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EFFECTIVENESS OF IMPROVED BASIC RIFLE MARKSMANSHIP TRAINING PROGRAMS

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The Basic Rifle Marksmanship training program comparison took place at Fort Jackson, SC, during the spring and summer of 1979. Improved periods of instruction were compared to provide the soldier in Basic Rifle Marksmanship training with better skill acquisition. Emphasis on fundamentals, downrange feedback for error correction, and improved instructor-to-student ratios were critical added components of the three experimental programs compared to the current marksmanship training program.

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Item 20 (Continued)

The findings of the test showed that instructional changes contributed to significant record fire score improvements. The issue of instructor-to-student ratio changes remains uncertain without further training and testing of instructor personnel.

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FOREWORD

The research reported here was performed by the Army Research Institute - Fort Benning Field Unit, Fort Benning, Georgia. It is part of an ongoing program of research directed toward development of cost effective methods for individual and collective training in M16A1 rifle marksmanship. It is concerned with all aspects of training inquiry from problem assessment, through instructional improvement, to consideration of appropriate training aids and devices. The effort involves close coordination and, in some instances, collaboration with various interested organizations, including: The US Army Infantry School (USAIS), US Army Infantry Board (USAIB), US Army Marksmanship Training Unit (USAMU), and the US Army Training Center, Fort Jackson, South Carolina.

The series of experiments which led to the comparison of candidate basic rifle marksmanship programs made in this report were conducted at Fort Benning, Georgia, and at Fort Jackson, South Carolina. The cooperation of Commanders and staff personnel contributed immeasurably to the conduct of these experiments.

This experiment compared the current standard Basic Rifle Marksmanship program with three candidate improved programs. The programs were designed to meet and work within the training resource constraints currently faced by US Army Training Centers.

ARI-Benning research in training systems development is conducted as an inhouse effort augmented by contracts with organizations selected as having unique capabilities for research in the area. The project was conducted as part of ARMY RDTE Projects 2Q163743A794, FY79 Work Program. It was directly responsive to the requirements of FORSCOM, USAIS and TRADOC.

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EFFECTIVENESS OF IMPROVED BASIC RIFLE MARKSMANSHIP TRAINING PROGRAMS

BRIEF

Introduction:

The Army has sought through Training Effectiveness Analysis (TEA) efforts to examine current training procedures and improve upon them. Rifle marksmanship, as a primary skill acquired by all new soldiers, has been the focus of TEA research by the Army Research Institute Fort Benning Field Unit on behalf of the United States Army Infantry School. The research conducted at Fort Jackson, South Carolina, and presented in this report represents the latest effort to maximize effectiveness in Basic Rifle Marksmanship (BRM) Training given constrained resources. The candidate programs were developed from results of previous field research in the marksmanship training arena.

Procedure:

Three candidate BRM training programs were developed to be tested against the standard program. All differed from the standard substantially in program content, but not substantially in number of training hours. Differences in one or more of the three candidate programs included improved zeroing targets and procedures, comparisons of down-range error correction information procedures for firers, transition to field silhouette firing improvements, and experimental increases in instructor to trainee ratios on the firing line.

Eight companies of basic trainees (both male and female) took part in this experiment, during their rifle marksmanship training at Fort Jackson, South Carolina. The groups were compared on their record fire (qualification) scores, comparable program component performances, and on knowledge questionnaire responses.

Findings:

The record fire scores of male trainees were superior in all training programs and related comparisons to those of females. The experimental program record fire performance results for both males and females were significantly better than standard program results. Substantial differences were found when performance results of trainees attending all training were compared with those of trainees having missed some periods of instruction within each training program. The differences in the standard on this point were nonexistent.

Two of the candidate training programs provided favorable comparisons of performance results necessitating a comparison of the knowledge questionnaire results to select the most effective training program.

The results of the increased instructor to student ratio comparison were inconclusive at best. There was evidence available to suggest that the instructor training provided before the experiment was not sufficient to markedly improve instructor performance. As a result, future examinations of instructor effects on training must include sufficient pre-test training and preparation of instructor personnel.

Utilization of Results:

The results of the experiment conducted at Fort Jackson, S. C., will be incorporated in the US Army Infantry School's Basic Rifle Marksmanship program. The experimental results will also serve as a basis for future research in advanced individual and unit marksmanship training.

EFFECTIVENESS OF IMPROVED BASIC RIFLE
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EFFECTIVENESS OF IMPROVED BASIC RIFLE MARKSMANSHIP TRAINING PROGRAMS

INTRODUCTION

The Army Research Institute Field Unit at Fort Benning, Georgia, (ARI-Benning) began work with rifle marksmanship programs under the sponsorship of the US Army Infantry School (USAIS) for the purpose of developing and implementing improved marksmanship training programs at basic, advanced, and unit levels throughout the Army. ARI involvement has been a result of widespread concern that marksmanship training was too expensive in terms of time and resources and that resultant performance standards were too low. Initially, ARI entered marksmanship training research by participating with the USAIS and TRASANA in the Basic Rifle Marksmanship (BRM) Test (TRASANA, 1977) which resulted in training program changes to reduce the time and cost of training. Several reports were generated by this test as well as subsequent research efforts to identify areas for improvement in training procedures (Evans, Thompson, & Smith, 1980; Hicks & Tierney, 1978; Klein & Tierney, 1978; Smillie & Chitwood, 1980; Smith, Thompson, Evans, Osborne, Maxey, & Morey, 1980; Tierney, Cartner, & Thompson, 1979; Tierney & Cartner, 1978).

The study being reported here was a major final field experiment conducted at Fort Jackson, South Carolina, and was designed to test program improvements for Basic Rifle Marksmanship (BRM) training. This study represents the culmination of a series of laboratory and field experiments conducted at Fort Benning, Georgia, and at Fort Jackson, South Carolina[1].

Earlier tests showed that the typical trainee received inadequate feedback and often confusing fundamental information during basic rifle marksmanship training. More emphasis was needed on marksmanship fundamentals, instructions and procedural improvements in the zeroing process, and enhanced feedback from errors made during field firing. Previous research findings indicated that there were alternate possible solutions to the training program's shortcomings. In order to determine which one answered the problems most adequately, each had to be tested independently in a training center. Independent candidate programs were implemented in a training center environment (Fort Jackson, South Carolina) with typical basic trainees participating as test subjects. The instructors and drill sergeants used were those normally assigned to teach BRM and to work with trainees. The cadre of instructors and drill sergeants were given training sessions to become familiar with the critical training components which differed from the standard program. A limited number of additional personnel were assigned to assist with data collection on firing ranges during the test.

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[1]ARI-Benning would have been unable to conduct this field work without the cooperation and full support of the Commanding General, his staff, and the BT Committee Group Commander, and his staff, at Fort Jackson, South Carolina.

METHODS

Subjects

The 1,151 subjects (910 males and 241 females) were members of eight basic training companies undergoing entry level training at Fort Jackson, South Carolina, during April and May, 1979. In order to avoid interrupting the normal flow of training and to prevent division of tightly constrained instructor resources, the experimental limitation of assigning an entire company to the same treatment condition had to be accepted. Assignments were further limited by the need of the training center to complete the test treatments requiring double drill sergeants first. There was, in effect, no random assignment of subjects to treatment conditions. As companies were filled for training they were assigned to treatments as required.

Procedures

The experiment consisted of a comparison of four training programs (hereafter called Tracks). Track I was the standard ongoing BRM program (which served as a baseline or control condition). Tracks II and III were new candidate BRM programs differing only in that Track III had a "walk down-range" feedback exercise for showing bullet location at distant targets and Track II did not. Tracks II and III used more than the usual number of instructors. The regular complement of instructors was employed by Track I and by Track IV (which was otherwise identical to Track III).

ARI-Benning, in cooperation with DTD, USAIS, and the BT Committee Group, Fort Jackson, South Carolina, developed the improved candidate BRM programs for testing during the spring of 1979. The basic training center at Fort Jackson had the necessary resources available to train cadre, conduct BRM training, and control data collection during the test under conditions that might reasonably be considered representative of those at other basic training centers.

A letter of instruction detailed procedures for Fort Jackson instruction and support participation (HQ, USATC, Fort Jackson, South Carolina, 1979). Included was the requirement for additional drill sergeants to aid in instructing Track II and Track III trainees.

The programs differed in a number of ways from the standard BRM program and were expected to improve skill acquisition and related record fire score performances.

- Instructors and drill sergeants received training to enhance instructional performance on the firing line.

- Higher instructor to trainee ratios were provided (Track II and III). The number of drill sergeants on the firing line to assist trainees was doubled.

- Emphasis was placed on shooting fundamentals and on logically sequenced instruction.

- Concurrent training was to be used to reinforce, through practice, primary shooting skills.

- Use of maximal performance feedback to aid in problem diagnosis was critical to all three experimental tracks (II, III and IV).

Table 1 presents a description of the experimental track programs as well as the standard training program, Track I. The first period, Mechanical Instruction, was taught by the training company cadre prior to the trainees arriving at the range sites.

The fundamentals block, Periods 2, 3, and 4, of the experimental tracks focused on developing tight shot groups and initial battle sight zero (BSZ) on trainees' weapons. Firing took place at the 25 meter range with all four tracks using the new BSZ target (Figure 1).

In period 5 the standard program (Track I) trainees moved to field fire ranges to engage 75, 175, and 300 meter silhouette targets. In contrast, all experimental tracks remained at the 25 meter firing line and were exposed to simulated field fire targets using the rifle's long range sight (which makes point of aim equal point of impact) (see Figure 2). This training at 25 meters permitted trainees to fire 18 rounds at (simulated long range) targets and obtain feedback from their errors.

Period 6 provided continued field firing for the standard program trainees. Track II trainees fired additional exercises at 25 meter silhouette targets using the long range sight. Tracks III and IV moved to another range to fire at full size silhouette targets, on larger panels, at 75 meters (D Repair target see Figure 3) and 175 meters (see Figure 4) to continue capturing error information and make necessary sight adjustments. All experimental tracks (II, III & IV) moved downrange to inspect their targets and be critiqued about their performance.

Period 7 was Practice Record Fire for the standard program while the experimental tracks were introduced to field fire targets. The experimental groups fired fewer rounds during a condensed version of the standard field fire exercises than did the track I trainees.

Table 1

RIFLE MARKSMANSHIP TRAINING PROGRAM COMPARISONS

CURRENT FT JACKSON PROGRAM: TRACK I	TRACK II	TRACK III	TRACK IV
	---------- IPST PROGRAMS BRM ----------		
PERIOD 1 Mechanical Hrs: 4 Rds: 0	PERIOD 1 Mechanical Hrs: 4 Rds: 0	PERIOD 1 Mechanical Hrs: 4 Rds: 0	PERIOD 1 Mechanical Hrs: 4 Rds: 0
PERIOD 2 25M Intro to Skills Tng Hrs: 6 Rds: 0	PERIOD 2 25M Intro to Skills Tng Hrs: 7 Rds: 0	PERIOD 2 25M Intro to Skills Tng Hrs: 7 Rds: 0	PERIOD 2 25M Intro to Skills Tng Hrs: 7 Rds: 0
PERIOD 3 Intro to Skills Tng Hrs: 2 Rds: 9	PERIOD 3 Intro to Skills Tng Hrs: 5.5 Rds: 18	PERIOD 3 Intro to Skills Tng Hrs: 5.5 Rds: 18	PERIOD 3 Intro to Skills Tng Hrs: 5.5 Rds: 18
PERIOD 4 BSZ Hrs: 6 Rds: 24+12	PERIOD 4 BSZ Hrs: 6 Rds: 18+12	PERIOD 4 BSZ Hrs: 6 Rds: 18+12	PERIOD 4 BSZ Hrs: 6 Rds: 18+12
PERIOD 5 Intro to Field Fire Hrs: 4 Rds: 42	PERIOD 5 25M 25-Mtr Enhancement Hrs: 2 Rds: 18	PERIOD 5 25M 25-Mtr Enhancement Hrs: 2 Rds: 18	PERIOD 5 25M 25-Mtr Enhancement Hrs: 2 Rds: 18
PERIOD 6 Field Fire Hrs: 4 Rds: 36	PERIOD 6 25M 25-Mtr Enhancement Hrs: 3 Rds: 18	PERIOD 6 175M Known Distance Hrs: 6 Rds: 18	PERIOD 6 175M Known Distance Hrs: 6 Rds: 18
PERIOD 7 Practice Record Hrs: 4 Rds: 40	PERIOD 7 Intro to Field Fire Hrs: 5 Rds: 42	PERIOD 7 Intro to Field Fire Hrs: 5 Rds: 42	PERIOD 7 Intro to Field Fire Hrs: 5 Rds: 42
	PERIOD 8 Target Detection	PERIOD 8 Target Detection	PERIOD 8 Target Detection
	Hrs: 3.5 Rds: 12 Blank	Hrs: 3.5 Rds: 12 Blank	Hrs: 3.5 Rds: 12 Blank
	PERIOD 9 25M 25-Mtr BSZ Confirmation and Timed Exercise Hrs: 3 Rds: 29	PERIOD 9 25M 25-Mtr BSZ Confirmation and Timed Exercise Hrs: 3 Rds: 29	PERIOD 9 25M 25-Mtr BSZ Confirmation and Timed Exercise Hrs: 3 Rds: 29
	PERIOD 10 Field Fire (on Practice Record Range Hrs: 4 Rds: 50	PERIOD 10 Field Fire (on Practice Record Range) Hrs: 4 Rds: 50	PERIOD 10 Field Fire (on Practice Record Range) Hrs: 4 Rds: 50
PERIOD 8 Record Fire	PERIOD 11 Record Fire	PERIOD 11 Record Fire	PERIOD 11 Record Fire
Hrs: 4.5 Rds: 40	Hrs: 4 Rds: 40	Hrs: 4 Rds: 40	Hrs: 4 Rds: 40
PERIOD 9 Auto Fire, Kneeling, Opposite Shoulder Hrs: 3 Rds: 44	PERIOD 12 Auto Fire, Kneeling & Opposite Shoulder Hrs: 3 Rds: 44	PERIOD 12 Auto Fire, Kneeling & Opposite Shoulder Hrs: 3 Rds: 44	PERIOD 12 Auto Fire, Kneeling & Opposite Shoulder Hrs: 3 Rds: 44
PERIOD 10 Night Fire Hrs: 5 Rds: 78	PERIOD 13 Night Fire Hrs: 4 Rds: 78	PERIOD 13 Night Fire Hrs: 4 Rds: 78	PERIOD 13 Night Fire Hrs: 4 Rds: 78
TOTAL HOURS: 57 TOTAL ROUNDS: 313	TOTAL HOURS: 54 TOTAL ROUNDS: 355	TOTAL HOURS: 57 TOTAL ROUNDS: 355	TOTAL HOURS: 57 TOTAL ROUNDS: 355
RETENTION (6 WEEKS AFTER BRM) Hrs: 3 Rds: 9 BSZ Hrs: 3 Rds: 40 Rcd	RETENTION (6 WEEKS AFTER BRM) Hrs: 3 Rds: 9 BSZ Hrs: 3 Rds: 40 Rcd	RETENTION (6 WEEKS AFTER BRM) Hrs: 3 Rds: 9 BSZ Hrs: 3 Rds: 40 Rcd	RETENTION (6 WEEKS AFTER BRM) Hrs: 3 Rds: 9 BSZ Hrs: 3 Rds: 40 Rcd

NOTE: 355 rounds ball ammunition does not include the 12 rounds for Remedial BSZ of 5% of the company present for training, nor the 12 rounds blank ammunition for Target Detection training.

NOTE: Tracks II and III had twice the normal number of drill sergeants for training - usually 16 instead of 8.

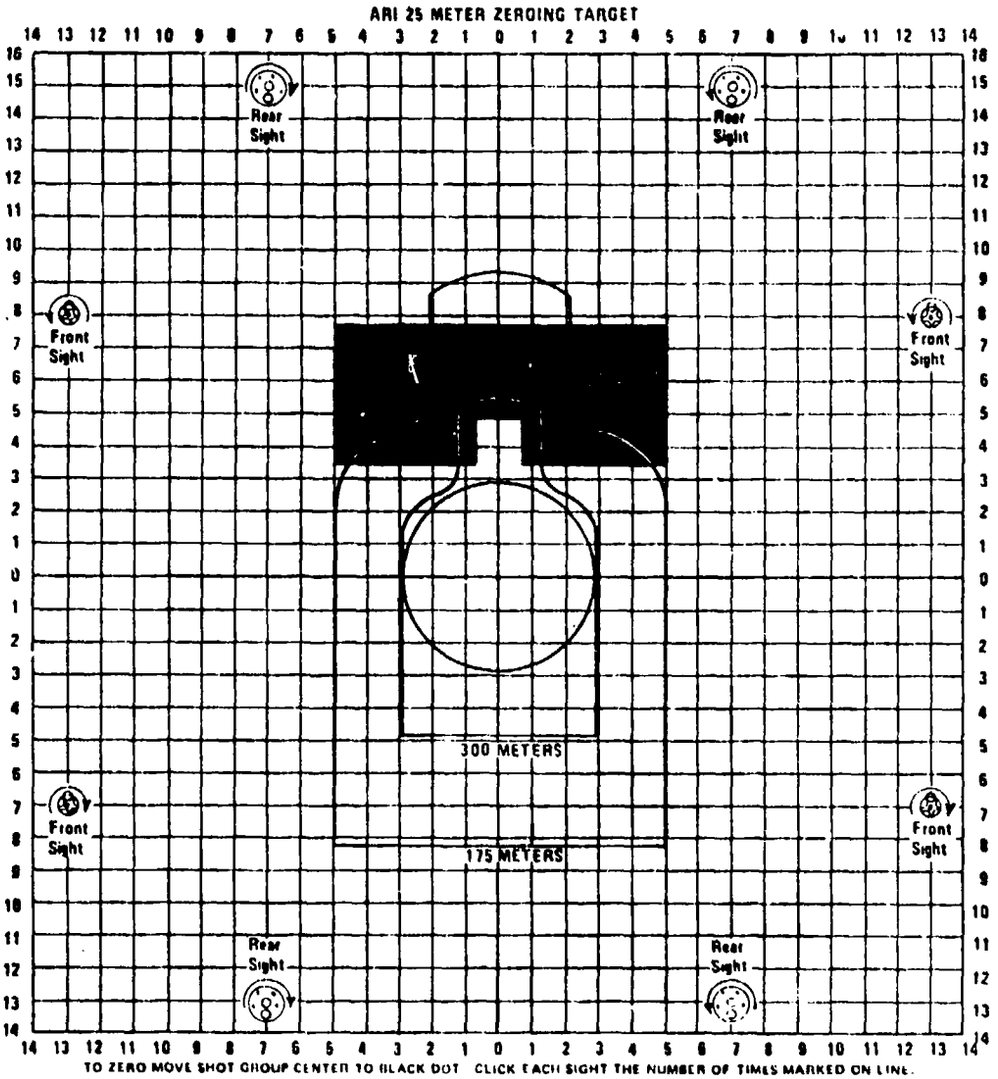

Figure 1. ARI 25 Meter Zeroing Target used at the 25 meter range for initial firing including zeroing (8½" x 9½" actual size).

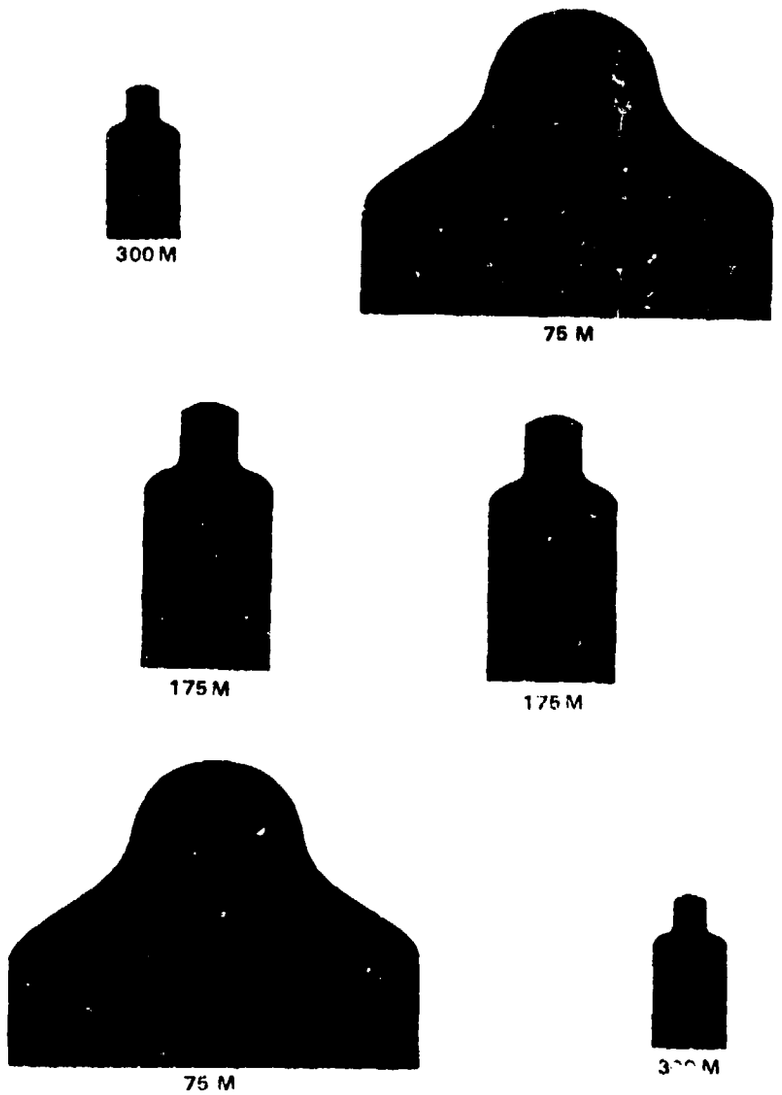

Figure 2. 25 Meter Target used to transition from the Canadian Bull (Figure 1) aiming point to a center of target mass aiming point on field fire ranges (actual size 17½" x 22½").

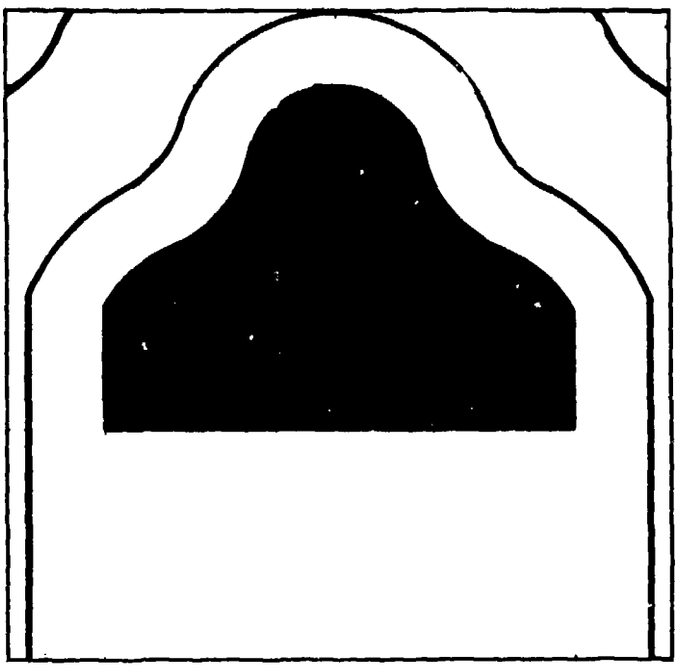

Figure 3. D Center Repair Target used at 75 meters to provide error feedback to the firer (actual size 26" x 36").

Period 8 was the standard Record Fire period for Track I. The experimental tracks had a target detection period during which 12 blank rounds were available per trainee to simulate target engagement.

Period 9, for the experimental tracks, was a return to the 25 meter firing range to confirm BSZ and to fire a 45 second timed exercise at silhouette targets simulating presentation at various ranges (see Figure 5). Each firer had to determine his own order of target engagement. This exercise was fired from both the foxhole supported and the prone unsupported positions. The time limit simulated the time pressure and rapid shifts to other targets faced by a firer during target engagement sequences on the Record Fire Range.

The experimental tracks fired a second field fire course on the practice record fire range during period 10.

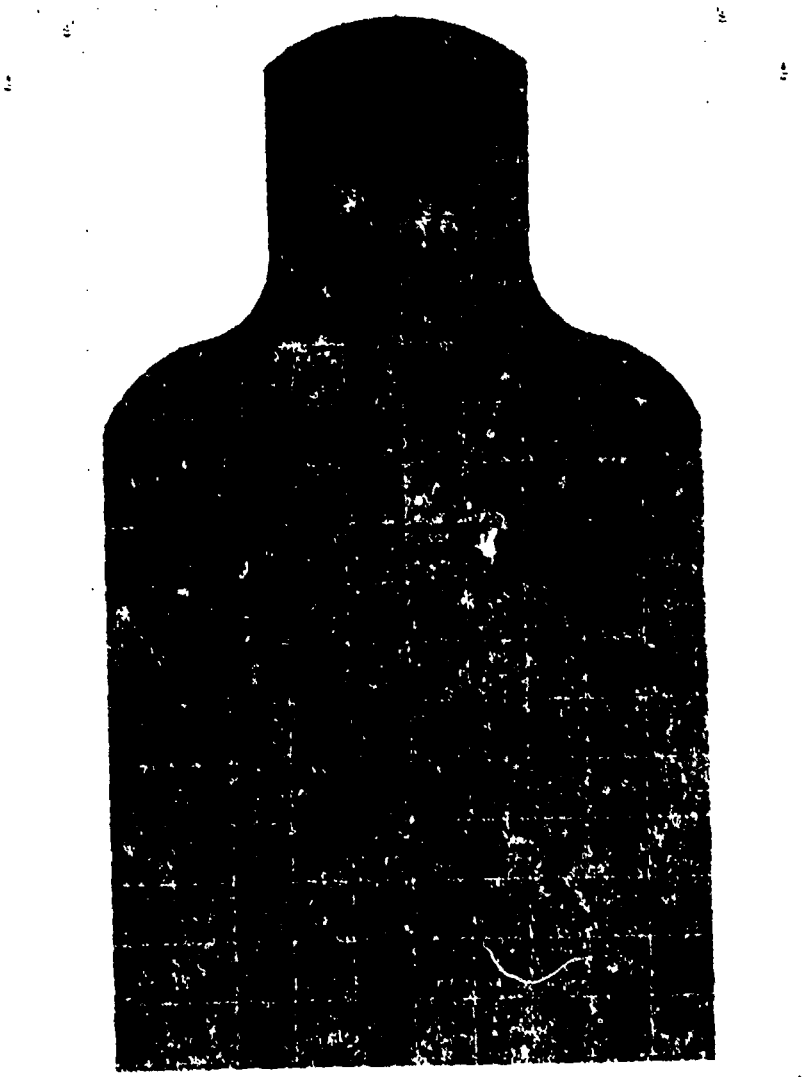

Figure 4. 175 Meter Target attached to a 6' x 6' witness panel and used to provide downrange error feedback to the firer (actual target size 30" x 40").

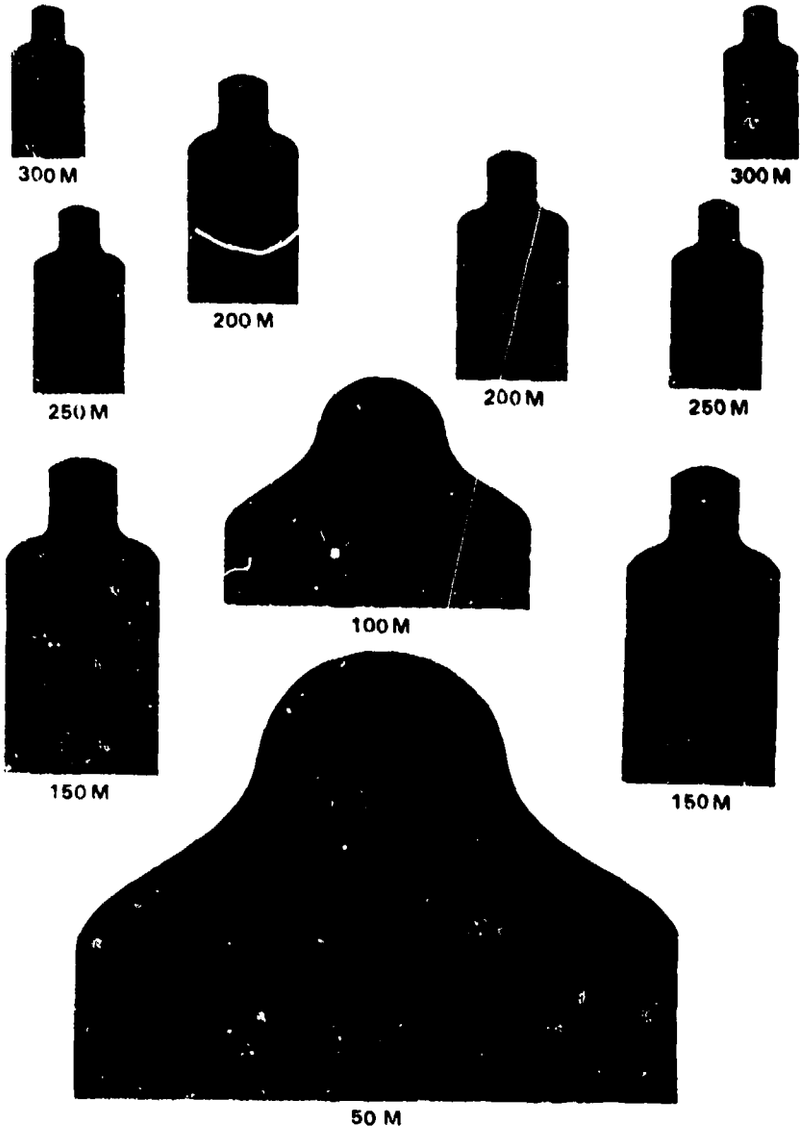

Figure 5. 25 Meter Target used to introduce the firer to timed target engagements. The firer has 45 seconds to engage 10 silhouettes during the exercise (actual target size 17½" x 22½").

Record Fire for the experimental tracks took place during period 11.

The remaining portions of the experimental tracks - automatic firing activities and night firing - were identical to that of the standard program.

Data Collection

Performance data were collected for each period of instruction which included live fire exercises (see Table 1). Demographic and marksmanship comprehension questionnaires were administered during the Record Fire period to all subjects. Specific data collection included:

- The number of rounds inside, or touching the four centimeter circle on the BSZ 25 Meter Target (Figure 1) for each of six shot groups. This information was recorded for each of the four tracks.

- Tracks II, III, and IV fired six 3-round shot groups at 25 meter silhouette targets simulating 75, 175, and 300 meter ranges during period 5 (Figure 2). Three groups were fired from the foxhole position and three were fired from the prone position. The numbers of hits (0-3) per shot group were recorded.

- Track II fired an additional six 3-round groups at 25 meter silhouette targets during period 6 (Figure 2).

- Tracks III and IV fired two 3-round shot groups at 75 meter targets (D repair targets) and four at the new 175 meter silhouette target (Figure 3). Period 6 for these two tracks involved actual known distance (KD) downrange feedback.

- Field Fire scores (Track I, Period 5; Tracks II, III, and IV, Period 7) were recorded as the number of target hits by range (75 meters, 10 possible; 175 meters, 14 possible; 300 meters, 18 possible).

- The data collected for tracks II, III, and IV during Period 9, included the number of rounds inside or touching the four centimeter circle on the BSZ target (Figure 1) out of three 3-round shot groups and the number of silhouette hits during two 10-round times fire exercises at 25 meters (Figure 4).

- The number of hits recorded during practice record fire (Track I, Period 7, Tracks II, III, and IV, Period 10) from the foxhole and prone positions was recorded. The experimental tracks had a 10-round warmup exercise before practice record fire which was recorded as well. A total of 40 hits on practice record fire was the possible score for all tracks.

- Record Fire scores for all four tracks were recorded for foxhole and prone firing position scores. A total of 40 hits was possible on Record Fire.

- The questionnaire which trainees completed during the Record Fire period is included as Appendix A. Appendix B shows the aggregation of individual questions into three conceptual areas.

RESULTS

The number of male and female trainees who completed all or part of the training in each of the experimental tracks and the standard track is shown in Table 2. Each track included trainees from two separate training companies.

Table 2

Male and Female Trainees Assigned to Each Treatment Group

Track	Males	Females	Total Subjects
I	229	58	287
II	246	75	321
III	224	60	284
IV	211	48	259
Total	910	241	1,151

Training Attendance

Test soldier participation in all periods of training was considered important for meaningful testing of the effectiveness of the candidate training programs. This was emphasized in the letter of instruction

Table 3

Trainin· Attendance

Track	Trainees with Record Fire (RF) Scores Providing Sex and Race Information	Number of Periods Missed	Percent Males	Percent Females	Percent Totals
I	238	0	33.5 (64)	57.4 (27)	38.2 (91)
		1	57.6 (110)	36.2 (17)	53.4 (127)
		2	8.9 (17)	6.4 (3)	8.4 (20)
		3	0	0	
					100.0 (238)
II	285	0	69.3 (149)	52.9 (37)	65.3 (186)
		1	16.7 (36)	22.9 (16)	18.3 (52)
		2	4.2 (9)	7.1 (5)	5.0 (14)
		3	7.4 (16)	11.4 (8)	8.2 (24)
		4+	2.3 (5)	5.7 (4)	3.2 (9)
					100.0 (285)
III	273	0	66.4 (144)	51.8 (29)	63.4 (173)
		1	9.7 (21)	12.5 (7)	10.3 (28)
		2	7.4 (16)	8.9 (5)	7.7 (21)
		3	9.2 (20)	17.9 (10)	10.9 (30)
		4+	7.4 (16)	8.9 (5)	7.7 (21)
					100.0 (273)
IV	250	0	55.9 (113)	37.5 (18)	52.4 (131)
		1	15.8 (32)	16.7 (8)	16.0 (40)
		2	11.4 (23)	10.4 (5)	11.2 (28)
		3	9.4 (19)	14.6 (7)	10.4 (26)
		4+	7.4 (15)	20.8 (10)	10.0 (25)
					100.0 (250)
Total percent attending all training across all tracks			57.0 (470 of 825)	50.2 (111 of 221)	55.5 (581 of 1,046)

Note: The number in parentheses ( ) is the number of trainees attending training.

Note: Totals for this table are less than other test track totals due to incomplete information provided in questionnaire responses by some trainees (sex and race information).

prior to the beginning of the test (HQ, USATC, Fort Jackson, April 1979). The results of some analyses presented in this report are based on subject totals which do not equal the total number of assigned subjects (Table 2). Trainee attendance during all critical training periods of instruction was considered important as was the accurate completion of the questionnaire. Analyses comparing groups having attended all training and having missed some training support this point (see Table 5). Table 3 presents the subject totals and percentages of those who completed training.

Record Fire Performance

A global measure of rifle marksmanship proficiency is the record fire qualification score. An analysis of variance of record fire scores (Table 4) resulted in significant main effects for tracks, (F (3,634) = 25.24, $p < .0001$) and for sex, (F (1,634) = 14.00, $p < .0001$) but no significant interaction, ($F < 1$.) Inspection of the mean record fire scores of trainees who completed all training (Table 5) revealed that in all tracks male performance was superior to female performance.

A series of independent group t tests (Table 5) demonstrated that for males in all the experimental tracks missing some training had the effect of significantly reducing average record fire scores. Average female performance was adversely affected in tracks II and IV. The impact of missing some training in the standard program (Track I) was negligible for both sexes. Standard training was insensitive to differences between soldiers missing some training versus completing all training. However, the new methods were variably sensitive to the amount of training.

Table 4

Analysis of Variance of Record Fire Scores for Trainees Who Completed All Training

Source	df	MS	F	p
Tracks	3	935.370	25.242	< .0001
Sex	1	518.753	13.999	< .0001
Tracks x Sex	3	12.311	.322	NS
Error	634	37.057		
Total	641			

Table 5

Comparison of Record Fire (RF) Scores for Males and Females Who Completed All Training and Who Missed Some Training

Track	Males					Females				
	Mean RF All Tng (N)	Mean RF Missed Some (N)	t	df	p	Mean RF All Tng (N)	Mean RF Missed Some (N)	t	df	p
I	20.48 (82)	21.27 (147)	<1	227	NS	18.97 (34)	18.67 (24)	<1	56	NS
II	26.32 (173)	22.78 (73)	4.13	244	<.0001	23.25 (40)	23.14 (35)	<1	73	NS
III	26.47 (146)	22.91 (78)	3.69	222	<.0001	24.47 (30)	19.10 (30)	3.16	47*	<.003
IV	25.30 (119)	22.74 (91)	2.96	208	<.003	22.83 (18)	19.00 (31)	2.00	47	<.051

*df adjusted for unequal variances of groups.

In order to assess the relative merit of the candidate programs of instruction with respect to record fire scores, separate analyses of variance were conducted for males and females who completed all training. These analyses appear in Tables 6 and 7 respectively.

The treatments sum of squares of each analysis of variance was decomposed into three contrasts reflecting a priori hypotheses regarding training program effectiveness. The first contrast compared average performance under the three experimental programs against the performance under the standard program. For both males ($t(520) = 7.51$, $p < .0001$) and females ($t(118) = 3.80$, $p < .001$) significant differences were obtained representing a 27 percent improvement for males and a 24 percent improvement for females. The second contrast evaluated the effect of reducing the

number of drill sergeants in Track IV. For neither males ($t(520) = 1.72$, $p > .05$) nor females ($t(118) = .66$, $p > .05$) was this found to affect record fire performance when the average performance of Tracks II and III was used as the basis of comparison. The last contrast sought to isolate which of the two conceptually different candidate programs, Track II or Track III, yielded superior record fire scores.

Table 6

Analysis of Variance and Contrasts of
Record Fire Scores for Males Completing All Training

Analysis of Variance

Source	df	MS	F	p
Between	3	760.6011	20.276	< .0001
Within	520	37.5118		
Total	523			

Contrasts

1 - Track I compared to average of Tracks II, III, and IV
2 - Track IV compared to average of Tracks II and III
3 - Track II compared to Track III

Contrast	Value	SE	t	df	p
1	5.487	.73	7.513	520	.000
2	1.121	.65	1.718	520	.086
3	.081	.34	.236	520	.813

Table 7

Analysis of Variance and Contrasts of
Record Fire Scores for Females Completing All Training

Analysis of Variance

Source	df	MS	F	p
Between	3	186.3133	5.468	.0015
Within	118	34.0715		
Total	121			

Contrasts

1 - Track I compared to average of Tracks II, III, and IV
2 - Track IV compared to average of Tracks II and III
3 - Track II compared to Track III

Contrast	Value	SE	t	df	p
1	4.501	1.185	3.80	118	.000
2	1.025	1.546	.66	118	.509
3	.608	.705	.863	118	.390

This contrast revealed no difference for either sex (both $t < 1$) leading to the conclusion no selection of candidate programs could be made solely on the basis of record fire scores.

Critical Periods Performance

Given that the record fire data revealed no differences among the experimental tracks, exploration of performance differences within tracks was undertaken. Periods of instruction which were determined to be critical to the POI, because they represented live fire performance feedbacks, differed by track. Track I critical periods included Battle Sight Zero (BSZ), and Field Fire (FF). Track II critical periods included BSZ, Silhouette Target A (STA), Silhouette Target B (STB), FF, Reconfirmation of Battle Sight Zero (RBSZ), Timed Fire A (TFA), and Timed Fire B (TFB). Tracks III and IV critical periods included BSZ, STA, Down-range Feedback at 75 and 175 meters (DF), FF, RBSZ, TFA, and TFB.

Practice Record Fire (PRF) was included in all tracks and provided performance measures for comparative analysis between tracks. The experimental programs included ten warmup rounds before PRF which might have caused equivalent performance comparison difficulties with Track I, the standard program.

Table 8 presents the performance results by track and sex for subjects completing all critical periods of instruction. All experimental tracks provided better performance results than the standard program, Track I, in common critical periods. Generally, with the exception of the Timed Fire A exercise Track III females (Table 8), Track IV provided a slight advantage in all instructional periods common to all tracks. This may be due to improvements in instructor presentations which resulted from experience with the other experimental tracks. Track IV was sequenced last in the experiment.

All training tracks shared three common blocks of instruction during which comparative performance measures could be taken. Table 9 presents the mean performance measures, by common period, for subjects who attended all training.

A comparative analysis of battle sight (BSZ) data is problematic since the trainees in the experimental tracks were given more opportunities to fire prior to and during the zeroing phase of training. However, all trainees fired at least three 3-round shot groups during Period 4 when zero sight adjustments were made. As shown in Table 9, the males in the experimental tracks achieved on the average at least 1.5 more hits within the target's four centimeter circle in the first nine rounds than the standard program males. This difference was statistically significant, F (3,519) = 14.40, $p < .00001$. The same comparison for females revealed a similar difference, F (3,118) = 8.72, $p < .00001$. Compared to females in the standard program, all other groups of female trainees achieved an average of at least twice as many hits within the zeroing circle during the first nine zeroing rounds.

These findings suggest that trainees in the experimental tracks benefited from greater familiarization firing (Period 3) prior to zeroing. This hypothesis was assessed by comparing the initial three round shot group of all trainees during zeroing. It was reasoned that any carry-over effects of familiarization firing during Period 3 would be apparent as the zeroing process began. As shown in the column of initial BSZ shot group size (Table 9), the mean number of hits in the experimental tracks exceeded that for the standard. This difference was statistically significant for both males, F (3,516) = 5.67, $p = .0008$, and females, F (3,118) = 5.90, $p = .0009$, which leads to the conclusion that the zeroing process benefits from more emphasis on familiarization (18 rounds as 9 rounds) prior to making sight changes.

Table 8

Critical Periods Mean Performance Scores of Males and Females Completing All Training

Period of Instruction and Possible Score	Sex	Track							
		I[1]		II[2]		III[3]		IV[4]	
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
BSZ (0-9)	M	3.7	2.2	5.9	2.7	5.9	2.6	6.4	2.9
	F	2.6	1.8	4.7	3.1	5.4	2.1	6.0	2.5
STA (0-18)	M	--	--	12.9	3.6	13.2	3.3	13.8	3.1
	F	--	--	11.2	3.7	11.9	2.5	13.4	2.4
STB (0-18)	M	--	--	14.1	3.2	--	--	--	--
	F	--	--	11.9	3.4	--	--	--	--
DF (0-18)	M	--	--	--	--	9.8	2.1	10.9	2.0
	F	--	--	--	--	9.4	1.6	10.3	2.2
FF (0-36 I 0-42 II-IV)	M	15.7	6.8	19.0	7.3	23.2	6.9	23.3	6.9
	F	14.3	5.6	16.9	6.5	21.4	6.6	23.3	6.7
RBSZ (0-9)	M	--	--	4.9	2.4	4.8	2.4	5.2	2.5
	F	--	--	4.2	2.1	3.3	2.2	4.8	1.8
TFA (0-10)	M	--	--	7.4	2.2	7.7	2.1	8.0	2.1
	F	--	--	7.2	2.1	7.8	2.0	7.2	2.3
TFB (0-10)	M	--	--	6.1	2.3	6.5	2.1	7.2	2.1
	F	--	--	5.5	2.3	5.1	2.2	7.0	2.8
PRF (0-40)	M	18.8	6.6	24.0	6.0	21.1	6.6	24.0	6.0
	F	15.7	4.8	20.5	6.5	17.8	5.8	22.8	8.6

Note: BSZ = Battle Sight Zero; STA = Silhouette Target (foxhole position); STB = Silhouette Target (prone position); DF = Downrange Feedback; FF = Field Fire; RBSZ = Confirmation of Battle Sight Zero; TFA= Timed Fire Exericse (foxhole position); TFB = Timed Fire Exercise (prone position); PRF = Practice Record Fire.

[1] $\underline{n}$ = 82 males and 34 females
[2] $\underline{n}$ = 173 males and 40 females
[3] $\underline{n}$ = 146 males and 30 females
[4] $\underline{n}$ = 119 males and 18 females

Table 9

Common Period Mean Performances for Trainees
Completing All Training

Males

Track	Initial BSZ Shot Group[a]	Battle Sight Zero[b]	Field Fire[c]	Practice Record Fire[d]	Record Fire[d]
I	.7	2.5	15.7	18.8	20.5
II	1.2	4.1	18.9	23.9	26.3
III	1.1	4.1	23.3	21.1	26.5
IV	1.3	4.5	23.3	24.0	25.3

Females

Track	Initial BSZ Shot Group[a]	Battle Sight Zero[b]	Field Fire[c]	Practice Record Fire[d]	Record Fire[d]
I	.2	1.7	14.3	15.7	19.0
II	.9	3.2	16.9	20.5	23.3
III	1.0	3.9	21.4	17.8	24.5
IV	1.1	4.2	23.3	22.8	22.8

[a] maximum possible = 3
[b] maximum possible = 9
[c] maximum possible = 42
[d] maximum possible = 40

The shooting superiority of the male experimental track trainees was maintained throughout subsequent periods of instruction as revealed in mean performance during Field Fire and Practice Record Fire. Using the planned comparisons statistical procedure, trainees in the three experimental groups (combined) had more hits than did those in the standard group for: (a) Field Fire, t (516) = 7.24, $p<.00001$ and (b) Practice Record Fire, t (516) = 5.63, $p < .00001$. Track IV was demonstrated to be superior when compared to the average performance of Tracks II and III for both Field Fire, t (516) = 2.93, $p = .004$ and Practice Record Fire, t (516) = 2.18, $p = .03$. The content of Track IV was identical to that of Track III with the exception that the normal student-instructor ratio was in effect for Track IV. Therefore, the presence of more drill instructors did not materially improve male firing performance during the middle portion of the experimental programs.

These findings for males were mirrored in the data from females. The aggregated data from experimental programs was shown to reflect superior performance when planned comparisons were made with the standard program for: (a) Field Fire, t (118) = 4.81, $p < .0001$ and (b) Practice Record Fire, t (118) = 3.65, $p < .0001$. Further comparisons of Track IV mean performance with the average of Track II and III performance revealed that Track IV female shooters scored more hits in Field Fire, t (118) = 2.48, $p < .02$, and in Practice Record Fire, t (118) = 2.19, $p < .05$. Since fewer instructors were programmed into Track IV, the conclusion for female shooters is identical to that for male shooters: the Track III/Track IV instructional content yielded superior performance during the middle portion of M16 rifle training.

Questionnaire Data

The questionnaire was administered at the end of BRM Record Fire qualification to assess the trainee's knowledge of three aspects of marksmanship fundamentals: zeroing, transition from 25 meter to field firing and effects of firing at greater range. Only data from trainees who completed all training were selected for analysis to exclude the responses of those who had not been exposed to all concepts and skills addressed in the candidate programs. Scores from individual items were added to yield the three composites below.

Knowledge of Zeroing. Since the experimental programs (Tracks II, III, and IV) focused on zeroing fundamentals, it was expected that improvement in trainees' knowledge of how to zero the rifle would be reflected in questionnaire responses when compared to the control, or standard program. Ten questions dealt with zero-related knowledge and zero concept comprehension. The questionnaire responses showed that males and females in all three experimental tracks scored somewhat higher than the standard track subjects (Table 10).

Table 10

Mean Questionnaire Scores for Male and Female Trainees Completing All Periods of Instruction

Males

		Zeroing Knowledge (0-10)		Transition Knowledge (0-5)		Effects of Range Knowledge (0-9)		Total Score (0-24)	
Track	n	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
I	68	7.0	1.5	2.7	1.3	4.2	1.7	13.9	3.2
II	149	7.8	1.6	2.8	1.4	4.1	1.8	14.8	3.5
III	144	7.8	1.9	3.2	1.4	5.3	1.9	16.4	4.0
IV	113	7.9	1.5	3.1	1.1	5.2	1.8	16.2	3.2

Females

		Zeroing Knowledge (0-10)		Transition Knowledge (0-5)		Effects of Range Knowledge (0-9)		Total Score (0-24)	
Track	n	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
I	27	6.4	1.7	2.4	1.2	4.0	1.8	12.8	3.0
II	37	7.6	2.0	2.4	1.1	4.0	1.9	14.0	3.3
III	29	7.7	1.9	3.1	1.0	5.6	1.5	16.3	3.3
IV	18	8.1	1.3	2.9	1.4	5.0	1.8	15.9	2.5

( ) parenthetical notes show the number of questions related to the knowledge area.

The correlation of record fire scores with zeroing knowledge was strong for Track III males (r = .50) and moderate for Track IV males (r = .22). On the other hand, a strong correlation (r = .51) was revealed between record fire and zeroing knowledge for females in the standard program. All correlation coefficients are listed in Table 11.

Knowledge of the Transition from 25 meter to Field Firing. Five questions addressed utilizing information provided on the ARI 25 meter target to make judgments about bullet strikes at greater range. The mean scores recorded for this concept area (Table 10) showed that all four groups were within one point of each other. For both sexes a slight advantage in transition knowledge is shown in Tracks III and IV.

A strong positive correlation between record fire scores and transition knowledge was demonstrated for Track IV females (r = .50). Moderate correlations were obtained for males in Track III (r = .33) and Track IV (r = .28). Accounting for this finding is difficult since the reasoning required to read the ARI 25 meter target is not put into use during record fire. The significant correlations may reflect improved teaching skills on the part of committee group personnel and drill sergeants, or in the case of the groups lacking moderate correlations, an absence of any teaching skill may exist.

Knowledge of Effects of Range. Nine questions dealt with the effects of range on the flight of the bullet and appropriate adjustments when firing at longer ranges. Trainees in Tracks III and IV responded to these questions with higher mean scores regardless of sex as shown in Table 10. Only in the case of males in Track III was the effects of range knowledge correlated with record fire performance (r = .31). This relationship indicates that trainees gained better knowledge of bullet trajectory and its relationship to aim through downrange inspection of their targets in Track III.

Total Questionnaire Scores. For each trainee the three subarea scores were added to yield a total unweighted score. The mean total score by track is reported in Table 10. An analysis of variance of total scores (Table 12) revealed a significant main effect for tracks, F (3,577) = 17.09, $p < .0001$. No differences due to sex of the trainees were evident. Comparisons of the mean total score for males showed both a significantly higher score for the experimental programs considered together (t (470) = 3.99, $p < .0001$) and a superior mean score for male trainees in Track III as compared to those in Track II, t (470) = 3.83, $p < .0001$. The remaining comparison between Track IV and the average score of Tracks II and III was not significant, t (470) = 1.73, $p > .05$. The contrasts are shown in Table 13.

Table 11

Correlation of Record Fire Scores With Questionnaire Scores for Male and Female Trainees Completing All Periods of Instruction

Males

Track	n	Zeroing Knowledge	Transition Knowledge	Effects of Range Knowledge	Total Score
I	68	.10	.07	-.04	.05
II	149	.05	.07	.07	.09
III	144	.50***	.33***	.31***	.49***
IV	113	.22*	.28**	.23	.27**

Females

Track	n	Zeroing Knowledge	Transition Knowledge	Effects of Range Knowledge	Total Score
I	27	.51*	.08	.04	.35
II	37	.21	.08	.19	.27
III	29	.05	.14	.27	.19
IV	18	-.05	.50*	-.05	.20

* $p < .025$
** $p < .005$
*** $p < .001$

Table 12

Analysis of Variance of Questionnaire Total Scores for Trainees Completing All Training

Source	df	MS	F	p
Tracks	3	206.312	17.090	<.0001
Sex	1	26.167	2.168	NS
Tracks x Sex	3	5.070	.420	NS
Error	577	12.072		
Total	584			

As revealed in Table 14, the females demonstrated the same pattern of differences in their questionnaire total scores. The experimental programs considered together produced higher questionnaire totals than the standard program, t (107) = 3.78, $p < .0001$. Of the remaining two contrasts, only that of Track II versus Track III was significant, t (107) = 3.01, $p = .003$, which supports the conclusion that for the females the content of the Track III program led to better understanding of marksmanship fundamentals.

Despite the fact that both males and females benefited most in their marksmanship knowledge by participating in Track III, only the males showed significant correlations of record fire with knowledge obtained in Tracks III and IV. The stronger correlation was obtained for Track III ($r = .49$) as compared to the correlation obtained in Track IV, $r = .27$. In contrast, no significant correlations were found between record fire and questionnaire total score for females. Although the knowledge base was comparable between sexes, for females the transfer of marksmanship principles into performance was less apparent.

Table 13

Analysis of Variance and Contrasts of
Questionnaire Total Scores for Males Completing All Training

Analysis of Variance

Source	df	MS	F	p
Between	3	138.464	10.962	<.00001
Within	470	12.632		
Total	473			

Contrasts

1 - Track I compared to average of Tracks II, III, and IV
2 - Track IV compared to average of Tracks II and III
3 - Track II compared to Track III

Contrast	Value	SE	t	df	p
1	5.579	1.399	3.989	470	<.0001
2	-1.359	.787	-1.726	470	NS
3	1.589	.415	3.826	470	<.0001

Table 14

Analysis of Variance and Contrasts of
Questionnaire Total Scores for Females Completing All Training

Analysis of Variance

Source	df	MS	F	p
Between	3	72.918	7.586	< .0001
Within	107	9.613		
Total	110			

Contrasts

1 - Track I compared to average of Tracks II, III, and IV
2 - Track IV compared to average of Tracks II and III
3 - Track II compared to Track III

Contrast	Value	SE	t	df	p
1	7.872	2.081	3.783	107	< .0001
2	-1.517	1.652	-.919	107	NS
3	2.317	.769	3.014	107	< .005

Hunting and weapons experience. To explore the possible influence of civilian experience with firearms, trainees' record fire scores were correlated with their reported experiences with various weapons. These correlations are reported in Table 15. Readily apparent are the facts that the female data show no significant correlations of weapons experience with record fire score and that, for Track I males, no significant correlations were revealed. With the exception of .22 caliber rifle experience, no consistent relationship between firing ability during record fire and level of civilian firearms experience was evidenced across tracks.

A possible explanation of the inconsistent correlational results is differential amounts of weapons experience across tracks. This possibility was explored by generating chi-square statistics using track as one classification variable and experience on individual weapons as the second variable. Only in the case of .22 caliber rifle experience for males did a significant chi-square result, $\chi^2 = 19.78$, $df = 6$, $p < .025$. Whereas for three tracks experiences tended to be bimodal (either no experience or a great deal), Track II males revealed a uniform distribution of experiences across the weapons experience rating scale. However, the generally nonsignificant chi-squares support the conclusion that differential weapons experience across tracks did not generate the pattern of correlations observed.

But given the correlational results, the influence of weapons experience in evaluating the relative merits of the candidate BRM programs was explored. Since .22 caliber rifle experience showed a relatively stable correlation for the three experimental programs, it was chosen as a covariate for an analysis of covariance of record fire scores. The data for the control group were not included due to its nonsignificant correlation of .22 caliber experience with record fire. The analysis of covariance revealed nonsignificant differences among the three tracks, $F(2,352) = 1.57$, $p > .05$, despite the anticipated finding that the covariate accounted for a significant portion of the variance in record fire scores, $F(1,352) = 20.79$, $p < .0001$. Adjusted means for Tracks II, III, and IV were 26.32, 26.47, and 25.30 respectively; these mean record fire scores are practically identical to those reported under the males' "completed all training" column of Table 5. These results suggest that, if it were possible, adjusting record fire scores on the basis of reported weapons experience would not alter the outcomes of other analyses reported above.

Table 15

Correlation of Record Fire Score with
Hunting and Weapons Experience

MALES

Experience	TRACK I (n = 82)	II (n = 173)	III (n = 146)	IV (n = 119)
Hunting	.06 (65)	.21** (149)	.23*** (144)	.17 (112)
Air Pistol	.08 (58)	.10 (116)	.20* (122)	.24** (107)
Handgun	.02 (60)	.22** (127)	.07 (119)	.18 (109)
.22 Cal Rifle	.04 (60)	.21** (126)	.25*** (122)	.25** (108)
Large Bore Rifle	-.01 (55)	.17 (117)	.24** (116)	.13 (108)
Shotgun	.11 (58)	.20 (126)	.29 (116)	.17 (107)

FEMALES

Experience	TRACK I (n = 34)	II (n = 40)	III (n = 30)	IV (n = 18)
Hunting	-.06 (27)	.03 (37)	-.02 (29)	.11 (18)

Table 15

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MALES

Experience	TRACK I (n = 82)	II (n = 173)	III (n = 146)	IV (n = 119)
Hunting	.06 (65)	.21** (149)	.23*** (144)	.17 (112)
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.22 Cal Rifle	.04 (60)	.21** (126)	.25*** (122)	.25** (108)
Large Bore Rifle	-.01 (55)	.17 (117)	.24** (116)	.13 (108)
Shotgun	.11 (58)	.20 (126)	.29 (116)	.17 (107)

FEMALES

Experience	TRACK I (n = 34)	II (n = 40)	III (n = 30)	IV (n = 18)
Hunting	-.06 (27)	.03 (37)	-.02 (29)	.11 (18)

Table 15 (continued)

Experience	TRACK I (n = 34)	II (n = 40)	III (n = 30)	IV (n = 18)
Air Pistol	-.24 (24)	.13 (31)	--	-.06 (18)
Handgun	.06 (25)	-.01 (33)	.01 (26)	-.07 (18)
.22 Cal Rifle	.12 (25)	.32 (35)	.01 (27)	.05 (18)
Large Bore Rifle	.23 (25)	.20 (31)	.06 (26)	.02 (17)
Shotgun	.12 (25)	.25 (33)	-.02 (27)	.05 (18)

Note: Numbers in parentheses are number of cases used in computing correlation coefficient.

* $p < .05$ ** $p < .025$ *** $p < .005$

DISCUSSION AND CONCLUSIONS

Improved Performance

The purpose of this field experiment was to test several marksmanship training program ideas with the intent of recommending worthwhile improvements to Army Basic Rifle Marksmanship Training. The three experimental programs tested shared in common the following features. All placed greater emphasis on fundamentals training than did the control (standard) program and all utilized the new 25 meter silhouette target firing exercises (see Figures 2 and 4) and the ARI zeroing target (see Figure 1). However, differences among the candidate programs were provided through variation of the number of instructors (more in Tracks II and III) and inclusion or exclusion of the 175 meter walk-down-range performance feedback exercise (included only in Tracks III and IV).

Evidence has been presented showing that all candidate experimental BRM Programs (Tracks II, III, and IV) provided record fire performance improvements for male and female trainees (see Table 5). The mean record fire performance of candidate track trainees clearly shows improvement over standard training and subsequent analyses showed expected significant performance differences between candidate training procedures and standard procedures. The record fire performance analyses revealed no program to be clearly superior among the candidates tested. Additional variables had to be considered to determine the best program to replace the current one. Analyses of the experimental tracks revealed that the instructional content of Track III/Track IV yielded superior performance on live fire in training (see Tables 8 and 9).

Questionnaire data were analyzed to determine the importance of instructional content to marksmanship knowledge and comprehension. Three areas of marksmanship fundamentals were addressed by the questionnaire: zeroing, transition from 25 meter to field firing, and the effects of firing at greater ranges. The results of analyses measuring these areas revealed that for Track III males understanding of marksmanship fundamentals and record fire performance correlated strongly (see Table 11). Track III females did not demonstrate nearly as clear a relationship between record fire performance and marksmanship knowledge (see Table 11) but did show generally greater marksmanship knowledge than males in other training tracks (Table 10).

Record fire performance supported by other evidence pointed to the superiority of the Track III program that included additional instructors and detailed performance feedback from down-range in addition to the enhanced 25 meter firing.

Ratio of Instructors to Students

The Army has greatly reduced the number of instructors committed to marksmanship training in recent years. In the current experiment an attempt was made to assess the impact of this reduction. Tracks III and IV were identical except that Track III had twice the normal number of assigned drill sergeants. The questionnaire data revealed that Track III subjects displayed greater knowledge of fundamentals than did those in Track IV, a fact that could be attributed to increased instructor/trainee interaction. Some additional understanding of marksmanship fundamentals occurred during the course of Track III training which was reflected in the post record fire questionnaire results. Track III record fire performance was also generally higher but the difference was not statistically significant. There is evidence that the drill sergeant instructors available were generally inadequately prepared for their assignment. Observation of these instructors throughout the experiment revealed their very limited comprehension of marksmanship skills. They were provided only two hours of familiarization training related to the experimental programs before the beginning of the test. They were themselves earlier products of the same standard BRM training program which has been shown to be deficient and they therefore could not be expected to impart knowledge and skill which they did not possess.

There has been a demonstrated loss of institutional knowledge over the years in fundamental marksmanship skills. Observations of drill sergeants who were unable to correctly diagnose trainee errors or more simply to recognize improper firing positions were not at all uncommon during the test. To assist in correcting trainee errors, the drill sergeants must be trained adequately themselves. In short, more unqualified instructors are not a training program improvement. The US Marine Corps uses highly qualified instructors in a ratio of one to two students at critical fundamental skill acquisition times. There is evidence that this has much to do with the excellence of their marksmanship training program. It remains to be seen what gains would occur for the Army as the ratio of student to qualified instructor drops from as much as 20 to 1, as now exists, to a smaller ratio permitting greater individual attention per student.

Instructional Improvements

The quality of instruction must be improved for instructors and drill sergeants as well as for trainees. The Fort Jackson test has clearly demonstrated this. Program improvements such as knowledge of firing results afforded by down-range feedback must be understood and practiced by cadre members before they can adequately deal with the task of training new firers. Drill sergeants, in particular, should receive more intense marksmanship skills training as part of their preparation for working with the trainees. This should be emphasized until good marksmanship skills acquisition again becomes truly fundamental to the soldier.

Guides. Two guides are being developed to accompany the new BRM program of instruction (Track III/IV), in part as an aid to improved instructional quality. A draft Instructor's Guide has been designed to introduce BRM instructors and drill sergeants to the fundamentals being taught in the new POI, the capabilities of the typical M16A1 rifle, and the principles of shooting which, though not new, have been lost over the years in the evolution of training (Osborne, 1980[1]).

The second guide (to be developed) is a shooter's book to track training performance during BRM. The trainee can refer, as can his or her instructor, to past performance to aid in correcting reoccurring shooting problems. These augmentations to the BRM program should help fill a knowledge gap which the test at Fort Jackson revealed.

Missed Training

In earlier observations at training centers it was obvious that trainees were often missing portions of training. It seemed important to see what impact missing training had on final performance so careful records of attendance were maintained during the experiment.

Assuming that the time available for basic rifle marksmanship training is already minimal (even in the experimental programs tested here), the impact of missing critical training periods was expected to be severe. Statistical comparisons demonstrated that males in all experimental tracks who missed some training had sizable and significant reductions in record fire scores. Females in Tracks III and IV were affected as well. The standard program showed no differences (see Table 5). Table 3 provides a detailed breakdown of the number of training periods missed across tracks. Command emphasis at the training center was placed on trainee attendance before the test began and was emphasized during conduct of the test (HQ, USATC, Fort Jackson, South Carolina, 1979). In spite of this emphasis 43 percent of males and almost 50 percent of the females missed at least one critical period of training (Table 3). This has basically two implications for training. The first is that missing critical periods of training clearly hurts performance and the second is that very large percentages of trainees are missing training and thus are poorer performers than they should be. Emphasis must be placed, at all levels, on trainee participation in all periods of instruction in order to insure maximum acquisition of marksmanship skills.

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[1]A. D. Osborne, Basic Rifle Marksmanship Instructor's Guide, Litton-Mellonics draft research report, January 1980.

Implications and Future Developments

As a result of this experiment and previous research the US Army has begun adoption of a revised basic marksmanship program at Fort Benning, Georgia. It is patterned after the Track III/IV program.

The key to good marksmanship skill acquisition is appropriate and repeated practice with feedback to the firer of performance results. Under the new program the periods of instruction have been redesigned and sequenced to provide the firer with logical transitions for maximum benefit. Continued developments in the training program may be expected as improved teaching techniques, aids, and range equipment become available.

A major area of potential for improving the quality of marksmanship training is use of devices to provide better feedback about shooting performance. Accurate down-range feedback equipment could save time and allow more time for practice. One very promising prospect is a developing projectile location system that automatically gives bullet location, whether hit or miss. Automated ranges combining such a location system with scorable targets would permit immediate feedback to the firer without the need for large witness panels and walks down range or pit crews lowering and scoring targets.

The Army Research Institute's marksmanship research continues in the areas of advanced individual training and unit training. The overall goal is to aid in developing programs for the acquisition and retention of combat riflery skills.

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APPENDIX A

BASIC RIFLE MARKSMANSHIP

QUESTIONNAIRE

DATA REQUIRED BY THE PRIVACY ACT OF 1974

TITLE: BRM Training Questionnaire

PRESCRIBING DIRECTIVE: AR 70-1

AUTHORITY: 10 USC Sec 4503

PURPOSE(S): The data collected with the attached form are to be used for research purposes only.

This is an experimental personnel data collection form developed by the U. S. Army Research Institute for the Behavioral and Social Sciences pursuant to its research mission as prescribed in AR 70-1. When identifiers (name or Social Security Number) are requested they are to be used for administrative and statistical control purposes only. Full confidentiality of the responses will be maintained in the processing of these data.

Your participation in this research is strictly voluntary. Individuals are encouraged to provide complete and accurate information in the interests of the research, but there will be no effect on individuals for not providing all or any part of the information.

BACKGROUND DATA

1. NAME _____ (Last) (First) (Middle)

2. SSAN: _____ AGE: _____

3. UNIT ASSIGNED: _____ CO _____ BN

CIRCLE ONE FOR EACH ITEM

4. SEX: a. Male b. Female

5. FIRE FROM RIGHT OR LEFT SHOULDER: a. Right b. Left

6. RIGHT OR LEFT HANDED: a. Right b. Left

7. EYE COLOR: a. Blue b. Hazel c. Green d. Brown

8. RACE: a. Black b. White/Caucasian c. Spanish d. Other

9. I'VE HUNTED WITH A FIREARM:
a. Never b. 1 to 5 Times c. More Than 5 Times

10. DO YOU NEED TO WEAR GLASSES: a. Yes b. No c. I Don't Know

11. IF YOU NEED TO WEAR GLASSES, CIRCLE ONE OF THE FOLLOWING:

a. I need to wear glasses, but I didn't have them to wear at any time during basic rifle marksmanship.

b. I need to wear glasses, but I had them only for some of basic rifle marksmanship.

c. I need to wear glasses, but I decided not to use them when firing the rifle.

FIREARMS EXPERIENCE

Listed below are different kinds of firearms. For each firearm, place an X in the box which shows how much experience you have had.

	No experience	A few experiences 1 - 15	Quite a lot experience 16 - 30	Many experiences 30 or more
Air Pistol				
Handgun				
.22 Cal Rifle				
Larger than .22 Rifle				
M14 or M16 Rifle*				
Shotguns				

*Do not include the M16 rifle marksmanship training you just completed at Ft. Jackson.

1. Shown below are pictures of shot groups on 25 meter zeroing targets. Use these shot groups to answer the following questions:

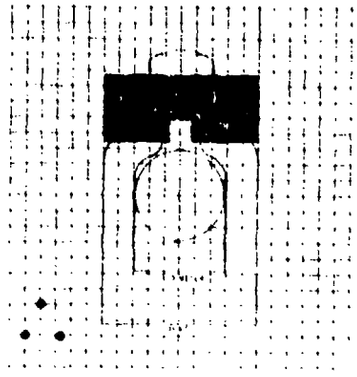
   A. Which shot group is referred to as a "tight" shot group? (Circle one)

      A B C

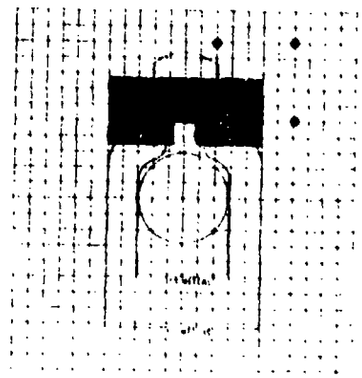
   B. Should the trainee who fired shot group B make sight changes? (Circle one)

      YES NO

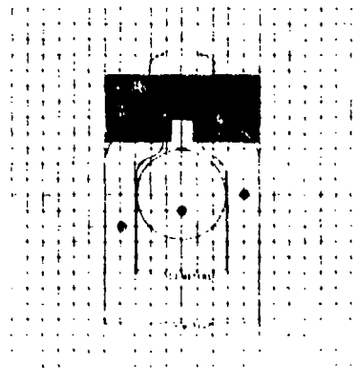
Shot Group A



Shot Group B



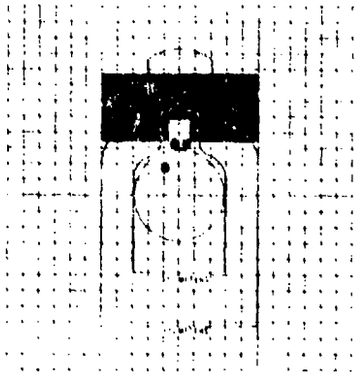
Shot Group C

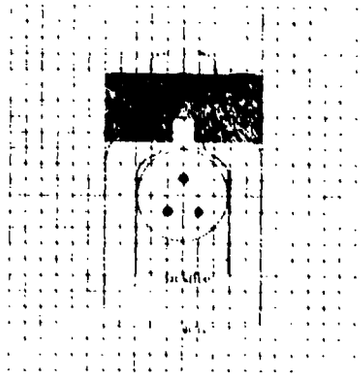


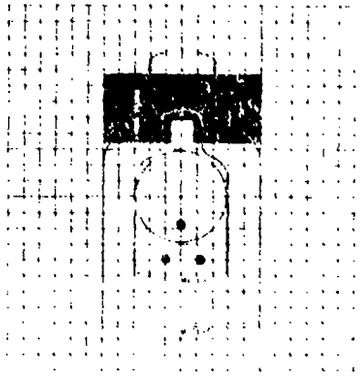
2. Three targets are pictured below. A different rifle was used to fire at one target. Which rifle was used? (Circle one)

A B C

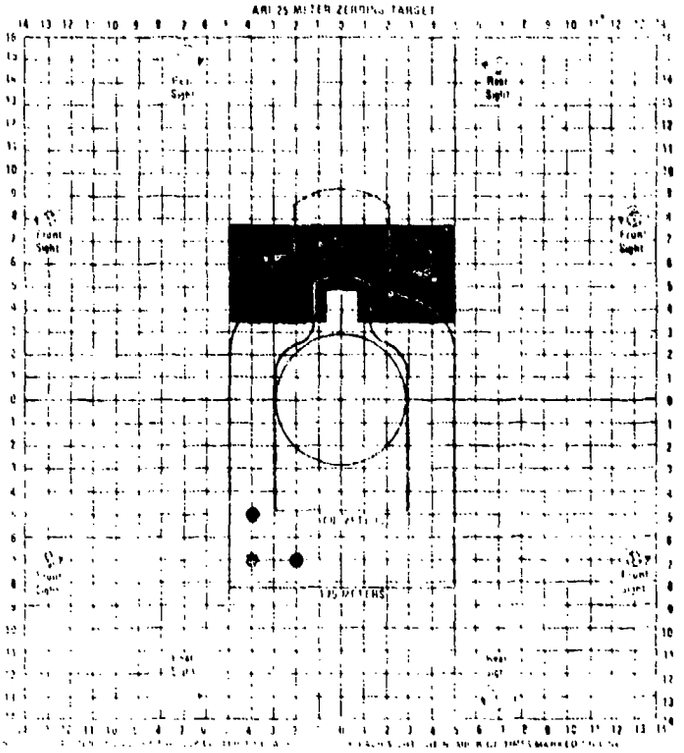
Rifle A







5. Pictured below is a shot group. Use this target to answer the following question :



A. Which sight moves the shot group UP or DOWN? (Circle one)

Front Sight Rear Sight

B. Which sight moves the shot group RIGHT or LEFT? (Circle one)

Front Sight Rear sight

C. How many clicks must the front sight be moved to zero the rifle? (Fill in)

... clicks

D. In which direction must the front sight be moved to zero the rifle? (Circle the correct answer)

(1) (2)

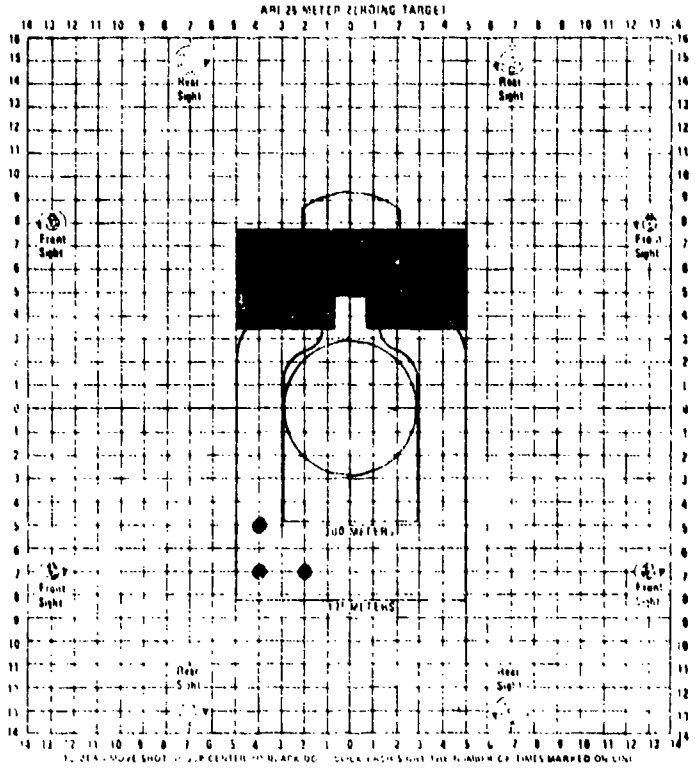
E. How many clicks must the rear sight be moved to zero the rifle? (Fill in)

... clicks

F. In which direction must the rear sight be moved to zero the rifle? (Circle the correct answer)

(1) (2)

5. Pictured below is a shot group. Use this target to answer the following questions: (Continued from question 3, on the previous page)



G. Now that the trainee has made the correct sight changes, the next time he or she fires the rifle the shot group will be: (Circle one)

(a) Up and to the right (c) Down and to the right

(b) Up and to the left (d) Down and to the left

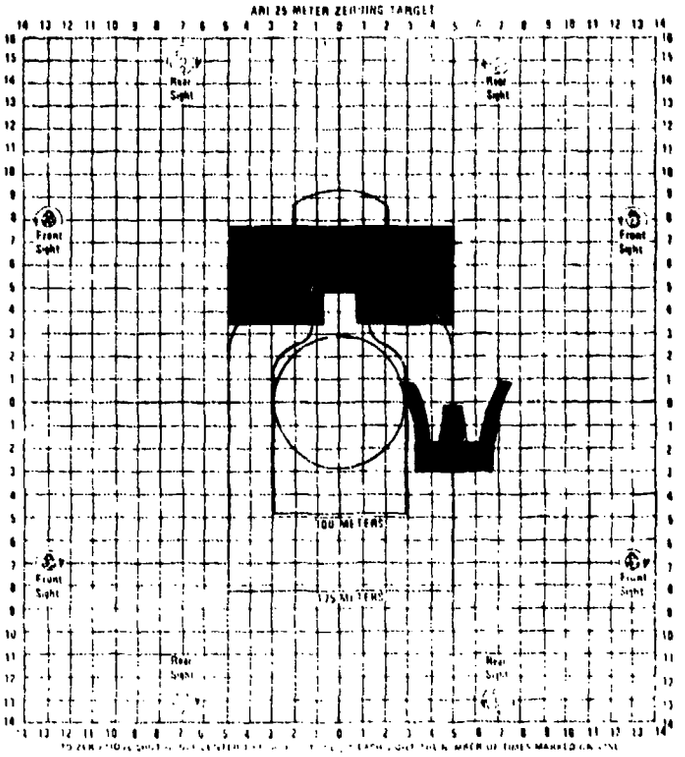
H. If NO sight changes are made, will the rifle hit targets at 175 meters? (Circle one)

YES NO

I. If NO sight changes are made, will the rifle hit targets at 300 meters? (Circle one)

YES NO

5. A trainee puts the front sight post on the 25 meter target as shown in the picture below. If the trainee fires the rifle at this target, where will the bullets hit? (Circle one)



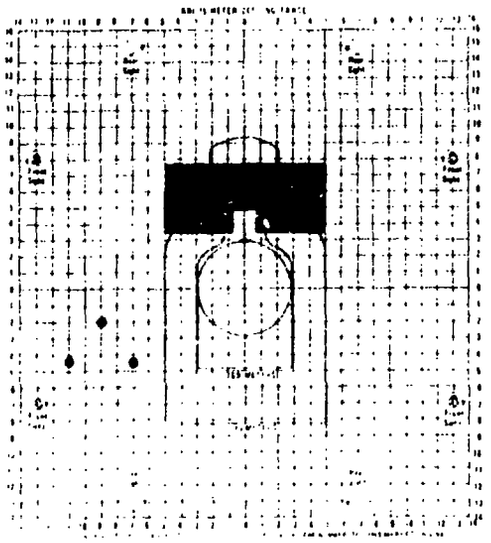
A. The bullets will hit inside the circle, but off to the right.

B. The bullets will hit low and outside the circle.

C. The bullets will hit high and ouside the circle.

D. The bullets will hit in the center of the circle.

6. Pictured below is a shot group fired at a 25 meter zeroing target. Use this target to answer the following question:



If a trainee uses the same rifle to fire at a 250 meter target and aims center of mass, where will the bullets hit? (Circle one)

A. Head

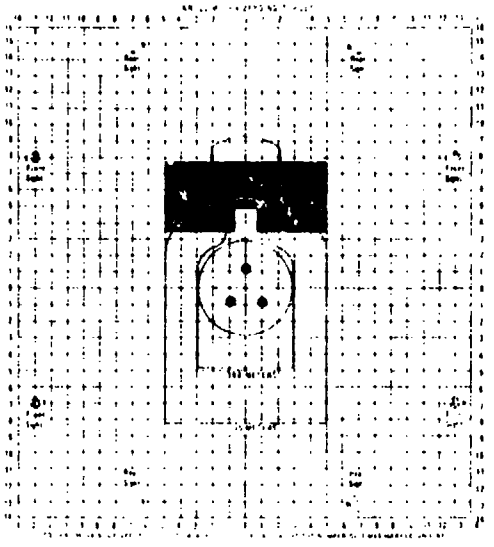
B. A little above center of mass

C. Center of mass

D. A little below center of mass

E. Off the target

7. Pictured below is a shot group fired at a 25 meter zeroing target. Use this target to answer the following question:



If a trainee uses the same rifle to fire at a 250 meter target and aims center of mass, where will the bullets hit? (Circle one)

A. Head

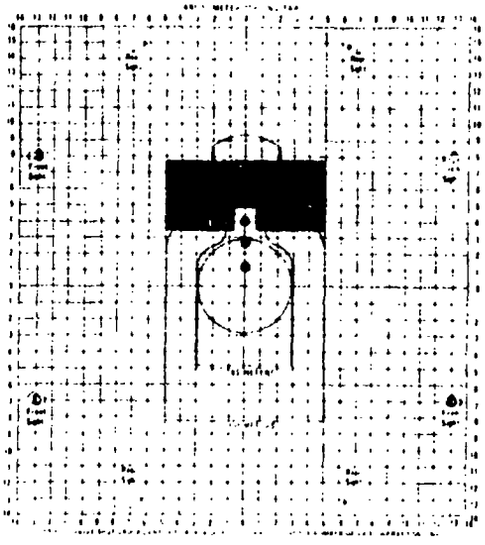
B. A little above center of mass

C. Center of mass

D. A little below center of mass

E. Off the target

8. Pictured below is a shot group fired at a 25 meter zeroing target. Use this target to answer the following question:



If a trainee uses the same rifle to fire at a 250 meter target and aims center of mass, where will the bullets hit? (Circle one)

A. Head

B. A little above center of mass

C. Center of mass

D. A little below center of mass

E. Off the target

9. Using a well-zeroed rifle, a trainee fires a shot group within the circle of a 25 meter target. Will the shot groups be bigger, smaller, or the same size when the trainee fires at a target at 175 meters? (Circle one)

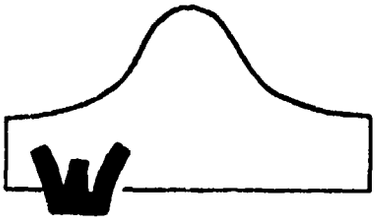
   A. Bigger at 175 meters.

   B. Same size at 175 meters.

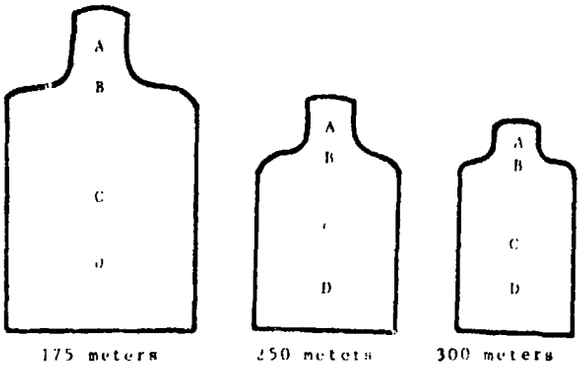
   C. Smaller size at 175 meters.

10. A trainee is aiming at a 75 meter target, but makes a mistake and aims to the left. The picture below shows the mistake. If the trainee fires the rifle, will the bullet hit the target? (Circle one)

    YES NO



11. Shown below are field fire targets at 175, 250, and 300 meters. What is the correct point of aim for each one?



175 meters 250 meters 300 meters

(Circle one for each target)

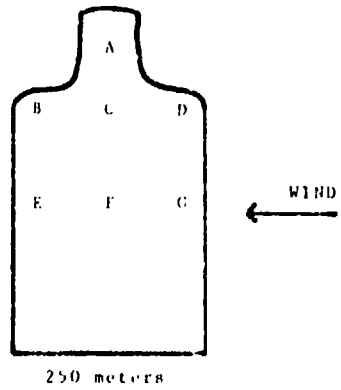
175 meter target: A B C D (Circle one)

250 meter target: A B C D (Circle one)

300 meter target: A B C D (Circle one)

12. Below is a field fire target at 250 meters. A light to medium wind (10 miles per hour) is blowing from the right to the left (as shown by the arrow). Where should the front sight post of the rifle be placed to hit the target? (Circle one)

A B C D E F G



13. A trainee is firing at a 75 meter target with a well-zeroed rifle, but is missing the target. What should the trainee do? (Circle one)

A. Aim more to the right.

B. Aim more to the left.

C. Aim a little bit higher.

D. Aim a little bit lower.

14. A trainee is firing at a 300 meter target with a well-zeroed rifle but is missing the target. What should the trainee do? (Circle one)

A. Aim more to the right.

B. Aim more to the left.

C. Aim a little bit higher.

D. Aim a little bit lower.

15. For each picture below are the front and rear sights lined up right (aligned)?

☐ Yes
☐ No

☐ Yes
☐ No

☐ Yes
☐ No

☐ Yes
☐ No

16. For each picture below is the aiming point (the [redacted]) properly lined up (aligned) with the front sight?

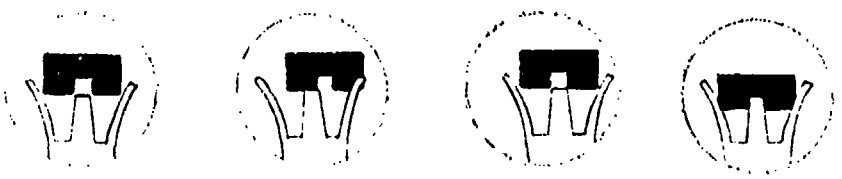
☐ Yes
☐ No

☐ Yes
☐ No

☐ Yes
☐ No

☐ Yes
☐ No

17. For each picture below is the sight picture correct?



☐ Yes
☐ No

☐ Yes
☐ No

☐ Yes
☐ No

☐ Yes
☐ No

APPENDIX B

AGGREGATION BY KNOWLEDGE AREAS OF QUESTIONNAIRE ITEMS

Zeroing Knowledge

1. Shown below are pictures of shot groups [illegible] Refer to the following questions:

1. A

A. Which shot group is referred to as the "first" shot group" (Circle one)

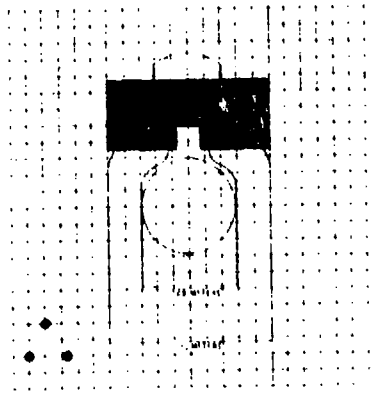
(A) B C

2. NO

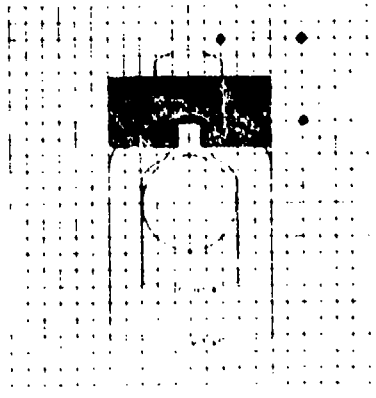
B. Should the trainee who fired shot group B make sight changes? (Circle one)

Yes (NO)

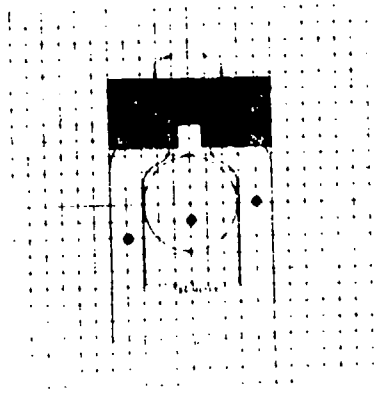
Shot Group A



Shot Group B



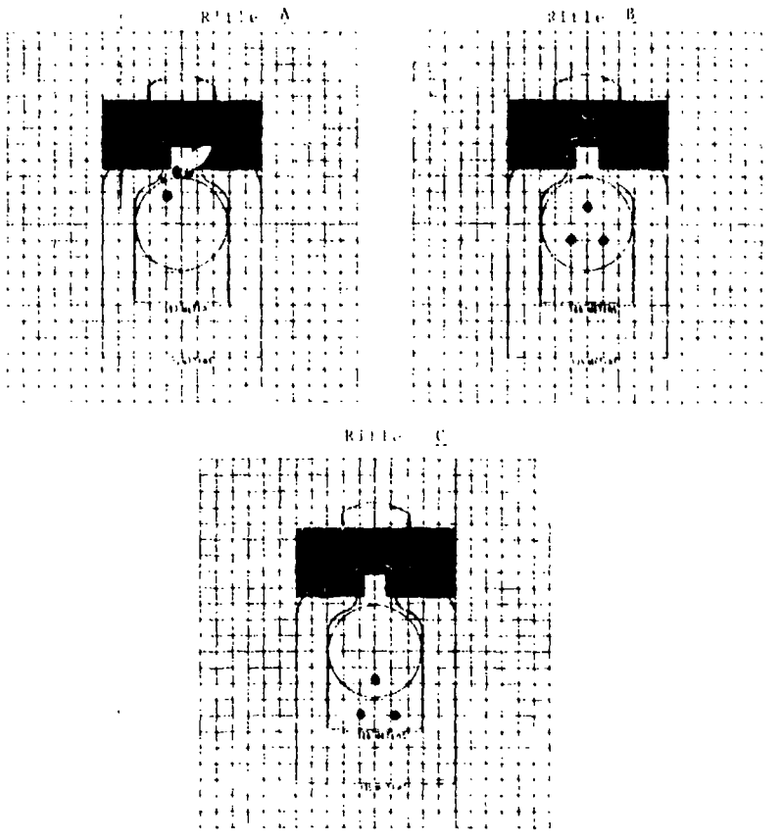
Shot Group C



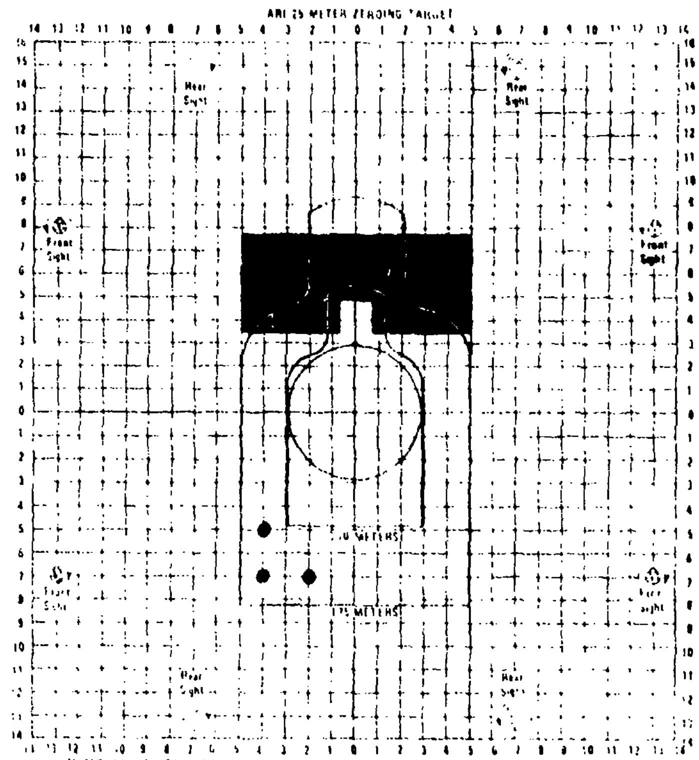
3. B

2. Three targets are pictured below. A different rifle was used to fire at each target. Which rifle has been zeroed. (Circle one)

A (B) C



3. Pictured below is a shot group. Use this target to answer the following questions:



4. FS — A. Which sight moves the shot group UP or DOWN? (Circle one)

Front Sight (circled)   Rear Sight

5. RS — B. Which sight moves the shot group RIGHT or LEFT? (Circle one)

Front Sight   Rear Sight (circled)

6. 6 or 7 — C. How many clicks must the front sight be moved to zero the rifle? (Fill in)

6 or 7 clicks

7. 2 — D. In which direction must the front sight be moved to zero the rifle? (Circle the correct answer)

(1)   (2) (circled)

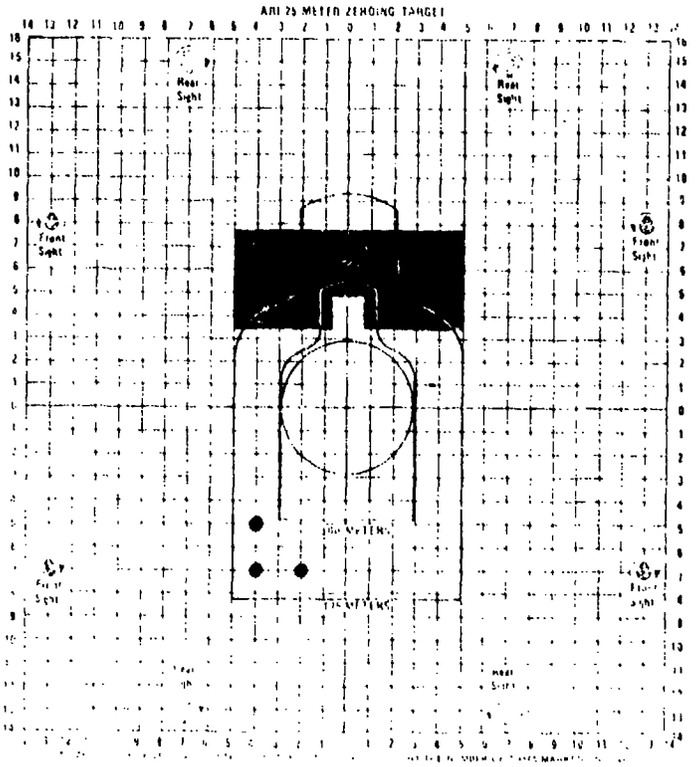
8. 3 or 4 — E. How many clicks must the rear sight be moved to zero the rifle? (Fill in)

3 or 4 clicks

9. 2 — F. In which direction must the rear sight be moved to zero the rifle? (Circle the correct answer)

(1)   (2) (circled)

4. Pictured below is a shot group. Use this target to answer the following questions: (Continued from question 3, on the previous page)



10. a

G. Now that the trainee has made the correct sight changes, the next time he or she fires the rifle the shot group will be: (Circle one)

(a) Up and to the right (c) Down and to the right

(b) Up and to the left (d) Down and to the left

Transition Knowledge

11. Yes

H. If NO sight changes are made, will the rifle hit targets at 17' meters? (Circle one)

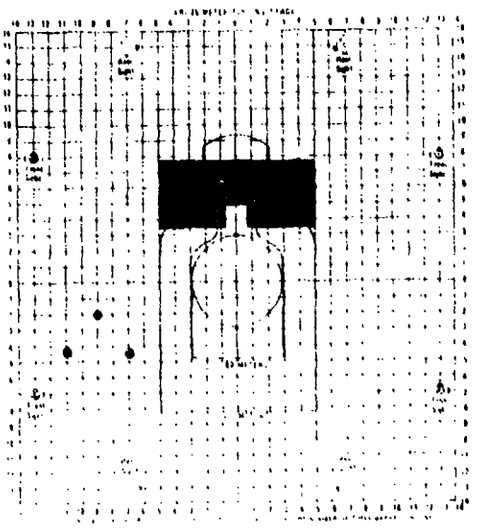
YES NO

12. NO

I. If NO sight changes are made, will the rifle hit targets at 300 meters? (Circle one)

YES NO

6. Pictured below is a shot group fired at a 25 meter zeroing target. Use this target to answer the following question:



If a trainee uses the same rifle to fire at a 300 meter target and aims center of mass, where will the bullets hit? (Circle one)

13. E

A. Head

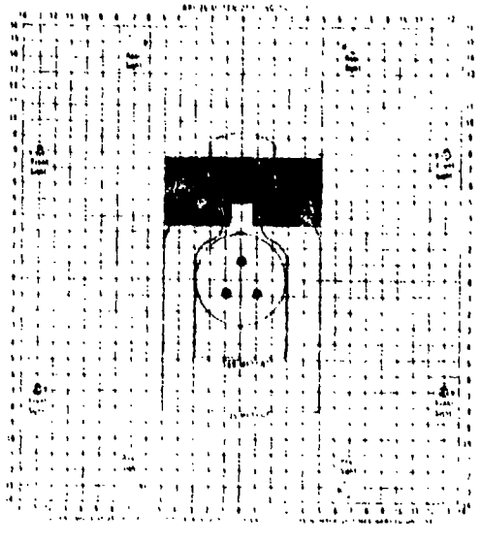
B. A little above center of mass

C. Center of mass

D. A little below center of mass

(E.) Off the target

7. Pictured below is a shot group fired at a 25 meter zeroing target. Use this target to answer the following question:



If a trainee uses the same rifle to fire at a 250 meter target and aims center of mass, where will the bullets hit? (Circle one)

14. C

A. Head

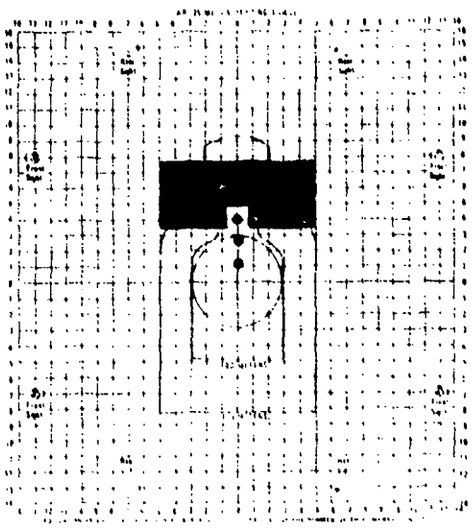
B. A little above center of mass

(C.) Center of mass

D. A little below center of mass

E. Off the target

Pictured below is a shot group fired at a 25 meter scoring target. Use this target to answer the following question:



If a trainee uses the same rifle to fire at a 25 meter target and aims center of mass, where will the bullets hit? (Circle one)

15. B

A. Head

(B) A little above center of mass

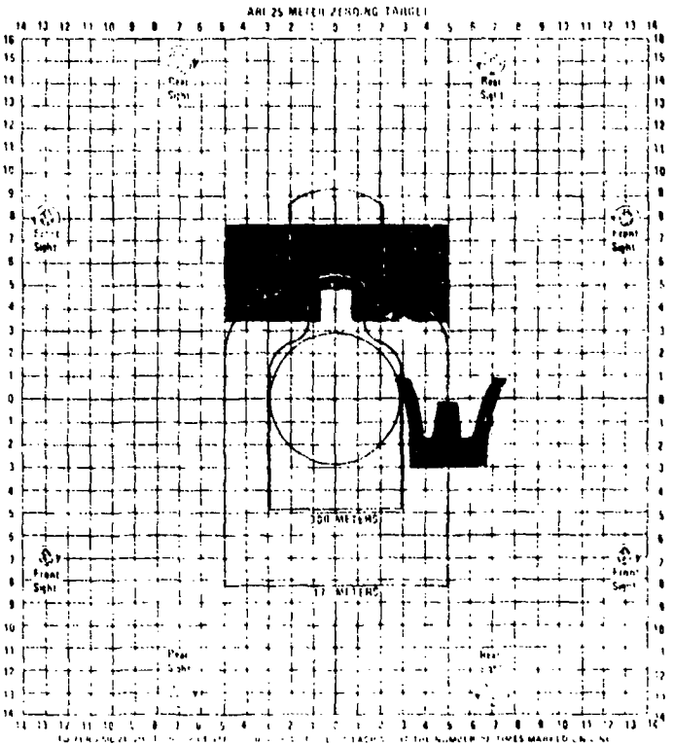
C. Center of mass

D. A little below center of mass

E. Off the target

Effects of Range Knowledge

5. A trainee puts the front sight post on the 25 meter target as shown in the picture below. If the trainee fires the rifle at this target, where will the bullets hit? (Circle one)



16. B

A. The bullets will hit inside the circle, but off to the right.

(B.) The bullets will hit low and outside the circle.

C. The bullets will hit high and outside the circle.

D. The bullets will hit in the center of the circle.

9. Using a well-zeroed rifle, a trainee fires a shot group within the circle of a 25 meter target. Will the shot groups be bigger, smaller, or the same size when the trainee fires at a target at 175 meters? (Circle one)

17. A

(A.) Bigger at 175 meters.

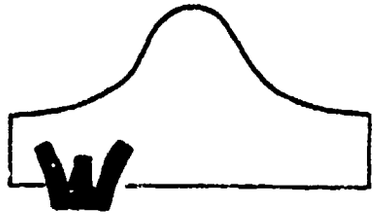
B. Same size at 175 meters.

C. Smaller size at 175 meters.

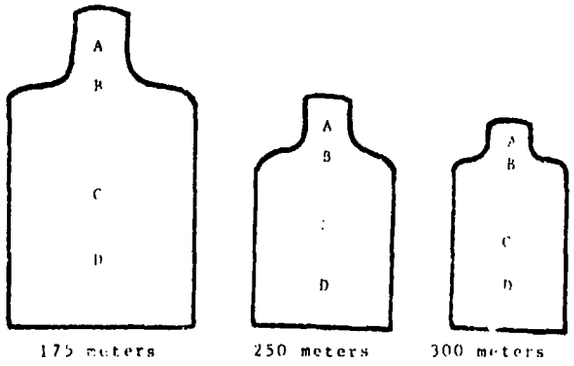
18. Yes

10. A trainee is aiming at a 75 meter target, but makes a mistake and aims to the left. The picture below shows the mistake. If the trainee fires the rifle, will the bullet hit the target? (Circle one)

(YES) NO



11. Shown below are field fire targets at 175, 250, and 300 meters. What is the correct point of aim for each one?



(Circle one for each target)

19. C 175 meter target: A B (C) D (Circle one)

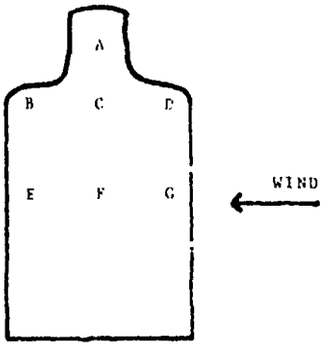
20. C 250 meter target: A B (C) D (Circle one)

21. C 300 meter target: A B (C) D (Circle one)

12. Below is a field fire target at 250 meters. A light to medium wind (10 miles per hour) is blowing from the right to the left (as shown by the arrow). Where should the front sight post of the rifle be placed to hit the target? (Circle one)

22. G

A B C D E F (G)



13. A trainee is firing at a 75 meter target with a well-zeroed rifle, but is missing the target. What should the trainee do? (Circle one)

23. D

A. Aim more to the right.

B. Aim more to the left.

C. Aim a little bit higher.

(D.) Aim a little bit lower.

14. A trainee is firing at a 300 meter target with a well-zeroed rifle but is missing the target. What should the trainee do? (Circle one)

24. C

A. Aim more to the right.

B. Aim more to the left.

(C.) Aim a little bit higher.

D. Aim a little bit lower.

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