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REVIEW OF LIGHT MACHINEGUN TRAINING IN INFANTRY BASIC TRAINING

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INTRODUCTION

BACKGROUND

The machinegun has been a critical weapon for use by infantrymen since its development and subsequent proliferation during World War I. Design improvements have been made over the decades to meet specific mission needs for machineguns in battle. Machinegun training in the U.S. Army presently suffers from resource austerity making it critical to identify the most efficient and effective training procedures possible. Litton Mellonics, under contract to the U.S. Army Research Institute (ARI) for the Behavioral and Social Sciences, in preparing this report, reviewed past and present machinegun training programs, programs from other services, as well as those of other countries. This was accomplished to establish a solid foundation for future research and training program developments.

PURPOSE

→ The purpose of this research is to place in context the current state of primary machinegun training in the U.S. Army. This effort focuses interest on the M60 machinegun, which has the most general application. The M60, a 7.62mm machinegun, is the primary machinegun used in Initial Entry Training (IET). The focus of this report is on issues relating to the current training effectiveness of the M60 machinegun. Accordingly, ARI/Litton undertook this effort to analyze machinegun training in IET and make recommendations for its improvement. *Keywords*

OBJECTIVES

The objectives of this research effort stated below are accompanied by specific steps which were taken to meet these objectives. 1473

Objective 1 - Review and evaluate methods of M60 machinegun employment and weapon effectiveness (training implications to be considered).

- o Review military training literature and doctrine.
- o Review historical documents which have pertinence to the development of the machinegun training methodologies in use.
- o Analyze historical doctrine and current procedures for appropriateness to the training mission currently accepted.
- o Observe training as it is conducted and determine how well it meets established doctrinal standards.
- o Review engineering and operational tests for weapon capabilities.

Objective 2 - Investigate current M60 machinegun training programs and their effectiveness.

- o Conduct observations of machinegun training.
- o Develop an improved machinegun training package consistent with current time and ammunition allotments.
- o Conduct field validation of the improved machinegun training within

present time and ammunition allotments.

METHOD

In order to pursue this effort, IET machinegun training was observed and was compared to historic U.S. Army training, and to current U.S. Marine Corps training, selected allied training programs, and a threat analysis in order to determine its comparable adequacy. Engineering tests and service tests of the M60 were also reviewed to better understand the M60's capabilities and the optimum size of burst.

A review has been conducted of available literature to include current training tasks outlined in Soldiers Manuals (FM 7-11B 1/2), and published programs (FM 23-67) which serve as resource materials to institutional trainers and to units training in the field. Our review disclosed that in recent years, the hours dedicated to M60 training have been drastically reduced; the trainee's ability to engage target arrays with the machinegun is judged to be poor.

A series of observations of training presented at the U.S. Army Infantry School (USAIS) was conducted. An analysis of training tasks, by program, has been developed from doctrine and the results of the field observations. An on-site visit was made to the U.S. Marine Corps Infantry Training School, Camp Lejeune, North Carolina, to provide a comparison of training procedures and philosophies for IET (U.S. Army) and Infantry machinegun training (USMC).

An immediate product of the present research has been a program modification in IET at USAIS based on field experimentation conducted with One Station Unit Training (OSUT) training cadre and soldiers. ARI/Litton conducted an experiment in basic training within the current 14-hour Program of Instruction (POI). Instruction was modified to include the principles of sight alignment, sight picture, proper setting of the sights, field zeroing, and the use of the assistant gunner to aid in the observation and adjustment of fire. The current 14 hours devoted to training was maintained. Soldiers receiving this instruction hit 64% more targets than the soldiers receiving the standard instruction. While this improvement is significant, it is most important to remember that the average hit rate went from 7 to 12 out of a hundred rounds fired at arrayed targets. In our opinion 12% hits is inadequate and serious consideration should be given to expanding the amount of time devoted to machinegun training in IET.

In summary, the methods employed to accomplish this research included: literature and training doctrine review, observations of training and related problem areas, and field experimentation.

ORGANIZATION OF THE REPORT

This report is, in general, a summary of historical reviews and field observations made during the research year. These reviews and activities are presented in five major sections:

- o Literature and Doctrine Review
- o Weapon Capabilities
- o Current Training Procedures

- o Analysis of the Current 14-hour IET Program
- o Recommended "Improved" 14-hour IET Program
- o Experimental Evaluation of the "Improved" 14-hour IET Program
- o Conclusions and Recommendations

LITERATURE AND DOCTRINE REVIEW

A review of historic data on machinegun training was undertaken in order to broaden our perspective of training practices. This was considered to be relevant because the art of firing a machinegun is not new in terms of theory or technology. The ballistics of the M60 machinegun are quite similar to the ballistics of the light machineguns employed during World War I. Sighting systems are comparable as well.

In the World War I era, the machinegun was a premier weapon and a great deal of time was devoted to its training. Today the M60 is just one weapon among many which must be taught within a time-constrained Initial Entry Training (IET) Program.

The hours devoted to light machinegun training during IET ranged from 88 hours in the 1917 era, to between 60 and 70 hours in the late 1950's and early 1960's. Practice and fundamentals training were considered imperative in producing qualified gunners. Unfortunately, today's abbreviated IET program of 14 hours of familiarization does not produce adequately trained gunners. Current training philosophy is that machinegunners will be qualified after assignment to units; however, limited observations of unit machinegun teams suggest that adequate training is not generally being conducted.

Earlier era training placed greater emphasis on preliminary marksmanship instruction. This training was not only to teach the correct fundamentals, but also to drill the soldiers so that they developed and internalized fixed habits before going to range firing for live fire practice.

The philosophy expressed was: "marksmen are made during preparatory training", and further, that "no man is allowed to fire on the range until he has received thorough training in preparatory marksmanship" (FM 23-55, Oct. 1955).

The preparatory exercises included:

- o Sighting-and-aiming exercises
- o Position exercises
- o Sight-setting and laying exercises
- o Manipulation exercises

The sighting-and-aiming exercises would appear comprehensive compared to current practices. There were a total of four:

- o First - use of a sighting bar -- front and rear sights with target
- o Second - laying the MG sights on a target -- checked by a coach
- o Third -- triangulation exercises
- o Fourth -- demonstrating and explaining the effect of weapon canting

An example was given and each man was rated as proficient in all of the preparatory training before he was allowed to fire a shot.

The course of fire began at close range using paper targets. This provided targets where errors could be readily detected and the strike of the bullets easily seen. In addition, targets were inspected frequently and without delay. It was considered essential to first develop skill and prove marksmanship ability at close range using paper targets before progressing to firing at longer ranges.

Firing on long range targets commenced with single shot firing. This was to zero-in the sights and demonstrate that the trainee could use the sights properly and perform the integrated act of firing in a consistent and uniform manner. Initial firing in bursts was then conducted and shot groups were measured to determine uniformity of weapon holding. Exercises in fire distribution were then conducted, using traversing fire and searching fire. Finally, when proficiency was proven, reduced time limits were imposed to develop target engagement speed.

Field firing was conducted on various arrays of silhouette targets at distances of from 300 yards to 700 yards, for direct fire, and out to 2000 yards for indirect fire.

Significantly, all firing was under the direct supervision of knowledgeable instructors. Each shot or burst fired was observed by an instructor, and coaching was provided as required. As part of all range firing, machinegun sights were blackened (front and rear) to reduce glare. This practice is still considered appropriate, although it is not enforced on marksmanship ranges as it was in the past.

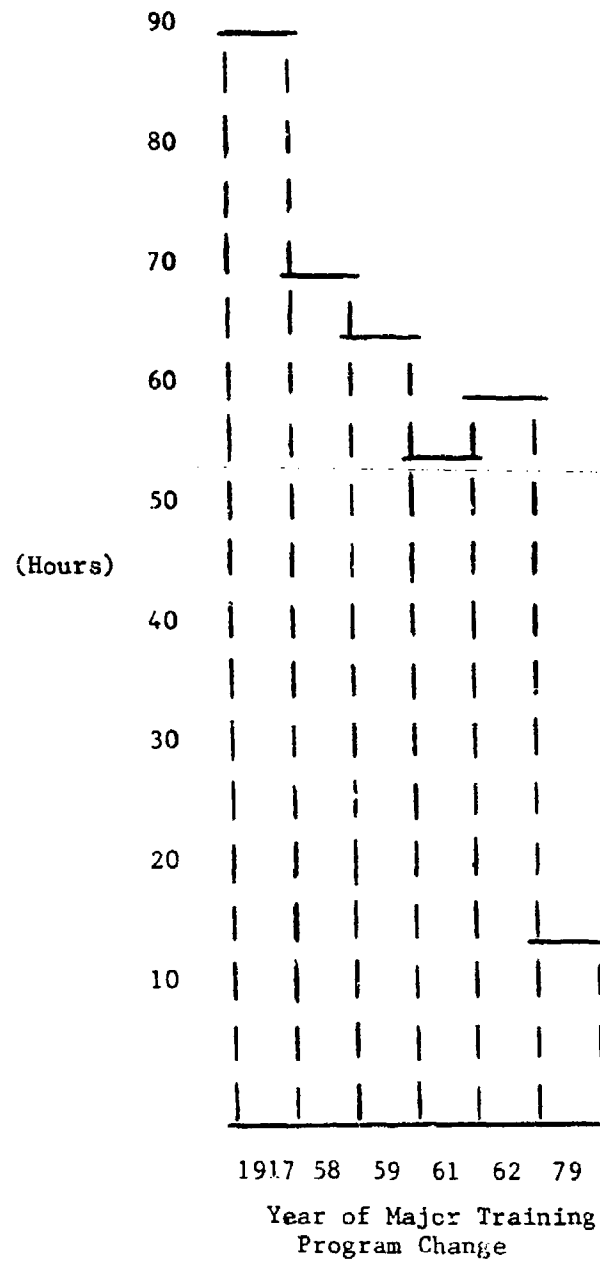
Machineguns in World War I and II were predominantly employed on tripods. The tripod provided stability to the weapon, and permitted the firing of thousands of rounds without unduly fatiguing the firer. The tripod was used both during an attack (from an overwatch position), and in the defense. The tripod permits precise target engagement, even in the dark, using traverse and elevation data recorded on prepared range cards. This employment method was practiced during range firing. Manipulation training made the gunner familiar with the traverse and elevation mechanism (T & E) and its use. This type of training is still expressed as accepted U.S. Army doctrine (FM 23-67).

Machinegun tasks have changed over the years as a result of differences in the employment techniques of machineguns. In the World War I era, machinegun companies and battalions were employed. Special training was required for officers assigned to those units because indirect fire employment was a common role for the machinegun. This mission is no longer trained using the current M60 machinegun.

Figure 1 illustrates the reduction in training hours committed to fundamental machinegun training since 1917. The reduction represents a lessening of time available for practice and reinforcement primarily, though some time was lost as a result of reduction in firing tasks.

Machinegun training, in summary, was considered important from its inception through the early Vietnam era, if numbers of training hours committed to it are considered (Figure 1). In practice, it is very likely that less time was actually spent than the subject schedules may suggest, particularly beginning in the late 1960's and early 1970's. The reduction in IET training hours reflected in the change from Army Subject Schedule 23-35 (1962) to the

FIGURE 1. Machinegun Training for the Basic Trainee



OSUT Program (1979) is drastic. Less than 25% of the training time for machineguns remained after this change.

WEAPON CAPABILITIES:
ENGINEERING, MAINTENANCE, AND OPERATIONAL TESTING

The foregoing review of training practices indicated that machinegun training was greatly curtailed over the years and was, in fact, reduced to familiarization training for infantrymen. While training and training program improvements will remain our focus of interest, this section deals with the capabilities of the weapon itself. In it we will consider: accuracy requirements, accuracy tests, ability to perform common operations, zero differences occurring with barrel changes, suppressive fire requirements, burst size considerations, automatic fire accuracy from assault fire positions, and M60 malfunction considerations.

Accuracy Requirements

Established production acceptance testing standards (MIL-M-45013C) require that M60 machineguns, when fired from rigid test stands, meet the following accuracy criteria:

Nine of ten shots fired in a ten shot burst must group within, or cut the edge of a circle which has its size determined by standard ranges. The accuracy requirements at three standard ranges are:

<u>Range</u>	<u>Circle Diameter</u>
1000 inches	3.0 inches
50 yards	5.4 inches
100 yards	10.8 inches

Accuracy of Fire

The data shown in Table 1 was extracted from an "Engineering Test of Small Arms Weapons Systems", conducted at Aberdeen Proving Grounds (Report No. DPS 1970, 1966). These data define the accuracy of the M60 machinegun, employed under controlled conditions on bipod and tripod. It is important to point out that the accuracy provided by the tripod mount is superior to that obtained by the bipod mounted firings.

These data suggest that in the hands of a skilled gunner considerable accuracy can be achieved from both tripod and bipod. Clearly, suppressive fire on point targets can be achieved at 800 meters.

Additional testing was conducted by the U.S. Army Infantry Board (USAIB) in 1965, in conjunction with the previously mentioned tests at Aberdeen Proving Grounds. The USAIB tests were conducted to determine the most appropriate operational methods of employment for the M60 machinegun and to determine typical user performance levels while firing the weapon. The results of a series of tests in USAIB Project Number 3110 (1965) more realistically portray infantry user potential, given proper training.

Ability to Perform Common Operations

Table 2 shows the average (Mean) time for practiced gun crews to change

TABLE 1. Results of
Engineering Test of M60 Machinegun, 1966
Spread in Inches

Range Meters	Full-Automatic		*Semi-Automatic		Full-Automatic		*Semi-Automatic	
	Extreme Spread	Mean Radius	Extreme Spread	Mean Radius	Extreme Spread	Mean Radius	Extreme Spread	Mean Radius
100 M	18.8"	5.3"	10.5"	3.2"	13.8"	4.3"	12.1"	4.0"
200M	30.1"	8.1"			23.1"	7.3"		
300M	47.4"	12.9"			41.9"	13.5"		
400M	68.1"	17.4"			50.1"	15.6"		
500M	99.9"	24.9"	78.4"	23.2"	48.5"	15.6"	52.6"	16.4"
600M	86.8"	24.3"			67.8"	19.5"		
700M	158.2"	38.0"			81.9"	26.1"		
800M	138.2"	40.1"			104.3"	30.0"		
900M	169.7"	53.4"						

NOTE: Mean Radius of shot groups is based on the mean obtained for five shot groups of 10 rounds each using skilled firers.

*Semi-automatic fire was achieved by loading and firing single rounds.

barrels developed during the U.S. Army Infantry Board tests.

TABLE 2. Barrell Change Times

Condition of Barrel on Gun	Mean Time in Seconds to Change	
	M60 Bipod Mounted	M60 Tripod Mounted
Cold barrell	8.7	7.5
Hot barrel*	10.2	8.5
Hot barrel	8.0	8.3

*(using asbestos glove)

The Infantry Board commented that the asbestos glove, while cumbersome, allows the assistant gunner to change the barrel on the machinegun without concern for burns. In practice, once a gun crew is familiar with the operation of the machinegun, the time required to perform common operations (clearing, immediate action for jams) is relatively short.

Zero Differences with Barrel Change

During the U.S. Army Infantry Board tests, the comparative zeroes for the two barrels of twelve machineguns were recorded. ~~Each machinegun was zeroed and then its barrel was changed. The weapon was then rezeroed because of the barrel change.~~ The results of the test are shown in Table 3.

TABLE 3. Sight Changes Required
Because of Barrel Change (in clicks)

	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>
Elevation	15	0	2.70 1/4 Milliradian each
Windage	4	0	0.83 1 Milliradian each

*In some cases, a given barrel change required only an elevation or windage change. All barrel changes required some sight adjustment.

On the average, a barrel change did not necessitate a major change in zero. However, the extreme cases did require a major change in zero, and failure to account for these cases could result in significant degradations in performance.

Suppressive Fire Requirements

The machinegun in particular, and automatic fire in general, is considered appropriate to provide suppressive fire against area targets. How close must automatic fire be to a target to be considered effective suppressive fire?

A study conducted by the U.S. Army Combat Developments Experimentation Command (CDEC) in 1976, attempted to answer the questions regarding effective suppression by automatic weapons. Suppression was defined as "the temporary degradation in the quality of performance of an individual due to the avoidance of a perceived threat," (CDEC, 1976). Suppression tests using live fire directed at volunteer test subjects protected by forward earthen cover under controlled conditions, showed that the amount of suppression was in proportion to how close the bullets came to the target. Figure 2 presents the measured effectiveness of fire, in percentages, as it relates to the distance the impacting fire is from the target being suppressed. This series of tests projects the effectiveness of suppressive fire while still protecting human subjects.

Figure 2 shows that an M60 machinegun placing fire within 10 meters of a target is predicted to be approximately 45 percent effective in suppressing the target. The findings suggests the M60 machinegunner should have a properly zeroed and ranged weapon, and that he be properly trained to aim for precise target engagement to optimize suppression effects.

Burst Size Considerations

Current training doctrine (OSUT) emphasizes a 6- to 9-round burst for target engagement. A variety of reasons have been given in interviews with range and training personnel regarding this burst size. They include:

- o ~~"It's the optimum size burst."~~
- o "It keeps malfunctions and jams of the gun to a minimum."
- o "It's policy."
- o "Fewer rounds wouldn't give suppressive fire."

During the Small Arms Weapons Systems tests (USAIB, 1965), burst sizes of 3, 6, 10, and 15 rounds were tested using the M60 machinegun. Variables considered as being influenced by burst size included:

- o Firer attainability - how well the gunner could control the gun/burst during firing.
- o Hit probability and capability - which burst could put more rounds on target (percentage of burst on target).
- o Percentage of target hits - which burst did produce more hits.

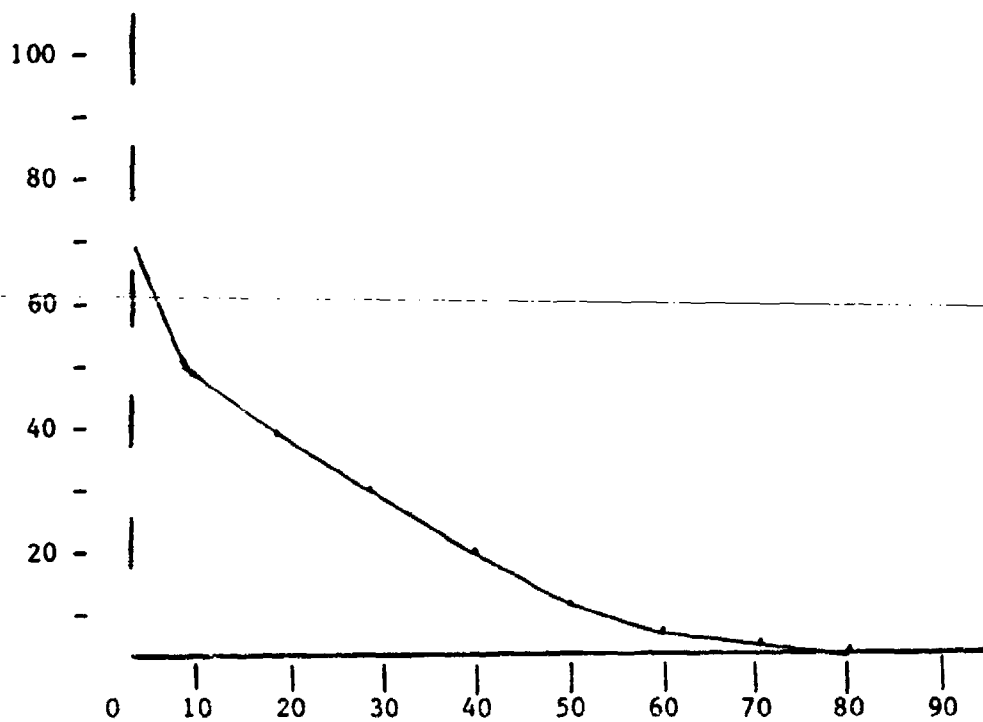
It was concluded in this test that six rounds was the optimum burst size for the M60 machinegun since a corresponding increase in target coverage (for the test targets) was not achieved when 10- and 15-round bursts were fired.¹

¹It would be fair to note, however, that many combat veterans would disagree with this conclusion.

FIGURE 2. Suppression vs. Miss Distance

M60 Machinegun

Percentage
of Effectiveness



Missed Distance in Meters from the Target.

Automatic Accuracy from Assault Firing Positions

An important doctrinal consideration for development in automatic fire weapons is effectiveness in the standing or assault fire position. FM 23-67 addresses this position. The USAIB (1965) study included effectiveness tests of this method of employment (Table 4).

TABLE 4. Assault Fire Accuracy*

Position	Burst Size	Extreme Spread (in inches)	
		By Range	
		<u>50 meters</u>	<u>100 meters</u>
Fired from Shoulder	6	99.7	131.9
	9	108.3	156.7
Underarm Fire	6	91.5	142.9
	9	93.8	161.0
Hip Fire	6	76.0	135.6
	9	76.6	149.4

*This method of fire does not presently receive training during the OSUT familiarization machinegun training.

Although the tactical situation may require an assault fire or bipod technique of employment, comparison (see Table 1) of the dispersion patterns discloses the superior accuracy of the overwatch position method of employment.

M60 Machinegun Malfunction Rate

The M60 machinegun production acceptance specifications (MIL-M-45013C) specify the following standards of reliability for 10,000 rounds fired.

<u>Type of Malfunction</u>	<u>Number Permitted*</u>
Failure to feed	4
Failure to eject	3
Failure to extract	1
Loosening of Parts	1
Other	<u>1</u>

*Total by type of malfunction permitted for a pass in a 10,000-round reliability test.

The results of the USAIB (1965) project revealed 40 recognizable malfunctions out of 181,768 rounds fired. This meant one malfunction per 4,544 rounds which clearly met the acceptance total-malfunction number test standards. (Distribution by type was not clearly discernable in all cases.)

Observations on the machinegun training ranges (OSUT) have suggested that malfunctions are a constant and prevalent problem. While not only interrupting training, they force larger numbers of machineguns to be made available on the firing line to serve as immediate replacements for jammed weapons. At Fort Benning, a central weapons pool supports firing training. Weapons are cleaned and inspected in a central facility before going to the ranges. Many of the weapons observers have inspected are worn, but pass standard inspections.

Ill defined problems exist in the present maintenance of the M60 machinegun being used in USAIC training. The limited scope of this initial research effort did not permit more detailed examination of problems relating to training center maintenance, or in a broader sense, maintenance of machineguns in general, and how this impacts on training. While the problem was recognized, it was not considered part of our work to become involved outside the training area directly.

An analysis of our present institutional training programs (OSUT and USAIS) can be presented most effectively by including comparisons with other machinegun programs. Our allies, our potential opposing force (Warsaw Pact), and sister services, each have a philosophy of training and employment for the medium machinegun. The approach taken by all other forces and services differ, in part, from that of the U.S. Army.

Allied Training

German

All machinegun training in the German Army takes place within the unit. The German Army is predominately mechanized; therefore, vehicle mounted training and utilization are of paramount importance. Ground bipod training is conducted as well; however, the German medium machinegun, which is equivalent to our M60, is employed primarily in the bipod mode against medium range targets. (Schiezen mit handwaffen, 1972)

Machinegun training is conducted progressively by guiding soldiers through a series of nine basic exercises. Each exercise becomes progressively more difficult; however, Exercise 1 must be completed satisfactorily before Exercise 2 is commenced. Exercises are (reported to be) repeated as necessary to assure proficiency. There is no fixed limit on ammunition. Exercises commence at 25 meters (25m) and progress out to 300 meters. All shots are fired on scoreable targets, and each exercise is observed and scored. Firing commences with single shot fire to develop accuracy in aiming and grouping (25m) firing and four shot bursts is done next to teach trigger control (25m). Firing progresses to engaging landscape targets with no time limit, and then with a time limit (25m). Night firing is done at a 25m at silhouette targets without illumination. The advantage of 25-meter firing is the easy observation of initial performance to provide the gunner with adequate performance feedback.

Exercises are then fired at 100, 200, and 300 meters at silhouette targets, and include wearing a protective mask after a 100-meter run.

Quarterly refresher training is utilized to maintain proficiency for all gunners in a unit. Machinegun proficiency is a critical military skill which receives command emphasis and is practiced.

British

The British annual qualification test for the machinegunner and assistant machinegunner, is noted here as being of particular interest with regard to the course of fire, targets and ranges, exposure time, and qualification score required.²

The course is fired by a two-man team, with the assistant gunner aiding in the observation of fire and providing corrections to the gunner. Table 5 presents the parameters for the qualification firing.

²This summary was drawn from Infantry Training, Vol 1, Pamphlet No. 1, Shoot to Kill. It has not been verified by direct observation.

TABLE 5. Annual Qualification Firing

Exercise	Range	Target/Exposure (Seconds)	Rounds Fired	Firing Position
1	200	Double silhouette/30	20	Foxhole
2	300	Triple silhouette/no limit	20	Foxhole
3	400	Triple Silhouette/30	20	Prone in open
4	400 & 300	Triple silhouette/45 + 45	20 + 20	Advance & Shoot
5	300	Triple silhouette/8exp. of 3 secs	20	Prone in open
6	500	Triple silhouette/4exp. of 4 secs	20	Prone in open
7	600	Triple silhouette/4exp. of 4 secs	20	Prone in open
8	800	Triple silhouette/4exp. of 4 secs	20	600-500m advance

Infantry troops fire Exercises 2 through 8 for record and must score 85% on the targets to qualify as marksmen, and 70% to pass.

Probably, most noteworthy are the moderate ranges used for engagement, small burst size, and the high percentage of hits required against point targets (triple silhouettes) in order to qualify. Successful qualification on this course of fire is based on extensive practice and initial training.

WARSAW PACT TRAINING

The source for these comments and illustrations is the manual for the Kalashnikov PK and PKN Medium machineguns (7.62mm) provided to an allied source. Like the U.S. Army (FM 23-67), the Warsaw Pact program incorporates its standard training program in its operator's manual.

The training theme stresses the importance of an accurate initial burst. A great deal of training emphasis is placed on gunnery situations which require engaging various types of stationary and moving targets. Considerable theory and dry fire, however, precede live fire training.

The Kalashnikov PK and PKN are reported to be capable of placing a 10-round burst in a 20-centimeter (8-inch) circle at 100 meters.

Zeroing of the PK and PKN is conducted initially using paper targets on a 100-meter range while battlesight zero is established at 300 meters. Zeroing begins with single round fire, which requires 3 of 4 rounds to be grouped within a 15-centimeter circle (6 inches at 100 meters).

Aiming and sight alignment are stressed in all training to obtain an accurate initial burst. Instructors demonstrate all aiming procedures, insure that trainees dry fire before they practice live fire, and constantly correct errors. Aiming practice begins slowly to establish accuracy and later in training the time to prepare to engage targets (aim) is reduced. Assistant gunners by now act as assistant instructors (coaches) to bring the gunner on target more quickly. The Warsaw Pact training materials address the effect of light on the weapon sights and gunners are trained to compensate for front sight reflection induced aiming errors. All these points reinforce the importance of accurate initial bursts.

Firing positions are drilled extensively as are marksmanship fundamentals, such as sight alignment, aiming, holding the weapon, and trigger manipulation. Common errors are addressed in training and reduced through practice. These errors include: trigger jerk, slack grip, loose hold on the weapon butt at the shoulder, and poor trigger squeeze techniques. These concerns appear to be universal to primary marksmanship instructors.

Observation of machinegun fire becomes the responsibility of all soldiers located in close proximity to the gun. While sensing bullet impacts is the duty of the assistant gunner primarily, it is taught as a duty to all new soldiers.

The instructions for developing engagement techniques through practice are extensive. They include:

- o Best times to engage - target location and behavior considerations.
- o Target engagement by type - point/area and dimension.

- o Moving targets - consider leads based on distance and speed to include anticipated speeds by target type.

- o Wind effects - detailed consideration of wind effects on trajectory. Tables included present velocity by range effects. Hold-off is taught.

- o Principles of firing from armored vehicles - techniques practiced to improve suppression and hits.

- o Sighting - set 400 meters for targets closer than 400 meters and set at actual range for those more distant.

- o Aerial target engagement - theory followed by practice against balloons, rockets, radio-controlled, and towed targets. Emphasis is also placed on helicopter engagement. Paratroop targets are also included.

United States Marine Corps

ARI/Litton Mellonics visited the USMC Infantry Training School, Camp Lejeune, North Carolina to observe and take part in M60 machinegun training.

The Marine Corps Infantry Training School conducts an M60 machinegun course to produce a machinegunner with the designated MOS of 0331. The course duration is four weeks with 18 training days and 212 hours of actual instruction. This course is designed for a Private or Private First Class that has completed Marine Corp recruit training. The Marine at the Infantry Training School is enroute to the divisions and is taking the equivalent of the Army Advanced Individual Training (AIT).

The course devotes 73 hours to range firing the M60 machinegun; the remainder of the hours are devoted to related subjects, such as organization, tactics, physical training, etc. During the machinegun portion, the trainee fires at least 1308 rounds of ammunition. Machinegun training mirrors the Marine philosophy that the machinegun is a crew-served weapon. It is never considered to be a one-man weapon.

The Marine Rifle Company is composed of three rifle platoons and one weapons platoon. The weapons platoon contains an assault section, a 60mm mortar section, and the M60 machinegun section. The machinegun section (8 MG's) has a section leader and four squads. Each squad has a squad leader and two four-man teams (2 MG's). Each team (1 MG) has a team leader, gunner, and two ammunition bearers. The squad leader is responsible for the operation of the squad (2 MG's), and is armed with a rifle and carries binoculars and compass. The machinegun team leader carries the tripod, one bandoleer of ammunition, and is armed with a rifle. He has responsibility for the operation of his team. The gunner carries the machinegun, and one bandoleer of ammunition (100 rounds), and is responsible for aiming and firing the machinegun. He is also armed with a .45 caliber pistol. The 1st ammunition bearer carries the spare barrel case with accessories, and two bandoleers of ammunition and is armed with a rifle. The 2nd ammunition bearer carries four bandoleers of ammunition and is armed with a rifle. Each machinegun team, when 100-round bandoleers are counted, is deployed with 800 pounds of ammunition.

The concept of employment is that the M60 is used primarily in the tripod supported mode with traversing and elevating mechanism. This is in both

offensive and in defensive operations. Consistent with the importance placed in this doctrine is the fact that the team leader carries the tripod. He personally emplaces the tripod in the position that he selects for his team, which establishes the fields of fire for the gun. The team leader directs the fire for the team as well, and it is his job to make corrections for the gunner to apply to the gun.

The typical class size for this course usually is between 30 and 50 (28 was the class size observed); therefore, a great deal of individual attention/coaching is provided to each trainee by the instructors who maintain a 1 to 2 instructor-to-guncrew ratio on the firing line.

The instructors are all graduates of the machinegun course; they are qualified machinegunners before they are permitted to teach. Reportedly, assistant instructors serve as assistants for months before becoming primary instructors themselves.

A gunner's exam is given after the first 17 hours of instruction on the M60. This examination is oral as well as equipment related, and includes organization of the weapons platoon, mechanical training, operation of the M60, malfunctions and corrective actions, care and cleaning, ammunition considerations, gun mounts and their use with the machinegun. Proficiency and knowledge must be proven before a shot is fired.

Marksmanship training commences using a paper target at 500 inches. Great emphasis is placed on the fundamentals of marksmanship - position, grip, holding techniques, sight alignment, sight picture, proper reading, setting, use of the rear sight, and zeroing-in. Initial firing and zeroing-in is conducted firing single shots (by loading one pound of ammunition). The coach and pupil method is used with a student acting as coach/leader. However, it is done under the intense supervision of the drill Corporal (assistant instructor). Only after the trainee can fire tight shot groups and zero-in with single shot fire, is burst firing begun. The primary purpose of the first exercise is to develop marksmanship ability and to obtain a good zero. An ammunition allotment of 84 rounds is available for this exercise, and is fired in the tripod mode using the T & E mechanism for adjustments.

The next stage of marksmanship training is field firing. This is done using the tripod mode, and allows the firing of 400 rounds. Marksmanship fundamentals are stressed again with field zeroing, range estimation, setting the sight for the proper range, windage, and the alternate aiming point method for rapid adjustment of fire. The targets used are 55-gallon barrels and vehicles at moderate ranges of 300-600 meters. The targets provide no specific hit feedback, like the bullet hole in paper targets. They are used to transition the crew to field fire target observation, which is the normal job of the assistant gunner (in training). This observation responsibility requires visual alertness and the development of trained eyes to sense the actual strike of the projectiles near the target. This observation of fire (bullet impact) is constantly supervised by the assistant gunner. Each burst is thus observed, and feedback from student-coach and instructor to the gunner is provided. A high degree of accuracy in target engagement is expected. There are no situations where rounds are fired downrange without instruction and feedback (i.e., for familiarization).

Firing is continued using the tripod mode (on a paper target at 500 inches) using single shots to obtain a zero, followed by burst firing at point targets.

After this can be successfully accomplished, traversing fire and searching fire are practiced to improve the use of the T & E mechanism. Record qualification firing on the 500-inch range, paper target is then conducted. A total of 162 rounds are allotted for this exercise. As before, all firing is done utilizing the assistant gunner to observe and assist in fire adjustment while being supervised by an instructor or assistant.

Field firing follows with the tripod mounted weapon with emphasis on the distribution of fire at targets between 200 and 600 meters. Offensive firing/assault (standing unsupported) is taught next and practiced by firing 250 rounds at field fire ranges (100-200 meters maximum).

Predetermined fire and range card preparation during daylight follows. Firing to determine the range to each of four targets is done with three rounds of tracer ammunition fired as single shots at each target. After darkness, 200 rounds of mixed ammunition (ball and tracer) are fired against four targets, 50 rounds each, using data from the prepared range card. Firing is conducted under the illumination provided by a 60mm mortar parachute flare. This illumination allows observation and adjustment of fire, if necessary, and simulates battlefield lighting conditions. All firing exercises emphasize the importance of training the assistant gunner to aid the gunner by observing and adjusting his fire. Table 6 presents, in summary, the distribution of both hours and rounds of ammunition for training USMC machinegunners. Each trainee rotates duty positions, and fires 1308 rounds of ammunition.

The Marines produce their machinegunners by the use of traditional methods of marksmanship instruction, coupled with ample training time, and highly-qualified instructors. No startling innovations were noticed, nor were any high-technology training aids or devices used. The Marine Corps' approach to marksmanship training is basically no different than that prescribed in the current U.S. Army FM 23-67, Machinegun M60, of October 1964. The Marine Corps is developing a training program monitoring structure, similar to the Army Training and Evaluation (ARTEP) and Skill Qualification Testing (SQT) programs and uses a list of common training tasks. In fact, the tasks the U.S. Army currently lists for M60 machinegun training, as part of the requirements for 11B skill levels 1 and 2, are being examined for acceptance by the U.S. Marine Corps Infantry Training School.

In summary, the high quality of the U.S. Marine Corps' instruction is clearly based on the following factors:

- o Highly skilled instructors
- o Sufficient training resources - ammunition, time and instructors (low student to instructor ratios).
- o Proven training procedures and constant practice
- o Training for a specific MOS which differs from the U.S. Army concept of general skill training

United States Army Infantry School (USAIS)

The majority of the report section on U.S. Army M60 machinegun training will address USAIS/USAIC (U.S. Army Infantry Center) observations and encounters with OSUT training of the IET soldier. It is interesting to note, however, that

TABLE 6. USMC Infantry Training School

M60 Machinegun Subjects

	<u>Hours</u>	<u>Ammo.</u>
Organization of Weapons Platoon	.75	
Nomenclature of M60 Machinegun	1.00	
General disassembly/assembly of M60	3.50	
Detailed disassembly/assembly of M60	3.75	
Operation of M60	1.00	
Functioning, Malfunctions, and Stoppages	2.00	
Mounts for the M60	3.50	
Care and Cleaning	2.00	
Ammunition for the M60	.50	
Gunners Exam	6.00	
Crew Drill	3.75	
Marksmanship with Bipod/Gun	3.50	84
Transition Firing	8.50	400
Basic Marksmanship Tripod*	7.50	162
Technique of Fire	4.00	200
Tactical Movement	2.50	
Offensive Employment	5.00	100
Camouflage Cover Concealment	1.00	
Assault Firing	3.00	150
Technique of Pre-determined Fire	8.75	212
Defensive Positions	1.00	
Range Cards	1.50	
	<u>73.00</u>	<u>1308</u>

*Constitutes firing performance for record qualification: This score represents approximately 20% of the Marine's final grade for MOS training.

an overview of M60 machinegun training programs reveals that Infantry Officer Basic Course (IOBC) students clearly receive the most comprehensive instruction relating to the M60 machinegun (Table 7).

Observations made by ARI-Litton Mellonics, revealed detailed comprehensive instruction (see Table 7) being presented by company cadre to IOBC students, which would prepare them to teach the machinegun skill development subjects when they become assigned to units. These acquired basic skills, along with ample employment technique training, would most reasonably be used to reinforce the training received by the new soldier in OSUT. As we have seen, the new soldier is exposed (familiarized) to the M60 machinegun briefly (14 hours) while undergoing OSUT training. Many basic skills necessary for effective employment are not taught by the institution (Table 7). It is interesting to note that no formal, or institutional program exists to train any enlisted man in the acquisition of all the basic machinegun skills (Table 7). Clearly, the first line supervisor/trainer, the NCO, should be provided with this instruction.

The majority of the time spent observing training took place at the U.S. Army Infantry Center Malone Range Complex, watching Initial Entry Training soldiers undergo M60 machinegun familiarization. As a result of our discussions with instructor personnel, some improvement was made in the course content within the current Program of Instruction. This consisted of zeroing-in the machineguns, teaching the proper use of the sights, and stressing feedback by the observation and adjustment of fire.

ANALYSIS OF THE OSUT IET 14-HOUR PROGRAM OF INSTRUCTION

The course of instruction, as it is currently presented, is organized as follows:

<u>Period 1</u>	Maintaining an M60 machinegun and ammunition, loading reducing a stoppage, unloading and clearing	4 hr
<u>Period 2</u>	Transition firing, concurrent training on crew drill, and the T & E mechanism	4 hr
<u>Period 3</u>	Techniques of fire with Bipod Mounted M60. Preparation of range cards	3 hr 1 hr
<u>Period 4</u>	Pre-determined fire with the M60	2 hr

All training periods were observed a number of times, during which academic instruction, hands-on manual functioning of the machinegun and T & E mechanism, and live firing using silhouette targets were conducted. It was determined by questionnaire results that the class academic instruction was meeting its objectives (see Table 9).

A detailed look at the training disclosed that the established fundamentals of machinegun marksmanship were not being taught, and furthermore, the POI did not stipulate that they would be taught. The live fire training was not meeting satisfactory standards of training.

The ranges and targets used during training were not appropriate for beginners being introduced to machinegun firing. This was exacerbated, in part, by the limited time allowed for training in the POI. This restricted training

time creates, or contributes to, a rushed situation that is not compatible with the detailed feedback and coaching that must be part of a basic course of marksmanship instruction. Firing did not produce a score, or meet a standard, to objectively allow a judgment whether good shooting or poor shooting was being done. The soldier simply experienced firing the machinegun downrange toward targets.

The IET soldiers' introduction to range firing is on a transition fire range where pop-up silhouette targets are available in lanes at ranges between 400 and 800 meters. The soldier is tasked in the following manner:

TASK - Engage Transition Targets with an M60 Machinegun

CONDITION - During daylight, on a transition fire range, given an M60 machinegun bipod mounted, an assistant gunner, and 120 rounds of ammunition

STANDARD - The trainee must engage the eight targets in his lane within 4 minutes

This task required the trainee's first firing experience with an M60 machinegun to be on a transition range which used single E-silhouette targets (roughly 39"x19" in size). He had to fire 120 rounds at the eight lane targets within 4 minutes. No instruction on the use of sights, or direction of the assistant gunner to help in the observation of fire was provided. Guns were not zeroed-in, nor were sights even set for the target engagement range. Because of this, the majority of the gunners, never hit a target and many were not visibly close. Adequate feedback was not provided to the gunner, nor was appropriate corrective action being taken to adjust fire properly in many situations. Most of the targets proved extremely difficult for the gunners to see. They were obviously extremely difficult to hit and not appropriate for the soldier's first exposure to live firing with the M60 machinegun.

This situation required the soldier, not versed in the fundamentals, to begin training with unclear performance objectives. Before firing, each soldier should have had (trained to have):

- o A properly supported gun
- o A zeroed weapon
- o Training in applying range estimation
- o Proper sight settings for target ranges
- o Correct sight picture - to include training in the appropriate use of the open rear sight

The time limit (4 minutes) for engagement was based on the doctrinal qualification standard for the transition range record fire course (FM 23-67). This course of fire is intended to be used only after basic classes on machinegun marksmanship training have been received and practiced. It was never intended to be used for a trainee's first live firing experience with the

TABLE 7. Distribution of M60 MG Tasks
Across USAIS Programs of Instruction (POI's)*

SOLDIER's MANUAL	IOAC	(RC) IOAC	IOBC	(RC) IOBC	BIOCC	(RC) OC	ANCOC	BNCOC	PNCOC	OSUT
Perform operator main- tenance on M60 and Ammunition		x	x	x	x	x	x	x		x
Operate the M60 (load, fire, reduce stoppage, unload, and clear)		x	x		x		x	x		x
Fire the M60 for familiarization	x	x	x	x			x			x
Construct a MG position			x							x
Lay a MG using field expedients			x				x			
Field zero a MG			x							
Prepare a MG range card	x	x	x	x	x	x	x	x		x
Zero a MG on 10 meter range			x							
Qualify with MG**			x							
Mount/Dismount AN/PVS-2 on MG	x	x	x		x	x	x			
Zero AN/PVS-2 to MG	x	x	x		x	x	x			

*Definition of terms:

IOAC - Infantry Officers Advanced Course

RC - Reserve Component

IOBC - Infantry Officers Basic Course

BIOCC - Basic Infantry Officer's Candidate Course

(RC)OC - Reserve Component Officer Candidate

ANCOC - Advanced Non-Commissioned Officer Course

BNCOC - Basic Non-Commissioned Officer Course

PNCOC - Primary Non-Commissioned Officers Course

OSUT - One Station Unit Training (Basic training for Infantry)

AN/PVS-2 - Starlight Scope

** Note: IOBC is the only course which includes an opportunity to complete
guaner qualification.

machinegun. The stated standard for this period, "engage targets", does not delineate any degree of accuracy for acceptable engagement.

The next firing task required soldiers to engage a linear target and targets in-depth under the following conditions: During daylight, on a machinegun field fire range, using a bipod mounted M60 machinegun given 100 rounds of ammunition, and linear, deep, and linear with depth targets.

STANDARD - The soldier must engage:

- a. the entire width of the linear target.
- b. the deep target, initially laying at the mid-point, and then searching down the near end, and back up the far end.
- c. the linear target with depth, initially laying and adjusting on the midpoint, and then, traversing and search to the near silhouette and then back to the far silhouette.

The standards are not being met, due principally to the fact that the essentials of machinegun marksmanship again have not been taught in any previous class period. The importance of an accurate initial burst was not being presented because machineguns were not zeroed-in, nor were sights being adjusted for the correct range to a given target. The assistant gunner was not being trained to aid in the observation of fire; thus, feedback to the gunner was minimal.

Fire adjustment was being taught improperly as well. Soldiers were instructed to adjust fire by moving their elbows for all impact adjustment (raise or lower to move the bullet strikes). The proper adjustment of the rear sight for major corrections was not being taught. The re-acquisition of the sight picture after each burst was not taught. In fact, proper sight picture was not taught, nor was the technique of fire distribution (by taking successive aiming points within the target area) taught.

Night fire training, as observed, had very limited training value. During daylight hours, the soldiers registered engagement data on their range cards and from machineguns. They used the traversing and elevating mechanisms in a manner which suggested that adequate classroom instruction (concurrent training) was being presented. The data recorded during the day was fired after dark against vehicular targets. No illumination was provided to aid in sensing round impacts in the target area. The firer could not know the effects of his fire and could not make appropriate adjustments, if necessary, because he received no feedback on his performance. After having fired 40 rounds at the preselected target, he knew as little about his performance as he did before firing. It was obvious that some feedback would be required to provide confidence in the M60's ability to engage targets at night.

Throughout the observed training, malfunctions occurred causing delays in firing. In discussions with other training departments, it was learned that this problem is more widespread than just during IET. The maintenance system has made efforts, but has been unable to resolve this problem. Observations and discussion indicate that apparently it is a problem contributed to by worn out guns. Consideration should be given to establishing a periodic depot rebuild program, particularly for training center weapons.

EXPERIMENTAL EVALUATION OF THE "IMPROVED" 14-HOUR MACHINEGUN POI

BACKGROUND

The majority of the observations and interviews related to current machinegun training, suggested to us that the simple application of marksmanship fundamentals could solve many of the problems which were in existence, and at least incrementally, improve trainee performance. The results of previous research in rifle marksmanship (Thompson, Smith, Morey & Osborne, 1980) clearly were applicable to training problems with the M60 machinegun.

The training cadre was charged with the mission to train OSUT soldiers with the 14-hour program, while ARI/Litton Mellonics provided modifications which would not disrupt this process. It was not possible to add, or reallocate, periods of instruction. In other words, modification had to be made within the framework of a given period of instruction, using the range available for training. These limitations prohibited lengthy single-round firing using paper targets on a 10-meter firing line for grouping and zeroing, which according to conventional experience and historical reviews, would provide significant additional performance improvement.

PURPOSE

The purpose of the brief experiment was to demonstrate machinegun firing performance improvements with modifications that could be accommodated within the rigidly timed POI. The training cadre worked with ARI/Litton Mellonics to implement the changes while they continued to conduct regular training.

Field Experiment Baseline Data

The subjects used to obtain baseline data before the experimental training were 22 soldiers drawn randomly from an OSUT company attending M60 machinegun familiarization training on the Malone 5 Field Fire Range. The 22 male soldier, test, subject groups fired their allocation of ammunition (100 rounds each) at three target arrays of ten E-type silhouette targets, located in front of their individual firing points. No effort was made to interact with the soldiers in any way that might influence their performance. Range NCO's behaved as they had been observed to behave with past training companies. After the soldiers finished firing on the target arrays (10 targets each at 300, 450, and 600 meters), the experimenters walked downrange and counted bulletholes. Next, each of the 22 soldiers was given a setting for the traverse and elevation mechanism to set on the tripod mounted machinegun (untimed), and each was asked to "clear" the machinegun (untimed). Neither performance task required successful completion of the other for its accomplishment.

The Experimental Group

Twenty-three (23) soldiers were randomly selected as subjects from the first company to be exposed to selected instructional blocks from the modified 14-hour Familiarization POI, which was proposed by ARI/Litton Mellonics research staff members. The entire company (115 soldiers) was exposed to the following change in bleacher instruction before firing.

- o Marksmanship Fundamentals - The block included proper weapon holding, grip, firing position, illustration of proper sight alignment on

picture,

improved

all-angle instruction for understanding sight adjustments required for range changes;
field zeroing instruction; and, sight adjustment for range variation instruction.

- o Assistant Gunner Duties - The assistant gunner was instructed (and coached during practice) to aid the gunner adjusting fire by providing feedback for errors in round impact points downrange.

All machineguns used for the experimental firing on Malone 5 Field Range, were fired by the instructors before the soldiers arrived at the range, in order to establish a field zero with proper sight adjustments. (Pre-zeroed machineguns were used since time was not available to actually teach zeroing during familiarization.)⁴

When the soldiers went to the firing line, another change had been made in the POI. Line instructors and drill sergeants were to act not only as safety personnel, but to assist the gunner and the assistant gunner/coach to accurately adjust fire to the targets by spotting impacts and by enforcing sight adjustments and fundamentals. The same array of 10 targets each at 300, 450, and 600 meters was used for the 23 soldiers assigned to the scoreable firing point.⁵

Performance Comparison of the Baseline and Experimental Groups

Table 8 presents the results of scored "E" silhouette target arrays for both the collective performance of all soldier test subjects, in both the baseline and experimental groups.

The results of the baseline group showed that a mean of 7.9 hits were achieved by each of the 22 shooters. The experimental group, which received pre-zeroed machineguns, instructions to adjust sights and properly sight and hold the machinegun, and assistance in spotting bullet impacts downrange achieved a mean performance of 12.4 hits per man. A binomial test was then performed on these data.⁶ The difference in performance between the two groups was found to be statistically significant (p less than .001). In our opinion this is a practically significant performance improvement. However, and most important, it does not constitute an "adequate" proficiency with the M60 machinegun. Direct comparison of the two mean scores would suggest an increase in measured performance of about 64%.

⁴The proposed POI calls for initial training on a 10 meter range to include zeroing. This was not a practical element to include under the administration conditions imposed for range activities.

⁵The 600 meter target array had to be located at a greater distance which was closer to 700 meters because of foliage which obscured the 600 meter area.

⁶See Conover (1971). The use of this statistic is based on the assumption that a .0796 probability of a hit is representative of all soldiers in the current

TABLE 8. Performance Comparison of the
Baseline and Experimental Groups

Test	Range	Target Number () and Hits										Total
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Baseline Group (N=22)	300	1	5	3	9	9	8	5	2	7	0	48
	450	1	9	8	3	8	13	12	6	3	6	69
	600	6	5	9	9	3	8	6	5	2	5	<u>58</u> 175
Experimental Group (N=23)	300	2	8	8	11	9	19	7	8	6	*	78
	450	3	4	1+	6	13	15	10	4	5	1	62
	700 ^o	6	5	9	9	3	8	6	5	2	5	<u>146</u> 286

* Silhouette target number 10 was lost from array before firing began.

+ Target fell before firing was complete

^o See Footnote 2, Page 39.

training program, not merely the 22 soldiers in the baseline group.

Questionnaire Results

The questionnaire results (109 returns out of 127 soldiers) indicated that the majority of the soldiers appeared to be comprehending the class instruction. The questionnaire was administered to the baseline company and to the post-modification company as well. Only the results of the baseline company are being reported because of uncertainty regarding the conditions of administration of the second. Informal review of the two indicates that there is little difference in the scores obtained for each question. Table 9 presents the results of the questionnaire.

The cadre responded favorably to the program changes once they saw the firing line performance improvements. Their overall criticism is that: "There isn't enough time available to improve the familiarization program, let alone consider qualifying machinegunners in OSUT." Additional trained instructors, including drill sergeants on the firing line, and the continued use of pre-zeroed weapons would improve the quality of instruction and the measured performances of the soldiers being trained.

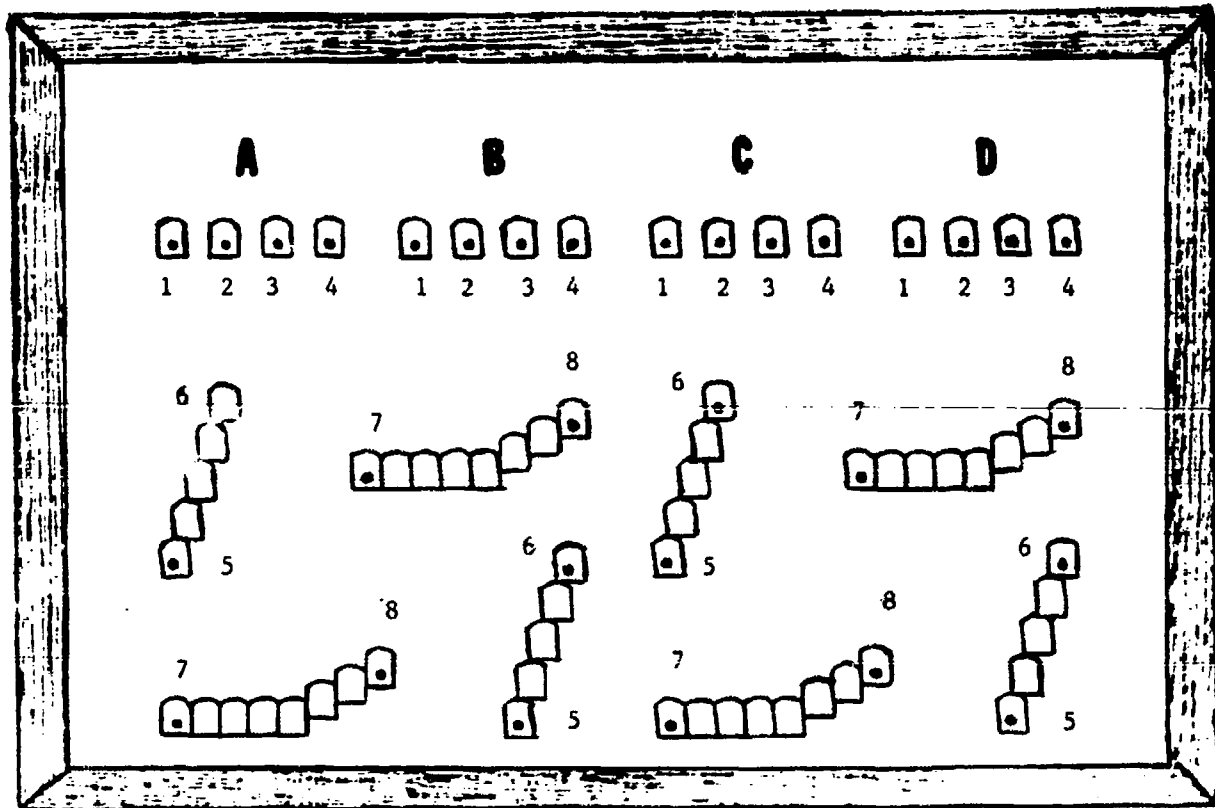
TABLE 9. M60 Machinegun Questionnaire Results

Question	Number Correct	% Correct	Total Response
1. How many mils are there between each SMALL line on the traversing bar?	82	(75.23%)	109
2. Which edge of the traversing bar slide is used to set gun direction on the bar scale?	105	(97.22%)	108
3. What does "mil" mean to you? (Fill in)	4	(3.96%)	101
4. How many rounds do we fire in a burst? (Fill in)	104	(100%)	104
5. If the traversing slide is on the left side of the 0 on the bar, we read the scale as _____. (left/right)	77	(74.75%)	103
6. Name the major components/groups on the M60 machinegun. (8 possible)	Named 8- 5	(4.59%)	109
	Named 4 or more- 42	(38.53%)	109
7. Identify the correct sight picture for the M60 machinegun. (Choice of 4)	70	(67.96%)	103
8. Which picture shows the correct hand pressure a gunner should apply when firing a bipod supported M60 machinegun? (Choice of 4)	75	(71.43%)	105

THE RECOMMENDED "IMPROVED"
14-HOUR IET PLAN OF INSTRUCTION

Given the time constraints currently imposed on OSUT subjects, it is extremely important to gain the maximum amount of benefit from the 14 hours available for machinegun familiarization. We continue to hold that firing on the 10 meter range using the paper target illustrated in Figure 3 is the essential first step in teaching machinegun firing techniques. It is essential to teach marksmanship fundamentals and to establish a consistent shot group using single rounds of ammunition before moving to the automatic fire mode.

FIGURE 3. Basic 10-Meter Machinegun Marksmanship Target



The bulk of this recommended familiarization program has been drawn from previous successful training programs. In fact, much of this proposal is based on published doctrine (FM 23-67, 19). The changes recommended to the 14-hour M60 machinegun POI do not reflect improvements in the program which could conceivably produce qualified gunners. However, the goals of training engagement skills and weapon maintenance are better met with these POI modifications. The modifications presented are based on experimentation in basic rifle marksmanship training, current M60 machinegun training, and observations, reviews, and experimentation with approaches to machine gun training.

Recommended 14-Hour POI Sequence of Events and Times

a. First Period: Maintaining an M60 Machinegun and Ammunition, and Loading, Reducing a Stoppage, Unloading, and Clearing (Task 071-312-3001)
(2 Hrs)

(1) Lesson Outline: The class will be divided into two groups. Station training will be conducted as outlined below. Groups will be rotated between stations as required. (NOTE: Class may be consolidated in one classroom if an adequate facility is available. Stations may then be conducted in sequence.)

(a) Station 1 - Maintaining an M60 machinegun and ammunition.

1. Briefly explain the characteristics and capabilities of the M60 machinegun.

2. Explain and talk trainees through the procedures for maintaining the M60 machinegun (see training objective/Task 1).

3. Conduct practical work on Training Objective/Task 1, if time permits.

(b) Station 2 - Loading, reducing a stoppage, unloading, and clearing of the M60 machinegun.

1. Explain and talk trainees through the procedures for loading, reducing a stoppage, unloading, and clearing of the M60 machinegun (see training objective/Task 2).

2. Conduct practical exercise and EOB testing on Training Objective/Task 2, if time permits.

(2) Administrative Requirements.

(a) References: FM 711B1, FM 23-67.

(b) Facilities: One or two 220-man classrooms (method dependent) or one or two training areas 100 meters x 100 meters.

(c) Training Aids and Equipment: Chalkboard - 1 ea; M60 mg disassembly/assembly mat - 1 per 3 trainees at station 1; M60 mg - 1 per 3 trainees; ctg DUNNY 7.62mm - 1 ea 10 round MLB per 3 trainees at station 1 and 1 ea 20 round MLB per 3 trainees at station 2; and M60 mg cleaning equipment.

(2) Administrative Requirements:

(a) References: FM 7-11B1, FM 23-67.

(b) Facilities: Machinegun 10 Meter range with bleachers and 2 adjacent training areas 100m x 10m.

(c) Training Aids and Equipment: Range card blackboard (FM 23-67) - 1 ea; Direction and elevation reading blackboard (FM 23-67) - 1 ea; Chalkboard - 1 ea; M60 mg - 1 per 3 trainees; M122 tripod mount - 1 per 3 trainees; caliber .30 cleaning rods - 12 ea; M60 mg combination wrenches - 12 ea; safety paddle - 1 per firing lane; ruptured cartridge extractor - 1 ea; 10 meter targets - 1 per 2 trainees.

(d) Ammunition. ctg ball 7.62mm TR 4-1 MLB - 108 per trainee; ctg TR 7.62mm MBL - 500 per co/dmst.

c. Third Period: Techniques of Fire with Bipod Mounted M60 Machinegun
(3)/Preparation of Range Cards (1) (Tasks 071-312-3003; 071-312-3007; 071-312-3006)----- (4 Hrs)

(1) Lesson Outline:

(a) Describe and demonstrate classes of machinegun fire with respect to the ground, target and gun.

(b) Explain and demonstrate methods of machinegun fire control and sight adjustment for range.

(c) Explain and demonstrate techniques for engaging linear, deep, and linear with depth targets, with a single machinegun.

(d) Explain and demonstrate use of assistant gunner, and binoculars, to adjust fire.

(e) Divide the class into two groups and conduct station training as outlined below. Rotate at approximately 70-minute intervals.

1. Station 1 - Field Firing.

a. Conduct range safety briefing.

b. Conduct field Zero of M60 Machineguns at 300 meters.

c. Conduct firing with trainees engaging linear, deep, and linear with depth targets on a machinegun field fire range with the bipod mounted machinegun. The trainee must engage: the entire width of a linear target; a deep target, initially laying at the mid-point, and then searching down laying and adjusting on the mid-point, and then, traversing and search to the near flank and then back to the far flank. Assistant gunner will aid gunner in determining impact of rounds and give corrections for fire adjustment.

2. Station 2 - Preparation of Range Card.

(2) Administrative Requirements:

(a) References: FM 7-11B1, FM 23-67.

(b) Facilities: Machinegun 10 Meter range with bleachers and 2 adjacent training areas 100m x 10m.

(c) Training Aids and Equipment: Range card blackboard (FM 23-67) - 1 ea; Direction and elevation reading blackboard (FM 23-67) - 1 ea; Chalkboard - 1 ea; M60 mg - 1 per 3 trainees; M122 tripod mount - 1 per 3 trainees; caliber .30 cleaning rods - 12 ea; M60 mg combination wrenches - 12 ea; safety paddle - 1 per firing lane; ruptured cartridge extractor - 1 ea; 10 meter targets - 1 per 2 trainees.

(d) Ammunition. ctg ball 7.62mm TR 4-1 MLB - 108 per trainee; ctg TR 7.62mm MBL - 500 per co/dmst.

c. Third Period: Techniques of Fire with Bipod Mounted M60 Machinegun (3)/Preparation of Range Cards (1) (Tasks 071-312-3003; 071-312-3007; 071-312-3006)----- (4 Hrs)

(1) Lesson Outline:

(a) Describe and demonstrate classes of machinegun fire with respect to the ground, target and gun.

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2. Station 2 - Preparation of Range Card.

a. Basic symbol for the machinegun (when an FPL is not assigned).

b. Final protective line (if assigned).

c. Limits of the primary sector of fire.

d. Limits of the secondary sector of fire.

e. A magnetic north arrow from the location of the machinegun, pointing in the direction of magnetic north.

f. Marginal data in corner of sketch.

g. Likely avenues of approach and target areas which may be recognizable manmade objects or natural terrain features.

(1) Targets will be numbered on range sketch in order of priority and a data section prepared below sketch to include direction, elevation, range, description, and remarks on targets, if applicable. When data is placed on the traversing and elevating (T&E) mechanism, gun will be aimed on appropriate target.

(2) When assigned, the FPL is target No. 1. If a PDF is assigned instead of an FPL, it is target No. 1.

h. Range estimation techniques.

(2) Administrative Requirements:

(a) References: FM 7-11B1, FM 23-67.

(b) Facilities: Machinegun field firing range with bleachers and 2 adjacent concurrent training areas 100m x 100m. Double "E" silhouettes may be used for transition firing.

(c) Training Aids and Equipment: Chart, classes of fire with respect to the target (fig. 159, FM 23-67) - 1 ea; chart, classes of fire with respect to the gun (fig 160, FM 23-67) - 1 ea; range card blackboard (fig. 166, FM 23-67) - 1 ea; direction and elevation readings blackboard (fig. 156 - FM 23-67) - 1 ea, PA set - 3 ea; M122 tripod mount with T&E mech and pintle mount - 1 per 3 trainees; M60 mg - 1 per 3 trainees; cal .30 cleaning rod - 12 ea; binoculars - 1 per firing lane.

(d) Ammunition: Ctg ball 7.62 TR 4-1 MLB - 100 per trainee; ctg TR 7.62mm MLB - 500 per co/dmst.

(3) At their firing points, trainees mount the machineguns to the M122 tripod mounts with pintle and T&E mechanisms.

(4) Trainees dry fire three targets (machinegun crews rotating positions after each target) and live fire three targets with 20 rounds each to get data to be used at night. The data obtained must be recorded on a range card.

NOTE: Once the tripod is emplaced, care must be taken not to disturb the weapon. If the tripod is disturbed, the range card data will be invalid. Crews must fire the same guns at night from which they obtained data for their range card. Training should be scheduled to terminate at or before EENT. At this time trainees move into the bleacher location for a brief explanation of the night firing phase.

(5) Conduct a safety briefing.

(6) Divide the company into three groups. Group "A" will fire, group "B" will coach, and group "C" will receive concurrent training (subject at the discretion of the training center commander). Trainees will alternate as firing is completed.

(7) Trainees engage one of the three targets with 40 rounds on which data was obtained during the daylight firing by taking headings from their range cards.

(2) Administrative Requirements:

(a) References: FM 711B1, FM 23-67.

(b) Facilities: Machinegun predetermined fire range with bleachers; adjacent concurrent training areas. Illumination of the target area to allow feedback of performance.

(c) Training Aids and Equipment: 1 chart ea: grazing fire (fig 165, FM 23-67); Military Symbols (fig 164, FM 23-67); 1 range card blackboard; 1 chalkboard; 1 blank range card per 2 trainees; 1 PA set; 1 M60 mg, and M122 tripod mount w/pintle and T&E mechanism per 2 trainees; 20 caliber .30 cleaning rods; 36 flashlights with/red filter; 1 spare barrel per machinegun; one 81mm mortar.

(d) Ammunition: Ctg ball 7.62mm MLB - 20 per trainee; ctg TR 7.62mm MLB - 500 per co/dmst, and 40 per trainee; sig illum ground green star cluster - 5 per co; sig illum ground red star cluster - 5 per co; 60 mortar illumination rounds (81mm) per company.

CONCLUSIONS AND RECOMMENDATIONS

Training Program Improvements for Initial Entry Training

The first requirements for initial training are firing ranges that provide specific feedback to the firer to let him know where rounds, or bursts, are impacting. This has been historically accomplished by shooting on paper targets at short ranges (1000 inches, 500 inches, or 10 meters). Within currently available methods, this approach may still be the simplest and best.

Before firing at even these short range paper targets, it is essential to instruct soldiers in the principles of machinegun marksmanship. The adage that "no man is allowed to fire on the range until he has received thorough training in preparatory Marksmanship" is as valid today as ever. Machinegun Marksmanship Training, as described in FM 23-67, Chapter 10, is suitable for training and should be adhered to until new training material is developed. Instructors should become subject matter experts in addition to having qualified with the machinegun over the standard qualification course.

Preparatory Marksmanship should include exercises which address the following subjects before actual firing takes place.

Preparatory Skill Development

Position and Grip

Uniform Holding

The rear sight and how it functions

Sighting and aiming exercises

Sight setting exercises

Laying exercises (sight picture)

Manipulation exercises

Observation of fire

Adjustment of fire

Range estimation

Zeroing in Procedures

Trigger Pull

Marksmanship fundamentals must be applied to machinegun training much as they are now taught in Basic Rifle Marksmanship. The fundamentals that are required to achieve an accurate initial burst should include:

Properly supported gun

Zeroed weapon

Skillful range estimation

Proper setting of sight for range

Correct sight picture

The fundamentals of predetermined fire can be taught effectively by first dry firing with landscape targets. These targets are designed to present a panoramic picture of a landscape of such a size that all, or nearly all, of the salient features will be recognizable at a distance of 1,000 inches. After a class on the T&E mechanism and range cards, the use of landscape targets to secure data for range cards will greatly facilitate the comprehension of the range card and the T&E mechanism by the soldier.

When firing is conducted on field fire-type ranges, at targets consisting of barrels and vehicle hulls, it is essential that a standard of accuracy be established. Too often a dust cloud raised by bullets impacting in the general vicinity of the target area, is accepted as effective fire. The trainee must be trained to be more discriminating. The standard must be to hit the target, or target array, being fired at. The size of the target, and range to the target, must be compatible with the skill level of the soldiers being trained.

Training Aids

Pictorial training aids will greatly facilitate soldier understanding of the principles that must be presented to effectively train the placement of accurate fire on the target. Many of the aids, to include charts, pictures, and models, are being incorporated into IET training already. Appendix A presents those aids considered appropriate, as explanatory graphics, to improve concept transfer during initial machinegun training. The use of training devices, to ease resource costs (ammunition, range space, and travel) should be explored. Devices similar to the WEAPONER, rifle marksmanship trainer, may have use in this regard. These devices, however, would have to be available in large quantity to significantly impact the training of a 200-man company in IET.

It becomes obvious, based on the above recommended additions, that of paramount concern is the lack of time devoted to training. The draft Program of Instruction (January, 1981) for OSUT, Annex C, Appendix 32 moves in the proper direction. It allocates 28 hours to M60 machinegun training for 11B MOS soldiers. While this falls far short of historical as well as more comprehensive contemporary programs, i.e., the US Marine Corps program, and will probably produce comparably weaker gunners, it does recognize the need to qualify soldiers on the machinegun while they are in an institutional setting. It should produce a better novice gunner for unit trainers to continue to develop. The gunner being trained under the 28-hour program will have had more practice and will have been exposed to a broader base of concepts and techniques than we would have been under the 14-hour familiarization program. Until the 28-hour M60 Machinegun POI is implemented, ARI/Litton Mellonics recommends the implementation of the modified 14-hour POI.

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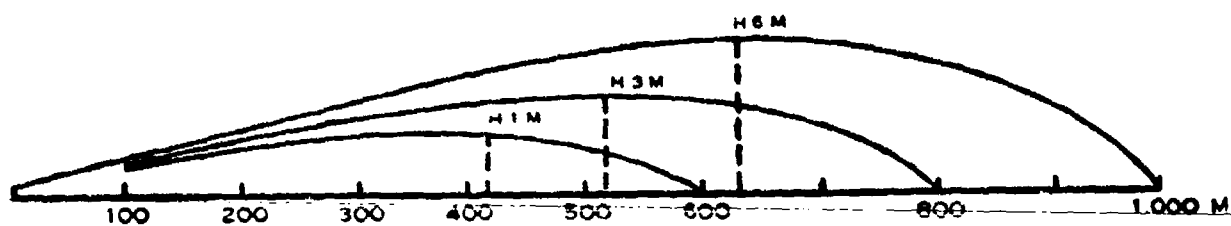
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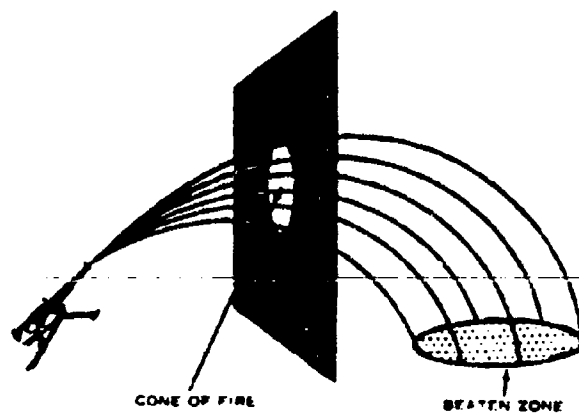
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APPENDIX A

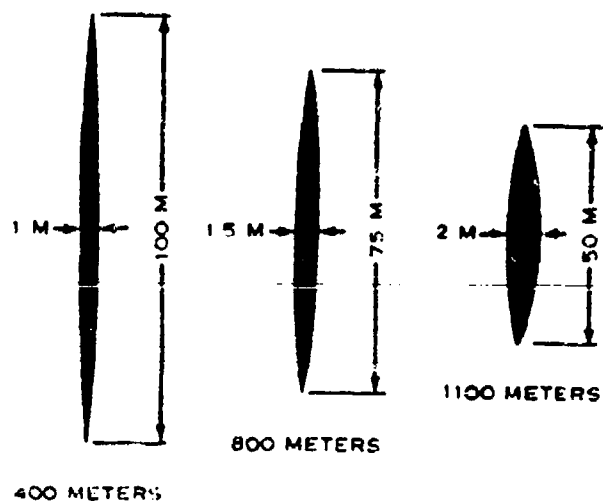
(H = MAXIMUM ORDINATE-HIGHEST POINT OF TRAJECTORY)



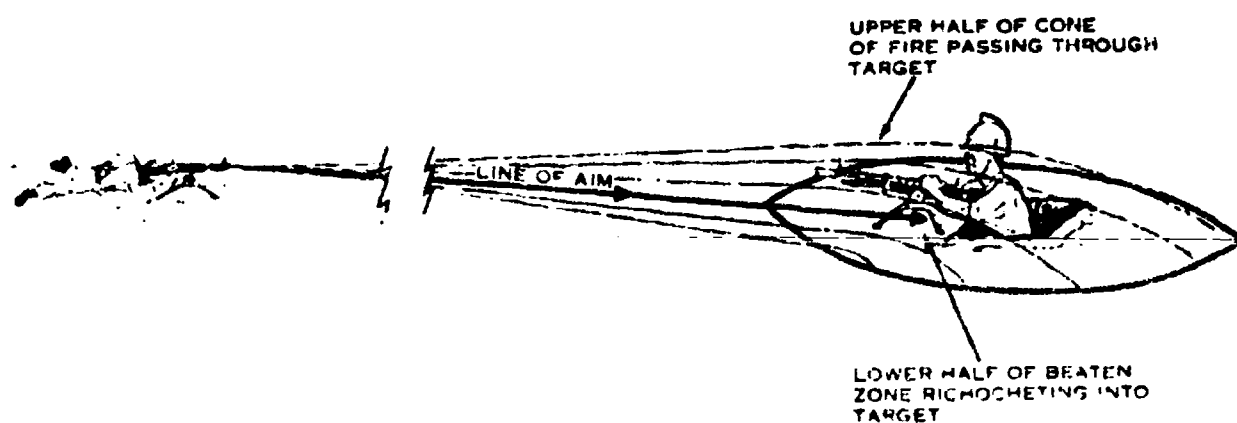
TRAJECTORY OF M60 MACHINEGUN FIRE
WHEN ENGAGING TARGETS AT 600, 800, AND 1000 METERS



CONE OF FIRE AND BEATEN ZONE



SIZE AND SHAPE OF BEATEN ZONE ON LEVEL TERRAIN



PLACEMENT OF CENTER OF IMPACT ON TARGET

ACCURATE INITIAL BURST

Zeroed Weapon

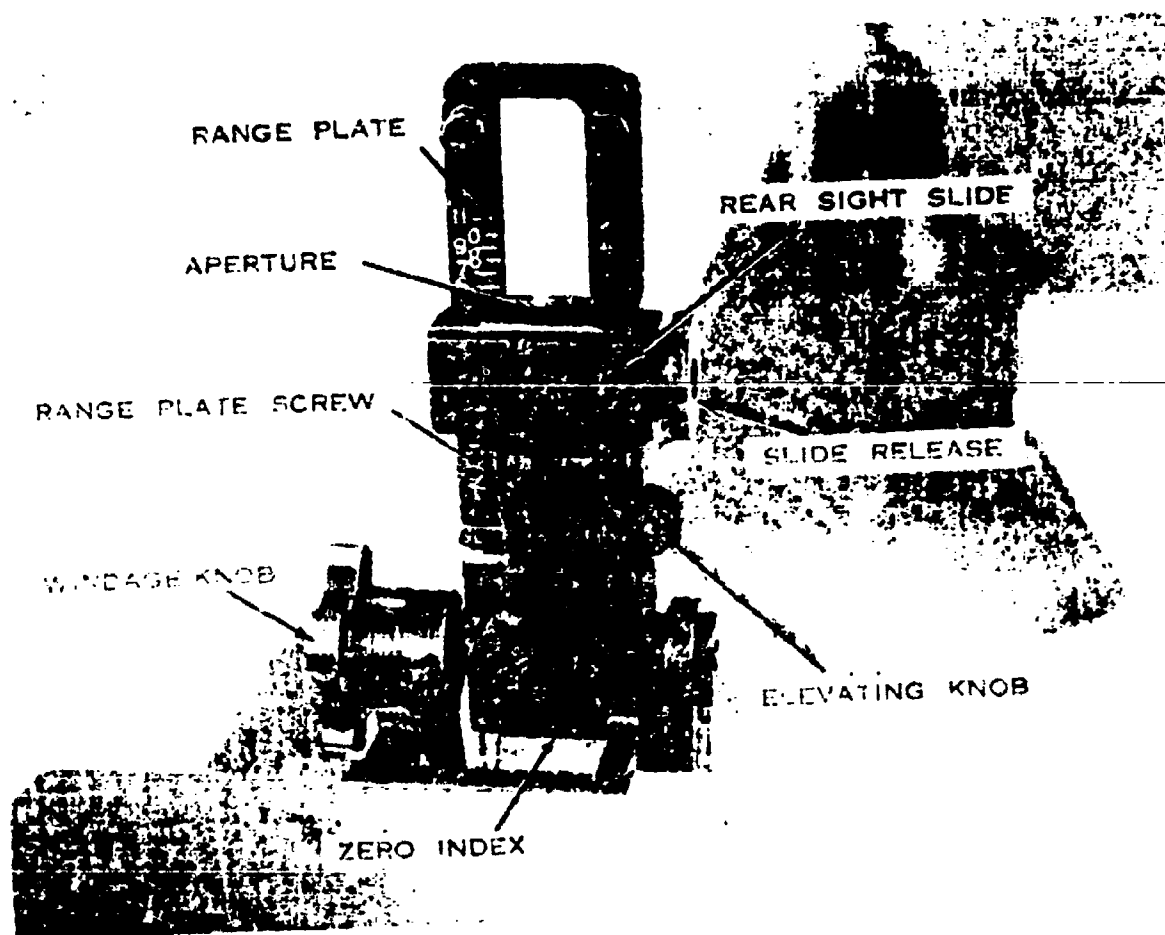
Accurate Range Estimation

Proper Setting of Sight for Range

Correct Sight Picture

Proper Position and Grip

Trigger Manipulation



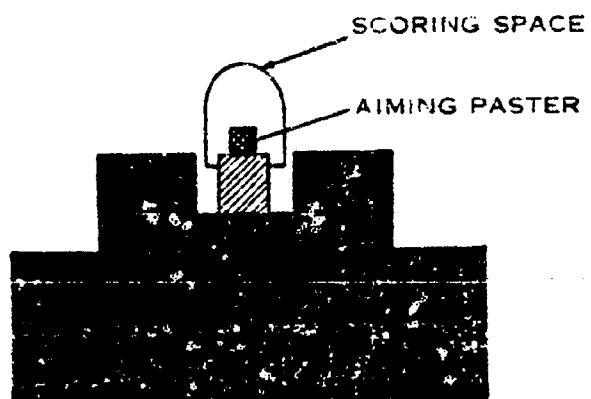
REAR SIGHT MOCK-UP WORKING MODEL

FRONT SIGHT

REAR SIGHT
SLIDE



SIGHT ALIGNMENT

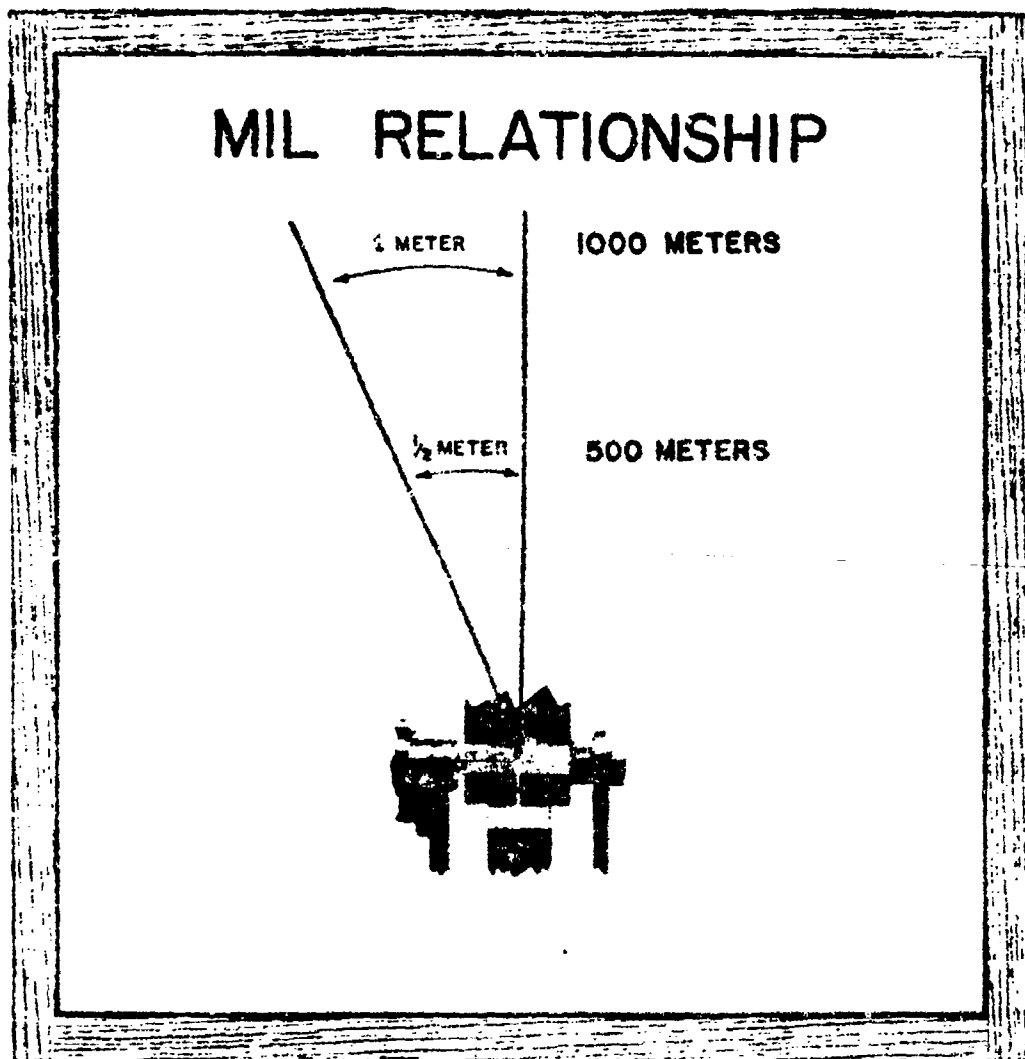


SIGHT PICTURE

M-60 ZEROING

- I. SET SIGHTS**
- II. FIRE 3 ROUNDS**
- III. CORRECT FOR DEFLECTION**
- IV. CORRECT FOR ELEVATION**
- V. CONFIRM**
- VI. ADJUST RANGE PLATE AND
RECORD DEFLECTION ZERO**

BASIC 10-METER RANGE ZEROING CHART



MIL RELATIONSHIP CHART

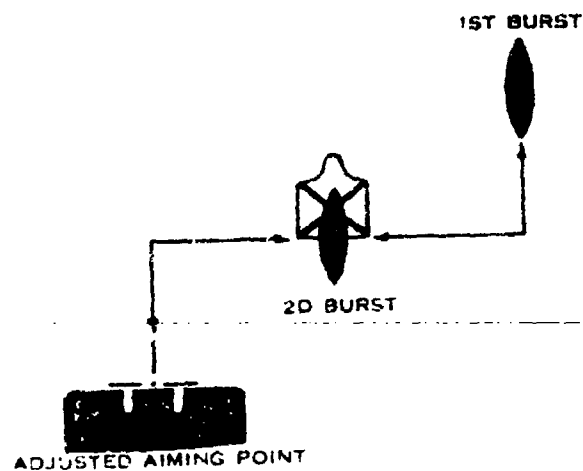
Wind Effects on M60 Machinegun

Wind deflects the cone of fire from its normal path according to the force and direction of the wind and the range to the target. The amount of windage required to correct for a 3 o'clock or 9 o'clock wind (considering 12 o'clock as being the direction of the target), having velocity of 10 miles an hour is as follows:

<u>Range (meters)</u>	<u>Correction (mils)</u>
300	1
500	2
700	3
900	4
1100	6

The effects of winds of other velocities or at other ranges can be approximated by using this table.

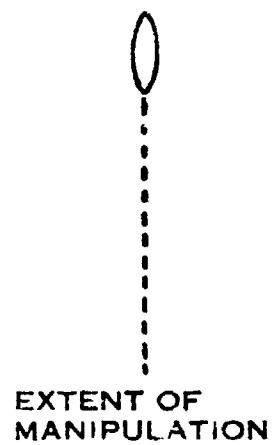
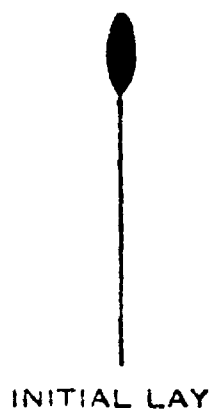
Stronger winds will show proportionately greater effects. For example, a 20 mph wind will require double the above correction.



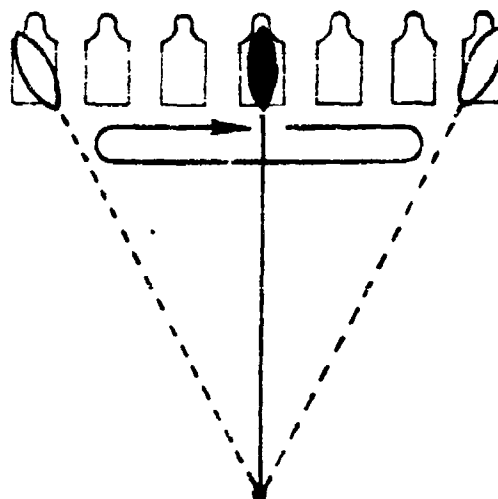
ADJUSTED AIMING POINT METHOD

NOTE: The first burst was fired with the sights placed on the center base of the target. The first burst hit high right.

The second burst was fired with the sights placed on the adjusted aiming point. This places the second burst on the target.



SYMBOLS

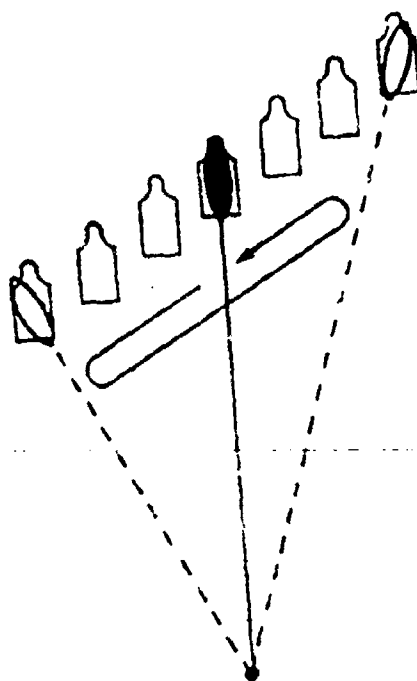


DISTRIBUTION OF FIRE, LINEAR TARGET

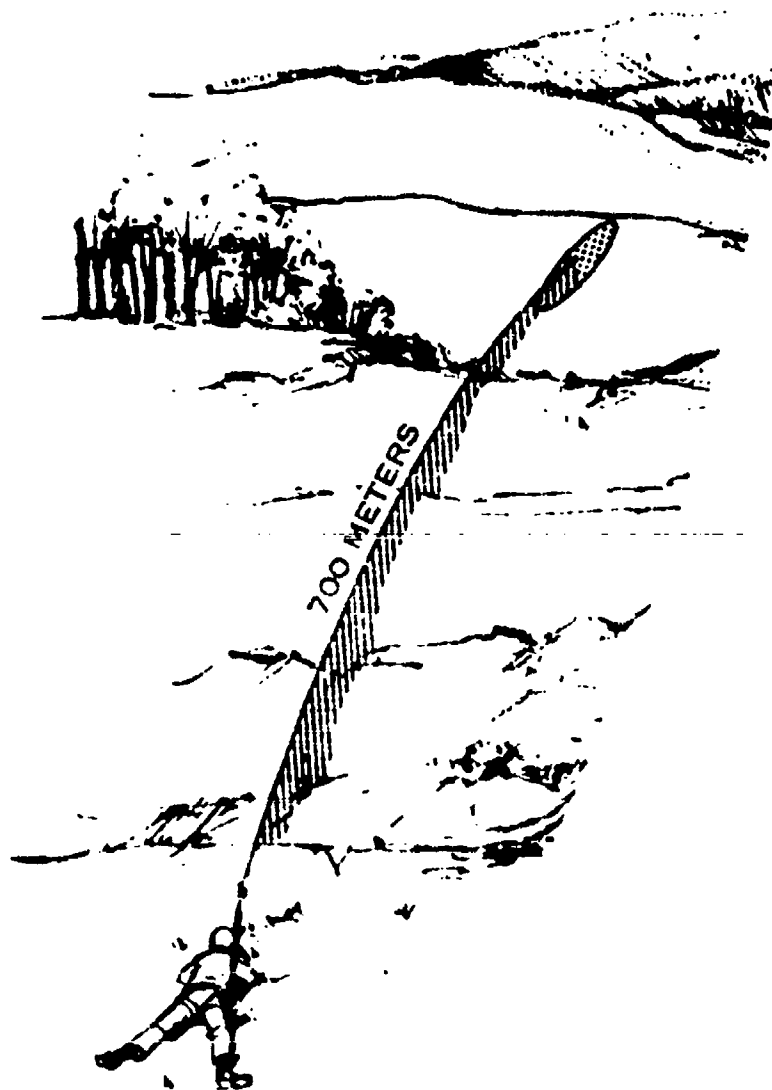
SUCCESSIVE AIMING POINTS IN THE TARGET AREA



DISTRIBUTION OF FIRE - DEEP TARGET
SUCCESSIVE AIMING POINTS IN THE TARGET AREA



DISTRIBUTION OF FIRE - LINEAR TARGET WITH DEPTH
SUCCESSIVE AIMING POINTS IN THE TARGET AREA



GRAZING FIRE