
* APPENDIX G

NIGHT OPTICS

Weapons-mounted night optics are less versatile than goggles with regard to situational awareness. However, they offer greater magnification and resolution at crew-served weapons ranges.

The graduated reticles on night optics offer the flexibility of engaging at various ranges. Laser pointers fix on one range, so the firer must "aim off" before engaging targets at a different range.

Night optics weigh more than goggles--they are awkward to move with and employ. Using night optics requires that the firer make specific adjustments to firing positions. Also, night optics may work poorly in some ambient light or thermal conditions.

Despite their drawbacks, properly boresighted night optics used in the right conditions offer units an extraordinary option: to engage targets beyond the range of opposing force weapons at night.

Section I. AN/PAS-13 (V3) HEAVY WEAPON THERMAL SIGHT

The AN/PAS-13 (V3) heavy weapon thermal sight (HWTS) (Figure G-1, page G-2) is a silent, lightweight, compact, durable, battery-powered, infrared imaging sensor that consumes little battery power. The self-contained infrared (IR) imaging sensor in this sight helps the firer acquire the target in low visibility conditions.

G-1. EQUIPMENT DESCRIPTION AND OPERATION

The HWTS works well at night and in the daytime. The telescope's IR sensor receives infrared light, converts it to digital data, processes it, and then displays it digitally as an infrared image for the user.

a. **Components.** The HWTS has two functional groups: the basic sensor and the telescope. See Figure G-1, page G-2, for equipment data.

(1) **Basic Sensor.** The scanner reflects the IR light it receives from the telescope onto the detective (sensor) assembly. The assembly senses IR light, converts it into a video image, then conditions the video for display on the LED array. The LED array illuminates both the IR image and the reticle. This light image reflects off the scanner, which forms the actual image the firer sees in the eyepiece.

(2) **Telescope.** The telescope receives IR light from an intended target and its surroundings, and then magnifies and projects this light onto the scanner on the basic sensor.

b. **Compatibility.** The heavy weapon thermal sight fits the weapons shown in Figure G-2:

- M2 .50-caliber machine gun.
- M24 sniper rifle.
- MK 19 grenade machine gun.
- Squad leader's M16.

c. **Operational Modes.** To place the HWTS in operational mode--

- (1) If you have an AN/PAS-13 (V3), see TM 11-5855-302-12&P.
- (2) If you have an AN/PAS-13 (OMNI), see TM 11-5855-312-10.

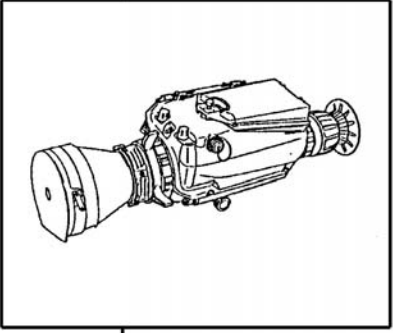
Weight:	4.5 pounds	
Field of View (FOV):		
Narrow	3 degrees	
Wide	9 degrees	
Telescopic Magnification:		
Narrow FOV	10X	
Wide FOV	3.3X	
Dimensions:		
Length:	18 inches	
Width:	6.25 inches	
Height:	6.25 inches	
Power Consumption:		
ON mode	12 watts	
STANDBY mode	5.5 watts	
Battery Life:		
71% STANDBY mode	10 hours	
EMERGENCY mode	3.5 hours	

Figure G-1. Heavy weapon thermal sight.

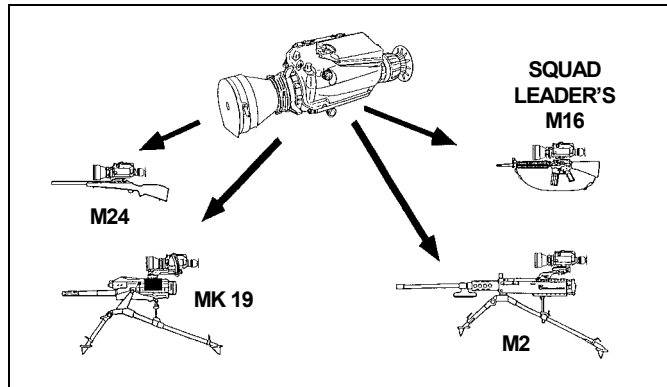


Figure G-2. Weapons that use the AN/PAS-13 (V3) HWTS.

G-2. FUNDAMENTALS OF MARKSMANSHIP

The fundamentals of marksmanship remain about the same for the AN/PAS-13 (V3) heavy weapon thermal sight (HWTS) as they do for the AN/PVS-4. (TM 11-5855-302-12&P discusses HWTS reticle selection and point of aim.)

a. **Firing Position.**

(1) **Sitting.** When using the tripod in the low or high position, sit directly behind the gun between the trail legs of the tripod. Extend your legs under the tripod, cross them, or brace your feet on the tripod. Regardless of which you choose, place your elbows on the inside of your thighs for support. Place your right eye in the HWTS eyepiece.

(2) **Standing.** When the M2 is mounted on a vehicle, stand with both hands on the control grips and your thumbs resting on the trigger. Keep your elbows against your body, your body forward, and your chest against your hands to brace the gun. Place your right eye in the HWTS eyepiece.

(3) **Kneeling.** When using the M2 in a fighting or hasty tripod-mounted position, kneel and grasp the control grips with your thumbs on the trigger. Place your eye in the HWTS eyepiece.

(4) **Prone.** Use the prone position when firing from a tripod that is sitting in a low position. Lie on the ground directly behind the gun and spread your legs a comfortable distance apart, with your toes pointed outward. Rest your left elbow on the ground and grasp the elevating handwheel of the T&E mechanism with your left hand. Grasp the right spade grip with your right hand, with the right thumb in position to press the trigger.

(5) **T&E Manipulation.** This is discussed later in this appendix.

b. **Aiming.**

(1) Determine the range to the target. The aiming point of the M2 reticle depends on the range to the target. To determine range, you can use a range card, estimate range, use the reticle's aiming box, or use TRPs. The HWTS has two M2 reticles--a wide and a narrow field of view.

(2) Use the wide or narrow field of view to scan, to help determine range, and to engage targets.

(3) Use the indicators on the reticle to determine range, or use other methods of range determination.

(4) Set the mounting bracket range selector to NEAR for any target less than 1,400 meters and to FAR for any target beyond 1,400 meters.

(5) Using the T&E mechanism, sight the reticle aiming point on the target (bottom center).

(6) Take the slack out of the T&E by holding the M2 down and to one side. A loose T&E mechanism can move the HWTS reticle off the target's aiming point.

NOTE: Squad leader: observe the impact of the round to help the gunner adjust the sight to bring the strike of the round onto the target.

c. **Breath Control.** This fundamental of marksmanship does not change.

d. **Trigger Squeeze.** This fundamental of marksmanship does not change.

WARNING

Do not press your eye hard against the HWTS eyepiece while engaging a target. The M2 kicks back slightly and could harm you. Make sure to secure the M2 as well as possible to aid in accuracy and help prevent injury

e. **Boresighting.** This paragraph provides guidance on boresighting. For zeroing procedures, see TM 11-5855-302-12&P and TM 11-5855-312-10. (This is kept in the pocket of the sight's soft storage case.) Boresight as follows:

(1) Place the M2 in the ready-to-fire position 10 meters from the boresight target offset. To avoid a failed boresight zero, level the target and weapon before you adjust the laser.

NOTE: The HWTS will not focus in on a silhouette copied to plain paper. To create a boresight target offset, use a 25-meter M16 zero target and attach to it a copy of the boresight target offset.

(2) Mount the HWTS and boresight the weapon. Set the M2 mount to the NEAR position.

(3) Use the reticle select switch to change to the M2 reticle. The reticle type displays in the upper right corner on the raster.

(4) Make adjustments with the T&E until the bore light moves onto the bore light aiming point on the boresight target offset.

(5) Adjust the reticle with the reticle adjuster on the right side of the HWTS. Remember to hold the adjuster down for a count of five. Press and hold the adjuster up to move the reticle up, down to move the reticle down, forward to move the reticle left, and back to move the reticle right.

(6) Use the vertical and horizontal reticle adjuster to move the 1,000-meter aiming point of the reticle to the HWTS aiming point on the boresight target offset.

(7) Recheck the bore laser point of aim and make sure the reticle remains in the center mass of the HWTS aim point on the boresight target offset.

TRAINING STRATEGIES:	When using night optics, M2 gunners use night initial training strategies. Additional nonfiring exercises also apply.
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f. **Qualifications.** Changes to M2 qualifications accommodate new night vision sights and laser pointers. Using the new tables reduces the time and ammunition required to train and qualify gun crews. Lack of ranges and other resources previously limited qualification options. The

new tables increase the opportunities for qualification and the flexibility in the process of qualification. Simpler scoring and grading procedures allow gunners to maintain a high level of proficiency.

(1) With the availability of night vision sights and laser pointers, the current night standards are not challenging. Taking into consideration the "own the night" concept, gunners need to qualify at night to the same or a greater standard than we do during the day. Using these proposed qualification tables and training strategies, the gunner can do so. Each night practice and qualification table has three variations, to reflect the different range, weapon, and sight combinations. Each day table has a variation for each type target.

(2) Use the training strategies and preliminary marksmanship instruction previously described to prepare for day practice and qualification tables. Graders need to prepare, and to ensure ranges are prepared, in accordance to the latest published manuals on the subject. After the gunner trains, he should use Firing Table I then Firing Table II. If he fails to meet the standards in Firing Table I, he must repeat the training and fire the table again. Gunners *must* pass the practice table before moving on to the qualification table.

(3) The gunner must pass day qualification before proceeding to night qualification training.

g. **Nonfiring Exercise.** Use this exercise to train the gunner to use the T&E in order to sight the laser on target.

(1) Place the M2 in the ready-to-fire configuration, with the sight mounted on the M2, and with the M2 mounted on the M3 tripod.

(2) Have the gunner close his left eye and look into the sight with his right eye.

(3) Tell the gunner to focus on a target in either the narrow or wide field of view.

(4) Tell the gunner to close both eyes. After he closes his eyes, you, the trainer, must turn and change the setting on the sight.

(5) Tell the gunner to achieve the same sight picture he had before you reset it.

(6) Look through the sight to ensure the gunner has acquired a clear sight picture. If not, show him how to get one.

(7) Repeat the exercise until the gunner achieves proficiency with the sight.

h. **T&E Manipulation and Aiming Exercise.** Use this exercise to train the gunner to manipulate the T&E, acquire targets, and properly sight the target based on the target range. This exercise also trains the gunner to use the mounting bracket to adjust for range.

(1) Set up two to three targets that the gunner can acquire with the HWTS using the T&E.

(2) Regardless of the actual range to the target, tell the gunner to sight in on the first target and give him the range you want it to be.

(3) Ensure the gunner sets the mounting bracket to the correct setting and uses the T&E correctly.

(4) Time the gunner as he conducts this exercise, and create a competition between the gunners in training.

i. **Practice Qualification.** Use practice qualification, modeled after the day qualification scenario, to transition the gunner into engaging multiple timed targets at various ranges.

j. **Qualification.** Use qualification to assess the gunner's ability to engage targets on a timed scenario. If he does not meet the standard during the night practice table, train him again. He must meet the standard on the practice table before firing the qualification table. Conduct the nonfiring exercise as follows:

(1) Place the M2, with HWTS mounted, in the ready-to-fire configuration on the M3 tripod.

(2) Have the gunner close his left eye and look into the HWTS with his right eye.

(3) Tell the gunner to focus on a target in either the narrow or wide field of view.

(4) Tell the gunner to close both eyes. After he closes them, change the setting on the sight.

(5) Tell the gunner to open his eyes and to achieve the same sight picture he had before you reset it.

(6) Look through the sight to ensure the gunner has acquired a clear sight picture. If not, show him how to get one.

(7) Repeat the exercise until the gunner reaches proficiency with the sight.

Section II. AN/TVS-5

Gunners use the AN/TVS-5 (Figure G-3, page G-7) a portable, battery-operated electro-optical instrument, to observe and aim weapons fire at night. The AN/TVS-5 amplifies reflected light such as moonlight, starlight, and sky glow, making the scene clearly visible to the operator. The sight *does not* emit visible or infrared light (except from the eyepiece) that the enemy can detect. By using this device, the gunner can observe the area, and then detect and engage any suitable target. The quality of the zero determines the usefulness of the weapon. Accurate zeroing requires practice. Figure G-3 also provides equipment data for the AN/TVS-5.

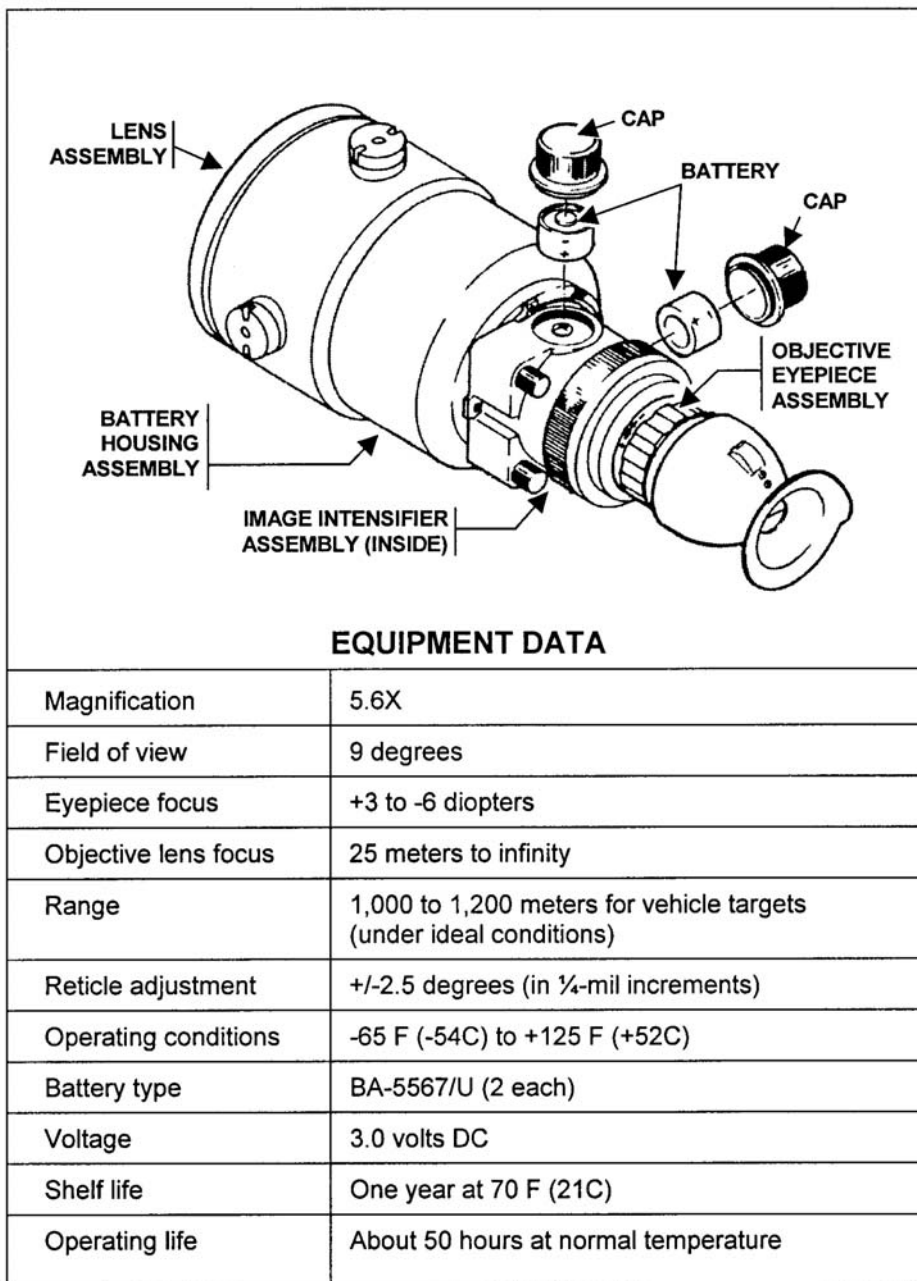


Figure G-3. AN/TVS-5 components and data.

CAUTION

Handle the AN/TVS-5, a precision electro-optical instrument, carefully at all times.

G-3. OPERATION

The AN/TVS-5 has the following controls and indicators:

- a. Use the ON-OFF/TUBE BRIGHTNESS control to apply power to the sight and to control the brightness of the image-intensifier tube. This control also enables the ON-OFF RETICLE BRIGHTNESS control to function.
- b. Use the ON-OFF RETICLE BRIGHTNESS to apply power to the reticle and to control the brightness of the reticle.
- c. Use the OBJECTIVE FOCUS RING to adjust the range focus from 25 meters to infinity.
- d. Use the DIOPTER FOCUS RING to focus the eyepiece.
- e. Use the DIOPTER INDICATOR to learn the current direction of rotation of the DIOPTER FOCUS RING for plus and minus diopters.
- f. Use the RETICLE ELEVATION ADJUSTMENT ACTUATOR to adjust the reticle up and down. Each click moves the strike of the round 1 inch at 100 meters.
- g. Use the RETICLE AZIMUTH ADJUSTMENT ACTUATOR to adjust the reticle right or left. Each click moves the strike of the round 1 inch at 100 meters.

WARNING

- ***Do not* press the eye guard except with your eye area and then only to operate the sight. Used improperly, the sight emits illumination that the enemy can detect.**
- ***Do not* use the sight without the eye guard attached, or you may receive an injury when the weapon recoils.**
- **Use care when discarding the batteries. Their contents cause extreme irritation to the eyes and to oral and nasal passages. To prevent explosion, avoid burning the batteries.**
- ***Do not* short-circuit the batteries.**
- ***Do not* recharge the batteries.**
- **Remove batteries before storing the night vision sight.**
- **Always replace both mercury batteries at the same time.**

G-4. MOUNTING AND DISMOUNTING PROCEDURES

The AN/TVS-5 mounts and dismounts as follows:

a. **Mounting Procedures.** If the mounting bracket (Figure G-4) has not been installed already, install it now as described in TM 11-5855-214-10.

(1) Align the scribe line on the sight with the scribe line on the bracket.

(2) Place the sight in the groove of the bracket and tighten the lever screw clockwise.

(3) Secure the lever screw with lacing wire or tape to ensure the sight does not vibrate loose.

(4) Seat the device. After firing the initial burst, retighten the lever screw to ensure a secure mount for the sight. If unable to fire at this time, lightly shake the sight to ensure it is mounted correctly.

b. **Dismounting Procedures.**

(1) Remove the lacing wire or tape from the lever screw.

(2) Loosen the lever screw until the sight comes free, and then lift it off the bracket.

(3) Remove the batteries and place the sight in its carrying case.

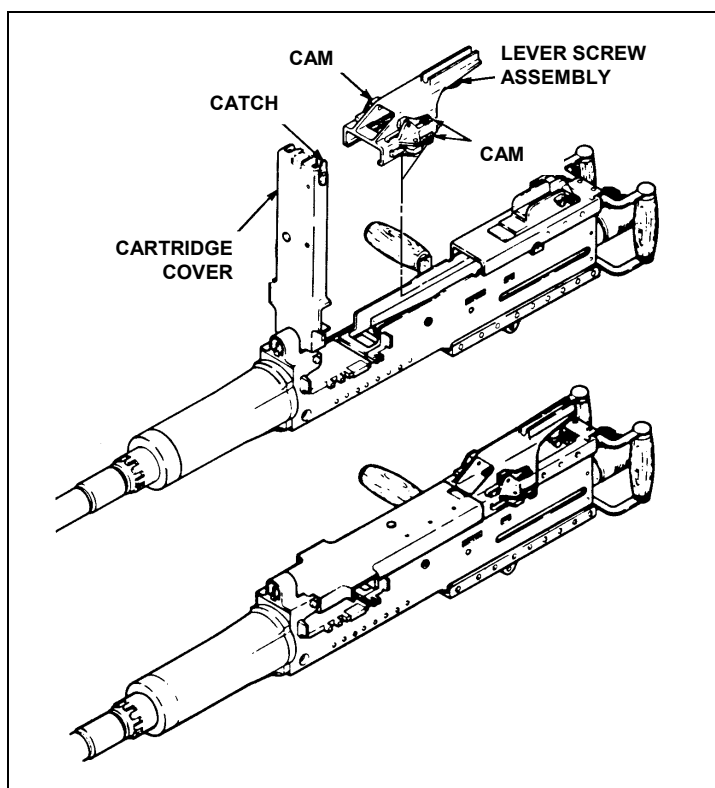


Figure G-4. Installation of M2 mounting bracket assembly.

G-5. FUNDAMENTALS OF MARKSMANSHIP

Except for aiming, the fundamentals of marksmanship for the AN/TVS-5 are the same as those for the AN/PAS-13 heavy weapon thermal sight.

a. Determine the range to the target (Figure G-5, page G-10). The range setting on the HWTS depends on the range to the target. To

determine range to target, use any of several methods: range cards, range estimation techniques, the upper portion of the AN/TVS-5 reticle, or TRPs.

b. After determining range, use the aiming point designated for that range on the M2 reticle (Figure G-6, page G-12 [old reticle]; Figure G-7, page G-13 [new reticle]). If using the HWTS bracket and the M2 reticle, adjust the bracket to the nearest range determined and use the 800-meter aiming point. Use the M2 reticle only if the sight is mounted on the HWTS mounting bracket. Regardless of the range to the target, the 400-meter aiming point serves as the aiming point. Use the bracket to adjust for range.

c. Bring the aiming point of the AN/TVS-5 onto the target using the T&E as explained in Section V.

d. Hold the weapon tight against the T&E, press the trigger, and adjust fire as needed.

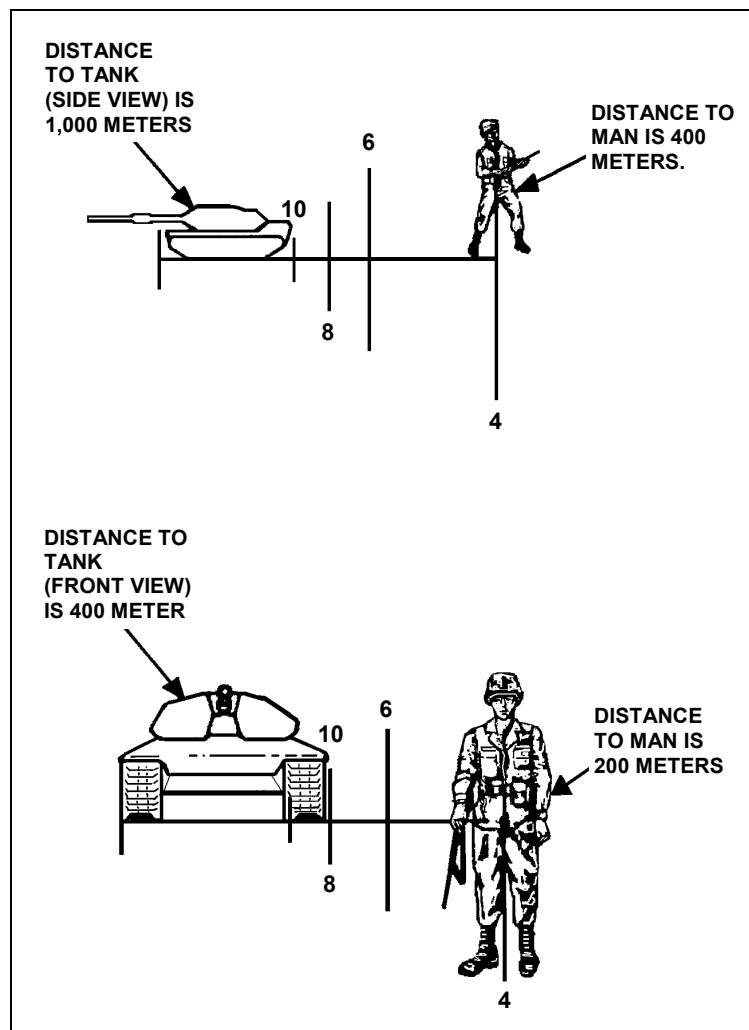


Figure G-5. Range estimation for M2 (old reticle).

G-6. BORESIGHTING PROCEDURES

Boresighting the AN/TVS-5 to the M2 requires the following steps:

- a. Place the M2 in the ready-to-fire configuration, with the AN/TVS-5 mounted, 25 meters from the bore-light-offset zero targets. Ensure the weapon and target sit level before making any adjustments.
- b. Adjust the T&E until the bore light moves onto the bore light aiming point on the boresight target offset.
- c. Use the vertical and horizontal reticle adjusters to move the 1,000-meter aiming point on the reticle to the AN/TVS-5 aiming point.
- d. Recheck the bore light aiming point and the AN/TVS-5 aiming points to ensure they remain center mass of the target.

G-7. ZEROING PROCEDURES

STRAC table (5-23, AT4 [Cat I] Ammunition) in DA Pam 350-38 (page 82) authorizes 12 rounds of 9-mm tracer ammunition to each squad so that additional squad members can go through Firing Tables I and IV (Table G-1).

EVENT	CURRENT STRAC	RECOMMENDED CHANGES	TOTAL
Table I	12 rounds	0 rounds	12 rounds
Table II	12 rounds	0 rounds	12 rounds
Table III (Qual)	8 rounds	0 rounds	8 rounds
Table IV (Night Qual)	6 rounds	2 rounds	8 rounds
Table V (Adv)	6 rounds	0 rounds	0 rounds
TOTAL	44 rounds	2 rounds	40 rounds

Table G-1. Changes to STRAC effective with this publication.

Section III

TABLES AND QUALIFICATION, NIGHT COURSE OF FIRE

Improved firing tables and qualification methods allow the gunner to track his performance while he fires the tables. Requalifying gunners need not repeat the entire course of fire. This section standardizes the four tables to lead the gunner on a gradual path to qualification. The gunner must pass each firing table before he moves on to the next one. The tables in this section require 691 rounds to qualify a gunner--93 more than the old tables required, and 120 more than the STRAC previously authorized. The guidance in this appendix supersedes the STRAC. Though the new tables allow more rounds, they cut the time allowed to qualify. However, they recommend a band of ranges rather than a specific range for each target. This adds considerable flexibility.

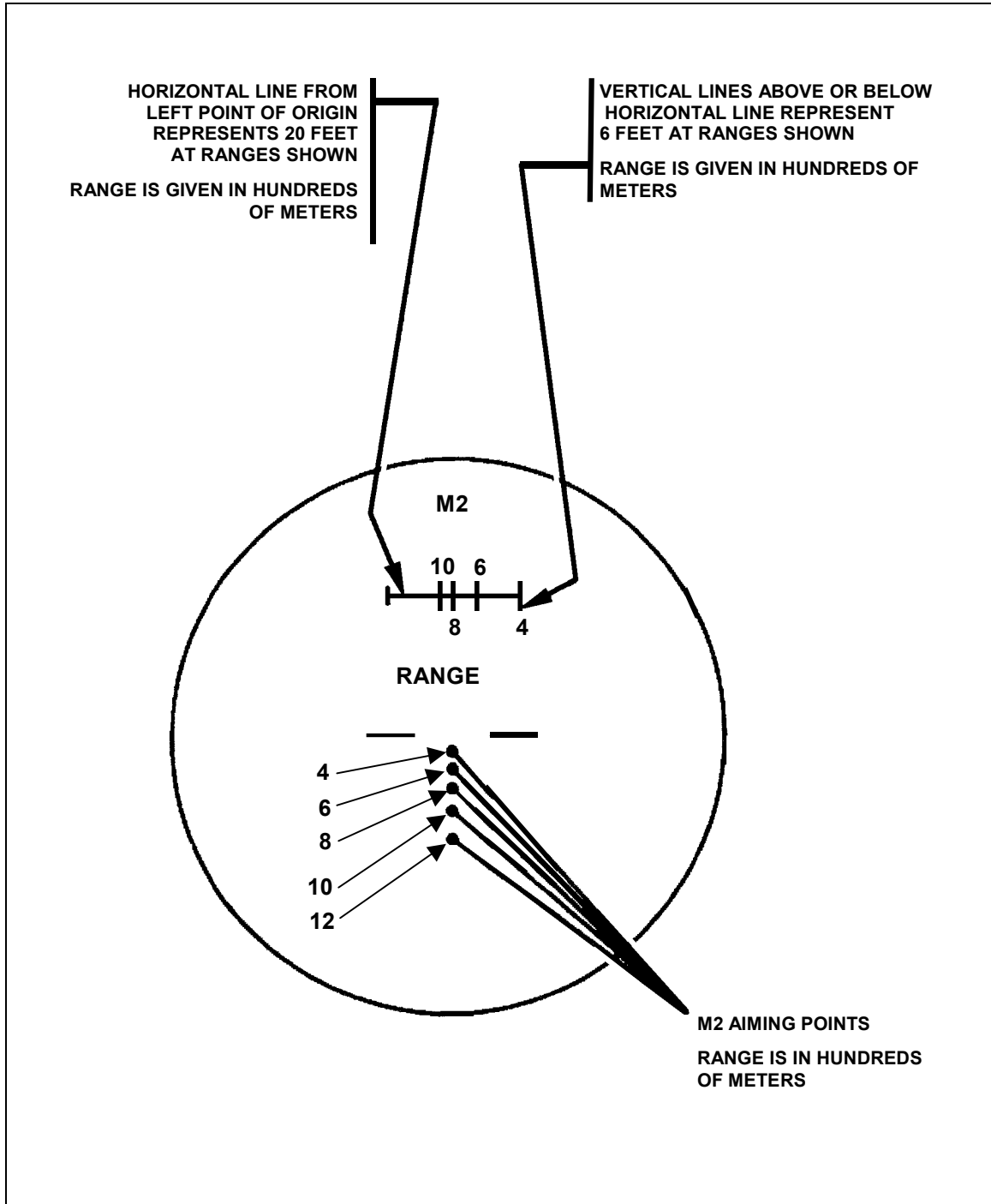


Figure G-6. Aiming points for the M2 (old reticle).

G-8. DIFFERENCES BETWEEN PRACTICE AND QUALIFICATION TABLES

Practice tables allow thirty extra seconds for each engagement. Also, infantry gun crews can practice in the daytime, but must qualify in both the daytime and at night.

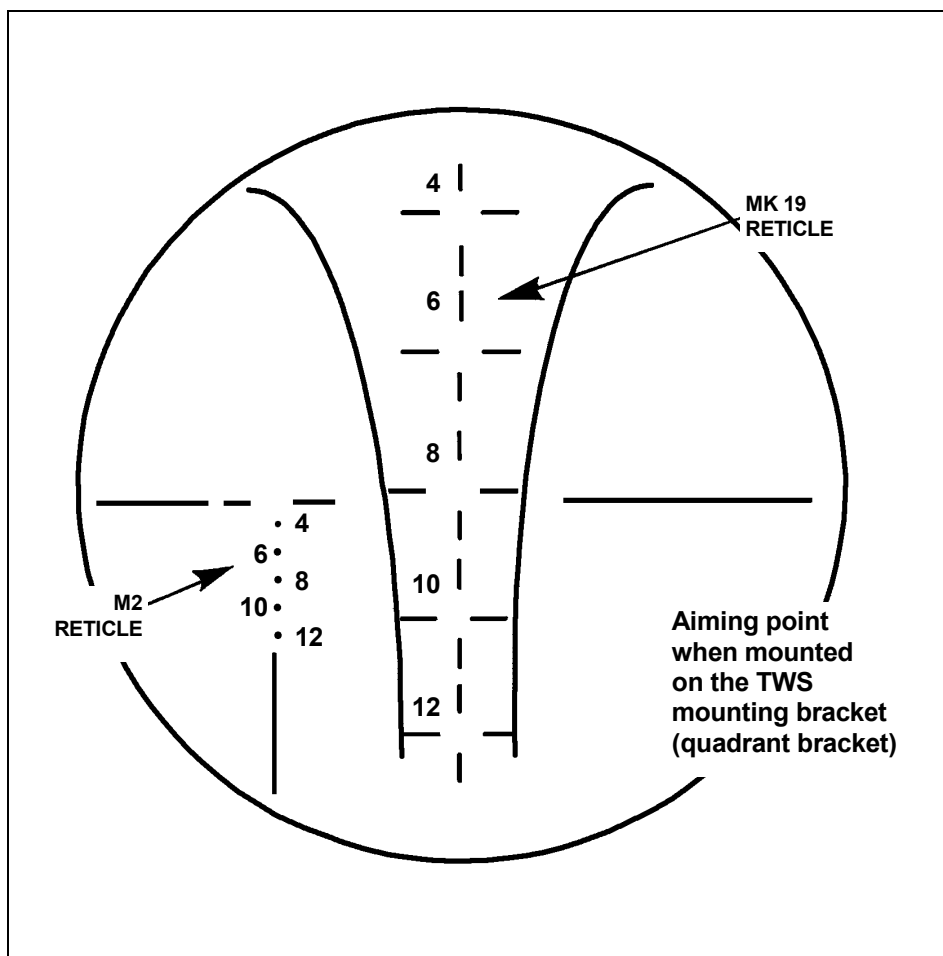


Figure G-7. Aiming points for the M2 (new reticle).

a. **Scoring.** For point target engagements (lightly armored vehicle targets, such as BRDMs and BTRs), give full credit (GO) when the gunner hits the target.

b. **Range Setup.** Set up targets and ranges as follows:

(1) **Targets.** Select target ranges IAW the scorecard for the applicable firing table. When choosing or placing targets, make sure no dead space falls within 100 meters of any of them. Any dead space near the target could keep the gunner from seeing the round impact, which he has to do in order to adjust fire.

(a) **Hull Targets.** You need not modify hull targets on an impact range.

(b) **Popup Silhouettes.** Set up a thermal source on popup silhouette targets so the gunner can acquire them with the HWTS. If the gunner will be using the AN/TVS-5, place a light source on each target.

- Targets between 400 and 600 meters--two chemical lights.
- Targets between 600 and 900 meters--three chemical lights.

(2) **Target Ranges.** Hull target ranges vary between 400 and 1500 meters; popup silhouette ranges vary between 400 and 800 meters.

Beyond 800 meters, gunners cannot engage silhouette targets with consistent results since, beyond that point, velocity and trajectory drop.

c. **Grading.** Each firing point requires one grader.

(1) **Grading Equipment.** While firing the day tables, the grader needs a set of binoculars. His other equipment needs vary according to the type of range used at night.

(a) *Night Vision Assistance.* When firing at hull targets, or when popup targets provide no downrange feedback, the grader must obtain an appropriate night vision device with which to observe the strike of the round.

- AN/PVS-14, 7B, with 3X magnifier.
- AN/TAS-4.
- AN/PAS-13 (heavy).

(b) *Target Scenario.* The grader needs this.

(c) *Range and Range Card.* At each particular firing point, the grader gives the gunner a target and a range at which the gunner must engage the target. The grader needs a range card for that firing range. The range card should include numbered targets and the ranges to them.

(2) **Start and End Times.** Time starts as soon as the grader provides the target range and the target appears--which occur in this order, since graders must provide all required information before the target appears. Sometimes the targets consist of vehicle hulls in stationary positions. In this case, time starts as soon as the grader tells the gunner which target to engage and gives him the range to the target. Regardless of the type of target, time ends when the time designated for that task expires, when the gunner successfully engages the target, or when the target moves out of sight.

(3) **Ammunition.** Ammunition breaks down by task. The gunner places each belt beside the assistant gunner in order of use. The number of rounds authorized for each task equals the number of rounds in each belt. For example, ten engagements require ten belts of ammunition, which should all sit within reach of the assistant gunner in the order the gunner plans to fire them.

(4) **Fire Control.** Controlling M2 firing presents no problem when the range setup includes a firing lane for each firing point. However, this ideal situation seldom occurs with hull targets. In fact, some ranges must use the same target for each lane. This can cause confusion. When, inevitably, more than one gunner fires at the same target, no one can tell who hit it. The 400-meter target usually presents this problem. To prevent it, make sure that only one gunner at a time engages each target. If you want to let more than one gunner to fire at the same time, and then mix up the tasks so the gunners are firing at different targets. For example, have Point One fire at the 1,500-meter target while Point Two engages the 600-meter target, and so on. This requires careful coordination and communication between the graders.

d. **Firing Tables.** Figures G-8 and G-9 (page G-16), Figure G-10 (page G-17), and Figure G-11 (page G-18) show completed examples of the recommended day and night practice and qualification tables for the infantry M2 gunner and crew. These blank, reproducible forms may be copied from the back of this manual onto 8 1/2 by 11-inch paper. They are also available on the Army Electronic Library (AEL) CD-ROM (EM0001) and at the USAPA website located at (<http://www.usapa.army.mil>).

(1) The first task allows evaluation of field zeroing. The gunner confirms the zero, even if he boresighted the weapon. If the gunner fails to zero within 14 rounds, graders remove him from the line and train him some more before letting him refire the table.

(2) All tasks have point targets. Graders should change one or two targets between the ranges of 600 and 900 meters to area targets, but should not change the round count or the time. They base their changes on range resources and the commander's guidance.

(3) Graders match the correct table to each target and weapon-sight configuration.

(4) Graders use range finders to predetermine the range to each target from each firing point.

(5) Graders set up M2s mounted or dismounted (in the tripod configuration), based on the range constraints and the commander's guidance.

e. **Ammunition Requirements for Night Training Strategy.** Table G-2, page G-19, shows the ammunition requirements for a night training strategy.

G-9. SPECIAL MOUNTING PROCEDURES

This paragraph explains the special mounting and dismounting procedures required to mount a night vision device on the M2 heavy barrel .50 caliber machine gun.

a. **Mounting Procedure.** Before mounting the sight, the gunner ensures the bolt is forward and the rear sight is in the down position.

(1) Release and raise the top cover assembly to the upright position.

(2) Place the mounting bracket over the breach and slide it rearward until it stops.

(3) Push the three locking cams rearward until the bracket is secured (lock the side-locking cam first), and close the top cover assembly.

M2 CALIBER .50 HEAVY BARREL MACHINE GUN FIRING TABLE I DAY PRACTICE SCORECARD For use of this form, see FM 23-65, Change 1; the proponent agency is TRADOC.						
DATA REQUIRED BY THE PRIVACY ACT OF 1974 AUTHORITY: 10 USC 3012(g)/Executive order 9397. PRINCIPAL PURPOSE: To aid individual training on targets at various ranges. ROUTINE USES: To evaluate individual proficiency. SSN is used for positive identification purposes only. DISCLOSURE: Voluntary. However, mass rating and scoring require some tracking method. Therefore, only those soldiers who provide their SSNs can receive scores or qualify on weapons or equipment.						
1a. LAST NAME HALSEY		1b. FIRST NAME WILLIAM		1c. MI X	2. DATE (YYYYMMDD) 20021101	
3. SSN 222-22-2222		4. UNIT 2/29TH INF		5. RANGE RUTH		6. LANE 4
7a. ENGAGEMENT	7b. STANDARDS	7c. AMMO	7d. TIME (Minutes)	7e. RANGE (Meters)	7f. GO	7g. NO GO
ZERO	1 BURST HIT	14	NA	400	NA	NA
2	1 BURST HIT	14	1.5	1,100 (±200)		×
3	1 BURST HIT	14	1.5	1,500 (±200)	×	
4	1 BURST HIT	14	1.5	600 (±100)	×	
5	1 BURST HIT	14	1.5	800 (±100)	×	
6	1 BURST HIT	14	1.5	400	×	
8. MULTIPLE TARGETS						
7	1 BURST HIT	28	2.5	1,100 (±200)	×	
	1 BURST HIT			600 (±100)	×	
8	1 BURST HIT	28	2.5	800 (±100)	×	
	1 BURST HIT			1,500 (±200)	×	
9. SCORING (Check one)						
EXPERT - 9 <input type="checkbox"/>		SHARPSHOOTER - 8 <input checked="" type="checkbox"/>				
MARKSMAN - 6 <input type="checkbox"/>		UNQUALIFIED - 5 OR BELOW <input type="checkbox"/>				
10. GUNNER'S SIGNATURE <i>William X. Halsey</i>						
11a. GRADER'S PRINTED OR TYPED NAME SSG GEORGE X. PATTON			11b. GRADER'S SIGNATURE <i>George X. Patton</i>			

DA FORM 7448-R, JAN 2002

USAPA V1.00

Figure G-8. Example completed DA Form 7448-R.

M2 CALIBER .50 HEAVY BARREL MACHINE GUN FIRING TABLE II DAY QUALIFICATION SCORECARD						
For use of this form, see FM 23-65, Change 1; the proponent agency is TRADOC.						
DATA REQUIRED BY THE PRIVACY ACT OF 1974						
AUTHORITY:		10 USC 3012(g)/Executive order 9397.				
PRINCIPAL PURPOSE:		To aid individual training on targets at various ranges.				
ROUTINE USES:		To evaluate individual proficiency. SSN is used for positive identification purposes only.				
DISCLOSURE:		Voluntary. However, mass rating and scoring require some tracking method. Therefore, only those soldiers who provide their SSNs can receive scores or qualify on weapons or equipment.				
1a. LAST NAME		1b. FIRST NAME		1c. MI	2. DATE (YYYYMMDD)	
YEAGER		CHARLES		X	20021102	
3. SSN		4. UNIT		5. RANGE		6. LANE
233-33-3333		2/29TH INF		RUTH		4
7a.	7b.	7c.	7d.	7e.	7f.	7g.
ENGAGEMENT	STANDARDS	AMMO	TIME (Minutes)	RANGE (Meters)	GO	NO GO
ZERO	1 BURST HIT	14	NA	400	NA	NA
2	1 BURST HIT	14	1	1,100 (±200)	×	
3	1 BURST HIT	14	1	1,500 (±200)	×	
4	1 BURST HIT	14	1	600 (±100)	×	
5	1 BURST HIT	14	1	800 (±100)	×	
6	1 BURST HIT	14	1	400	×	
8. MULTIPLE TARGETS						
7	1 BURST HIT	28	2	1,100 (±200)	×	
	1 BURST HIT			600 (±100)	×	
8	1 BURST HIT	28	2	800 (±100)	×	
	1 BURST HIT			1,500 (±200)	×	
9. SCORING (Check one)						
EXPERT - 9		<input checked="" type="checkbox"/>		SHARPSHOOTER - 8		<input type="checkbox"/>
MARKSMAN - 6		<input type="checkbox"/>		UNQUALIFIED - 5 OR BELOW		<input type="checkbox"/>
10. GUNNER'S SIGNATURE						
<i>Charles X. Yeager</i>						
11a. GRADER'S PRINTED OR TYPED NAME				11b. GRADER'S SIGNATURE		
SSG CHESTER X. NIMITZ				<i>Chester X. Nimitz</i>		

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Figure G-9. Example completed DA Form 7449-R.

M2 CALIBER .50 HEAVY BARREL MACHINE GUN FIRING TABLES III (A) AND III (B) NIGHT PRACTICE SCORECARDS						
For use of this form, see FM 23-65, Change 1; the proponent agency is TRADOC.						
DATA REQUIRED BY THE PRIVACY ACT OF 1974						
AUTHORITY:	10 USC 3012(g)/Executive order 9397.					
PRINCIPAL PURPOSE:	To aid individual training on targets at various ranges.					
ROUTINE USES:	To evaluate individual proficiency. SSN is used for positive identification purposes only.					
DISCLOSURE:	Voluntary. However, mass rating and scoring require some tracking method. Therefore, only those soldiers who provide their SSNs can receive scores or qualify on weapons or equipment.					
1a. LAST NAME CHURCHILL		1b. FIRST NAME WINSTON		1c. MI X	2. SSN 222-22-2222	
TABLE III (A). NIGHT PRACTICE SCORECARD						
NOTE: Use this table if the M2 has an AN/TVS-5 that has not been upgraded.						
a. RANGE RUTH		b. UNIT 2/29TH INF		c. LANE 4	d. DATE (YYYYMMDD) 20021207	
e. ENGAGEMENT	f. STANDARDS	g. AMMO	h. TIME (Minutes)	i. RANGE (Meters)	j. GO	k. NO GO
ZERO	1 BURST HIT	14	NA	400	NA	NA
2	1 BURST HIT	14	1.5	1,100 (±200)	X	
3	1 BURST HIT	14	1.5	1,500 (±200)	X	
4	1 BURST HIT	14	1.5	600 (±100)		X
5	1 BURST HIT	14	1.5	800 (±100)	X	
6	1 BURST HIT	14	1.5	400	X	
I. MULTIPLE TARGETS						
7	1 BURST HIT	28	2.5	1,100 (±200)	X	
	1 BURST HIT			600 (±100)	X	
8	1 BURST HIT	28	2.5	800 (±100)	X	
	1 BURST HIT			1,500 (±200)	X	
4. SCORING (Check one)				5. GUNNER'S SIGNATURE		
EXPERT - 9 <input type="checkbox"/>				<i>Winston X. Churchill</i>		
SHARPSHOOTER - 8 <input checked="" type="checkbox"/>						
MARKSMAN - 6 <input type="checkbox"/>						
UNQUALIFIED - 5 OR BELOW <input type="checkbox"/>						
				6a. GRADER'S PRINTED OR TYPED NAME		
				SSG DWIGHT X. EISENHOWER		
				6b. GRADER'S SIGNATURE		
				<i>Dwight X. Eisenhower</i>		
TABLE III (B). NIGHT PRACTICE SCORECARD						
NOTE: Use this table if the M2 has an AN/TVS-5 that has been upgraded.						
a. RANGE RUTH		b. UNIT 2/29TH INF		c. LANE 4	d. DATE (YYYYMMDD) 20021102	
e. ENGAGEMENT	f. STANDARDS	g. AMMO	h. TIME (Minutes)	i. RANGE (Meters)	j. GO	k. NO GO
ZERO	1 BURST HIT	14	NA	400	NA	NA
2	1 BURST HIT	14	1.5	1,100 (±200)	X	
3	1 BURST HIT	14	1.5	1,500 (±200)	X	
4	1 BURST HIT	14	1.5	600 (±100)	X	
5	1 BURST HIT	14	1.5	800 (±100)	X	
6	1 BURST HIT	14	1.5	400	X	
I. MULTIPLE TARGETS						
7	1 BURST HIT	28	2.5	1,100 (±200)	X	
	1 BURST HIT			600 (±100)	X	
8	1 BURST HIT	28	2.5	800 (±100)	X	
	1 BURST HIT			1,500 (±200)	X	
8. SCORING (Check one)				9. GUNNER'S SIGNATURE		
EXPERT - 9 <input type="checkbox"/>				<i>Winston X. Churchill</i>		
SHARPSHOOTER - 8 <input checked="" type="checkbox"/>						
MARKSMAN - 6 <input type="checkbox"/>						
UNQUALIFIED - 5 OR BELOW <input type="checkbox"/>						
				10a. GRADER'S PRINTED OR TYPED NAME		
				SSG ERWIN X. ROMMEL		
				10b. GRADER'S SIGNATURE		
				<i>Erwin X. Rommel</i>		

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Figure G-10. Example completed DA Form 7450-R.

M2 CALIBER .50 HEAVY BARREL MACHINE GUN FIRING TABLES IV (A) AND IV (B) NIGHT QUALIFICATION AND DAY PRACTICE SCORECARDS						
For use of this form, see FM 23-65, Change 1; the proponent agency is TRADOC.						
<p style="text-align: center;">DATA REQUIRED BY THE PRIVACY ACT OF 1974</p> <p>AUTHORITY: 10 USC 3012(g)/Executive order 9397. PRINCIPAL PURPOSE: To aid individual training on targets at various ranges. ROUTINE USES: To evaluate individual proficiency. SSN is used for positive identification purposes only. DISCLOSURE: Voluntary. However, mass rating and scoring require some tracking method. Therefore, only those soldiers who provide their SSNs can receive scores or qualify on weapons or equipment.</p>						
1a. LAST NAME RICKENBACKER		1b. FIRST NAME EDWARD		1c. MI X	2. SSN 444-22-3333	
3. TABLE IV (A). NIGHT QUALIFICATION SCORECARD NOTE: Use this table if the M2 has the TWS, or if it has an AN/TVS-5 that has been upgraded with the third-generation tube.						
a. RANGE RUTH		b. UNIT 2/29TH INF		c. LANE 4	d. DATE (YYYYMMDD) 20021112	
e. ENGAGEMENT	f. STANDARDS	g. AMM	h. TIME (Minutes)	i. RANGE (Meters)	j. GO	k. NO GO
ZERO	1 BURST HIT	14	NA	400	NA	NA
2	1 BURST HIT	14	1	1,100 (±200)	X	
3	1 BURST HIT	14	1	1,500 (±200)	X	
4	1 BURST HIT	14	1	600 (±100)	X	
5	1 BURST HIT	14	1	800 (±100)	X	
6	1 BURST HIT	14	1	400	X	
I. MULTIPLE TARGETS						
7	1 BURST HIT	28	2	1,100 (±200)	X	
	1 BURST HIT			600 (±100)	X	
8	1 BURST HIT	28	2	800 (±100)	X	
	1 BURST HIT			1,500 (±200)	X	
4. SCORING (Check one) EXPERT - 9 <input checked="" type="checkbox"/> SHARPSHOOTER - 8 <input type="checkbox"/> MARKSMAN - 6 <input type="checkbox"/> UNQUALIFIED - 5 OR BELOW <input type="checkbox"/>				5. GUNNER'S SIGNATURE <i>Edward Rickenbacher</i> 6a. GRADER'S PRINTED OR TYPED NAME SSG DOUGLAS X. MACARTHUR 6b. GRADER'S SIGNATURE <i>Douglas X. Macarthur</i>		
7. TABLE IV (B). DAY PRACTICE SCORECARD NOTE: Use this table if the M2 has an AN/TVS-5 that has not been upgraded.						
a. RANGE RUTH		b. UNIT 2/29TH INF		c. LANE 4	d. DATE (YYYYMMDD) 20021112	
e. ENGAGEMENT	f. STANDARDS	g. AMMO	h. TIME (Minutes)	i. RANGE (Meters)	j. GO	k. NO GO
ZERO	1 BURST HIT	14	NA	400	NA	NA
2	1 BURST HIT	14	1	1,100 (±200)	X	
3	1 BURST HIT	14	1	1,500 (±200)	X	
4	1 BURST HIT	14	1	600 (±100)	X	
5	1 BURST HIT	14	1	800 (±100)	X	
6	1 BURST HIT	14	1	400	X	
I. MULTIPLE TARGETS						
7	1 BURST HIT	28	2	1,100 (±200)		X
	1 BURST HIT			600 (±100)	X	
8	1 BURST HIT	28	2	800 (±100)	X	
	1 BURST HIT			1,500 (±200)	X	
8. SCORING (Check one) EXPERT - 9 <input type="checkbox"/> SHARPSHOOTER - 8 <input checked="" type="checkbox"/> MARKSMAN - 6 <input type="checkbox"/> UNQUALIFIED - 5 OR BELOW <input type="checkbox"/>				9. GUNNER'S SIGNATURE <i>Edward Rickenbacher</i> 10a. GRADER'S PRINTED OR TYPED NAME SFC NATHAN X. TWINING 10b. GRADER'S SIGNATURE <i>Nathan X. Twining</i>		

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Figure G-11. Example completed DA Form 7451-R

EVENT	CURRENT STRAC BALL/MIX	RECOMMENDED CHANGES	TOTAL BALL/MIX
10M ZERO	12 BALL	0	12 BALL
10M RECORD	119 BALL	0	119 BALL
TRANSITION ZERO/ PRACTICE	50 MIX	ELIMINATE	0
TRANSITION RECORD	154 MIX	ELIMINATE	0
NIGHT ZERO/PRACTICE/RECORD	182 MIX	ELIMINATE	0
ASST GUNNER INSTR FIRE	54 MIX	ELIMINATE	0
TABLE I	0	140 MIX	140 MIX
TABLE II	0	140 MIX	140 MIX
TABLE III	0	140 MIX	140 MIX
TABLE IV	0	140 MIX	140 MIX
TOTAL	131/440 = 571	560 MIX	131/560 = 691
<p>NOTE: The above STRAC supports one qualification. Allocations increase with the frequency of qualifications required. Check the firing unit's force activity designator (FAD).</p>			

Table G-2. Ammunition for night training strategy.

DANGER

BEFORE INSTALLING THE BRACKET, MAKE SURE THE WEAPON IS *UNLOADED* AND THE SAFETY IS SET ON *SAFE*. A LOADED WEAPON CAN DISCHARGE ACCIDENTALLY, INJURING OR KILLING SOMEONE.

NOTE: If the bracket sticks before reaching its correct position, rock the bracket up and down while sliding it.

b. **Dismounting Procedure.** Ensure the weapon is clear and the bolt is forward.

- (1) Raise the top cover assembly to the upright position.
- (2) Push the three locking cams forward until the bracket is free.
- (3) Slide the mounting bracket forward over the breach until the mounting bracket clears the weapon.

**Section IV.
BORE-LIGHTING PROCESS AND BORESIGHT TARGET
OFFSETS**

The bore light allows gunners to accurately zero weapons and most aided vision equipment without the use of bullets. Table G-3 shows different combinations of weapons and aided vision devices that gunners can use to zero the bore light.

DANGER

- **DO NOT STARE INTO THE VISIBLE LASER BEAM.**
- **DO NOT LOOK INTO THE VISIBLE LASER BEAM THROUGH A TELESCOPE OR A PAIR OF BINOCULARS.**
- **DO NOT POINT THE VISIBLE LASER BEAM AT A MIRROR-LIKE SURFACE.**
- **DO NOT SHINE THE VISIBLE LASER BEAM INTO OTHER PEOPLE'S EYES.**

WARNING

- **Make sure the weapon is CLEAR and on SAFE before using the bore light.**
- **When rotating the bore light to zero it, ensure the mandrel turns. Do not tighten the bore light down on the mandrel; doing so could strip or break the mandrel's stud.**

	M16A2	M4/MWS	M249	M240B/M60	M2	M203	AT4
AN/PAQ-4C	X	X	X	X		X	X
AN/PEQ-2A	X	X	X	X	X	X	X
AN/PAS-13	X	X	X	X	X		X
M68 CCO	X	X					
AN/PVS-4	X	X	X	X		X	
AN/TVS-5					X		

Table G-3. Possible weapon-aided vision-device combinations.

G-10. BORESIGHTING PROCESS

Properly boresighting a weapon requires two gunners--a firer and a target-holder.

a. Personnel.

(1) *Firer.* The firer zeroes the bore light and adjusts the aided vision device. Before boresighting, he locks the M2 down in a cradle or some other device to keep the weapon stable during the boresighting process. In the absence of such a device, he assumes the most stable supported firing position possible and makes sure the weapon does not cant during boresighting.

(2) *Target holder.* The target holder keeps the target straight up and down at the appropriate distance from the firer and directs the firer in making necessary sight adjustments. The target holder *must* wear night vision goggles when viewing laser aiming light offsets.

b. Steps.

(1) *Align Bore Light.* Checking the alignment of the bore light requires the following actions:

(a) Place the appropriate mandrel, with bore light attached, in the muzzle of the weapon.

(b) Turn the bore light on so that the laser beam strikes the target (offset) 10 meters away.

(c) Slowly rotate the bore light one-half turn (180 degrees) while watching the beam on the target area, noting any circular patterns made.

(d) If the beam remains stationary, you have boresighted the M2. Move forward to the next paragraph and use the appropriate boresight target for the given weapon.

(e) If the beam rotates in a circle, adjust the windage, elevation, or both, until the beam remains stationary or rotates on itself no more than 1 centimeter.

(2) *Adjust Bore Light.* If necessary, the firer and target holder must adjust the bore light.

(a) Move the target 2 meters away.

(b) Mark the location of the laser beam.

(c) Slowly rotate the bore light one-half turn.

(d) Note the new location of the laser beam.

(e) Adjust the windage and elevation until the laser beam moves halfway back to its original location.

(3) *Adjust elevation adjustment screw.* One click at 25 meters equals 4 millimeters; clockwise equals down.

(4) *Adjust windage adjustment screw.* One click at 25 meters equals 4 millimeters; clockwise equals left.

(5) *Continue adjusting the bore light.* Keep adjusting it until the laser beam either stops moving or spins upon itself within 1 centimeter.

(6) *Move the target, and recheck the boresight.* Move it 10 meters away and recheck the boresight. Repeat this process every 10 meters if necessary.

NOTE: Because the M2 requires such a large offset, place the offset for the boresight target 5 meters away.

(7) *Boresight the Aided Vision Device to the Weapon.* Select the boresight target offset for the appropriate aided vision device. For laser aiming lights, position the weapon so the bore light strikes the black dot on the boresight target.

(a) Adjust the *laser* until it centers on the cross on the boresight target offset. For aided vision optics, position the weapon so the *reticle* centers on the cross on the boresight target offset (the firer must physically aim the weapon).

(b) Adjust the aided vision optic until the bore light strikes the black dot on the boresight target. Refer to specific instructions on each boresight-offset target.

(c) You have boresighted the weapon when both the laser bore light and the aiming point or laser move to the appropriate position on the boresight target offset.

G-11. TARGET OFFSETS

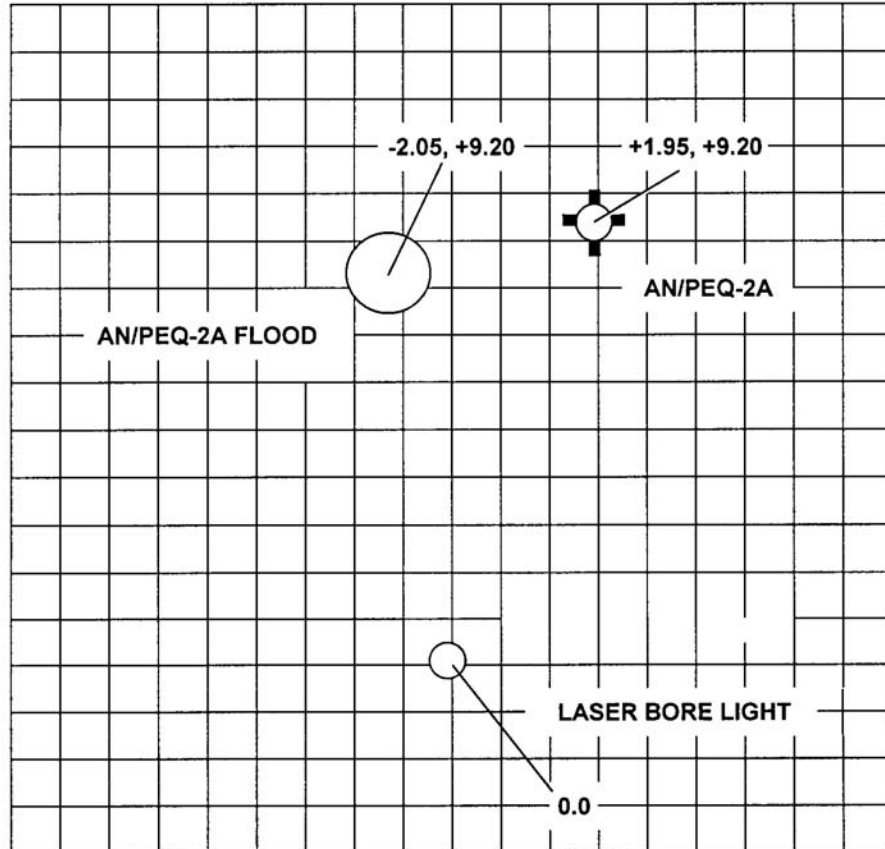
Figure G-12 (page G-23), Figure G-13 (page G-24), and Figure G-14 (page G-25) show example boresight target offsets. The gunner measures boresight offsets in 1-centimeter squares. For targets, he copies M16A2 25-meter zero targets, with the silhouette representing the point of aim.

a. **Aligning the M2 with the AN/PEQ-2A.** Using the 10-meter boresight target, align the bore light on the dot and adjust the AN/PEQ-2A to the cross. This gives an 800-meter zero (Figure G-12, page G-23).

b. **Aligning the M2 with the AN/TVS-5.** Using the 10-meter boresight target, place the target at a distance of 10 meters. Aim the 400-meter AN/TVS-5 reticle at the cross and adjust the sight so that the bore light strikes the dot (Figure G-13, page G-24).

c. **Aligning the M2 with the AN/PAS-13.** Using the 10-meter boresight target, place the tips of the index fingers on the gray circles. Aim between the hot spots provided by the fingers. Adjust the TWS so that the bore light strikes the dot when you aim between the hot spots at 10 meters. If using a spacer, increase the offset by the height of the spacer (Figure G-14, page G-25).

**10-meter boresight target AN/PEQ-2A
mounted on an AN/TVS-5 feed tray cover bracket
and plastic spacer on M2 MG**



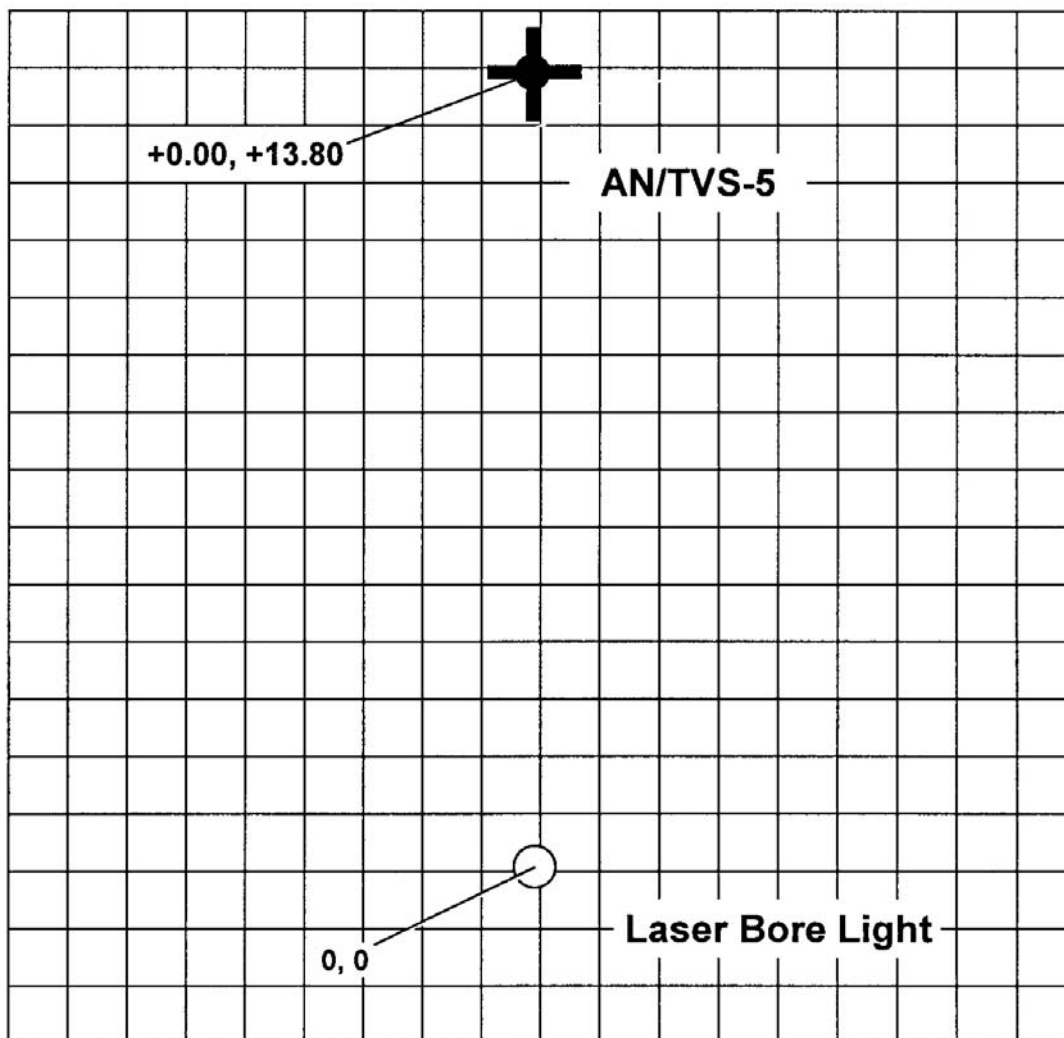
**This is the 10-meter boresight target for 500-meter zero.
Grids are 1-centimeter square.
Units manufacture targets locally.**

Zero target data for M2 MG:

- 1. Stabilize the weapon.**
- 2. Align laser borelight on its dot.**
- 3. Adjust the AN/PEQ-2A until aiming laser centers on the dot cross hair.**

Figure G-12. Alignment of M2 with the AN/PEQ-2A.

**10-meter boresight target
AN/TVS-5 mounted on AN/TVS-5 feed tray cover bracket
on the M2 MG.**



**This is the 10-meter boresight target for the
500-meter zero. Grids measure 1 cm square.
Units manufacture targets locally.**

Zero target data for M2 MG:

1. Stabilize the weapon.
2. Aim the AN/TVS-5 at the cross hair and adjust until the borelight strikes the laser's borelight dot.

Figure G-13. Alignment of M2 with the AN/TVS-5.

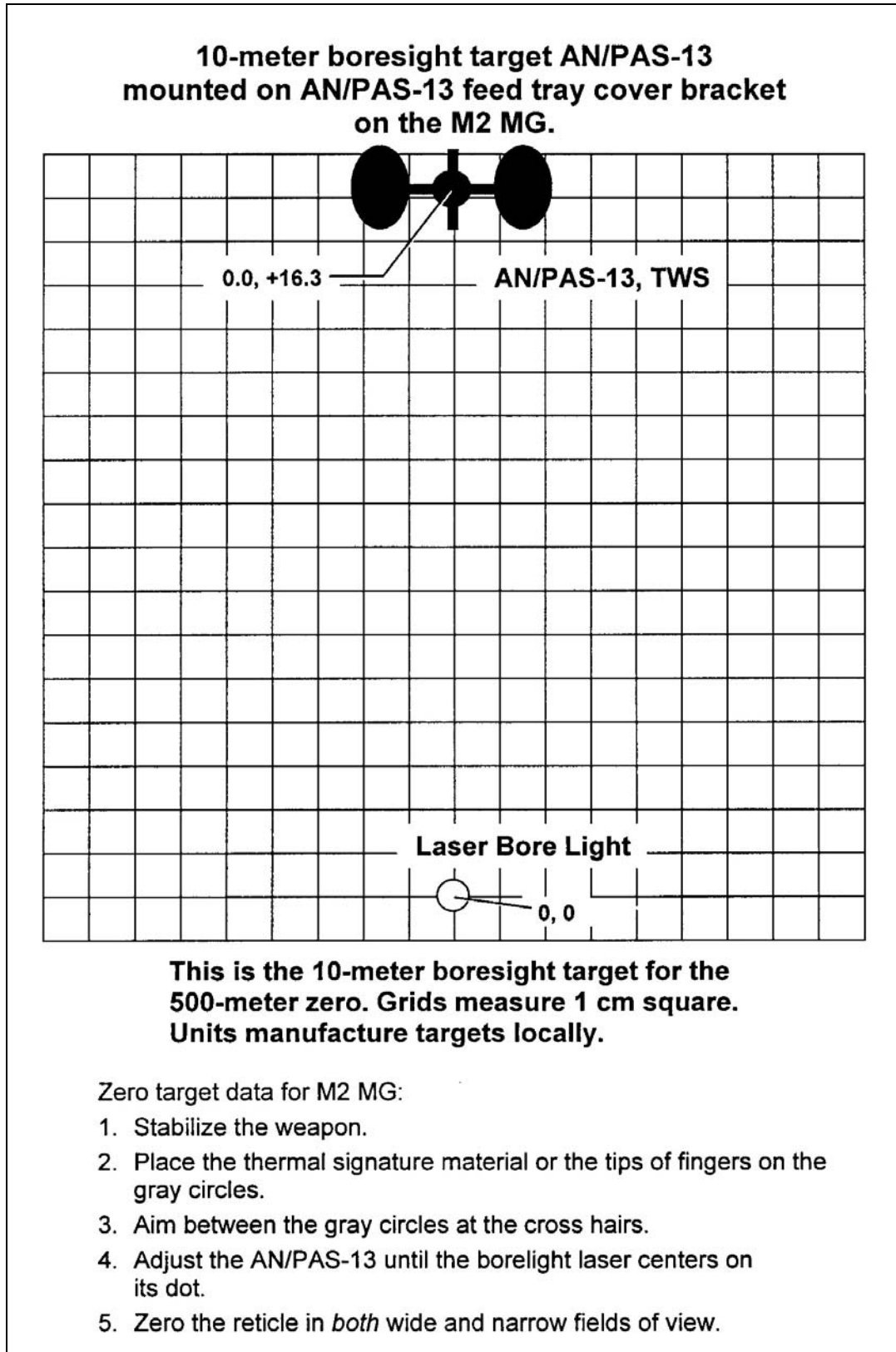


Figure G-14. Alignment of M2 with the AN/PAS-13.

Section V. T&E MANIPULATION

The T&E mechanism allows engagement of preselected target areas at night or during limited visibility. The gunner records (in mils) the direction and elevation readings from the traversing bar and T&E mechanism.

G-12. ZEROING THE T&E

Before a gunner can effectively engage targets with the T&E, he must zero it to the weapon:

a. **Zero Traversing Handwheel.** Hold the T&E so the traversing handwheel sits on the left as you look at it.

(1) Turn the traversing handwheel toward you until it stops.

(2) Loosen the locking nut slightly.

(3) Align the zero on the scale with the zero on the elevating screw yoke.

(4) Hold the scale (with the zeroes aligned) and tighten the locking nut. Make sure the zeroes remain aligned.

(5) Turn the traversing handwheel two complete revolutions away from you. If doing this at night, count 50 "clicks" away from you.

b. **Zero Elevating Handwheel to Upper Elevating Screw.** Align the two zeroes.

(1) Rotate the elevating handwheel up or down until you can see a zero with a line below it on the upper elevating screw.

(2) Position the elevating handwheel so the indicator points to the zero on the handwheel.

c. **Zero Elevating Mechanism Sleeve to Lower Elevating Screw.**

(1) Rotate the elevating mechanism sleeve all the way up, and then rotate it down until it stops. Note the number of complete turns down.

(2) Rotate the elevating mechanism sleeve up half that many turns.

(3) Position the slide lock lever to face you.

(4) Attach the T&E to the tripod and gun.

G-13. LAYING THE GUN FOR DIRECTION

After the gunner receives an assigned sector of fire, he should--

a. Pick up the rear legs of the tripod.

b. Shift the tripod until the muzzle of the weapon points to the center of the sector of fire.

c. After laying the weapon for direction, firmly stamp in the tripod shoes and place sandbags on the legs. This aids stability and may prevent accidental movement.

d. Obtain and record directional readings to all targets within the sector and perform the following:

(1) Loosen the traversing slide lock lever and move the slide along the traversing bar until the weapon lays either on the center of a point target or on the flank of a linear target.

(2) Lock the traversing bar. Read the direction from the scale on the traversing bar. If the left edge of the traversing slide falls anywhere outside the 5-mil tick mark, the gunner moves the left edge of the traversing bar slide back to the next smaller mil reading. Then, the gunner uses the traversing handwheel to complete the initial lay.

e. Obtain a reading to the target by the direction of the weapon barrel. If the barrel is moved to the right, the gunner records a right heading. He reads the number on the traversing bar from the left side of the traversing slide lock. If the barrel is moved to the left and the traversing slide lock is on the right side of the zero, he records a left reading.

f. After taking a directional reading for a target, measure the width of the target in mils. Then, he uses the traversing handwheel to move the barrel across the target--one click equals one mil.

g. Before moving to another target, reposition the traversing mechanism.

h. Obtain elevation readings. The gunner verifies that the weapon is laid on the center base of the target. Read the elevation from two scales.

i. Get the first, or major, part of the elevation from the elevating screw plate scale.

j. Get the second, or minor, part of the elevation from the elevating handwheel.

k. Separate the two parts of the elevation reading with a slash (/). For example, the gunner could write "-50/3." An elevation reading might apply only to the T&E where he reads it.

l. Note that, if the number of threads increases or decreases after he records the data, he cannot place accurate fire on the target. For example, rotating the base of the T&E mechanism to engage a secondary sector makes the data incorrect--unless the same number of threads appear both before and after the move.