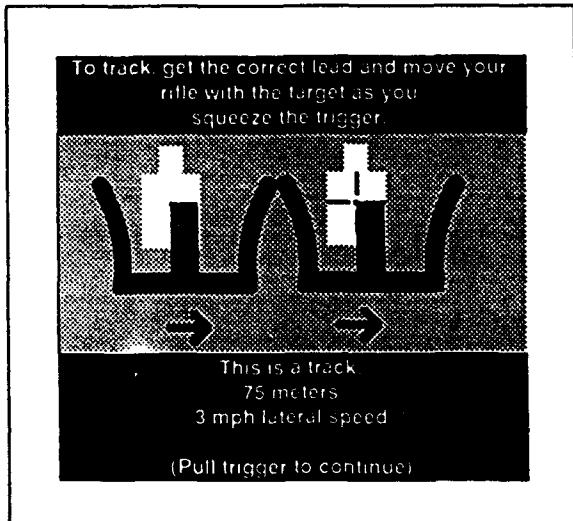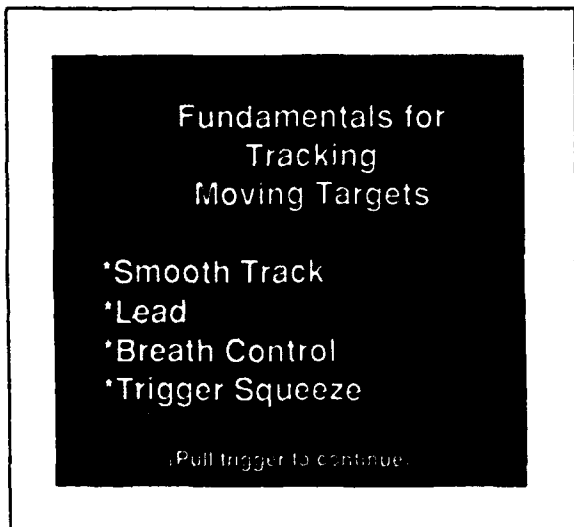
This is a track
75 meters
3 mph lateral speed

(Pull trigger to continue)

- When using the tracking technique, the trigger can be squeezed similar to a stationary target engagement. The shooter should establish the correct lead and then attempt to maintain that lead as he applies more and more pressure to the trigger.

Fundamentals for
Tracking
Moving Targets

*Smooth Track
*Lead
*Breath Control
*Trigger Squeeze

(Pull trigger to continue)

- Note that the four fundamentals of marksmanship have been modified only slightly, with steady position being replaced by smooth track and aiming replaced by lead.

```
Use the non-firing
hand as a pivot.
Smoothly track the
target by moving
your upper body.

(Pull trigger to continue)
```

- Prior to starting the exercise, each soldier should adjust his position so he can smoothly track the width of the screen, from left to right and from right to left.

```
10 targets
Feedback after each
shot
Standard:
Smooth track and
proper lead on
3 of 5 targets
in each direction.

Pull trigger for targets
```

- The first five targets will move from left to right.

```
SMOOTH TRACK          EXCELLENT
LEAD                       GOOD
BREATH CON                   OK
TRIGGER SQ                 GOOD
```

```
Pull trigger to continue.
```

- When each shot is fired, miss or hit will be displayed on the screen and the bullet location will be shown with a crosshair.

- Each fundamental is rated POOR, BELOW AVERAGE, AVERAGE, GOOD or EXCELLENT. A rating is provided for shot locations which are hits.

- The black sight on the display shows the perfect sight placement while the white sight shows the shooter's aiming track.

- This feedback screen will be repeated until the trigger is pulled to continue.

On the last target
you trapped. Try to
track every target
for the rest of this
practice exercise.

Pull trigger for targets

· If at any time the shooter does not track (traps instead), this screen is provided. When this occurs, shooter cycles back to the same target.

Your 5 shots
75 meters
3 mph →

(Pull trigger to continue)

· When five targets have been tracked, this screen shows the location of the five bullets.
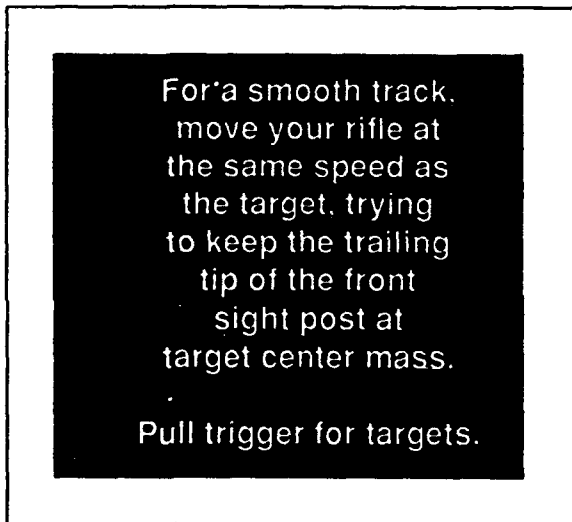
Summary
Standard: Good or
Excellent Track and
· Lead on 3 of 5
targets
Your Score:
Smooth Track - 4 of 5
Lead - 3 of 5

(Pull trigger to continue)

· To progress, the shooter must have received a GOOD or EXCELLENT score for smooth track on at least 3 of 5 targets and must have received a score of GOOD or EXCELLENT on lead for at least 3 of 5 targets.

```
You did not meet
- the standard.
Prepare to refire.

(Pull Trigger to Continue.)
```
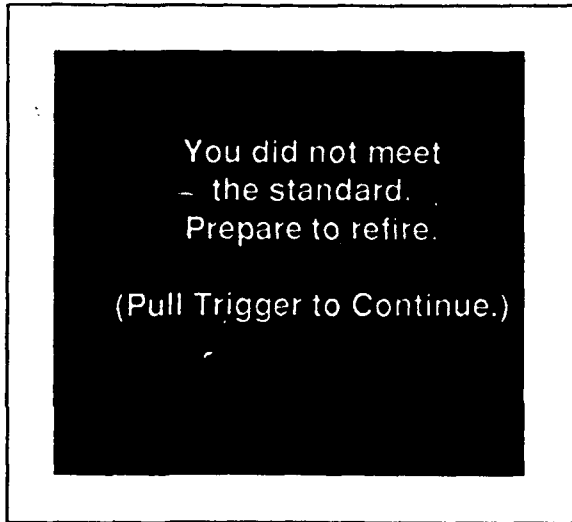
· If the shooter does not obtain at least 3 of 5 on smooth track and lead, this screen will be displayed.

```
For a smooth track.
move your rifle at
the same speed as
the target, trying
to keep the trailing
tip of the front
sight post at
target center mass.

Pull trigger for targets.
```

· This screen is provided as a reminder of what the requirements are to obtain a smooth track and proper lead.

· Once the standard has been met on targets moving from left to right, the soldier progresses to the next series of five targets.

· When standards have been met on targets moving from right to left, the shooter advances to Level 2.

Level 2. Trapping Practice

PURPOSE

- Explanation of trapping.
- How to trap.
- Trapping practice.

SUMMARY DESCRIPTION

- Ten targets presented.
- Five moving from left to right and five moving from right to left.

FEEDBACK

- Words HIT or MISS appear on screen for each shot.
- Cross hair appears on screen to show bullet strike.
- Replay after each shot.
- Shooter will be corrected if tracking technique is used to engage targets.

STANDARDS

- Good or excellent trap lead on 3 of 5 targets.
- Refire of targets is required if standard is not met.

Level 2
Trapping Exercise

(Pull trigger to continue)

- This level requires the soldier to use the trapping technique of moving target engagement.

To trap, establish a steady position in front of the target and pull the trigger when the target gets to the right spot.

This is a trap.
75 meters
3 mph lateral speed
(Pull trigger to continue)

- A good trap establishes a steady position forward of the target and waits for the target to get to the right position to pull the trigger.

Fundamentals for
Trapping
Moving Targets

*Steady Position
*Lead
*Breath Control
*Trigger Pull

(Pull trigger to continue)

- To trap targets, a steady position is established in front of the target. Lead is a matter of timing — the rifle should be fired when target center reaches the near edge of the sight post. Breath control is the same as for other engagements. The trigger cannot be squeezed, but it must be pulled so the shooter knows precisely when the rifle is going to shoot.