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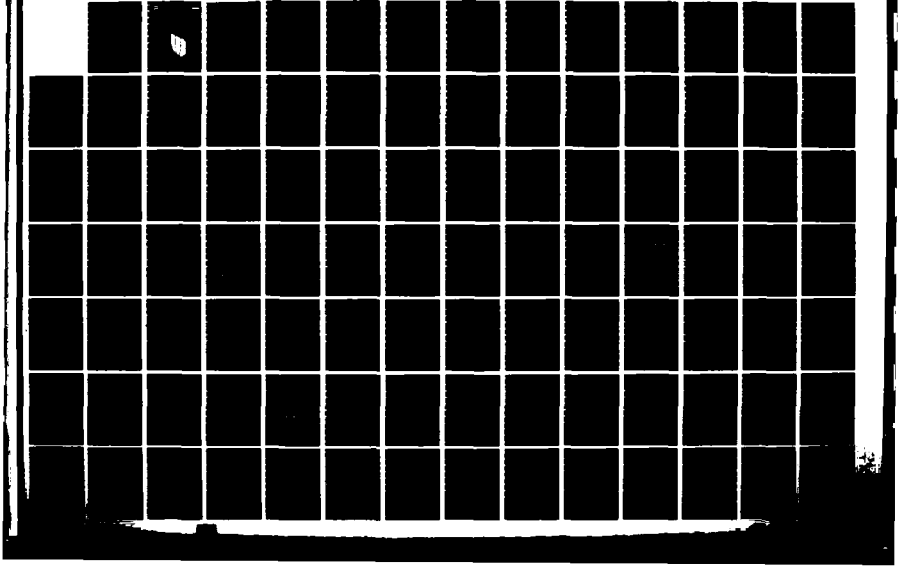

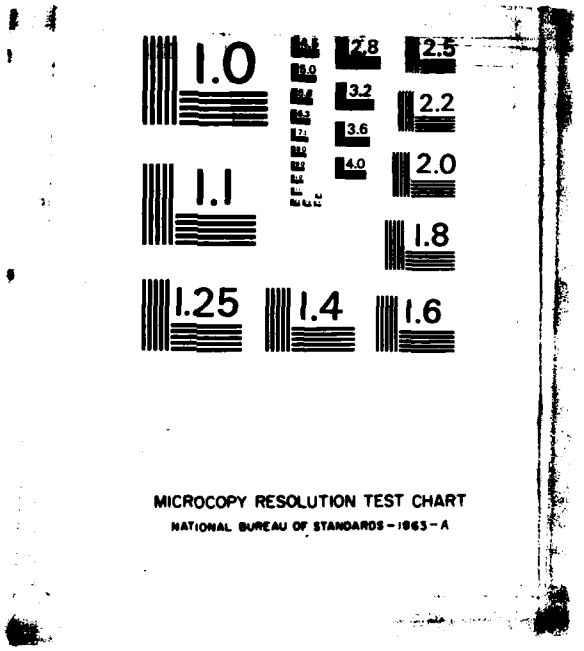
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A MODEL FOR TRAINING RANGE PLANNING DATA

AD-A141 140

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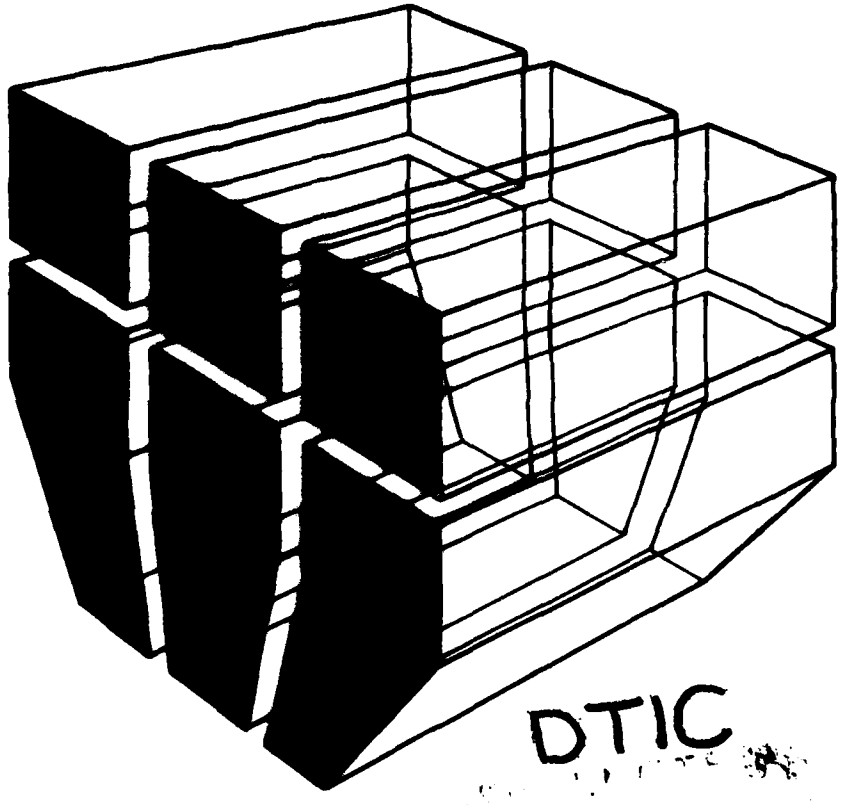

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This report describes how to organize and communicate the training range planning data installation personnel need to plan and program Military Construction, Army (MCA), training range projects to support new and existing weapon systems and training methods. It describes an MCA range project planning method that will help installation personnel meet MCA policy as it relates to unique range considerations. Planning data for three weapon systems (the M-1 tank, the Infantry/Cavalry Fighting Vehicle, and the Advanced Attack Helicopter) are given as examples.

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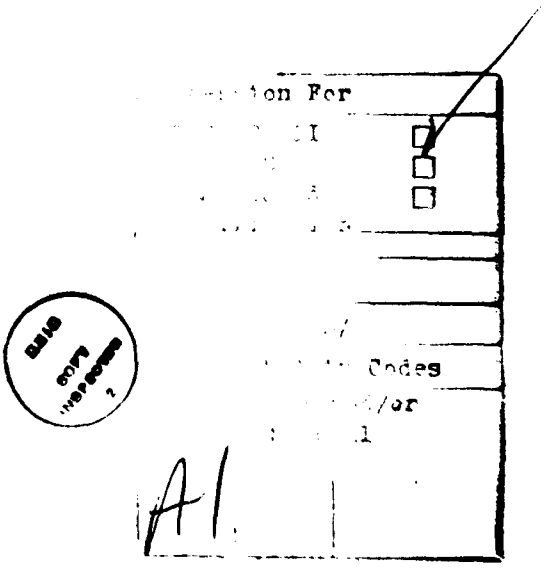
FOREWORD

This investigation was performed for the Directorate of Engineering and Construction, Office of the Chief of Engineers (OCE), under Project 4A762731AT41, "Military Facilities Engineering Technology"; Task Area A, "Facility Planning and Design"; Work Unit 048, "Training Range Planning and Design Information for Mission Responsive Facilities." The OCE Technical Monitor was Mr. Gordon Velasco, DAEN-ECE-I.

This investigation was performed by the Facility Systems (FS) Division of the U.S. Army Construction Engineering Research Laboratory (CERL). Mr. Edward Lotz is Chief of CERL-FS.

Appreciation is expressed to the personnel at Fort Knox, Fort Benning, and Fort Rucker involved in doctrine and training development for the three weapon systems included in this report; and to LTC Martin Fisher and many others at the Headquarters, U.S. Army Training and Doctrine Command (HQ TRADOC) for providing data, assistance, and comment during this study.

COL Paul J. Theuer is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.



CONTENTS

CONTENTS (Cont'd)

TABLES

TABLES (Cont'd)

TABLES (Cont'd)

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FIGURES

FIGURES (Cont'd)

** NOTE **

The planning and design data in this report are for example purposes only, intended to illustrate the method described. Data are not official Army criteria.

Current data for planning and designing training ranges can be obtained from:

CDR TRGSPTCEN
ATTN: ATIC-ART
FT EUSTIS, VA 23604

A MODEL FOR TRAINING RANGE PLANNING DATA

1 INTRODUCTION

Background

To ensure that today's soldiers are adequately prepared for mobilization, the Army relies on training ranges to develop, maintain, and assess the skills of individual soldiers and troop units. However, some of the Army's existing training ranges cannot meet the requirements for many of the new material systems and training methods in development or being fielded for the first time in service schools and combat units. In such cases, either new ranges must be built or existing ranges must be improved and modernized.

A project to improve or build a new range occurs through an orderly but complex process called Military Construction, Army (MCA).[1] The installation, major commands (MACOMs), and many other Army organizations are involved in a range project, which can take from 3 to 5 years to plan, program, budget, design, and build.[2]

A key factor in completing projects that will provide the most effective ranges is communication. The flow of information from weapon, doctrine, training, and policy developers to range planners and designers is vital.

Communication involves four components: sender, receiver, message, and media. Just making information available (message from senders) to range planners and designers (receivers) is not enough. Documents (media) must organize that information so it can be used conveniently for planning and design tasks.

A new organization, the Directorate of Army Ranges, Targets, and Ammunition at the Army Training Support Center at Fort Eustis, was recently created to improve the availability and communication of range planning and design information, and to clarify range responsibilities and policy for other Army organizations. The Corps of Engineers, Huntsville Division, is responsible for range design data.

The kind of data needed for planning are not the same as for design: planners do not need as much detail as designers. What planners need is information about:

1. The characteristics of the weapon systems for which a range is needed.

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[1] Military Construction, Army (MCA) Program Development, Army Regulation (AR) 415-15 (Department of the Army [DA], 4 December 1975); and Project Development and Design Approval, AR 415-20 (DA, 28 March 1974).

[2] Master Planning for Army Installations, AR 210-20 (DA, 26 January 1976); and Ranges and Training Areas, AR 210-21 (1 April 1982).

2. How training will be accomplished and managed.

3. What equipment and structures will be put on the range.

4. What land areas and support structures are needed.

Some planning data are given in weapon system field manuals, others are in training circulars, special texts, and Army regulations. But for convenience and efficiency, planning data should be organized around the specific needs of planning tasks and not confused with the needs of range designers or range managers.

Objective

The objective of this study was to develop a way to communicate range planning data for various weapon systems. The objective of this report is to list data typically needed to plan a training range and describe how to format these data for use in range planning tasks.

Scope

This report is not intended to convey official policy or provide the latest data for the weapon systems included.

Approach

1. A concept for a range planning document was developed.

2. Data were compiled for three new weapon systems and organized in an example planning format.

3. Range planning methods were developed to meet MCA process requirements and some unique problems associated with range development.

4. Primary users for range planning data were identified: installation master planners and staff in the Directorate of Engineering and Housing (DEH) and range specialists in the Directorate of Plans and Training (DPT).

5. The uses of range planning data were identified: to select sites for ranges, to lay out ranges to meet training requirements, to update installation master plans, to prepare DD Form 1391 and justification paragraphs, to prepare Project Development Brochures for range projects, and to accomplish other range planning activities.

6. Planning data were divided into two groups (Figure 1): general planning data and data by weapon system.

a. General planning data includes information about range features, components, and support structures for many different types of ranges.

b. Data for specific weapon systems include background information about weapon characteristics, training tasks, training operations, and target requirements plus detailed facility data (Table 1).

Mode of Technology Transfer

It is recommended that the results of this study be incorporated into a Department of the Army Pamphlet or a Technical Manual on range planning or some other suitable training range publication.

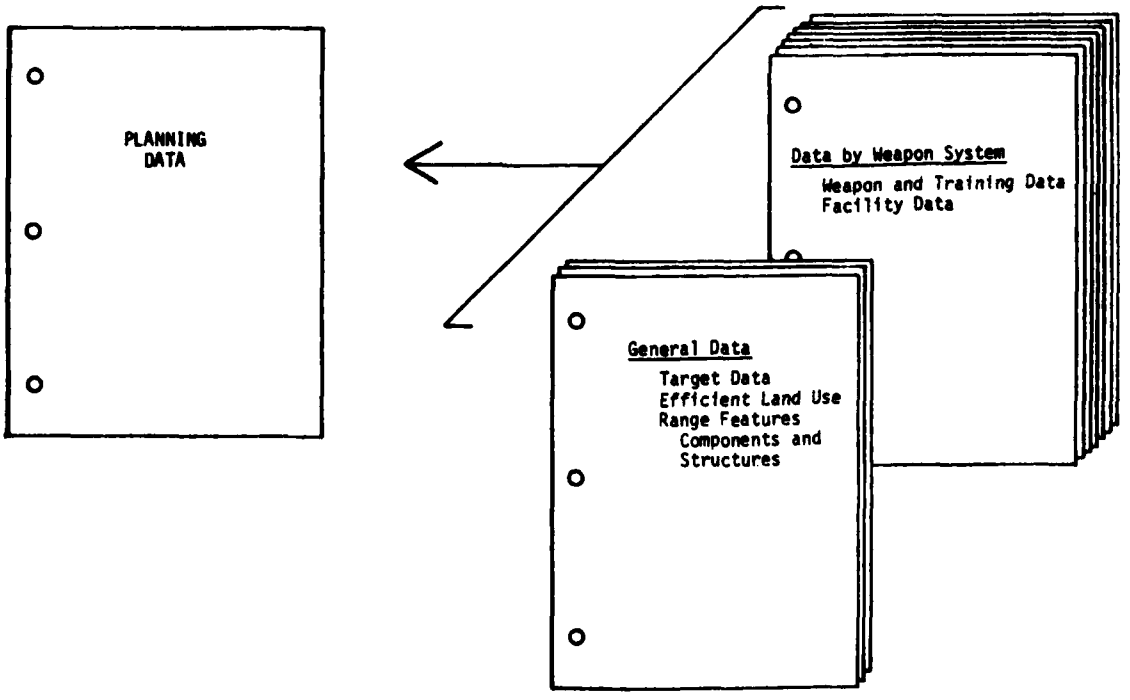

Figure 1. Planning data structure.

Table 1

Classes of Detailed Facility Data

Land Use Areas

- Target area
- Maneuver area
- Firing points
- Ammo/fuel/supply area
- Food/latrine/briefing area
- Aircraft landing area
- Access roads
- Service roads/trails
- Parking areas
- Range operation/maintenance area
- Other

Targets

- Stationary (fixed)
- Stationary (pop-up)
- Moving
- Coffins/emplacements
- Other equipment/emplacements

Structures

- Control tower
- Range personnel building
- Storage building
- Ammo breakdown/issue building
- Latrine
- Mess shed
- Lyster bag shed
- Briefing stand/bleachers
- Flag pole
- Misfire bunker
- Defilade positions
- Battery recharge
- Other structures

Utilities

- Lighting
- Poles
- Wiring (underground)
- Wiring (overhead)
- Communication (telephone/computer/loudspeaker)
- Power supply
- Lightning protection
- Solid waste/refuse
- Storm sewer
- Sanitary sewer

Earthwork/Vegetation

- Berms
- Demolition of existing target emplacements
- Foxholes
- Paving
- Structures
- Other improvements
  - Clearing/grubbing
  - Cut/fill
  - Grading
  - Erosion control planting
  - Tree/shrub planting
  - Gravel placement
  - Paving (other than roads)
  - Walks
  - Grass/ground cover
  - Other

Miscellaneous

- Lane markers
- Firing point markers
- Safety fan markers
- Signage
- Environmental protection
- Noise control
- Archaeological protection
- Other

2 RANGE PROJECT DEVELOPMENT

There are many reasons why an installation may ask for an MCA range project. The installation may have to furnish training on a new weapon system or support needs that cannot be met by an existing range. The installation's mission may change, and existing ranges may have to be improved so they can be used more often by more units. Changes in the way training or land is managed may mean old ranges must be moved (or closed) and new ones built. Mobilization plans may need more range capabilities.

Figure 2 shows how to plan a range. The figure lists most of the key references used in each planning Step. Also, major commands (MACOMs), the Directorate of Army Ammunition, Ranges and Targets (DAART), at Fort Eustis, VA (ATSC-ATIC-ART), can help an installation with range plans.

In Step 1, an installation's pre- and post-mobilization plan is used to decide what kind and how many units and soldiers need training. Also, the Army Modernization Information Memorandum (AMIM) is used to find out when new weapons will be delivered.

In Step 2, Army Training Circulars, Field Manuals, etc., are used to help decide what type of training must take place on the range.

The information from Step 2 is used in Steps 3 and 4 to decide the type and capacity of all needed training facilities, including ranges. (A way to find range capacities is given in a revision to TC 25-1.)

In Step 5, the type and numbers of ranges an installation needs are compared to those it already has.

In Step 6, range shortages are listed.

In Step 7, details are compared to design standards.

The information from Step 8 is used in Step 9 to find and list qualitative shortages.

In Step 10, support items and installation needs (like roads and electrical, sewer, and water systems) are compared to those it already has. (A way to estimate system capacity is given in TB Eng 354.) These shortages are added to the list of other shortages compiled in Steps 6 and 9.

Range Procurement Methods

1. Range Development Plan. This method lets the Department of the Army (DA) ask for special range project funds through a Program Development Increment Package (PDIP) in the DA budgeting process. This takes place in Step 11 of Figure 2. An installation's range shortages are listed and a 5-year plan drawn up. After an installation's range review board agrees to the

plan, it is sent to the major command (MACOM) range project review board, then to DA (Step 12 of Figure 2).*

2. MCA projects. This is the normal way to get any project (not just ranges) designed and built. MCA projects are large projects which will cost more than $500,000. Ranges are put on the installation master plan (Step 13 of Figure 2).** The plan is then sent to the MACOM and DA (Step 14 of Figure 2). Projects needed to resolve facility shortages are programmed, designed, and built according to AR 415-15, AR 415-20, and TM 5-800-3. This report describes how to plan ranges using the MCA procurement method, but it can also be used to help do some steps of the Range Development Plan method.

3. MCA/minor projects. These are projects which will cost less than $500,000. AR 415-35 gives the policy and procedures for funding and approving MCA/minor projects.

4. O&MA projects. These are small projects paid for from the installation's own operation and maintenance activity (O&MA) funds. These projects cannot cost more than $100,000.

Overview of the MCA Process

Figure 3 shows the six phases a project must go through to be planned, programmed, designed, and built. The figure shows the process from the installation's point of view. The formal process is defined in AR 210-20, AR 415-15, and AR 415-20.

The MCA process works on an annual cycle. This means an installation can ask for a project (or projects) at only a certain time each year. And as each phase shown in Figure 3 is finished, its results must be reported at a time allowed only once each year. If an installation misses a deadline, its project usually must wait a whole year before it can go on to the next step in the MCA process. Thus, it is very important that the installation complete those phases on time and in the right way. Otherwise, the project either is delayed, or goes to the next step before it is ready (which can mean the project will be missing important details that will make it work poorly when built).

A more formal view of the MCA process is shown in Figure 4. The "guidance year" is when the installation collects information about the project and asks for funding and permission to begin working on the project (Phase 1 through 4 in Figure 3). Phase 5 from Figure 3 happens during both the "design year" and "budget year" of Figure 4. This is because an MCA project is designed in two steps--concept design (up to 35 percent complete) and final design. When the final design is finished, Congress releases the money set aside for the project, and construction can begin. Phase 5 also can last through the "program year" shown in Figure 4, or longer, depending on the project's size. Phase 6 is when the project is turned over to those who will use it. Phase 6 happens during or after the "program year."

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*For details, consult AR 210-21 or contact DAART.
**For details, see AR 210-20.

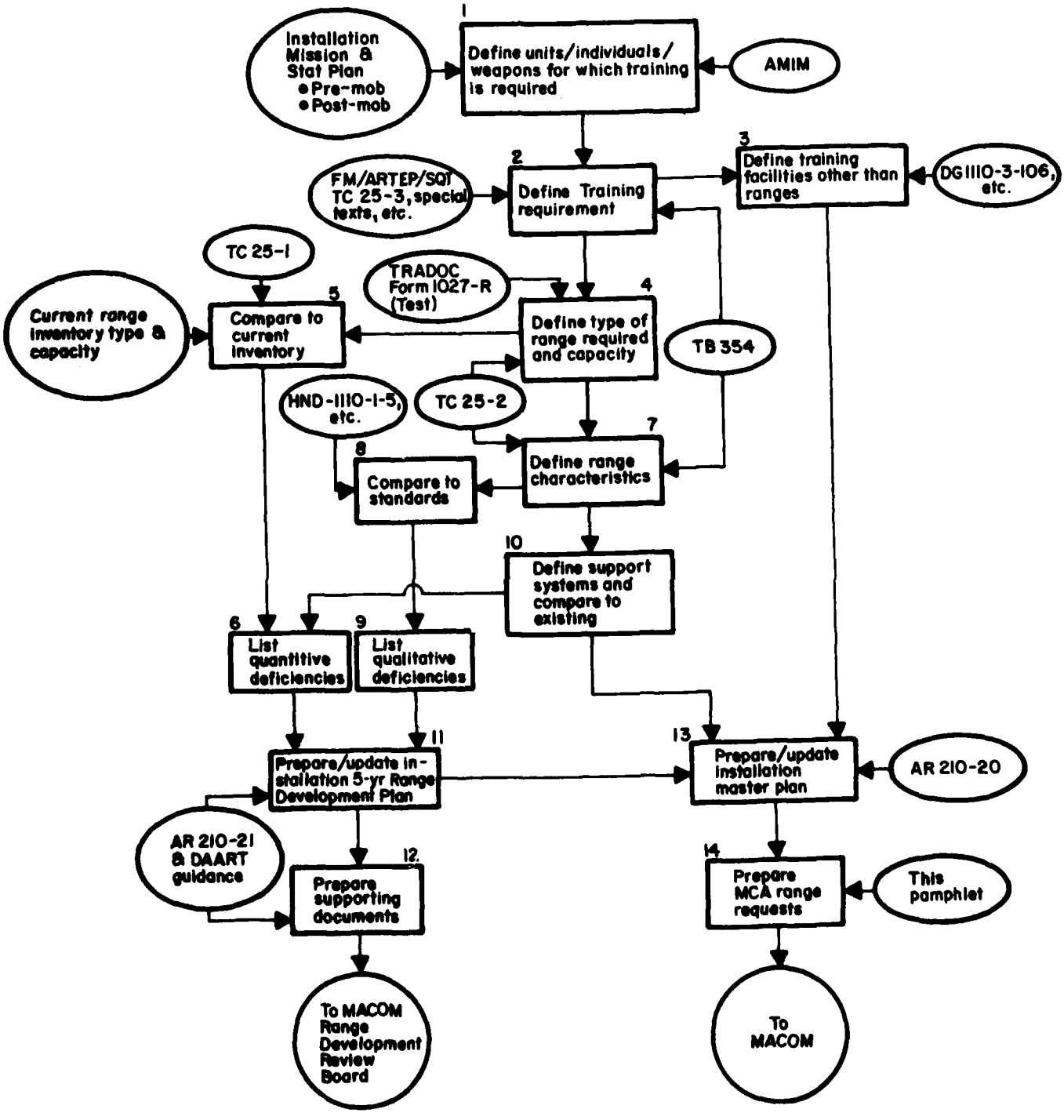


Figure 2. Range planning flowchart.

Phase 1: Getting Ready

(a) Select range project staff
(b) Set up work schedule
(c) Find sources of help
(d) Collect and organize resource documents and data
(e) Decide on the type of range to be built or improved

Phase 2: Site Analysis and Selection

(a) Name candidate range sites
(b) Analyze sites
(c) Select best site
(d) Decide what kind of project funds are needed

Phase 3: Preliminary Documentation

(a) Do a draft range layout
(b) Check draft layout
(c) Fill out PDB-1 and the one-page DD Form 1391

Phase 4: Final Documentation

(a) Complete draft range layout
(b) Fill out PDB-2 and DD Form 1391 with justification paragraphs
(c) Prepare procurement requests

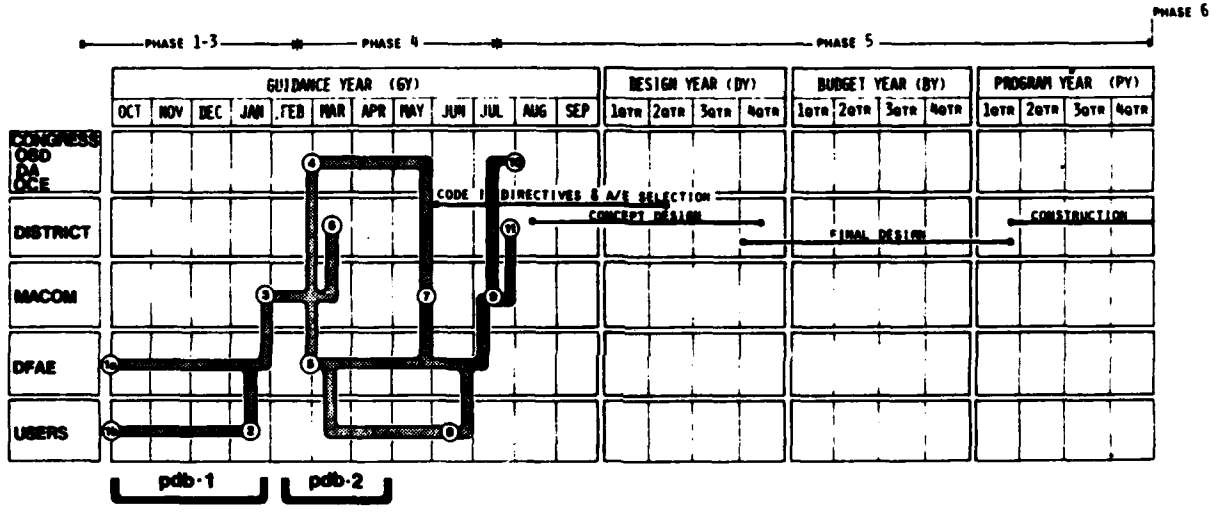
Phase 5: Design and Construction

(a) Answer questions from the design firm
(b) Review designs
(c) Oversee construction

Phase 6: Evaluation

(a) Rate the range project
(b) Report findings

Figure 3. The six-step range project development process.



1. Development of project information begins
2. Using Service submits Functional Requirements Summary to DFAE
3. DFAE Submits PDB-1 and one-page 1391 to MACOM
4. MACOM construction program submitted to DA
5. Installation receives MACOM guidance and PDB-2 begins
6. PDB-1 and 1391 to district
7. MACOM receives DA program guidance and informs installation
8. Using Service submits Detailed Functional Requirements to DFAE
9. PDB-2 and 1391 with justification paragraphs due at MACOM
10. 1391 with justification paragraphs due at DA
11. PDB-2 and 1391 submitted to District

Figure 4. The MCA process.

3 STAFFING RECOMMENDATIONS

A good project request must have complete background information. Thus, it is vital that the persons who work on it understand exactly what the new mission of the range will be. They also must have the skills and experience to give designers and administrators the information needed to make sure the range fits the exact requirements of the installation. If the project staff cannot meet these standards, it is unlikely the range will be built or improved in the correct way, and much work and money will be wasted.

The range project staff must include the master planner in the Directorate of Engineering and Housing (DEH) and a person called a range specialist from the Directorate of Plans and Training; this person must know the details about the training tasks and operations planned for the range. The staff also must include experts in gunnery, targets, training needs, range safety, engineering and design, and funding and procurement. Typists, clerks, and drafters also will be needed.

Because MCA projects must be developed and documented on schedule (see Chapter 2), the master planner and range specialist must work as a team. They also must make sure the range is designed and built to meet the installation's functional and technical needs.

The range specialist's main duty is to make sure the range, as planned and built, will support training goals in an efficient, effective, economic way. Because the range specialist is important from the beginning to the end of a project, the person given this job must not be near the end of his or her tour-of-duty cycle and must be able to spend a great deal of time working at planning and managing the range project. Demands on the range specialist's time are greatest when the draft layout is being done and when the project request is being written.

The master planner's main duty is to make sure the technical details of the range's design will make it easy to use and maintain.

The master planner, the range specialist, and other members of the range project staff will do the early planning for the range. They also will collect and organize information about the range for the Project Development Brochure (PDB) and the DD Form 1391 and update the installation master plan. The staff will give their draft plan to the design firm that does the final plan and explain what the installation's range needs are and how to apply them. The staff will keep in touch with the design firm while it is doing the final plan and review the plan when it is complete. The design firm must consult the range specialist during building; the range specialist will make sure the plan's details, as built, will satisfy the functional requirements of training.

Help in planning a training range is available from many places outside the installation:

1. General information is available from MACOMs, other installations, and Corps of Engineers divisions and districts (chiefly, the Corps of Engineers Center of Range Competence, Huntsville Division).

2. Range safety information is given in AR 385-62 and AR 385-63.

3. Help in understanding and using safety data is available from the range safety office at HQ TRADOC (ATEN-S).

4. Help with TC 25-1 and TC 25-2 requirements, or with special range projects, is available from the Directorate of Army Ammunition, Ranges and Targets (ATIC-ART), at Fort Eustis, VA.

5. FORSCOM installations can get help from the Range Modernization and Improvement Division (AFOP-TM) in HQ FORSCOM.

4 PHASES I THROUGH VI

Phase I--Getting Ready

Phase I Actions

Action 1: Select the range project staff.

Action 2: Set up a work schedule.

Action 3: Find sources of help.

Action 4: Collect and organize resource documents and data.

Action 5: Decide on the type of range to be built or improved.

Suggestions

Action 1. The first persons named to the project staff should be the master planner and the range specialist, since they will be the two most important staff members (see Chapter 3). They decide how many experts in what kind of specialties they will need to help them. Those experts--plus clerks, typists, and drafters--are then assigned to the range project staff.

Action 2. The master planner and range specialist must study the MCA process and find which key dates in the process create deadlines for documentation or action the staff must meet. They then decide the best way to use their time to meet those deadlines. The information in this report should be used to help set up schedules during Action 2 of Phase I.

Action 3. Because the master planner and range specialist will not be experts in all aspects of range planning, they probably will need help from other installation staffs, the MACOM, and other Army organizations. It is a good idea to list all persons or organizations that gave the staff advice, background data, or other information during the project. This list can be filed and used for future projects.

Action 4. All reference materials needed to plan the range should be organized and kept where they are easy for all staff members to find and use. This central file should include.

1. Documents about the weapon system for which the training range is needed.

2. Descriptions of training tasks and training requirements.

3. Policies and procedures about safety and operating training ranges.

4. Maps of training range areas and routes from the main installation to the training ranges.

5. Copies of AR 385-62, AR 385-63, TC 25-1, TC 25-2, and TC 25-3.

6. Special texts, field manuals, and field manual supplements about the weapon and training tasks to be used on the range.

7. The ARTEPs and programs of instruction which apply to the planned range's training activities.

8. Documents which govern range projects, like AR 415-15, AR 415-20, and TM 5-800-3.

9. Design standards.

Action 5. The decision about the kind of range to be built or improved is based on the type of weapon system to be used on the range, the exact training tasks for the weapon system or unit that will train on the range, the number of firing points needed, and how often and by how many the range must be used. (For a list of range types, see TC 25-2.)

Phase II--Site Analysis and Selection

Phase II Actions

Action 1: Name candidate range sites.

Action 2: Analyze sites.

Action 3: Select best site.

Action 4: Decide what kinds of project funds are needed.

Suggestions

Action 1. Before looking for candidate sites, the staff must study information collected in Phase I to find (1) a clear statement of the training tasks which must take place on the range and (2) the time needed to complete training time needed for the number of troops or units for which training must be furnished to the number of days the installation allows for training. This comparison shows whether the range project will meet the installation's basic training needs. After the basic training needs are decided, the staff begins its search for candidates by asking:

1. Does the installation already have a range big enough to furnish the space needed for the training task? (How much of its land is in surface danger areas [SDAs]? How big is its maneuver area?)

2. If yes, can that range be improved to meet the basic training needs?

3. If no, is a new range site needed?

Action 2. After a list of possible candidate sites is made, the staff decides which site is the best. To do this, they score each site against the list of standards given in Table 2. They should also use TM 5-800-3 to make sure each candidate site meets the many planning and design standards for MCA projects. If the staff looks at TM 5-800-3 and the DD Form 1391 at this stage in the project, they will know what kinds of data they will need to collect or develop for the final project request.

Action 3. The information collected in Action 2 must be compared with range requirements. The site which best meets those requirements should be chosen. After the range project staff picks a "best" site, they must tell the installation range review board and the master planning committee of their decision.

Action 4. A "best" site that is too expensive to build or improve cannot be used. So, it is vital that the range project staff decide very early whether MCA, MCA/minor, or O&MA money will be used to pay for the project. Knowing how much money is allowed for the project, and where that money comes from, could change the staff's opinion of which candidate site is best for the project.

Phase III--Preliminary Documentation

Phase III Actions

Action 1: Do a draft range layout.

Action 2: Check draft layout.

Action 3: Fill out PDB-1 and the one-page DD Form 1391.

Suggestions

Action 1. Before the range project staff does a draft range layout, they look at the training, safety, operation, size, and use information collected in Phases I and II and decide what support items, buildings, or equipment the range will need. If the staff is not sure what else the range may need, they must ask for help from the local, MACCOM, or other Army experts they talked to during Phase I. They also should study TC 25-2 and special texts and field manuals about the weapons or training to be done on the range. When they are sure they have a complete list of the range's support needs, they can do a draft range layout. Appendix A lists the basic information requirements for a range project. Figure 5 describes, step-by-step, how to do a draft range layout.

Action 2. After a draft range layout is done, local range and training experts should be asked to look at it and give the range project staff comments about ways to improve the layout.

Action 3. The PDB-1 must be used for almost every MCA project. Since it is used for all kinds of facilities, data special to and important for ranges may need to be added. Appendix B shows how the PDB-1 can be used to describe the range projects.

Phase IV--Final Documentation

Phase IV Actions

Action 1: Complete draft range layout.

Action 2: Fill out PDB-2 and DD Form 1391 with justification paragraphs.

Action 3: Prepare procurement requests.

Suggestions

Action 1. After the range project request is approved by the MACOM, the final range layout must be done. This layout will be used to show some of the functional requirements which will make the range work well. If the MACOM has comments about the layout or the PDB-1, the layout may have to be changed. It is a good idea to go over the layout with local range experts before doing the final sketch.

Action 2. Like the PDB-1, the PDB-2 is used for many kinds of facility projects. Thus, data special to or important for ranges may have to be added to it. It is vital that these data be added, since the design firm uses the PDB-2 to set its design standards for the project. Appendix B shows how a PDB-2 can be written to describe a range project. Also see Appendix A and Table 2.

Action 3. An MCA range project cannot be sent to Congress for approval unless the installation master plan is changed to show the new project (see AR 210-20). Also, the installation must write an Environmental Assessment Report which describes how the possible master plan changes will impact the environment. This report must have an installation map showing the planned range's site. The report is used by the Army to answer questions from Congress about the project. The information in this report is like that in the DD Form 1391 justification paragraphs, but more detailed.

Action 4. Not all range support items are procured with MCA construction funds. Targets and target mechanisms often are procured in other ways. Since range equipment must be delivered when the range is being built, procurement requests for range equipment should be made when the PDB-2 and the DD Form 1391 justification paragraphs are prepared.

Phase V--Design and Construction

Phase V Actions

Action 1: Answer questions from the design firm.

Action 2: Review designs.

Action 3: Check construction.

Suggestions

Action 1. AR 415-15 and AR 415-20 explain what an installation must do during the design of a range. It also is important for the installation--especially the range project staff--to work closely with the Corps of Engineers district in charge of the range's design contract. This will help make sure that range is designed so it will work well after it is built. The best help the installation and range project staff can give is to answer the district's or designer's questions quickly and completely. This is vital because the designers are working against deadlines, and delays caused by missing or incomplete information may harm the project. The installation's role in design is to make sure the range works; communications should go through channels.

Action 2.

1. The installation and range project staff has two chances to review the range's design. The first chance is at the end of concept design, when the design is 35 percent complete. The second chance is when the design is finished (or almost finished).

2. The range specialist's main job in the design review is to make sure the design meets the range's functional requirements and that it will support the training for which it was planned. The master planner's main job is to see that the PDB's technical requirements are met.

3. To make the design reviews effective, the installation and range project staff must give the designers exact, useful comments about how the design meets (or does not meet) the functional and technical requirements listed in the PDB. Some questions the installation, chiefly the range specialist, should ask about the design are given in Table 3.

Action 3. During construction, the range specialist and master planner may have to help the Corps district and construction contractor carry out range details. But, it is important this help be given through proper channels and that the installation and range project staff not interfere with the construction work. The main reason the installation helps at this stage is to make sure the project, as built, will meet the functional and technical requirements of the PDB.

Phase VI--Evaluation

Phase VI Actions

Action 1: Rate the range project.

Action 2: Report findings.

Suggestions

Action 1. When a finished project is rated, defects should be listed and suggestions for doing things better or producing a better product should be

given. It also is very important to list features that turned out well and to describe the ways the delivery process may have helped make the project a success.

Action 2. The report which rates the project can be written in any format. When complete, the original should be sent to the MACOM and a copy of it given to the Corps of Engineers district which handled the design and construction contract.

Table 2

Range Planning Factors

Considerations	Reference	Action
1. SIZE	TC 25-1	-Locate ranges so that range fans and surface danger areas overlap.
a. What is the dimensional size of the site?	AR 210-20	-Land area must contain required safety fan.
b. Is it physically possible to fit all required functions on the usable area?	AR 210-30	-Utilize unusable terrain as surface danger areas.
	Installation Base Map	-Scale range perimeter and overlay on installation base map.
2. AIRSPACE		
a. Can training be accomplished in site airspace with present restrictions?	AR 95-50	
b. Will training include weapons firing in which the maximum ordinate of fire exceeds 45 meters above ground level?	AR 385-63	
c. If so, has the FAA established the airspace as a permanent or temporary restricted area or as a controlled firing area?	Airspace utilization Plan	
3. ADJACENT LAND USE		
a. What are the land uses of adjacent property?	AR 210-20	
b. Do they conflict with proposed site use? Are they complementary?	AR 420-74	
c. Have noise overlays been prepared for proposed site use?	Installation Base Map	
d. Will noise produced on site conflict with adjacent land use?	Reservation Plan	
e. Will future enroachment of existing land use area be adversely affected by proposed site use?	Installation Analytical/Environment Assessment report	
f. Do existing land uses or future encroachment of existing land use areas create security problems for proposed training areas?		
4. HISTORICAL		
a. Did any historical events occur on or in the vicinity of the site?	TM 5-801-1	-Determine suitability for development.
b. Does the site possess archaeological potential?	TM 5-802-2	
c. Will site development adversely affect any historical or archaeological potential?		
5. FLORA		
a. Has tree cover been mapped? Can clearing and grubbing be minimized?	AR 200-1	-Locate areas least degraded by development.
b. Are endangered species present?	AR 200-10	-Site development must not disrupt timber or grazing lands.
c. Do unique habitats exist on site?	CERL Technical Reports: N-110 N-121	
d. Do cropland, forest land, grazing land, and/or recreational areas exist on site which would be adversely impacted by site development?	General Tree-Cover Plan Installation	

Table 2 (Cont'd)

Considerations	Reference	Action
e. Has ecological degradation caused by site development been considered?	Analytical/Environmental Assessment Report	
6. FAUNA		
a. Are endangered or rare species present?	CERL Technical Reports: N-110, N-121	-Site development must not disrupt fishing areas.
b. Do unique habitats exist on site?		
7. TOPOGRAPHY		
a. What is the site topographic configuration?	Defense Mapping Agency Maps	-Flat/lightly rolling land - best for intensive activity.
b. Has a slope analysis been prepared indicating slope types of 0-2%, 2-5%, 5-10%, 10-20%, 20-40%, 40%	Installation Base Map	-Slight grades-usable for movement and activity.
c. Does slope change enough to present difficulties in circulation routes?		-Steep grades-difficult to move over and line of fire must be perpendicular to high ground.
d. Do ravines exist which would cut off portions of the site without bridging?		-Check for terrain backstops.
e. Will site development require excessive cut and fill? If so, what is the nearest dumping site or source of fill materials?		-Target areas must be visible from firing points for direct fire weapons.
f. Do any features worthy of conservation, such as unique outcrops, exist?		-Seek terrain which slopes down from firing points to targets.
g. Are snowslides or rockfalls likely?		
8. CIRCULATION		
a. What are the modes of transportation to be used to and from site?	FM 5-36	-Determine conflicts.
b. Can bridges between cantonment area and training site accommodate the highest vehicle class used in training?	General Road Plan	-Assess cost/work required to alleviate conflicts.
c. What are the existing routes to and from the site? Will training operations conflict with traffic flow?		-Compare routes with geology/soil erodibility.
d. Are existing routes, grades, and surfaces acceptable? Are route widths suitable for vehicles and expected traffic volumes?		-Identify road alignment and range-use conflicts.
e. What is the direction and time/distance to supporting facilities? Will fuel consumption be a problem?		-Use of routes between ranges and ammunition supply points must not interfere with facility use.
9. HYDROLOGY		
a. Where are the existing swales, ditches, and channels? What is their condition and flow capacity?	AR 115-21	-Danger signal: high water table or underground streams.
b. What is the general drainage pattern?	TM 5-700	-Avoid flood plain.
c. What is the depth of water table during different seasons?	FM 101-10-1	
d. Where are poorly drained areas?	General Drainage Plan	

Table 2 (Cont'd)

Considerations	Reference	Action
e. Is the site in a flood plain? Will it affect training?		
f. Is the surface or subsurface water potable?		
g. Is the site an aquifer recharge area?		
10. LEGAL/SAFETY		
	AR 385-62	-Site development cannot infringe
a. Has site been surveyed by a school-trained safety officer?	AR 385-63	on public health, safety,
b. Will the site require any de-dudding?	AR 385-64	and welfare.
c. Will it be necessary to obtain safety waivers?		
11. GEOLOGY		
a. What is the bearing capacity of the soil?	USGS Soil Survey	-Danger signals: rock close to
b. What is the depth of bedrock? Is excessive modification necessary for construction?	TM 5-330	surface, soft clay, loose silt,
	TM 5-332	fine water-bearing sand, newly
c. What is the existing state of compaction or settling potential?	TM 5-545	filled dumping area, and peat or
	TM 5-820-4	muck in large areas.
d. What is the potential for borrow-pit exploitation?		
e. What is the depth of topsoil?		
f. What is the depth of frost penetration?		
12. FIRE PROTECTION		
a. Will fire hazards require seasonal range closing?	AR 420-90	
b. If range fires are a potential hazard, are sufficient water supplies, fire-fighting vehicles and staff, and methods of detection available?	PAM 420-2	
c. Can fire fighting units reach site quickly in case of accidents?		
d. Will controlled burning of vegetation be required?		
13. UTILITIES		
a. Do present lines or easements exist on site? Will it be cost effective to reroute lines?	TM 5-303	
	TM 5-660	
	TM 5-700	
b. Is there a stable water supply? Electrical?	TM 5-813-1 through TM 5-813-7	
c. Do phone lines exist?	General Utilities Plan	

Table 2 (Cont'd)

Considerations	Reference	Action
14. EXISTING STRUCTURES a. Are there any existing structures on site? b. Will they be retained, destroyed, or moved? c. Are cemeteries located on site?	Installation Base Map Building Information schedule	-Examine costs for building demolition or moving. -Select site without cemeteries.
15. CLIMATE a. What are the sun angles for the four seasons? b. Do potential sources for glare exist on site? c. How many sunny days per year are there? d. What is the velocity and direction of unfavorable winter winds? e. What is the average annual rainfall? f. How many rainy days per year are there? g. What is the annual snowfall? h. How many days per year does snow cover the ground? i. What is the maximum accumulation? j. What are the seasonal temperature averages? k. What is the average winter day chill factor?	TM 5-785	-Check for locality's suitable orientation to the sun.
16. INSPECTION Has an on-site inspection to verify findings and to assess environmental historical, economic, and operational considerations been completed?		-Look at each site. -Features not evident during research but discovered in inspection must be considered when selecting site. -Identify similar problem areas. -Identify key points, lines, and areas.
17. UNINTENDED EFFECTS Examine possible effects of development on site and the surrounding area	Installation Analytical/ Environment Assessment Report Future development Plans GENERAL REFERENCE: FM 5-35	-Consider land requirement for future growth.

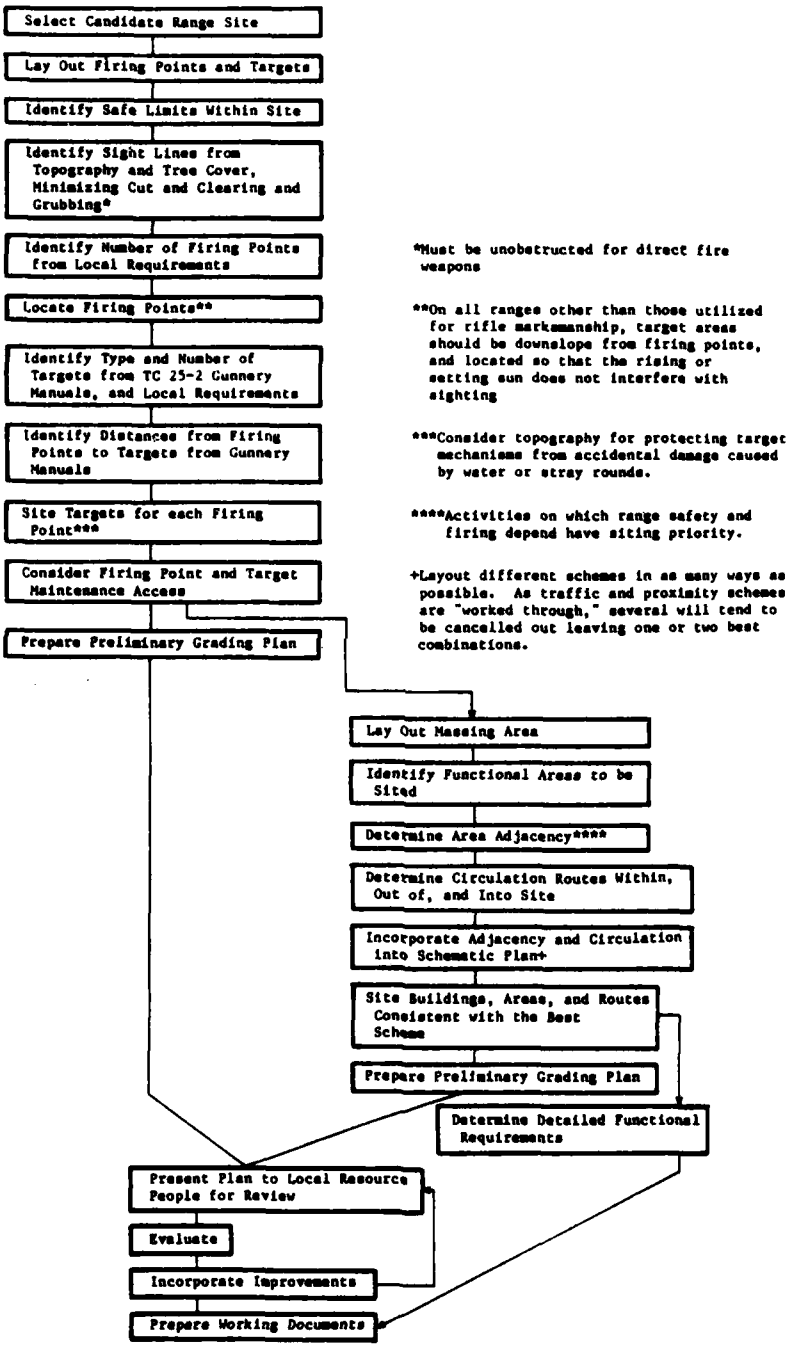


Figure 5. Suggested steps in preparing a range layout.

Table 3

Design Review Questions for Range Specialist

1. Are all land areas accounted for in the design?
2. Are all support facilities provided?
3. Are all the land areas and support facilities organized correctly?
4. Are all land areas and support facilities the correct size?
5. Is there enough access to the range, to support facilities, and to targets?
6. Will target mechanisms and other equipment fit into coffins?
7. Will equipment fit into support facilities?
8. Can targets be seen from firing points?
9. Are maneuver areas laid out in the proper task sequence?
10. Is there enough power for all targets and support facilities?
11. Are all target mechanisms protected?
12. Have all other detailed requirements been met?
13. Can all training activities and other support activities be performed as planned?
14. Considering the entire range, can the planned training mission be carried out successfully?

5 GENERAL PLANNING DATA

A number of general considerations and facilities can be applied to many types of ranges. This chapter gives information about such repetitive factors, plus general references that may help during range planning.

Targets

Training exercise actions are "driven" by threat target movement or firing simulation, or by the appearance of threat hard targets as the firing vehicle unmasks terrain and vegetation screens and other obstructions.

Information about sample target arrays, which are idealized, is given in Chapters 6 and 7. These arrays must be fit to specific terrain and safety requirements to meet overall range planning goals.

For immediate range construction purposes, installations should plan on using some hard targets, the Stationary Tank Automatic Target System (STATS), the standard A-trainfire mechanism, a moving target, and locally made day and night (thermal) targets.

Hard Targets

Steel objectives like old tank hulls, turrets, armored personnel carriers (APCs), and truck chassis make good hard targets. When filled with sand or earth they can withstand many hits.

Stationary Tank Automatic Target System (STATS)

The STATS (Navy Device A3A123, Army DVC 17-63A) is made up of three subsystems: the Automatic Tank Target Subsystem (ATTS) (A3A123/1), the Dismounted Infantry Target Subsystem (DITS) (A3A123/2), and the Remote Control Demolition Subsystem (RCDS) (A3A123/3). The STATS only includes the ATTs.

The STATS' capabilities include pop-up tank and infantry targets, visual hit scoring (smoke or lamp), and optional hostile fire simulation. The system is controlled by an FM transmitter. The power sources it needs are listed below.

Tank targets: 12-V, 98-Ah lead acid battery

Infantry targets: 24-V, 5-Ah lead acid battery

RCDS: NiCad battery pack of twelve 1.5-V batteries

Control device: 12-V, 1.8-Ah NiCad battery.

Alternatively, targets may be controlled and powered by underground cable. Low voltage cables carry target-movement and hit-sensing signals between the control point and the targets. The control cables must be able to handle any targets raising at the same time. Target power may be provided by 120-V AC lines connected to trickle-type battery chargers at each target. The

chargers supply a constant level of current during firing exercises and prevent the battery from freezing during cold weather. This system saves considerable target detail effort and extends battery life because batteries are moved and recharged less often. Target support facilities are described in Table 4.

Trainfire

The standard A-trainfire mechanism (M31A1) is a pop-up infantry silhouette target holder with hit-sensing capabilities. It can be remote controlled by a radio frequency transmitter and receiver link and is powered by a 12-V marine battery support pack. One radio frequency receiver can control up to forty M31A41 target mechanisms. This receiver has a primary voltage (input) of 120 and 240 VAC and a secondary operating voltage of 12 to 16 VDC.*

Moving Targets

Moving target systems available from commercial sources vary in design. Some tank and vehicle targets travel on a monorail driven by an electrohydraulic power system, while other systems travel on a two-dual rail power-driven by an electromechanical system on a cable.** Commercial moving vehicular target systems should meet the following criteria:

1. Speed: the speed shall be variable and selectable within a range of 0 to 50 km/hr. The carrier shall perform and react to forward, reverse, and stop commands via controlled signals from a control console at present speed in a safe manner.

2. Acceleration: acceleration shall be no less than 8 ft/s^2.+

3. Incline and curvature: the vehicle shall be capable of traveling at a specified speed on inclines up to 5 percent and at track curvatures up to a 40-m radius.

Moving targets can be made locally.[3]

Thermal Targets

Thermal targets are devices used to train soldiers on night-vision sighting equipment. Target thermal signatures should simulate threat vehicle thermal signatures. Targets which only present a "blob" signature are of little value. Electroconductive paper may be applied to the plywood targets used with the STATS. The paper is then electrified with battery and/or commercial power. When using commercial AC power, the voltage and current have to be transformed to a lower voltage and current. The same is true when using DC high-amperage battery support power. The high amperage (98 to 105 A) has to

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*For more information, see TM 9-6920-203-14.

**For details, consult the local Corps of Engineers district office.

+Metric Conversion Table is on p 123.

[3]"The Rodriques Tactical Training Range." The Engineer (Winter, 1978-79), pp 22-25; and "Moving Targets for Tank Gunnery," Armor (November-December 1979), p 8.

be reduced to usable current. For some higher resistance DC thermal targets, the target connector can be directly installed to 12-V marine battery terminals.*

Radio-Controlled Miniature Aerial Target (RCMAT)

The RCMAT is used for air defense training. The target has an almost 100 percent recoverability rate when landing under radio control and a 15-minute endurance time.

Armor Remoted Target System (ARETS)

ARETS is currently being developed to support gunnery training against vehicular targets. ARETS is a pop-up and moving target system. The electrically driven moving target carriers are mounted on vertical tracks. An operator control console lets a single operator control as many as 50 pop-up and five moving targets. It also provides a hard-copy printout of training exercise scores.

Target Support Facilities

Table 4 gives detailed facility information on target support.

Combat Battlefield Simulation Devices

These devices must be inspected and cleared for use by Range Control officials and Installation Safety officials. Personnel installing, operating, and disarming battlefield simulation devices should be school-trained and certified in the use of pyrotechnics and demolition.

Laser Safety

For a complete discussion of laser safety requirements, see AR 385-63. Also see Table 5.

Efficient Land Use

Overlapping Safety Fans

Land requirements may be reduced by locating ranges so that the various range fans overlap and extend toward a common center. The most desirable arrangement would position firing areas in an arc around a common impact area (see Figure 6).

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*Field-expedient thermal targets heated by kerosene are described in Appendix B of TC 25-2: commercial thermal targets are being developed under the guidance of the Directorate of Training Development of the U.S. Army Armor Center, Fort Knox, KY.

Use of Terrain Features

Sloping ground and hills in the firing and impact areas can affect surface danger areas. By placing targets in front of a hill mass (Figure 7), the impact area may be significantly reduced. Except for rifle and small arms ranges, the site should slope downward from the firing points to the target area. Sites which slope up from firing areas to targets should be avoided because this configuration increases the required land area. Terrain features are particularly important on ranges designed for use with laser rangefinder and laser target designator devices.

Fire and Maneuver Area Layout

Moving vehicle firing exercises may be carried out on a course with firing points in a straight line. This layout, however, may require several kilometers of forward travel when training with high-speed vehicles. A course on which the vehicle must change direction frequently will more closely approximate tactical conditions and reduce maneuver land requirements (Figure 8). It also is best to design the range to present differing situations to the vehicle crew. A configuration similar to the idealized layout shown in Figure 9 permits the crew to follow many patterns on a single range.

Multi-Use Ranges

When the utilization rate of a dedicated range will be low, the range should be designed to accommodate different training tasks. Traditionally, each firing range supports training on an individual task for one weapon. High costs and extensive land requirements, however, may now make multiuse of ranges a necessity. Also, a range designed for use by multiple weapon systems may be used for combined arms training such as aerial gunnery (Tables IX A and IX B*).

Ammunition and Targets

Surface danger areas may sometimes be reduced by using inert ammunition (see AR 385-63). Also, a target area that is not contaminated with dud ammunition may be used for maneuver training.

If wooden, plastic, or other soft materials are used for targets and the target area contains no rocks, stones or steel, the chance of ricochets and risk of injury are lower, thus reducing the surface danger area.

*Taken from FM 17-40, Attack Helicopter Gunnery, Department of the Army (DA), Washington, DC.

Table 4

Detailed Facility Data for Target Support Facilities

Target Storage Shed

Requirement

TARGET STORAGE AREA SHOULD BE PROVIDED AT THE RANGE FOR BACK-UP TARGET FORMS AND FOR REPAIR OR DISPOSAL OF DAMAGED TARGETS.

Criteria

Size: about 300 sq ft

Location: the target storage shed should be located outside of the surface danger area, to the rear of the firing line, and adjacent to the target service road(s) at the range or range complex.

Special Building Features: the targets may be stored in either an enclosed building or a covered area. The storage area must have a minimum lighting level of 5 to 10 foot-candles during night operations. Lighting must be manually operated so it can be switched off during training exercises. Minimum heights and openings shall be determined by the size of the target forms which must be moved in and out of the shed.

Battery Charging Room

Requirement

A BATTERY CHARGING ROOM IS NEEDED TO SUPPORT BATTERY-POWERED TARGET MECHANISMS

Criteria

Size: about 600 sq ft, depending on type of batteries.

Temperature limits for optimum charging: freezing to 90°F

Safety: the charging room must meet the local, State, and Federal standards for battery charging rooms. Lead acid and nickel cadmium batteries must be charged in separate rooms. Adequate ventilation shall be provided to prevent the build-up of hazardous gases during charging.

Security: the charging room must meet minimum security requirements; (i.e., deadlocks and security lighting) to guard against battery theft.

Location: the charging room should be located as close to the range target arrays as possible to reduce hauling distances and the time between battery replacements.

PLL/Supply Area

Requirement

AN AREA FOR STORING TARGET MECHANISM PARTS AND SUPPLIES AT THE RANGE IS REQUIRED

Criteria

Size: about 100 sq ft

Access: door to allow issues.

Security: door must provide physical security for contents.

Equipment: parts bins and shelves.

Table 4 (Cont'd)

Battery Storage Area

Requirement

AN AREA FOR CHARGED-BATTERY STORAGE AND ISSUE IS REQUIRED

Criteria

Size: based on the number and kinds of target arrays being supported.

Location: adjacent to the battery charging room.

Access: an overhead or double-wide door shall be provided to make it easy to issue charged batteries.

Security: the battery storage area shall meet security standards.

Target and Target Material Area

Requirement

AN AREA FOR STORING LUMBER AND COMPLETED OR REPAIRED TARGETS IS REQUIRED

Criteria

Size: based on the number and types of target arrays being supported.

Location: adjacent to the target repair area.

Environment: indoor preferred, but not required.

Target Repair Area

Requirement

AN AREA IS NEEDED TO CONSTRUCT AND REPAIR TARGETS

Criteria

Size: about 1000 sq ft with a ceiling about 10-ft high.

Access: large garage door so materials and targets can be moved in and out easily.

Location: the target repair area and target material storage area are usually located within the main installation complex, but it may be advantageous to locate these facilities at or near a range control complex.

Target Mechanism Repair Area

Requirement

AN AREA TO TEST, REPAIR, AND MAINTAIN TARGET MECHANISMS

Criteria

Size: about 200 sq ft with a ceiling at least 8-ft high.

Access: oversized door.

Security: door must provide physical security for contents.

Location See Target Shop: Location.

Table 4 (Cont'd)

Utilities

Requirement

ELECTRICAL THERMAL TARGETS MAY BE BATTERY POWERED, COMMERCIALLY POWERED, OR A COMBINATION

Guidance

Full-scale thermal targets require four wet-cell batteries for each 8 to 10 hour period. Batteries are Standard Part No. 30-H, 575 cold-crank A; 105 A/hr, deep cycle, and are recharged after each period of use. See also: Battery Charging Room and Battery Storage Area.

Requirement

COMMERCIAL POWER SHOULD BE LOCATED TO PROVIDE FLEXIBILITY OF TARGET LOCATIONS

Criteria

1. Power lines should be buried or protected downrange.

2. Targets must be placed on pads to accommodate power line terminals.

3. Additional electrical outlets should be provided during initial construction in locations other than those used for the primary target array.

Guidance

If commercial power is not used, considerable storage and recharge facilities are required to support the target and battery requirements. A possible solution to this logistical problem could be the construction of a downrange storage and charging facility (bunker) to support the target clusters.

Table 5

Detailed Facility Data for Laser-Compatible Training Areas

Requirement

The LRF is used on all M-1 live-fire activities while the LTD is used on aerial gunnery Tables I, IX A, and IX B, and with artillery.

Requirement

Laser rangefinders and laser target designators should be used only on those ranges approved and established for such use. Practice in lasing (i.e., use of only the laster) firing exercises in the laser training area (LTA) may be conducted only at those LTA which meet or exceed all safety requirements and have been approved for such use.

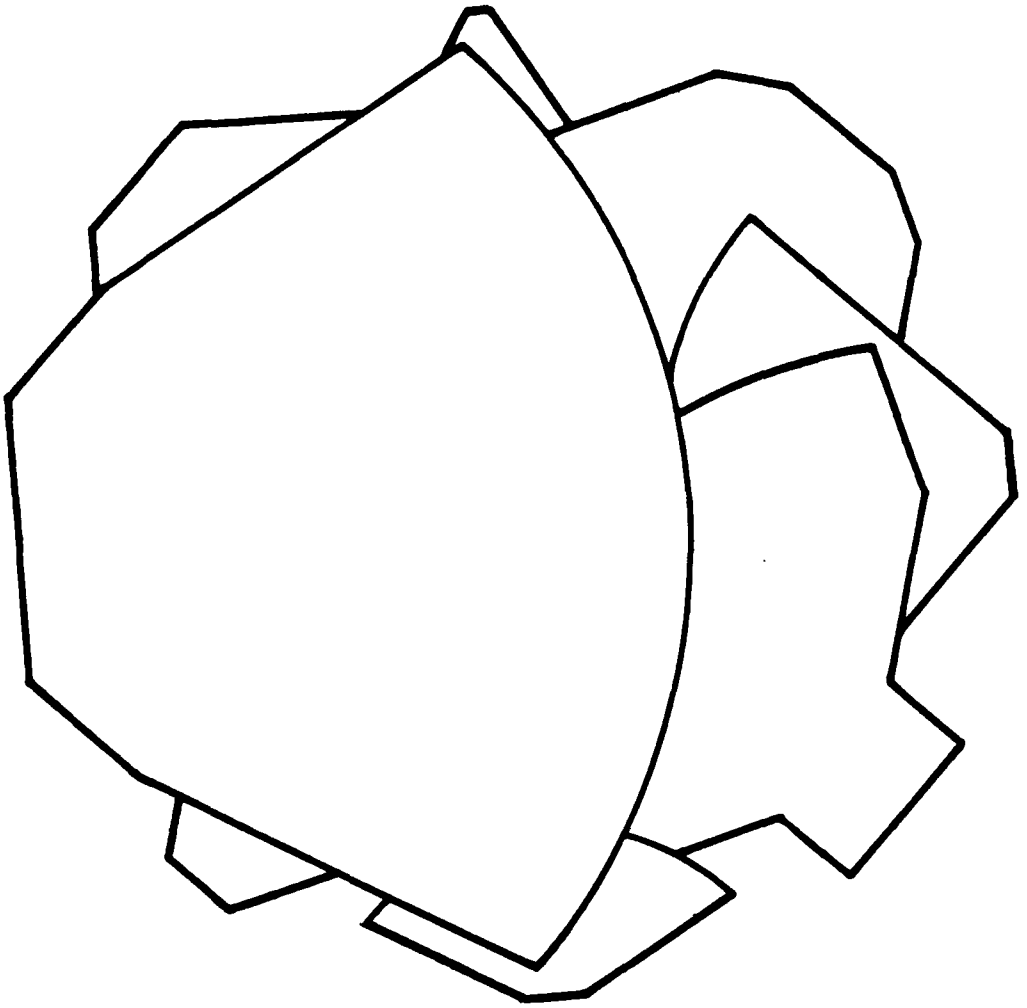

Figure 6. Overlapping safety fans. The eight ranges illustrated are positioned to utilize a common impact area.

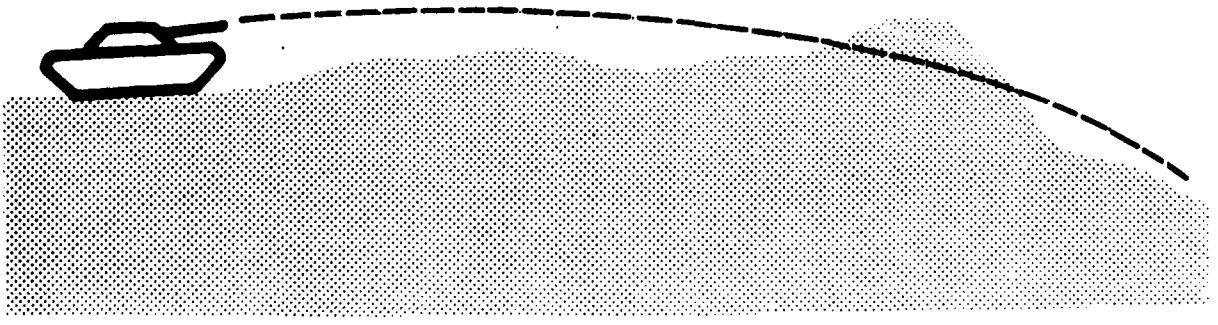

Figure 7. Impact area reduction. The position of the hill mass causes the round to impact short of its normal ballistic range.

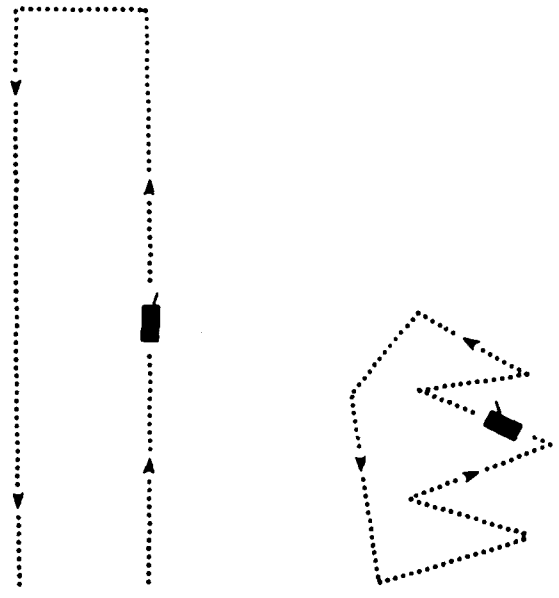

Figure 8. Alternative maneuver area layouts. The firing course on the right requires a smaller surface danger area and is more tactically realistic than the straight-line course.

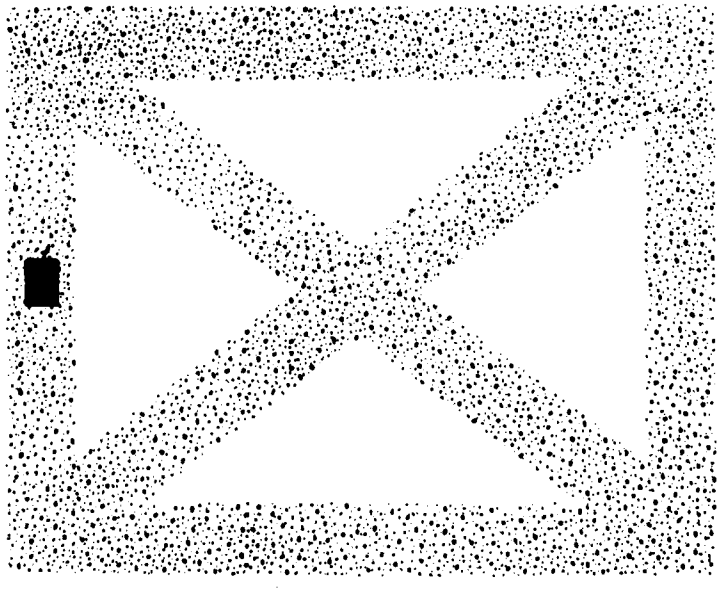

Figure 9. Variable course maneuver area.

6 M-1 TANK DATA

Weapon Training Data

Table 6 summarizes the weapon characteristics of the M-1 Tank.

Tank Gunnery Program

The tank gunnery program is designed to develop and test the proficiency of tank crews, sections, and platoons. Training tasks simulate realistic battlefield conditions. The program's training exercises use single and multiple targets under all weather conditions, day or night. Tables 7 and 8 summarize the tank gunnery annual training program.

Because of time or ammunition constraints, it may be necessary to modify either the number of tables fired or the table tasks. Any modification should have standards which are no less demanding than those it replaces. All modifications should be temporary. In no case will standards be lowered.

M-1 Tank range training activities are divided into six groups:

1. Tables IIIA* and IIIB: crew drills.
2. Tables VA and VB: crew subcaliber exercise (degraded mode).
3. Table VIA: machinegun exercise.
4. Tables VIIA and VIIB: practice crew qualification exercise.
5. Tables VIIIA and VIIIB: crew qualification exercise.
6. Tables IXA and IXB: platoon qualification exercise.

Day firing tables ("A" tables) train and test tank crews and platoons in rapid engagement and daylight target destruction. Night firing tables ("B" tables) train and test tank crews and platoons in rapid engagement and night target destruction. Tables are fired from both stationary and moving tanks.

Targets

About 44 stationary (pop-up) and 40 moving targets are needed to complete all gunnery exercises. It is best to have 15 to 25 percent excess target emplacements, so training scenarios can be varied occasionally.

Full-scale targets should be of the same shape, size, and color as the threat targets they represent. They should be placed in realistic battlefield positions (e.g., hull-down and threat formations). When available and where

*Tables references in this chapter by roman numerals were taken from FM 17-12, Tank Gunnery (DA, Washington, DC).

ricochets do not present safety hazards, some hard targets are preferred when firing main gun combat ammunition.

Soft targets are made by the unit or range control activity. When target cloth or wood is used, the targets should be olive-drab. White targets are preferred for zeroing because it is easier to sense the round's strike.

Until a standard thermal target is introduced into the Army inventory, range support facilities and units must make their own. For main gun and sub-caliber firing, the targets must be made of metal (to absorb heat). Smudge pots, filled with kerosene, make good thermal targets.

Ammunition Requirements

Several types of ammunition are required for the M-1 Tank to conduct specified training exercises. The types of ammunition used in various training exercises directly affect the amount of land needed to conduct exercises safely. Table 9 lists typical annual ammunition expenditures.

Range Personnel

Instructors and range staff must conduct and score training exercises and operate and maintain the range, targets, and range equipment. Up to 60 target support personnel may be needed to prepare, operate, service, and maintain an array of 50 stationary and five moving targets in day and night operations. Even more help may be needed to rapidly set up thermal targets.

Typical tasks for target support personnel include: (1) prepare, test, repair, and emplace targets; (2) emplace, test, and repair target mechanisms; (3) service and repair moving target carrier and motor; (4) charge and replace batteries for transmitters, mechanisms, and thermal targets; and (5) supervision. The range staff usually includes an officer in charge of the range (OIC), a range safety officer or noncommissioned officer (NCO), a noncommissioned officer in charge of the range (NCOIC), an ammunition NCO, a target NCO, tank-crew evaluators, a fire-fighting detail, bunker personnel, radiotelephone operators, and a medical aidman.

Range Support Vehicles and Equipment

A variety of equipment is needed to conduct range tank training. For M-1 Tank gunnery training, the following are usually needed:

Six APCs with trailers
One stake and platform truck
Four to six 2-1/2 ton trucks
Targets and target operating/control mechanisms
Flashlights for scorers
Range lights or lanterns
Batteries for lights and radios
Flag sets
Tank-crew evaluator communication sets
Briefing tent
Lighting for briefing tent
Field telephones

Latrine supplies
Trash cans
Water supplies
Fire-fighting equipment
Generators *

Surface Danger Areas

Surface danger area diagrams show range boundaries and safety features in overlay form, including safety limit markers for each firing position. Graphic firing tables, which give values for range, maximum ordinates, and superelevation for each ammunition type, are needed to construct surface danger area diagrams. (The surface danger areas for M-1 Tank projectiles are given in AR 385-63 and FM 17-12.)

Surface danger area diagrams on established ranges should be modified when these ranges are not realistic or do not make maximum use of available terrain. Total range distance includes the horizontal range corresponding to a 10-ft quadrant elevation, an allowance for the maneuver area, and Area B. This total range distance will be decreased only on a waiver basis. No tank cannon will be fired at quadrant elevations greater than $+5^{o}$ (+24 mils). This provides a safety factor of 5^{o} within the surface area diagram.

Crew Drills

Tables IIIA and IIIB consist of target engagement crew drills vital to the M-1 Tank gunnery program. Crew drills should be conducted monthly at home-station. The entire drill package should not be attempted at once. Rather, it should be distributed so all target engagement drills are completed each 6 months.

Crew drills are conducted in two phases: stationary and moving. Crews should successfully meet the standards for day drills before attempting the same drills at night. Crew drills must be completed before the crews are allowed to fire live ammunition.

All stationary drills in Table IIIA begin from a turret-down position. All stationary drills in Table IIIB begin from a hull-down position. The tasks and performance standards for the crew drills are listed in Table 10. Table 11 summarizes target requirements for Tables IIIA and IIIB.

Crew Subcaliber (Degraded Mode)

Tables VA and VB are fired subcaliber to teach degraded mode gunnery. The subcaliber exercises can be performed on ranges which prohibit live fire by dry-firing to maintain crew interaction proficiency. Exercises are conducted under both day and night conditions and in stationary and moving phases.

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*Other equipment which may be needed is listed in FM 17-12, Chapter 19.

Crews fire stationary tasks before moving tasks. An evaluator accompanies the crews during both dry- and live-firing exercises. Table VA should be fired dry before firing live. Table VB should be fired live only.

Stationary tasks are fired before moving tasks. Table VA stationary tasks start from a turret-down position, and Table VB stationary tasks start from a hull-down position. Table 12 lists task and performance standards for Tables VA and VB. Table 13 summarizes the target and ammunition requirements for Tables VA and VB.

Machinegun Exercise

Table VI is fired to further develop the crew coordination needed to engage moving and stationary targets with tank machineguns from a moving and stationary tank during daylight. The machinegun exercise is conducted during the day only, in two phases: stationary and moving.

Each crew makes a dry run of the exercise before making a firing run. Stationary tasks are fired before moving tasks. All stationary tasks begin from a turret-down position; exposure time begins when the tank is in the hull-down position and ends when the firing tank begins to back into a turret-down position. Crews use direct fire to engage point and area targets from moving and stationary positions. Table 14 lists the tasks and Performance Standards for Table VI. Table 15 summarizes the target and ammunition requirements for Table VI.

Practice Crew Qualification Exercise

Tables VIIA and VIIB train tank crews to engage stationary and moving targets during day and night with tank-mounted weapons. Tables VIIA and VIIB prepare crews for the training tasks of Tables VIII and IX. The target sequence may be varied to conform to available range facilities. Task A, Table VIIA is fired to confirm boresight.

This exercise is conducted both day and night in two phases: stationary and moving. The tables may be fired on the same range as Table VIII; however, the target sequence must be varied between tables.

Each crew dry fires the exercise before live firing. Stationary tasks are fired before moving tasks. Table VIIA is fired before Table VIIB. Table VIIA stationary tasks begin from a turret-down position. Table VIIB stationary tasks begin from a hull-down position. Firing tanks will remain exposed no longer than 15 seconds, with exposure time beginning when the tank is in a hull-down position and ending when the tank begins to move back to a turret-down position. A maximum of two targets are engaged from the primary hill-down firing position, after which the firing tank moves to an alternate firing position for subsequent engagements.

Crews use direct fire to confirm boresight and to engage moving targets arranged in tactical formations. Table 16 lists the tasks and performance standards for Tables VIIA and VIIB. Table 17 summarizes the target and ammunition requirements for Tables VIIA and VIIB.

Crew Qualification Exercise

Tables VIIIA and VIIIB test the crews' ability to engage stationary and moving targets with tank-mounted weapons. These tables are the basis for crew qualification; there is no dry or practice run. The exercise is conducted both day and night in two phases: stationary and moving. Tables VIIIA and VIIIB may be fired on the same range; however, the target sequence should be varied between tables.

Crews fire stationary tasks before moving tasks, and Table VIIIA before VIIIB. The Table VIIIA stationary tasks begin in a turret-down position, and the Table VIIIB stationary tasks start from a hull-down position. Firing tanks remain exposed no longer than 15 seconds, with exposure time beginning when the tank is in a hull-down position and ending when the tank begins to move back to a turret-down position. Crews use direct fire to engage stationary and moving targets arranged in tactical formations.

Table 18 lists the tasks and performance standards for Tables VIIIA and VIIIB. Table 19 summarizes the target and ammunition requirements for Tables VIIIA and VIIIB.

Platoon Qualification Exercise

Tables IXA and IXB, the platoon battleruns, incorporate tank fire with tactical maneuver. They enforce and test the proper control and distribution of platoon fire. In the offensive portion of the battleruns, the platoon is the lead element of a simulated company team, which is conducting a counterattack. These tables can be used by both tank and armored cavalry platoons. Before firing Table IXA for qualification, the platoon should fire the course dry and subcaliber (if time permits).

Battleruns begin when the platoon receives an operations order in an occupied assembly area. The platoon then moves tactically to the initial battle position. Tanks not fully operational conduct the exercises in a degraded mode. Hoffman simulators (SAAB hostile fire simulators) are detonated by targets upon target exposure. Targets remain exposed during the stationary phases for 40 seconds, and during the moving phases for 25 seconds. Time begins for tasks when the Hoffman simulator is detonated. Evaluations will be conducted for each platoon run to include dry and subcaliber runs. Table IXB is a repeat of Table IXA, except that all tanks have operational TIS sights, and firing lights are employed for control and safety. The tank platoon engages a series of targets arrayed in threat formations using both offensive and defensive maneuvers.

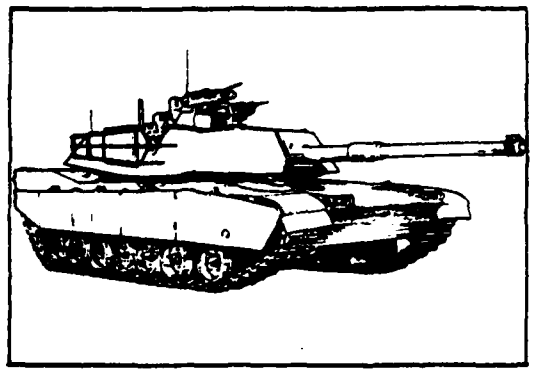
Tables 20 and 21 list the tasks and performance standards for Tables IXA and IXB. Table 22 summarizes the target and ammunition requirements for Tables IXA and IXB.

Facility Data

Table 23 lists the facilities that make up a typical range for M-1 Tank training exercises. Note that facility requirements will vary for each range project. Many requirements must be established locally, based on local terrain, soil, use, and other factors. Figure 10 shows a typical site layout for an M-1 Tank training range. Table 24 lists detailed requirements, criteria, and guidance for specific range facilities.

Table 6

Characteristics of the M-1 Tank



Size

Length, tip-to-tip: 384.5 in.

Operating Width: 144 in.

Operating Height: 93.5 in.

Ground Clearance: 19 in.

Weight: 60 tons

Ground Pressure: 13.3 psi

Features/Capabilities

Heavily Armored

Fully Tracked

Speed: 75 kph (45 mph)--paved roads
58 kph (30 mph)--cross-country

Cruise Range: 275 miles (minimum)

Obstacle Crossing: Vertical--49 in.; trench--9 ft.

Power Pack: 1500 hp turbine engine

Fuel: Diesel fuel (DF2), 508-gal capacity

Suspension: Torsion bar sprung, hydraulically damped

Weapons: 105-mm main gun
7.62-mm coaxial machine gun
7.62-mm machinegun (loader's gun)
.50-caliber machinegun (commander's weapon)

Gunner's Primary Sight: Laser Range Finder, 200 to 8000 m capability; line-of-sight stabilization for vertical axis

Turret: Stabilization is azimuth for aim retention; stabilization firing primarily over front slope of tank; firing over flank avoided; reduced accuracy

Thermal Imaging System: For day and night target acquisition and aiming

Digital Ballistic Computer: Accommodates changes in ammunition and/or ballistic data; automatic and accurate lead correction for moving targets

Self-Screening System: Fires red phosphorus grenades to hide from enemy direct-fire weapon gunners

Crew Size: 4-man

Table 7

Tank Gunnery Annual Training Program

Table		Schedule											
		1	2	3	4	5	6	7	8	9	10	11	12
	Pregunnery	M	M	M	M	M	M	M	M	M	M	M	M
	Gunnery Skills Test		S							S			
	Basic Gunnery	Q		Q				Q			Q		
III	Crew Drills	M	M	M	M	M	M	M	M	M	M	M	M
V	Crew Subcal Exercise												
	Degraded Mode Dry	Q			Q			Q			Q		
	Subcaliber				S						S		
VI	Machinegun Dry				S						S		
	Exercise Machinegun				S						S		
VII	Crew Qualification Practice Exercise												
	Dry				S						S		
	Main Gun				S						S		
VIII	Crew Qualification Exercise												
	Main Gun				A								
	Platoon Drills	M	M	M	M	M	M	M	M	M	M	M	M
IX	Platoon Qualification Exercises												
	Dry										A		
	Subcaliber										A		
	Main Gun										A		

Table 8

Yearly Tank Gunnery Training Program for a Typical Calendar Quarter

Month 1	Month 2	Month 3
Pregunnery Training	Pregunnery Training	Pregunnery Training
Basic Gunnery Training	Platoon Drills	TCGST
Platoon Drills	Table III	Table III
Table III and Table V		

Notes: 1. Crew changes must be made early and crew stabilization maximized.
2. Accurate scoring records must be maintained to determine crew progress.

Table 9

Typical Annual Ammunition Requirement for an M-1 Tank Crew

Qualification Period 1

Allocated by Tables

Table	Exercise	TPDS-T	Heat - TPT	7.62	.50 Cal APT	50 Cal API-T
V	Crew Subcaliber	--	--	500	100	100
VI	Machinegun	--	--	700	200	--
VII	Practice Crew Qual	27	6	300	150	--
VIII	Crew Qualification	32	10	200	100	--
IX	Plt Qualification Subcal			200	50	20
	TOTALS	59	16	1900	600	120

Qualification Period 2

Allocated by Tables

Table	Exercise	TPDS	Heat-TPT	7.62	.50 Cal APT	.50 Cal API-T
V	Crew Subcaliber	--	--	500	100	100
VI	Machinegun	--	--	700	200	--
VII	Practice Crew Qual	27	6	300	150	--
IX	Plt Qualification	18	2	200	50	--
	TOTALS	45	8	1700	500	100

Total Annual Per Crew

TPDS-T: 104 rounds*
HEAT-TPT: 24 rounds*
7.62: 3600 rounds
.50 Cal API: 1100 rounds
.50 Cal API-T: 220 rounds

*The amount of available ammunition may dictate a different mix of TPDS-T and HEAT-TPT.

Table 10

Crew Drills Performance Objectives (Tables IIIA and IIIB)

TABLE IIIA

	Task	Condition Targets/Situation	Performance Standards
A	Move an M-1 Abrams tank into a firing position	1 stationary tank, 3 hull-down firing positions	Move an M-1 Abrams tank from a turret-down position to a hull-down position. Return to a turret-down position, move to an alternate hull-down position. Return to a turret-down position. Complete all action within 60 seconds.
B	Engage a moving target from a stationary tank	1 moving tank (1500-2000 m)	Move from a turret-down position to a hull-down position. Complete a 2-round engagement and return to a turret-down position within 60 seconds. Tank is not exposed for more than 15 seconds.
C	Engage a moving target from a stationary tank	1 moving tank (1500-2000 m)	Move from a turret-down position to a hull-down position. Complete a 2-round engagement and return to a turret-down position within 60 seconds. Tank is not exposed for more than 15 seconds.
D	Engage multiple stationary tank targets from a stationary tank	1 stationary tank (1500-2000 m) 1 stationary tank (1500-2000 m)	Move from a turret-down position to a hull-down position, engage both targets. Return to a turret-down position, move to an alternate hull-down position, repeat target engagement and return to a turret-down position within 60 seconds. Tank is not exposed for more than 15 seconds.
E	Engage simultaneous targets from a stationary tank using the main gun and .50 cal	1 stationary tank (1500-2000 m; 1 stationary tank (800-1200 m)	Move from a turret-down position to a hull-down position, engage both targets. Return to a turret-down position, repeat the engagement, and return to a turret-down position within 60 seconds. Tank is not exposed for more than 15 seconds.
F	Engage a stationary tank from a moving tank	1 stationary tank (1500-2000 m)	Engage the target and complete a 2-round engagement within 28 seconds.
G	Engage a moving target from a moving tank	1 moving tank (1500-2000 m)	Engage the target and complete a 2-round engagement within 28 seconds.
H	Engage multiple stationary tank targets from a moving tank	1 stationary tank (1500-2000 m) 1 stationary tank (1500-2000 m)	Engage both targets and complete a 2-round engagement within 35 seconds.
	Engage a moving target from a moving tank using main gun in degraded mode (LRF and LAS inoperable)	1 moving tank (1500-2000 m)	Engage the target and complete a 2-round engagement within 28 seconds.
J	Engage troop targets from a moving tank using the coax machinegun	1 troop position (600-800 m)	Engage the targets and complete the engagement within 28 seconds.
K	Engage troop targets from a moving tank using the loader's M-240 machinegun.	1 troop position (600-800 m)	Engage the targets and complete the engagement within 28 seconds.

Table 10 (Cont'd)

TABLE IIIB

	Task	Condition Targets/Situation	Performance Standards
A	Engage a stationary target from a stationary tank	1 stationary tank (1500-2000 m)	Complete a 2-round engagement and move to a turret-down position, move to an alternate hull-down position, complete a 2-round engagement and move to a turret-down position within 60 seconds. Tank cannot be exposed for more than 15 seconds.
B	Engage a moving tank from a stationary tank	1 moving tank (1500-2000 m)	Complete a 2-round engagement and move to a turret-down position, move to an alternate hull-down position, repeat the engagement, and move to a turret-down position within 60 seconds. Tank cannot be exposed for more than 15 seconds.
C	Engage multiple stationary targets	1 stationary tank (1500-2000 m) 1 stationary tank (1500-2000 m)	Engage both targets, move to a turret-down position, move to an alternate hull-down position. Repeat engagement, and return to a turret-down position within 60 seconds. Tank is not exposed for more than 15 seconds.
D	Engage a stationary target from a moving tank	1 stationary tank (1500-2000 m)	Engage the target and complete a 2-round engagement within 28 seconds.
E	Engage a moving target from a moving tank	1 moving tank (1500-2000 m)	Engage the target and complete a 2-round engagement within 28 seconds.
F	Engage multiple stationary targets from a moving tank	1 stationary tank (1500-2000 m) 1 stationary tank (1500-2000 m)	Engage the targets and complete a 2-round engagement within 28 seconds.
G	Engage a moving target from a moving tank in degraded mode (LRF and LAS inoperable)	1 moving tank (1500-2000 m)	Engage the target and complete a 2-round engagement within 28 seconds.

Table 11

Crew Drills (Tables IIIA and IIIB) Summary Sheet

Stationary (Day and Night)

Targets: Seven stationary tanks
Three moving tanks

Moving (Day and Night)

Targets: Six stationary tanks
Four moving tanks
Two troop positions

Table 12

Crew Subcaliber Exercise (Degraded Mode) Performance Objectives
(Tables VA and VB)

TABLE VA

	Task	Condition Targets/Situation	Ammo	Performance Standards
A	Employ direct fire (TCs engagement)	1 stationary BRDM (1000-1200 m)	100 rounds (.50 Cal)	Target engaged. Tank returns to turret-down position within 50 seconds. Tank is not exposed for more than 15 seconds.
B	Employ direct fire LAS failure (multiple)	1 stationary tank (1000-1200 m) 1 stationary tank (1000-1200 m) 1 moving tank (1000-1200 m)	6 rounds (subcaliber)	All targets engaged. Tank returns to turret-down position within 50 seconds. Tank is not exposed for more than 15 seconds. No more than 2 targets engaged from primary firing position.
C	Employ direct fire GPS battlesight (multiple) NBC engagement	1 stationary tank (1000-1200 m) 1 stationary tank (1000-1200 m) 1 moving tank (1000-1200 m)	6 rounds (subcaliber)	All targets engaged. Tank returns to turret-down position within 50 seconds. Tank is not exposed for more than 15 seconds. No more than 2 targets engaged from primary firing position.
D	Employ direct fire GAS battlesight (multiple)	1 stationary tank (1000-1200 m) 1 moving tank (1000-1200 m)	4 rounds (subcaliber)	All targets engaged. Tank returns to turret-down position within 50 seconds. Tank is not exposed for more than 15 seconds.
E	Employ direct fire GPS battlesight (Multiple)	1 stationary tank (1000-1200 m) 1 troop position (600-800 m)	2 rounds (subcaliber) 100 rounds (7.62-mm)	All targets engaged. Tank returns to turret-down position within 50 seconds. Tank is not exposed for more than 15 seconds.
F	Employ direct fire emergency mode from a moving tank (multiple)	1 moving tank (1000-1200 m) 1 troop position (600-800 m)	2 rounds (subcaliber) 100 rounds (7.62-mm)	Targets engaged within 30 seconds.
G	Employ direct fire emergency mode from a moving tank (multiple)	1 stationary tank (1000-1200 m) 1 moving tank (1000-1200 m) 1 stationary tank (1000-1200 m)	6 rounds (subcaliber)	Targets engaged within 30 seconds.
H	Employ direct fire GPS battlesight from a moving tank (multiple)	1 stationary tank (800-1000 m) 1 moving tank (1000-1200 m)	4 rounds (subcaliber)	Targets engaged within 30 seconds.
I	Employ direct fire GAS battlesight from a moving tank (multiple)	1 stationary tank (800-1000 m) 1 moving tank (1000-1200 m)	4 rounds (subcaliber)	Targets engaged within 30 seconds.
J	Employ direct fire GAS battlesight from a moving tank (multiple)	1 moving tank (800-1000 m) 1 troop position (600-800 m)	2 rounds (subcaliber) 100 rounds (7.62-mm)	Targets engaged within 30 seconds.
K	Employ direct fire GPS battlesight from a moving tank NBC (multiple)	1 stationary tank (1000-1200 m) 1 stationary tank	6 rounds (subcaliber)	Targets engaged within 30 seconds.

Table 12 (Cont'd)

TABLE VB

	Task	Condition Targets/Situations	Ammo	Performance Standards
A	Employ direct fire TIS LAS failure (multiple)	1 stationary tank (800-1200 m) 1 moving tank	4 rounds (subcaliber)	Targets engaged. Tank moves to a turret-down position within 50 seconds. Tank is not exposed more than 15 seconds.
B	Employ direct fire TIS battlesight (multiple)	1 stationary tank (800-1200 m) 1 stationary tank (1000-1200 m) 1 moving tank (1000-1200 m)	6 rounds (subcaliber)	Targets engaged. Tank moves to a turret-down position within 15 seconds. No more than 2 targets engaged from primary firing position. Tank is not exposed more than 15 seconds.
C	Employ direct fire TIS battlesight (multiple) NBC	1 stationary tank (800-1200 m) 1 stationary tank (1000-1200 m) 1 moving tank (1000-1200 m)	6 rounds (subcaliber)	Targets engaged. Tank moves to a turret-down position within 50 seconds. No more than 2 targets engaged from primary firing position. Tank is not exposed more than 15 seconds.
D	Employ direct fire TIS emergency mode from a moving tank (multiple)	1 stationary tank (800-1200 m) 1 troop position (600-800 m)	2 rounds (subcaliber) 100 rounds (7.62-mm)	Targets engaged within 30 seconds.
E	Employ direct fire TIS emergency mode from a moving tank (multiple)	1 stationary tank (800-1200 m) 1 stationary tank (1000-1200 m) 1 moving tank	6 rounds (subcaliber)	Targets engaged within 30 seconds.
F	Employ direct fire TIS battlesight from a moving tank (multiple)	1 stationary tank (800-1200 m) 1 stationary tank (1000-1200 m) 1 moving tank (1000-1200 m)	6 rounds (subcaliber)	Targets engaged within 30 seconds.
G	Employ direct fire TIS GPS battlesight (multiple) NBC	1 stationary tank (800-1200 m) 1 moving tank (1000-1200 m)	4 rounds (subcaliber)	Targets engaged within 30 seconds.

Table 13

Crew Subcaliber Exercise (Tables VA and VB) Summary Sheet

Stationary (Day and Night)

Targets: One stationary BRDM
11 stationary tanks
Six moving tanks
One troop position

Moving (Day and Night)

Targets: 12 stationary tanks
Eight moving tanks
Three troop positions

AMMUNITION/EXERCISE: (One Repetition)

	.50 cal	7.62-mm	Subcaliber
Stationary (day)	100	100	18
Stationary (night)	0	0	16
Moving (day)	0	200	24
Moving (night)	0	100	18
Total/tank	100	400	76

Table 14

Machinegun Exercise Tasks (Table VI)

TABLE VI

	Task	Target Situation	Ammo
A	Employ direct fire (TCs .50 cal)	1 BTR-50 w/troops (600-1000 m)	100 rounds (.50 cal)
B	Employ direct fire (gunner's coax)	Troops (300-850 m)	100 rounds (7.62-mm)
C	Employ direct fire (simultaneous) TCs .50 cal & gunners coax	Troops (300-850 m) BTR 50 (600-1000 m)	100 rounds (7.62-mm) 100 rounds (.50 cal)
D	Employ direct fire (loader's M240, TC initiated)	Troops (300-600 m)	100 rounds (7.62-mm)
E	Employ direct fire (gunner's coax) moving tank	Troops (300-700 m)	100 rounds (7.62-mm)
F	Employ direct fire (loader's M240, TC initiated) moving tank	Troops (300-500 m)	100 rounds (7.62-mm)
G	Employ direct fire (gunner's coax) moving tank	Troops (300-600 m)	100 rounds (7.62-mm)

Table 15

Machinegun Exercise (Table VI)
Summary Sheet

Stationary

TARGETS: 2 BTR-50s w/troops
24 troop silhouettes

MOVING

TARGETS: 18 troop silhouettes

AMMUNITION/EXERCISE: (1 repetition)

	.50 cal	7.62-mm
Stationary	200	300
Moving	0	300
Total/tank	200	600

Table 16

Practice Crew Qualification Exercise Performance Tasks
(Tables VIIA and VIIB)

TABLE VIIA

	Task	Target Situation	Ammo
A.	Calibration screening exercise	1 No. 59 target (1200 m) 1 No. 60 target (950 m) 1 No. 70 target (1500 m)	3 KE
		.50-cal zero panel (500 m) Coax zero panel (800 m)	50 .50 cal (100 coax)
Note: Fire 1200 m target only if 950/1500 targets are sensed as 1 hit/1 miss.			
B	Employ direct fire (single engagement) stationary tank	1 stationary ZSU 23-4 (2000-2300 m)	2 KE
C	Employ direct fire (simultaneous) stationary tank	1 stationary tank (1600 and 1800 m) 1 BTR 50 w/troops (1000-1200 m)	2 KE 100 .50 cal
D	Employ direct fire (multiple engagement) stationary tank	1 stationary BMP (1300 m) 1 stationary tank (1200 m) 1 moving tank (1300-1400 m)	2 HEAT 3 KE
E	Employ direct fire (multiple engagement) moving tank	2 stationary tanks (1600 and 1800 m)	3 KE
F	Employ direct fire (multiple engagement) moving tank	1 moving tank (1300-1400 m) 1 stationary BMP (1000 m)	2 KE 1 HEAT
G	Employ direct fire (loader's engagement-TC initiated) moving tank	1 troop position (500-800 m)	100 7.62-mm

Table 16 (Cont'd)

TABLE VIIB*

	Task	Target Situation	Ammo
A	Employ direct fire (single engagement) stationary tank	1 stationary tank (1600-1800 m)	2 KE
B	Employ direct fire (multiple engagement) stationary tank	1 moving tank (1300-1400 m) 1 troop position (600-900 m)	2 KE 100 coax
C	Employ direct fire (multiple engagement) stationary tank	1 stationary BMP (1000-1100 m) 1 stationary tank (1600-1700 m) 1 moving tank (1300-1400 m)	2 HEAT 3 KE
D	Employ direct fire (multiple engagement) moving tank	1 stationary tank (1000-1200 m) 1 stationary tank (1500-1600 m)	3 KE
E	Employ direct fire (multiple engagement) moving tank	1 moving tank (1300-1400 m) 1 stationary BMP (1200-1300 m)	2 KE 1 HEAT

*NBC will be fired with entire crew masked and hooked to gas particulates.

Table 17

Practice Crew Qualification Exercise (Tables VIIA and VIIB)
Summary Sheet

Stationary (Day and Night)

TARGETS: 1 stationary ZSU 23-4
1 BTR 50 w/troops
2 stationary BMP
4 stationary tanks
3 moving tanks
1 No. 59 target
1 No. 60 target
1 No. 70 target
3 troop silhouettes

Moving (Day and Night)

TARGETS: 2 stationary BMP
4 stationary tanks
2 moving tanks
6 troop silhouettes

AMMUNITION/EXERCISE: (1 repetition)

	.50 cal	7.62-mm	KE	HEAT
Stationary (day)	150	100	10	2
Stationary (night)	0	100	7	2
Moving (day)	0	100	5	1
Moving (night)	0	0	5	1

Table 18

Crew Qualification Exercise Performance Tasks (Tables VIIIA and VIIIB)

TABLE VIIIA*

	Task	Target Situation	Ammo
A	Employ direct fire (simultaneous) stationary tank	1 stationary tank (1900-2200 m) BTR 50 w/troops (1000-1200 m)	2 KE 1 hundred .50 cal
B	Employ direct fire (multiple engagement) stationary tank	3 stationary tanks (1400-1800 m)	4 KE
C	Employ direct fire (multiple engagement) stationary tank	2 stationary tanks (1000 and 1200 m) 1 moving tank (1300-1400 m)	5 KE
D	Employ direct fire from a moving tank	1 moving tank (1800-2000 m)	2 KE
E	Employ direct fire (multiple engagement) from moving tank	1 stationary tank (1600-1800 m) 1 moving tank (1300-1400 m)	3 KE
F	Employ direct fire (multiple engagement) from moving tank	1 stationary BMP (1200-1300 m) 1 moving tank (1300-1400 m)	2 HEAT 2 KE
G	Employ direct fire (multiple engagement) from moving tank	1 stationary BMP (1000-1200 m) 1 troop position (600-800 m)	1 HEAT 100 coax
H	Employ direct fire (loader's engagement; TC initiated) from moving tank	1 troop position (500-800 m)	1 hundred 7.62-mm

*NBC will be fired with entire crew masked and hooked to gas particulates.

Table 18 (Cont'd)

Table VIIIB*

	Task	Target Situation	Ammo
A	Employ direct fire stationary Tank	1 stationary tank (1800-2000 m)	2 KE
B	Employ direct fire (multiple engagement) stationary tank	3 stationary tanks (1400-1800 m)	4 KE
C	Employ direct fire (multiple engagement) stationary tank	2 stationary BMPs (1200 and 1400 m)	3 HEAT
		1 moving tank (1300-1400 m)	2 KE
D	Employ direct fire from a moving tank	1 moving tank (1400-1600 m)	2 KE
E	Employ direct fire (multiple engagement) from moving tank	1 stationary tank (1600-1800 m)	3 KE
		1 moving tank (1300-1400 m)	
F	Employ direct fire (multiple engagement) from moving tank	1 stationary BMP (1200-1300 m)	1 HEAT
		1 moving tank (1000-1200 m)	2 KE
G	Employ direct fire (multiple engagement) from moving tank	1 stationary BMP (1400-1500 m)	2 HEAT
		1 troop position (600-800 m)	100 coax

Table 19

Crew Qualification Exercise (Tables VIIIA and VIIIB)
Summary Sheet

Stationary (Day and Night)
TARGETS: 1 BTR 50
2 stationary BMPs
10 stationary tanks
2 moving tanks

Moving (Day and Night)
TARGETS: 4 stationary BMPs
2 stationary tanks
6 moving tanks
18 troop silhouettes

AMMUNITION/EXERCISE: (1 repetition)

	.50 cal	7.62-mm	KE	HEAT
Stationary (day)	100	0	11	0
Stationary (night)	0	0	8	3
Moving (day)	0	200	7	3
Moving (night)	0	100	7	3

Table 20

Platoon Qualification Exercise Performance Objectives
(Tables IXA and IXB, Scenario 1)

TABLE IXA (SCENARIO 1)

	Task	Condition Targets/Situation	Standards
A	Occupy battle position		Within 30 minutes platoon: a. Occupied turret-down primary position b. Selected at least 1 alternate position per tank c. Prepared a platoon fire plan covering all troops, sectors, etc.
B	Employ direct fire (platoon multiple engagement)	3 BMPs (1200-1500 m) 2 stationary tanks (1800-2300 m)	1. Within 40 seconds employed direct fire from primary or alternate positions. 2. Satisfactory subjective evaluation of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.
C	Employ direct fire	2 moving tanks (1000 and 1600 m) 1 stationary tank (1400 m)	1. Within 40 seconds employed direct fire from primary or alternate positions. 2. Satisfactory subjective evaluation of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.
D	Move to subsequent battle position	Company Commander orders movement to subsequent battle position.	1. Platoon displaced to subsequent battle position over previously selected covered and concealed routes and occupied battle positions. 2. Used indirect and other fire during displacement. 3. Satisfactory subjective evaluation of: a. Maintain command and control b. Movement techniques and use of terrain c. Control of fires.
E	Employ direct fire (platoon multiple engagement)	6 stationary tanks (four tanks at 1000-1200 m; 2 tanks at 1300-1400 m)	1. Within 40 seconds employed direct fire from primary or alternate fire positions. 2. Satisfactory subjective evaluation of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.

Table 20 (Cont'd)

TABLE IXA (SCENARIO 1)

	Task	Condition Targets/Situation	Standards
F	Move to subsequent battle position	Company commander orders movement to subsequent battle positions.	1. Platoon displaced to subsequent position over previously selected covered and concealed routes and occupied battle position. 2. Used indirect and other fire during displacement. 3. Satisfactory subjective evaluation of: a. Maintain command and control b. Movement techniques and use of terrain c. Control of fires.
G	Employ direct fire (platoon multiple engagement)	2 stationary tanks (800 and 1200 m) 2 BTR-50s w/troops (1000-1200 m)	1. Within 40 seconds employed direct fire from primary or alternate fire positions. 2. Satisfactory subjective evaluation of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.
H	Conduct counter-attack	Company commander orders platoon to counterattack	Satisfactory subjective evaluation of: a. Maintain command and control b. Movement techniques and use of terrain c. Control of fires.
I	Employ direct fire from a moving tank (platoon multiple engagement)	4 stationary tanks (2 tanks at 1200-1400 m; 2 tanks at 1600-1800 m)	1. Within 25 seconds employed direct fire on targets presented. 2. Satisfactory subjective evaluation of: a. Maintain command and control b. Movement techniques and use of terrain c. Reports d. Use of indirect and other fires e. Control of fires.
J	Employ direct fire from a moving tank (platoon multiple engagement)	4 stationary tanks (2 tanks at 1000-1200 m; 2 tanks at 1200-1400 m)	1. Within 25 seconds employed direct fire on targets presented. 2. Satisfactory subjective evaluation of: a. Control of fires b. Maintain command and control c. Movement techniques and use of terrain d. Reports e. Use of indirect and other fires.

Table 20 (Cont'd)

TABLE IXA (SCENARIO 1)

	Task	Condition Targets/Situation	Standards
K	Employ direct fire from a moving tank (platoon multiple engagement)	4 ATGM teams (600-900 m)	1. Within 25 seconds employed direct fire on targets presented. 2. Satisfatory subjective evaluation of: a. Control of fires b. Maintain command and control c. Movement techniques and use of terrain d. Reports e. Use of indirect and other fires.

TABLE IXB (SCENARIO 1)

	Task	Condition Targets/Situation	Standards
A	Occupy battle position		Within 30 minutes platoon: a. Occupied hull-down primary position b. Selected at least 1 alternate position per tank c. Prepared a platoon fire plan covering all troops, sectors, etc.
B	Employ direct fire (platoon multiple engagement)	3 BMPs (1400-1600 m)	1. Within 40 seconds employed direct fire from primary or alternate positions. 2. Satisfactory subjective evaluations of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.
C	Employ direct fire (platoon multiple engagement)	2 moving tanks (1000-1600 m) 2 stationary tanks (1400-1600 m)	1. Within 40 seconds employed direct fire from primary or alternate position. 2. Satisfactory subjective evaluation of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.
D	Move to subsequent battle position	Company commander orders movement to subsequent battle position	1. Platoon displaced to subsequent position over previously selected covered and concealed routes and occupied battle position. 2. Used indirect and other fire during displacement. 3. Satisfactory subjective evaluation of: a. Maintain command and control b. Movement techniques and use of terrain c. Control of fires.

Table 20 (Cont'd)

TABLE IXB (SCENARIO 1)

	Task	Condition Targets/Situation	Standards
E	Employ direct fire (platoon multiple engagement)	4 stationary tanks (2 tanks at 1000-1200 m; 2 tanks at 1200-1400 m)	1. Within 40 seconds employed direct fire from primary or alternate positions. 2. Satisfactory subjective evaluation of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.
F	Move to subsequent battle position	Company commander orders movement to subsequent battle position	1. Platoon displaced to subsequent position over previously selected covered and concealed routes and occupied battle position. 2. Used indirect and other fire during displacement. 3. Satisfactory subjective evaluation of: a. Maintain command and control b. Movement techniques and use of terrain c. Control of fires.
G	Employ direct fire (platoon multiple engagement)	4 stationary tanks (2 tanks at 800-1000 m; 2 tanks at 1000-1200 m)	1. Within 40 seconds employed direct fire from primary or alternate positions. 2. Satisfactory subjective evaluation of: a. Control of fires b. Movement techniques c. Reports d. Use of indirect and other fires.
H	Conduct counter-attack	Company commander orders platoon to counterattack	Satisfactory subjective evaluation of: a. Maintain command and control b. Movement techniques and use of terrain c. Control of fires.
I	Employ direct fire from a moving tank (platoon multiple engagement)	4 stationary tanks (2 tanks at 1200-1400 m; 2 tanks at 1200-1400 m)	1. Within 25 seconds employed direct fire on targets presented. 2. Satisfactory subjective evaluation of: a. Control of fires b. Maintain command and control c. Movement techniques d. Reports e. Use of indirect and other fires.

Table 20 (cont'd)

TABLE IXB (SCENARIO 1)

	Task	Condition Targets/Situation	Standards
J	Employ direct fire from a moving tank (platoon multiple engagement)	4 stationary tanks (2 tanks at 1400-1600 m; 2 tanks at 1600-1800 m)	1. Within 25 seconds employed direct fire on targets presented. 2. Satisfactory subjective evaluation of: a. Control of fires b. Maintain command and control c. Movement techniques d. Reports e. Use of indirect and other fires.
K	Employ direct fire from a moving tank (platoon multiple engagement	4 ATGM teams (600-800 m)	1. Within 25 seconds employed direct fire on targets presented. 2. Satisfactory subjective evaluation of: a. Control of fires b. Maintain command and control c. Movement techniques d. Reports e. Use of indirect and other fires.

Qualified Platoon: Hits 35 of 50 main gun targets.
Hits 7 of 10 machinegun targets.
Receives a YES on 75 of 107 control areas.

Unqualified Platoon: 34 or fewer main gun target hits.
6 or fewer machinegun target hits.
Receives a YES on 74 or fewer control areas.

Table 21

Platoon Qualification Exercise Performance Objectives (Tables IXA and IXB, Scenario 2)

TABLE IXA (SCENARIO 2)

	Task	Condition Targets/Situation	Standards
A	Initial battle position		Within 30 minutes after movement begins, platoon: 1. Occupied turret-down primary position 2. Selected at least one alternate position tank 3. Prepared a platoon fire plan covering all troops, sectors, etc.
B	Employ direct fire (platoon multiple stationary engagement)	6 stationary tanks (2 at 1200-1500 m; 2 at 1400-1600 m; 2 at 1600-1800 m) 1 moving tank (1000-1200 m) 1 stationary tank (1200-1300 m)	1. Within 40 seconds employed direct fire from primary or alternate positions. 2. Satisfactory subjective evaluations of: a. Maintain command and control b. Correct use of firing positions c. Reports d. Use of indirect and other fires.
C	Conduct counter-attack	Company commander orders platoon to conduct counter-attack to seize a portion of the company team's objective	Satisfactory accomplishment (subjective) of: 1. Maintain command and control 2. Movement techniques and use of terrain 3. Reports 4. Use of indirect and other fires.
D	Employ direct fire (platoon multiple moving engagement)	5 stationary tanks (3 at 1200-1400 m; 2 at 800-900 m) 2 moving tanks (1200 and 1400 m)	1. Within 40 seconds employed direct fire on targets presented. 2. Satisfactory accomplishments (subjective) of: a. Maintain command and control b. Movement techniques and use of terrain c. Reports d. Use of indirect and other fires.
E	Assault, employ direct fires (platoon multiple moving engagement)	4 stationary tanks (2 at 1000-1200 m; 2 at 1600-1800 m) 1 stationary tank (1000-1200 m) 2 ATGM teams	1. Within 40 seconds employed direct fire on targets presented 2. Satisfactory accomplishment (subjective) of: a. Maintain command and control b. Movement techniques and use of terrain c. Reports d. Use of indirect and other fires.

TABLE IXA (SCENARIO 2)

	Task	Condition Targets/Situation	Standards
F	Assault, employ direct fire (platoon multiple stationary engagement) 2 ATGM teams	4 stationary tanks (2 at 1200-1400 m; 2 at 1400-1600 m) 1 stationary tank (1300-1400 m) 2 BTR 50s (600-900 m) (600-900 m) Targets are arrayed near or on the objectives	1. Within 40 seconds employed direct fire on targets presented. 2. Satisfactory accomplishment (subjective) of: a. Maintain command and control b. Movement techniques and use of terrain c. Reports d. Use of indirect and other fires.
G	Occupy hasty defensive positions on the objective	Platoon move onto the objective	Satisfactory accomplishment (subjective) of: 1. Maintain command and control 2. Movement techniques and use of terrain 3. Reports 4. Occupation of defensive position 5. Reorganization and consolidation procedures.

TABLE IXB (SCENARIO 2)

	Task	Condition Targets/Situation	Standards
A	Occupy initial battle position		Within 30 minutes after movement begins, platoon: 1. Occupied hull-down primary positions. 2. Selected at least one alternate position per tank. 3. Prepared a platoon fire plan covering all troops, sectors, etc.
B	Employ direct fire (platoon multiple stationary engagement)	6 stationary tanks (2 at 1200-1400 m; 2 at 1400-1600 m; 2 at 1600-1800 m) 1 moving tank (1000-1200 m) 1 stationary tank (1200-1300 m)	1. Within 40 seconds employed direct fire from primary or alternate position. 2. Satisfactory accomplishment (subjective) of: a. Maintain command and control b. Correct use of firing positions c. Reports d. Use of indirect and other fires.
C	Conduct counter-attack	Company commander orders platoon to conduct attack to seize a portion of a company team objective	Satisfactory accomplishment (subjective) of: 1. Maintain command and control 2. Movement techniques and use of terrain 3. Reports 4. Use of indirect and other fires.

TABLE IXB (SCENARIO 2)

	Task	Condition Targets/Situation	Standards
D	Employ direct fire (platoon multiple moving engagement)	5 stationary tanks (3 at 1200-1400 m; 2 at 800-900 m) 2 moving tanks (1200 and 1400 m)	1. Within 40 seconds employed direct fire on targets presented. 2. Satisfactory accomplishment (subjective) of: a. Maintain command and control b. Movement techniques and use of terrain c. Reports d. Use of indirect and other fires.
E	Assault, employ direct fire (platoon multiple moving engagement)	4 stationary tanks (2 at 1000-1200 m; 2 at 1600-1800 m) 1 stationary BMP (1000-1200 m) 2 ATGM Teams	1. Within 40 seconds employed direct fire on targets presented. 2. Satisfactory accomplishment (subjective) of: a. Maintain command and control b. Movement techniques and use of terrain c. Reports d. Use of indirect and other fires.
F	Assault, employ direct fire (platoon multiple stationary engagement)	4 stationary tanks (2 at 1200-1400 m; 2 at 1400-1600 m) 1 stationary tank (1300-1400 m) 2 ATGM teams (600-900 m) Targets are arrayed near or on the objective	1. Within 40 seconds employed direct fire on the targets presented. 2. Satisfactory accomplishment (subjective) of: a. Maintain command and control b. Movement techniques and use of terrain c. Reports d. Use of indirect and other fires.
G	Occupy hasty position on the objective	Platoon moves onto objectives	Satisfactory accomplishment (subjective) of: 1. Maintain command and control 2. Movement techniques and use of terrain 3. Reports 4. Occupation of defensive position 5. Reorganization and consolidation procedures.

Qualified Platoon: Hits 35 of 50 main gun targets.
Hits 7 of 10 machinegun targets.
Receives a YES on 44 of 63 control areas.

Disqualified Platoon: 34 or fewer main gun target hits.
6 or fewer machinegun target hits.
Received a YES on 43 or less control areas.

Table 22

Platoon Qualification Exercise (Tables IXA and IXB)
Summary Sheet

Scenario 1 (Day and Night)

TARGETS: 6 stationary BMPs
37 stationary tanks
4 moving tanks
2 BTR-50s
32 troop silhouettes (8 ATGM teams)

Scenario 2 (Day and Night)

TARGETS: 1 stationary BMP
43 stationary tanks
6 moving tanks
32 troop silhouettes (8 ATGM teams)
2 BTR-50s

Table 23

Facilities Typical for M-1 Tank Training Ranges

Facility	Units
Land Areas	
Firing line	*
Maneuver area	*
Target area	*
Surface danger area	*
Parking assembly area	*
Misfire area/bunker	*
Structures	
Ammo pad	30 x 60 ft
Tower	*
Personnel/storage building	30 x 30 ft
Mess	*
Latrine	200 sq ft (separate for M&F)
Bleacher	30-person
Lane markers	*
Fan markers	*
Targets	
Emplacements (for pop-up)	*
Emplacements (for moving)	*
Earthwork	
Berms	*
Utilities	
Telephone lines between tower and personnel building	*

*To be determined locally

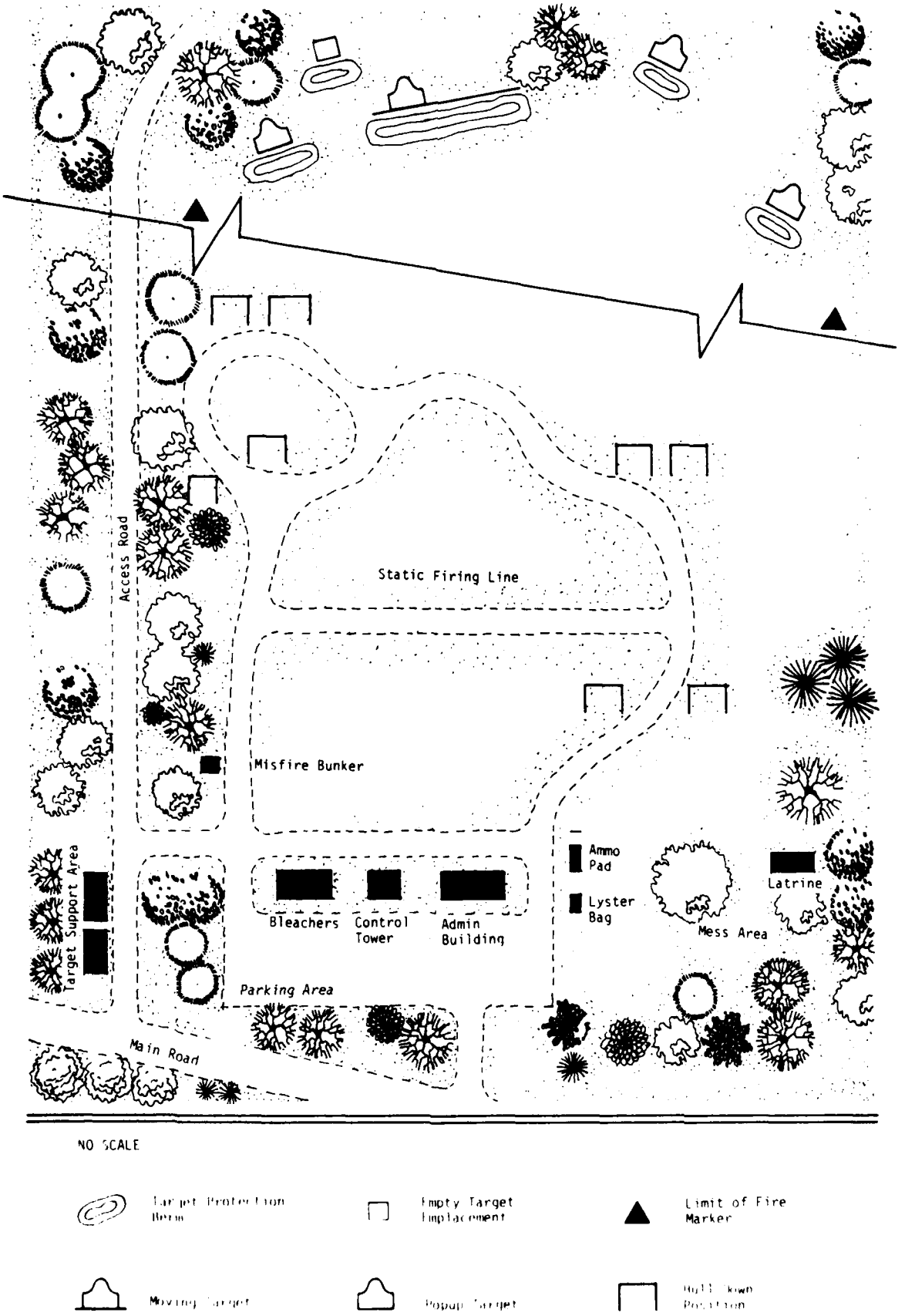


Figure 10. Typical layout for an M-1 Tank Training Range.

Table 24

Detailed Facility Data for M-1 Tank Training Ranges

LAND USE/LAND AREAS

General

Requirement

THE EXERCISES AND RANGE CONFIGURATIONS MUST MAXIMIZE THE M-1 TANK'S CAPABILITY FOR FIRING ON THE MOVE AND ENGAGING MOVING TARGETS

Guidance

1. Installation commanders and their staffs must use all their imagination, resourcefulness, and ingenuity in planning and establishing their gunnery ranges so that crews will receive maximum benefit from challenging training. Enhanced vehicle capability, such as firing infantry and armor vehicles on the move at high speeds, day or night, bring new dimensions to the training arena. The key task is fitting the required range requirements to existing terrain, while taking advantage of all available natural target sighting potential and ensuring enough attention is given to increased logistical support.

2. The actual placement of a particular range or a particular target array will be an installation planning task, taking into consideration the constraints of available real estate.

Requirement

CONSIDERATION MUST BE GIVEN TO PROVIDING A COMBINED ARMS ENVIRONMENT IN WHICH ALL WEAPON SYSTEMS ARE EMPLOYED

Guidance

To increase range use and to ensure efficient use of installation land, the same range must be the site of different training activities for a single weapon, for different weapon systems, and for concurrent firing of different weapons.

Requirement

RANGES SHOULD BE STRUCTURED TO PROVIDE SUFFICIENT AREA FOR REALISTIC COMBAT-ORIENTED GUNNERY TRAINING, WHETHER OFFENSIVE OR DEFENSIVE

Criteria

See this chapter for target layouts and surface danger areas for each exercise.

Requirement

MAXIMUM USE OF AVAILABLE SPACE MUST BE MADE, PARTICULARLY IN LIGHT OF LASER RANGEFINDER REQUIREMENTS

Guidance

At Fort Bliss during XM1 OT-II, 9 km were used for the platoon battleruns. This will not be possible at most other installations.

Requirement

RANGES MUST BE SIZED (CAPACITY OF LANES, MANEUVER AREAS, FIRING LINES, ETC.) TO ACCOMMODATE THE NUMBER OF TANK CREWS TO BE TRAINED

Guidance

Exercises are operated for either individual crew training or for a platoon. Although there are variations by exercise, it is estimated that an individual tank crew can complete the tasks in an exercise in about 15 minutes. For those exercises involving an entire platoon, a typical completion time is about 60 minutes. This does not include preparation and debriefing activities that would occur outside of the firing area before and after the task sequence.

Table 24 (Cont'd)

Firing Line

Requirement

A FIRING LINE IS NEEDED FOR SOME STATIONARY TASKS

Misfire Area

Requirement

A MISFIRE AREA IS NEEDED TO REMOVE ROUNDS THAT DID NOT FIRE OR JAMMED

Guidance

An area outside but near the exit to the maneuver area or training course is preferred.

120-mm Tank Gun

Requirement

RANGES SHOULD BE PLANNED TO ACCOMMODATE A 120-mm MAIN GUN

Guidance

Safety standards have not been developed for surface danger area dimensions for ranges which will be used by the M-1 Tank equipped with the 120-mm tank gun. Current "best guess" estimates indicate that the distance X for the 120-mm projectile will approximate that of the 105-mm M735 round (see AR 385-63). Ricochet and dispersion dimensions and angles are also expected to remain approximately the same as for the M735 series of ammunition.

Firing Points/Defilade Positions/Trails

Requirement

THE RANGE SHOULD TAKE INTO ACCOUNT COMBAT DOCTRINE

Guidance

Wherever possible, terrain features should be used or defilade positions created to allow tanks to acquire targets, fire, and hide in accordance with armor doctrine. For example, positions should be provided in pairs so that crews can routinely change locations in the target acquisition-fire-hide sequence.

TARGETS

(See Chapter 5)

STRUCTURES

Ammo Pad

Requirement

A PAD IS NEEDED WHERE AMMUNITION CAN BE STORED AND LOADED ON A VEHICLE BEFORE IT ENTERS THE TRAINING COURSE

Criteria

Size: 30 x 60 ft

Material: Concrete (to prevent dirt from getting on ammunition)

Location: In view of tower; near firing line and entry to maneuver area

Table 24 (Cont'd)

Tower

Requirement

A CONTROL TOWER IS NEEDED TO OBSERVE AND CONTROL RANGE ACTIVITIES

Criteria

Height: Should be able to see target area, maneuver area, firing line, and ammo pad.

Size: 10 x 10 ft

View: 270° clear view toward range

Communication: Telephone to personnel buildings; radios to range

Personnel/Storage Building

Requirement

A BUILDING IS NEEDED FOR RANGE PERSONNEL AND TO STORE EQUIPMENT, SPARE PARTS, AND TOOLS

Criteria

Size: 30 x 30 ft (800 to 1000 sq ft)

Security: Lockable

Mess

Requirement

MESS FACILITIES ARE NEEDED FOR TROOPS

Guidance

The type of structure, degree of enclosure, and furnishings depend on local climate, food system, and other factors.

Latrine

Requirement

A LATRINE IS NEEDED AT THE RANGE FOR TROOPS AND STAFF

Guidance

Separate washrooms are needed for males and females. Typically, male facilities are sized for urinals for three to six persons and toilets for three or four. Female facilities typically have one or two toilets.

Bleacher

Requirement

A BLEACHER IS NEEDED TO BRIEF AND DEBRIEF TRAINEES

Criteria

Size: Seating for 30 persons

Location: Behind and to the side of control tower

Table 24 (Cont'd)

Lane Markers

Requirement

LANE MARKERS ARE NEEDED TO DEFINE FIRING POINTS

Guidance

Standard signage includes:

- start point
- cease fire

Target Storage Shed, Battery Charging Room, PLL/Supply Room, Battery Storage Area

(See Chapter 5)

MISCELLANEOUS

Range Markers

Requirement

1. THE COMBAT VEHICLE CREW MEMBER VIEWING TO HIS FRONT BEFORE NEGOTIATING A FIRING EXERCISE SHOULD NOT BE ABLE TO OBSERVE ANY PHYSICAL CONTROL MEASURES WITH THE EXCEPTION OF FIRING-LIMIT MARKERS

2. MARKERS ARE NEEDED TO DEFINE SIDE LIMITS FOR FIRING

Guidance

Markers must be clearly visible by standard illumination or daylight and by thermal imaging at the same time.

7 FIGHTING VEHICLE SYSTEMS DATA: INFANTRY FIGHTING VEHICLE (IFV) AND CAVALRY FIGHTING VEHICLE (CFV)

Weapon/Training Data

Table 25 lists pertinent characteristics for the Fighting Vehicle Systems (IFV/CFV).

Fighting Vehicle (FV) Gunnery Program

The FV gunnery qualification program develops and tests squad/crew and section/platoon proficiency in gunnery techniques used to destroy all types of targets under realistic (simulated) battlefield conditions, day or night, in all weather conditions. The FV gunnery exercises are designed to be as realistic as possible, within the constraints of a training environment. The program's training exercises use single and multiple targets. Depending on unit time constraints or available ammunition, it may be necessary to modify the number of exercises fired or their content (i.e., number of engagements). Any modification should have standards which are no less demanding than those of the exercise it replaces. All modifications should be temporary. In no case will standards be lowered.

Unit commanders must work continuously with installation or regional range authorities to modify and improve gunnery ranges so that the prescribed gunnery programs can be conducted, day or night. When rain, fog, snow, or other adverse atmospheric conditions reduce visibility, range firing must continue, since combat would continue under similar weather conditions.

The FV firing exercises are designed to qualify an FV-equipped section/platoon in gunnery skills against realistic targets, to maximize the effectiveness of the FV weapon system, and to progress from subcaliber to full caliber and from squad/crew to section/platoon.

IFV/CFV training activities fall into four groups:

1. Squad/Crew Subcaliber Exercise
2. Vehicle Team/Crew Combat Exercise
3. Squad Combat Qualification Exercise (IFV only)
4. Platoon/Section Qualification Exercise.

These exercises are described in detail later in this chapter.

Within each exercise, section will refer to a cavalry squad of two CFVs. Squad will refer to an infantry squad of one IFV. Crew will refer to one CFV. Platoon is an infantry platoon of four IFVs.

Training Schedule

Units equipped with FVs are to conduct live-fire exercises four times annually: qualification (once), sustainment (twice), ARTEP (once). Before live-fire exercises, training activities and drills are dry fired. Table 26 summarizes this annual gunnery training program.

Targets

Targets used in FV gunnery exercises fall into three general categories: the pop-up personnel target (M31A1), the STATS, and the vertical rail, electrically powered moving vehicle targets. While the M31A1 and STATS target systems are "type-classified" systems, no commercially manufactured or Army-developed moving vehicle target system has yet been type-classified for use on the Army's training ranges. In the absence of a type-classified system, installations should use the target performance standards given in Chapter 5. Local installations may also need to use either hard targets (vehicle hulls, etc.) or locally made target systems. The need fr alternative target systems is determined on an installation-by-installation basis. Also, in all FV gunnery exercises, thermal targets must be used which represent the thermal signature of threat vehicles (see Chapter 5).

Target arrays are based on a representative threat force, such as segments of a motorized rifle regiment. The type and number of threat vehicles is based on the threat that an FV-equipped unit could be expected to oppose. Only a portion of this force will be visible at extended ranges, others will be masked by terrain. Visible portions are indicated on the scorecards as targets to be engaged. Enemy tanks that an FV-equipped unit could be expected to oppose are reflected on the scorecards, but they will be limited in number since other weapon systems' fires will strip most tanks from the attacking/defending force.

Ammunition Requirements

Several types of ammunition are required for FV systems to conduct the FV program's specified training exercises. The type of ammunition used in these exercises directly affects the amount of land needed to conduct the exercises safely. Ammunition types are listed in the following paragraphs and their related safety fans or surface danger areas are published in AR 385-63 and FM 71-999A (Draft).

1. 25-mm Armor-Piercing Discarding Sabot (APDS). The 25-mm APDS is the FV's fastest, most-accurate, and most-effective conventional round. It will penetrate any lightly armored personnel carrier on the battlefield. Its subprojectile is a solid, heavy mass-penetrator, propelled at extremely high velocities. The muzzle velocity of the round is 1345 m/s as the round leaves the gun muzzle.

WARNING: The APDS round must not be fired over the heads of friendly troops. The discarding parts of this round are dangerous to unprotected troops for up to 175 m from the muzzle, and for as much as 10^{o} to either side of the line of fire at that range.

2. 25-mm High Explosive, Incendiary Tracer (HE-IT). The HE-IT round is used to engage area targets. The round detonates upon impact and breaks into smaller pieces of white-hot material causing casualties and starting fires in wheeled and unarmored vehicles. The burning particles will penetrate fuel tanks, ammo cans, etc., on and in these vehicles.

The HE-IT round has a muzzle velocity of 1100 m/s. It is much less accurate than the APDS round.

3. 25-mm Target Practice Tracer (TP-T). The TP-T round is used instead of service ammunition in training to engage targets. The round is inert and will not produce duds. It has the same muzzle velocity as an HE-IT and may be used as a substitute for HE-IT or APDS-T. However, it is less accurate than HE-IT and APDS-T.

4. TOW Missile. The TOW missile is classified service or target practice. The service missile has a HEAT (high-explosive antitank) warhead and is encased in a launch container, which is loaded in the luncher as a complete unit. The TOW missile's primary use is to destroy tanks and heavily armored vehicles.

5. 7.62-mm Coax Ammunition. The 7.62-mm coaxial machinegun fires standard NATO-belted ammunition normally linked in the ratio of four nontracer rounds to one tracer round. Tracer rounds enable the gunner to adjust his line of fire visually. Machinegun ammunition may be armor piercing, armor-piercing incendiary, armor-piercing incendiary tracer, tracer, ball, blank, or dummy.

6. 5.56-mm Firing Port Weapon Ammunition. The 5.56-mm firing port weapons on the IFV fire standard 5.56-mm NATO ammunition from 30-round magazines. Ammunition may be ball, tracer, blank, or dummy. The normal load, though, will be all tracer.

7. Smoke Grenades. The FV uses two smoke grenade launchers, each with four smoke grenades. All eight grenades are fired at once. The smoke grenades used in the smoke grenade launchers are red phosphorus grenades. This compound produces a rapid smoke screen.

Tables 27 and 28 list the training ammunition needed to support the annual IFV and CFV gunnery program.

Range Personnel

Presently, it takes more training unit personnel to set up and take down targets than the automated target control system will require. Some personnel are expected to be assigned to the range by the installation. These would most likely include a range officer, a range safety officer, technicians, and target detail supervisors.

An estimate of the personnel needed to support IFV/CFV gunnery exercises is listed with each exercise. Additional data about range personnel can be found in Special Text 25-2-1, IFV/CFV Live-Fire Ranges.

Surface Danger Area

The surface danger areas needed to conduct the required training safely depend on the ammunition used in the training exercise. Standard surface danger areas for ammunition used in IFV/CFV gunnery exercises are published in AR 385-63.

Squad/Crew Subcaliber Exercise

Subcaliber exercises teach the FV squad/crew to engage multiple stationary and moving targets from a stationary and moving FV while exercising full squad/crew interaction. They also provide a means to sharpen skills when fired quarterly. The range scale for firing the subcaliber exercises is a 1:1 scale with full-scale targets only. The coax machinegun is substituted for the 25-mm gun to simulate full caliber firing. Full-scale targets at a 1:1 scale range will be used for targets out to 900 m actual range. This range is limited to 900 m because of the 7.62-mm tracer burnout.

Dry-run subcaliber precedes actual subcaliber firing exercises. Each squad/crew should fire the exercises from their assigned FV. Crews should be proficient in all dry-run exercises before firing full-caliber exercises.

The subcaliber exercise emphasizes (1) multiple targets, (2) moving targets, and (3) the number of repetitions necessary for FV squads/crews to consistently achieve stated standards (based on threat antiarmor capabilities).

Limited access to adequate full-caliber ranges does not mean that gunnery standards can be met using full-caliber firing alone. Units must use supplementary training techniques as an alternative to full-caliber firing to achieve the required training standards.

Squads/crews are taught to engage targets using standard gunnery procedures and battlesight procedures under limited visibility, and in a nuclear/biological/chemical (NBC) environment. As a minimum, exercises are fired under the following conditions:

1. Using integrated sight (daylight mode)
2. Using integrated sight (thermal mode--day and night)
3. Battlesight and precision techniques
4. Wearing protective masks

Stationary Exercise

During an FV squad/crew stationary subcaliber exercise, the crew occupies a firing position from which it must engage an attacking threat target array. The exercise may be dry-fired and subcaliber fired by as many FVs as the target arrays and range facilities will permit. Exercises are fired at least three times during daylight (integrated sight--day mode, protective mask) and twice during limited visibility (integrated sight--thermal mode) by the dedicated crew. Crews are debriefed and then they refire identified weak

areas. For stationary CFV exercises only, each crewmember (TC, driver, and scouts for CFV only) then fires one repetition day/night as a gunner. Table 29 lists the tasks and performance standards for the stationary subcaliber exercise.

The personnel detailed from the training units to support the installation range officer, range safety NCO, and others assigned to the range are:

Three control officers

One assistant instructor per vehicle on line

Four target array operators

Two target detail NCOs

Two target details (four enlisted personnel plus two persons for each additional increment of 15 targets over 30)

The training unit must also supply one 5-ton truck to support this training exercise.

Moving Exercise

As part of a scout squad or infantry platoon (simulated), the FV crew conducts a movement to contact during which it engages several surprise targets. At the conclusion of the last task, the FV crew is debriefed. Task repetitions for the moving phase are the same as the stationary phase. Table 30 lists the tasks and performance standards for the moving exercise.

Personnel detailed from the unit include:

Three control officers

One assistant instructor per firing vehicle

Two target detail NCOs

Four target details (four enlisted personnel plus two persons for each additional increment of 15 targets over 30)

One scorer (NCO) per firing vehicle

Four vehicle drivers (1/4-ton and 5-ton)

The support unit must also supply one 2-1/2- or 5-ton truck and one 1/4-ton truck.

Table 31 summarizes the target and ammunition requirements for the Squad/Crew Subcaliber Exercise. Figures 11 and 12 show the suggested target array for the same exercise. To help range planners, a conceptualized range layout for the Squad/Crew Subcaliber Exercise is shown in Figure 13. This layout can be modified to meet local site conditions.

Vehicle Team/Crew Combat Exercise

This exercise develops skills in the rapid engagement and destruction of single, multiple area, and moving-type targets from both a stationary and a moving FV during both daylight and limited visibility conditions. Performance objectives, performed by the IFV vehicle team (TC, gunner, driver) and CFV crew, are injected with "dirty battlefield" conditions: threat/friendly artillery, NBC, and threat/friendly smoke.

Before firing the full-caliber exercise, work areas should be corrected with additional dry runs. Each IFV team/crew will fire one day and one night stationary and moving practice full-caliber iteration. As a minimum, alternate target positions for each task in the exercise must be used when firing the practice and record iterations so the IFV team/crew does not become too familiar with target locations and sequencing. If possible, a separate range with similar sequencing should be used for the practice and record iterations.

This is the first full-caliber, live-fire exercise. It follows the squad/crew subcaliber exercise. The exercise is briefed to the crew in the context of a tactical scenario. Initially, the FV crew occupies a firing position as part of a platoon covering force (simulated) from which it must engage an attacking threat array. The FV crew is then ordered to conduct a reconnaissance or movement to contact as part of a platoon (simulated), where it has to face several surprise targets. A road march is then conducted away from the surface danger area to an assembly area where the crew is debriefed.

The Vehicle Team/Crew Combat Exercise has a stationary and a moving phase. The exercise emphasizes fast-moving operations. To properly control and score the exercise, the control officer, scorer, and target operator must move behind or to the side of the firing vehicle, preferably in an FV. Because the FV travels more easily cross-country than a 1/4-ton truck, the control vehicle should use existing trails to insure that the control officer is positioned well enough to control the firing FV effectively. The control officer and scorer both need on-board thermal imagery viewing devices during periods of limited visibility. Additional viewing devices may be used to let observers and sensors strategically located behind the initial firing position see the entire course.

Table 32 lists the stationary tasks and performance standards for this exercise. Table 33 lists the exercise's moving tasks and performance standards.

One control officer, one scorer/observer, one target array operator, and one FV driver are needed to support this exercise. For continuous operations, the following personnel, detailed from the training unit, are needed:

Three control officers (one per 8-hour shift)

Three target array operators (one per 8-hour shift)

Three NCO observer scorers (one per 8-hour shift)

Two target detail NCOs

Two target details (four enlisted personnel plus two persons for each additional increment of 15 targets over 30)

Two vehicle drivers (one for the FV and one for the 5-ton or 2-1/2-ton truck).

The unit must also provide one truck (5-ton or 2-1/2-ton) to help with target emplacement and an FV for the control officer, scorer, and target operator.

Table 34 summarizes the target and ammunition requirements for this exercise. Figures 14 and 15 show the exercise's suggested target array. To help range planners, Figure 16 shows a conceptualized range layout for this exercise.

Squad Combat Qualifications Exercise (IFV Only)

This exercise is IFV-squad specific. The objective is to teach rapid engagement and destruction of single, multiple, area, and moving-type targets from both a stationary and a moving FV. All weapons are fired mounted. The weapons include the 25-mm automatic gun, the TOW launcher, coax machinegun, and port weapons. Dismounted infantry operations are conducted with live-fire organic weapons (M60 machineguns, M203s, and M16 rifles). Mounted and dismounted operations are conducted during daylight and in limited visibility conditions. Dirty battlefield conditions are injected in the performance objectives. This exercise is fired full-caliber only.

The exercise is briefed to the squad in the context of a tactical scenario. The squad must successfully complete four performance objectives: movement to contact, dismounted attack, hasty defense, and a move to a subsequent battle position. The entire squad is evaluated and all squad weapons are employed.

Tables 35 through 38 list the training tasks for each of the exercise's four performance objectives.

Neither personnel nor vehicles needed to support this exercise have been determined.

Table 39 summarizes the target and ammunition requirements for this exercise, and Figure 17 shows a suggested target array. To help range planners, Figure 18 shows a conceptualized range layout.

Platoon/Section Qualification Exercise

This exercise is organized into the Infantry Platoon Qualification Exercise for the IFV-equipped units and the Scout Squad Qualification Exercise for CFV-equipped units. Both exercises are conducted in an offensive and defensive scenario and fall under the general heading of the Section/Platoon Qualification Exercise. Both exercises may be conducted on the same range. However, tasks and performance standards are different. Alternate target

locations must be used when firing the practice battleruns so crews do not become too familiar with target locations and sequencing.

These exercises teach leadership, control and distribution of fire, fire and movement teamwork, and most important, accurate employment of direct fire against threat target arrays which outnumber friendly elements in "dirty battlefield" environments during day and night offensive and defensive battleruns.

Before firing the course with full-caliber ammunition, the FV unit will dry run the exercises. Weak areas should be corrected with additional dry runs before full-caliber firing.

The Platoon/Section Qualification Exercise is a fast-paced exercise using many targets in a short period of time. Control, scoring, and safety personnel must keep pace with the firing platoon/section at all times. This means the control FVs must be on the range's roads and trails. The control officer, target operator, and scorer move in one FV behind the center of the platoon/section, while two other FVs, each manned by one safety NCO and a scorer, move along the flanks of the firing platoon/section. The safety officer, in a separate vehicle, moves behind the center of the platoon/section. Thermal viewing devices are required for all control, safety, and scoring personnel during periods of limited visibility.

During the defensive battlerun, the scout squad or infantry platoon, while conducting combat operations, engages elements of a threat motorized rifle battalion array as it appears in the platoon sector. The unit engages and wears down the threat force until the platoon leader orders the unit to move to its subsequent battle position. The unit continues to service targets from the platoon's subsequent battle position. NBC protective measures and smoke are integrated into the defensive battlerun.

During the offensive battlerun, the unit is conducting a movement to contact. During movement (30 kph), the unit takes action to engage threat security and main defensive-belt elements. All targets are engaged on the move.

One control officer, two safety NCOs, three scorers, three FV drivers, and one target array operator from the training unit are required to help conduct this exercise. For continuous operations, the following are required:

Three control officers (one per 8-hour shift)

Six safety NCOs (two per 8-hour shift)

Nine scorers (three per 8-hour shift)

Nine vehicle drivers (three per 8-hour shift)

Two target detail NCOs

Two target details (six enlisted personnel plus two persons for each additional increment of 25 targets more than 30).

The unit must also supply one 5-ton truck for target emplacement and three FVs NCOs, scorers, the target operator, and the control officer.

Infantry Platoon Qualification Exercise

This exercise is conducted with four IFVs moving through both an offensive and defensive scenario. The exercise includes both direct fire and dismounted attack tasks. The exercise generally involves a variety of tasks while either moving to contact with threat forces or engagement of threat forces while occupying a subsequent battle position.

Tables 40 and 41 list tasks and performance standards for the defensive and offensive battleruns of this exercise. Table 42 summarizes the exercise's target and ammunition requirements.

Scout Squad Qualification Exercise

This exercise is conducted with two CFVs moving through both an offensive and defensive scenario. Tasks are similar to those listed for the IFV, with the exception of the dismounted assault portions.

Tables 43 and 44 list the tasks and performance standards for the defensive and offensive battleruns of this exercise, respectively. Table 45 summarizes this exercise's target and ammunition requirements, and Figures 19 through 22 show suggested target arrays. To help range planners, Figure 23 shows a conceptualized range layout.

Facility Data

Table 46 lists the facilities that comprise a typical IFV/CFV range. Facility requirements will vary for each range project. Many requirements must be established locally based on local terrain, soil, use, and other factors.

Table 47 gives detailed requirements (and criteria or guidance, when available) for specific range facilities.

Table 25

IFV/CFV Characteristics

Size

Tip to tip: 245 in.
Operating width: 126 in.
Operating height: 119 in. (antennas extend higher)
Reducible height: 103 in.

Weights

	IFV	CFV
Weight:	48,500 lb	47,964 lb
Ground pressure:	7.5 psi	7.4 psi
Approximate military load class:	48.5	48

Features/Capabilities

	IVF	CFV
Speed:	36 km/h (22.4 mph) cross-country 66 km/h (41 mph) on paved road	
Range:	300 miles	
Crew:	9	5
Storage on board:		
25-mm rounds	900	300
7.62 mm-coax rounds	2340	4540
TOW/Dragon missiles	7 (5 internal, 2 in launchers)	12 (10 internal, 2 in launchers)
Rounds for port weapons	4200	No port weapons

Soldier protection: protection against small arms and machinegun fire, shell fragments; some protection against nuclear effects, automatic cannons, antiarmor, and aircraft attacks.

Armament: Primary: 25-mm, high-velocity, Bushmaster, rapid-fire weapon system (VRFWS)
Secondary: 7.62-mm machinegun, coaxially mounted with main gun (M240C)
2 TOW launchers
Firing port weapons: 6 M231 5.56-mm port weapons (2 on right side, 2 on left and 2 in rear ramp)

Turret: 2-man; all-electric, fully-stabilized drive for firing accuracy even while in motion over rough terrain.

Projectiles: 25-mm Armor Piercing Discarding Sabot-Tracer (APDS-T) (3000-m range); High Explosive Incendiary Tracer (HE-IT) (2700-m range); 7.62-mm standard NATO Ammunition (900-m range); TOW (3000- to 3750-m range); 5.56-mm standard NATO ammunition.

Table 25 (Cont'd)

Sighting devices:	Integrated (day/night) sight unit (ISU); 4X or 12X options for days; thermal imagery for night, light foilage, camouflage, and smoke; stadia-line reticle in optical sight (for 25-mm only)
Other features:	500 hp turbo-charged diesel engine; hydromechanical transmission; suspension system has 14-in. vertical wheel travel and high-performance shock absorbers for rough terrain operation and mininum shock to crew and vehicle; smoke screen generator from diesel exhaust; 8 smoke grenade launchers (four per side), reloaded from outside; image intensification device (AN/VSS-2) for night driving; can ford 3 ft of water; can swim water obstacles at 4.5 mph.

Table 26

Typical Annual Gunnery Training Program*

ACTIVITY		QUALIFICATION 1	2	3	4	5	6	SUSTAINMENT 7	8	9	10	11	ARTEP 12
Gunnery Skills Test			S						S				
Crew/Squad Drill	COFT	M	M	M	M	M	M	M	M	M	M	M	M
	Dry	M	M		M	M		M	M	M	M	M	M
Crew/Squad Subcaliber	COFT	M	M	M	M	M	M	M	M	M	M	M	M
Exercise and Vehicle Team/Crew	Dry			Q			Q			Q			Q
Combat Exercise	Subcal			Q			Q			Q			Q
Scout/Squad Combat Qualification	Dry			S			S						
Exercise	Full Caliber			S			S						
Battle Drills	Dry			Q			Q			Q			Q
	Subcal			Q			Q			Q			Q
Section/Platoon Qualification	Dry			S						S			
Exercise	Full Caliber			S						S			
ARTEP	MILES			Q			Q			Q			Q
	Full Caliber												A
Assistant Squad Leader/Scout Firing Exercise	Full Caliber			S			S						

*A-Annual
S-Semiannual
M-Monthly
Q-Quarterly
COFT-Conduct of Fire Trainer
MILES-Multiple Integrated Laser Engagement System

Table 27

IFV Ammunition Requirements

Exercise*	TOW	APDS-T	HE-IT	TPT	7.62-mm (441)	7.62-mm (Tracer)	5.56-mm (Ball)	5.56-mm (FPW)	Smoke Grenade
Zero		4		6	80	40			
Squad Subcaliber Exercise						2200		3600	
Squad Combat Evaluation Exercise	1**	240		240	400				8
Squad Combat Qualification Exercise		200		40	700		480	660	8
Platoon Qualification Exercise		380		240	1150		580	180	32
Assistant Squad Leader Firing Exercise		124 (4 rds for zero)			200				

*All ammunition requirements are per IFV except the Platoon Qualification Exercise, which is per platoon.
**The 1 TOW missile per IFV per year may be fired during any exercise.

Table 28

CFV Ammunition Requirements

Exercise*	TOW	APDS-T	HE-IT	TPT	7.62-mm (441)	7.62-mm (Tracer)	Smoke Grenade
Zero		4		6	80	40	
Crew Subcaliber Exercise						2200	
Crew Combat Evaluation Exercise	1**	240		240	400		8
Scout Squad Qualification Exercise		200		140	400		
Scout Proficiency Firing		124 (4 rds for zero)			200		

*The 1 TOW missile per CFV per year may be fired during any exercise.

Table 29

Squad/Crew Subcaliber Exercise
(Performance Objective 1; Stationary--Day/Night)

	Task	Conditions Targets/Situation	Ammo	Performance Standards	
A	Engage low performance aircraft (day only)	1 R/C MAT flying head-on to FV (600 to 800 m) 1 R/C MAT flying oblique to FV (600 to 800 m)	200 rounds subcaliber	Kill both aircraft within 40 seconds	
B	Employ direct fire (multiple)	1 stationary BMP (700 to 900 m) 1 moving BMP (700 to 900 m)	40 rounds subcaliber	Kill both BMPs within 40 seconds	
C	Employ direct fire (multiple)	1 moving BMP (600 to 800 m) 1 moving BMP (600 to 700 m)	40 rounds subcaliber	Kill both BMPs within 40 seconds	
D	Employ direct fire (multiple)	2 stationary BMPs (500 to 600 m)	40 rounds subcaliber	Kill both BMPs within 40 seconds	
E	Employ direct fire (multiple)	1 stationary BRDM (firing missile) (600 to 900 m) 1 stationary ZSU 23-4 (700 to 800 m)	40 rounds subcaliber (2) Kill ZSU 23-4	(1) Kill BRDM	Both within 40 seconds
F	Employ direct fire	1 moving BMP (400 to 600 m) 1 stationary BMP (700 to 900 m)	20 rounds subcaliber 20 rounds subcaliber	(1) Kill BMP (2) Kill BMP	Both within 40 seconds
		INFANTRY FIGHTING VEHICLE ONLY			
G	Engage target with firing port weapons (right bank)	1 RPG-7 (200 m)	120 rounds 5.56-mm tracer	Suppress RPG-7 within 20 seconds	
H	Engage target with firing port weapons (rear bank)	1 RPG-7 (200 m)	120 rounds 5.56-mm seconds tracer	Suppress RPG-7 within 20	
I	Engage target with firing port weapons (left bank)	1 RPG-7 (200 m)	120 rounds 5.56-mm seconds tracer	Suppress RPG-7 within 20	

NOTE: All targets except R/C MAT will be full scale at actual ranges up to 900 m (tracer burnout of 7.62-mm).

REMARKS: To satisfactorily complete this exercise, the IFV squad must kill/suppress 9 of 13 targets and meet time standards on 6 of 8 tasks, and the CFV crew must kill/suppress 7 of 10 targets and meet time standards on 3 of 5 tasks.

Table 30

Squad (IFV)/Crew (CFV) Subcaliber Exercise
(Performance Objective 2; Moving--Day/Night)

	Task	Conditions Targets/Situation	Ammo	Performance Standards
A	Employ direct fire (multiple)	1 stationary BRDM (firing missile) (800 to 900 m) 1 moving BMP (700 to 900 m)	40 rounds subcaliber	Kill BMP and BRDM within 30 seconds
B	Employ direct fire (multiple)	1 stationary BMP (600 to 800 m) 1 moving BMP (600 to 700 m)	40 rounds subcaliber	Kill both BMPs within 30 seconds
C	Employ direct fire (multiple)	1 stationary BMP 500 to 700 m) ATGM position (700	40 rounds subcaliber to 900 m)	Kill BMP and suppress ATGM within 30 seconds
		INFANTRY FIGHTING VEHICLE ONLY		
D	Engage target with firing port weapons (left bank)	1 RPG-7 (150 m) tracer	120 rounds 5.56-mm seconds	Suppress RPG-7 within 20
E	Engage target with firing port weapons (right bank)	1 RPG-7 (150 m)	120 rounds 5.56-mm seconds	Suppress RPG-7 within 20
F	Engage target with firing port weapons (rear bank)	1 RPG-7 (150 m)	120 rounds 5.56-mm seconds	Suppress RPG-7 within 20

NOTES: 1. At night, engagement times increase to 40 seconds.
2. Targets are full-scale at actual ranges. Up to 900 m (tracer burnout of 7.62-mm).

REMARKS: To satisfactorily complete this exercise, the IFV squad must kill/suppress 6 of 9 targets and meet time standards on 4 of 6 tasks, and the CFV crew must kill/suppress 4 of 6 targets and meet time standards on 2 of 3 tasks.

Table 31

Squad (IFV)/Crew (CFV) Subcaliber Exercise Summary Sheet

Stationary (Day and Night)

TARGETS

3 stationary BMPs
4 moving BMPs
1 stationary ZSU 23-4
1 stationary BRDM
18 troop silhouettes
1 R/C MAT

Moving (Day and Night)

TARGETS:

2 stationary BMPs
2 moving BMPs
1 stationary BRDM
8 troop silhouettes

AMMUNITION/EXERCISE (one repetition):

	COAX	FPW (IFV Only)
Stationary (day)	400	360
Stationary (night)	200	360
Moving (day)	120	360
Moving (night)	120	360
TOTAL PER VEHICLE	840	1440

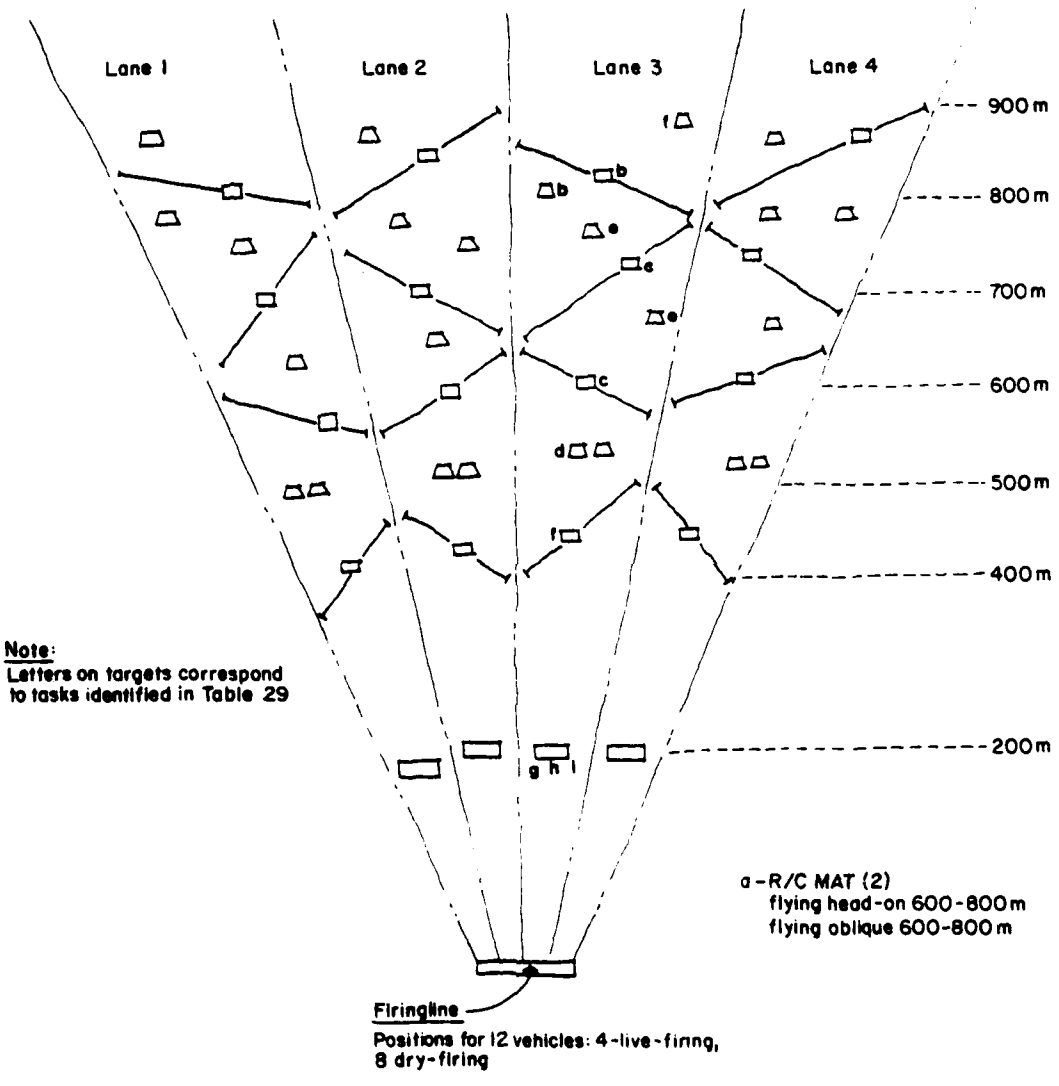


Figure 11. Squad/Crew Subcaliber Exercise--stationary.

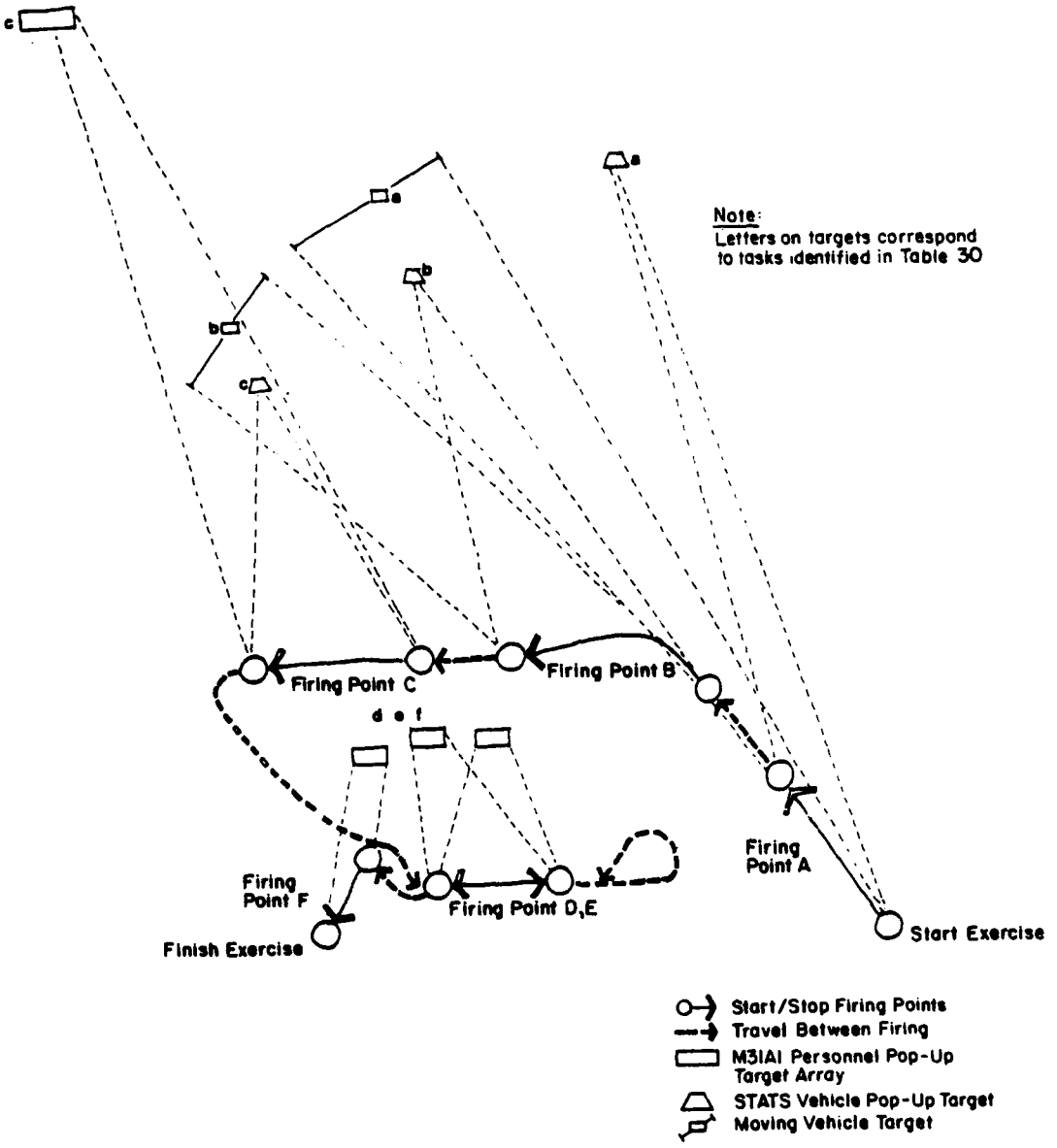


Figure 12. Squad/Crew Subcaliber Exercise--moving.

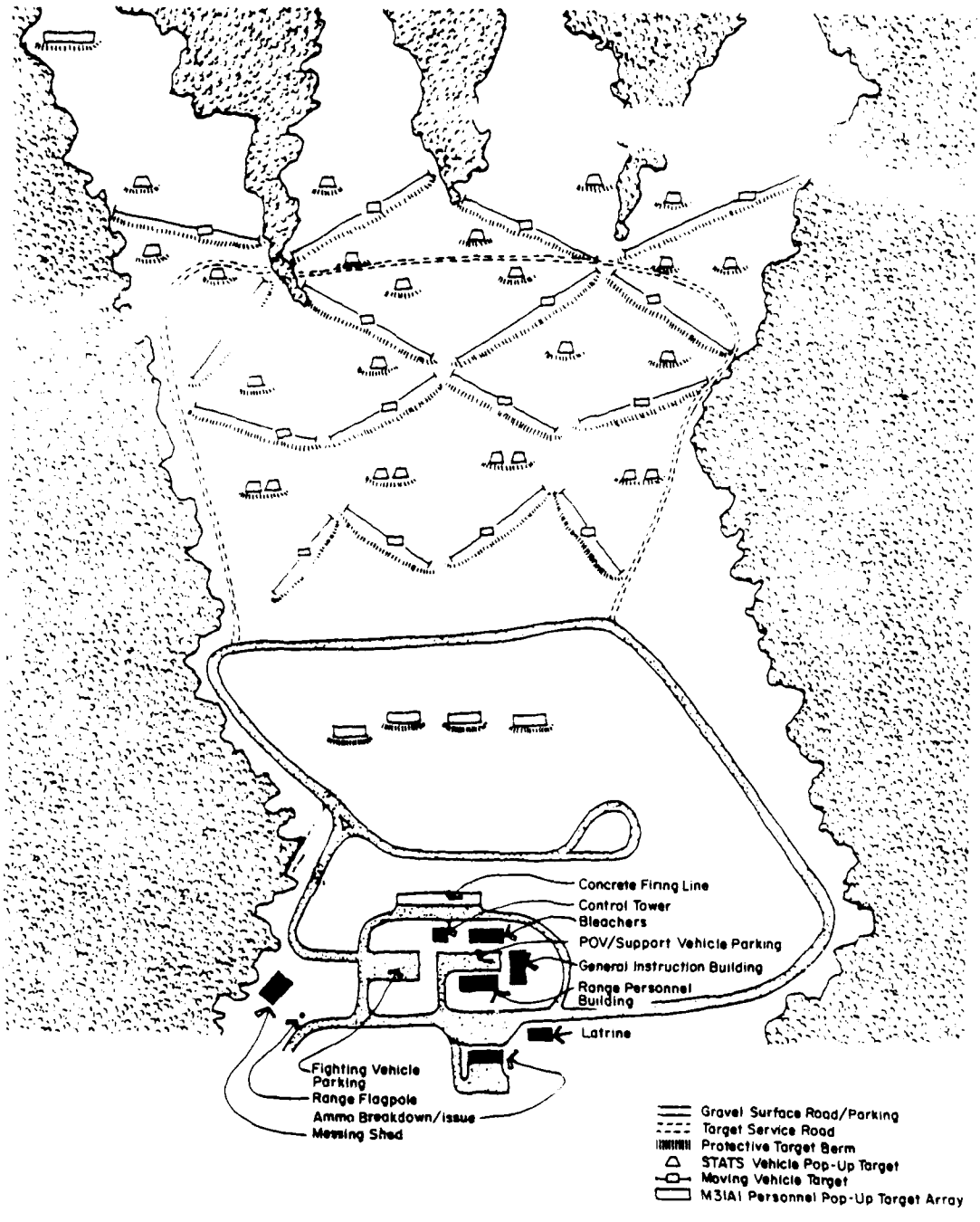


Figure 13. Squad/Crew Subcaliber Range.

Table 32

Vehicle Team (IFV)/Crew (CFV) Combat Exercise
(Performance Objective 1; Stationary FV--Day and Night)

	Task	Conditions Targets/Situation	Ammo	Performance Standards
A	Employ direct fire (missile) (launcher erect)	1 moving tank (1800 to 3750 m)	1 TOW missile	Launch missile within 15 seconds and hit target
B	Employ direct fire (multiple) (crew in MOPP Level 4)	1 stationary BMP (1500 to 2000 m) 1 moving BMP (1600 to 1800 m)	40 rounds APDS	Kill both targets within seconds. FV returns to full defilade within 15 seconds of initiating each engagement.
C	Employ direct fire (multiple)	1 moving BMP (1200 to 1400 m) Dismounted ATGM team (1800 to 2500 m)	40 rounds TP-T	Kill BMP and suppress ATGM team within 40 seconds. FV returns to full defilade within 15 seconds of initiating each engagement.
D	Employ direct fire (multiple)	1 stationary BRDM (firing missile) (1800 to 2400 m) 1 ZSU 23-4 (1600 to (2200 m)	40 rounds TP-T	Kill both targets within 40 seconds. FV returns to full defilade within 15 seconds of initiating each engagement.
E	Employ direct fire (multiple)	1 moving BMP (800 to 1000 m) 1 troop position (600 to 800 m)	20 rounds APDS 100 rounds coax	Kill BMP, suppress troops within 40 seconds. FV returns to full defilade within 15 seconds of initiating each engagement.

REMARKS: To satisfactorily complete the IFV team/crew combat exercise, a kill/suppress of 6 out of 8 targets must be made and the time standards for 3 out of 4 scored tasks must be met.

Table 33

Squad Combat Qualification Exercise (IFV Only)
(Performance Objective 2; Moving FV--Day and Night)

	Task	Conditions Targets/Situation	Ammo	Performance Standards
A	Employ direct fire (multiple)	1 stationary BRDM (firing missile) (1800 to 2000 m) 1 moving BMP (1600 to 1800 m)	20 rounds TP-T 20 rounds APDS	Kill BMP and BRDM within 30 seconds.
B	Employ direct fire (multiple)	1 ATGM team (1400 to 1800 m) 1 moving BMP (1000 to 1200 m)	20 rounds TP-T 20 rounds APDS	Kill BMP and suppress ATGM within 30 seconds
C	Employ direct fire (multiple)	1 stationary BMP (600 to 800 m) 1 troop position (600 to 800 m)	20 rounds APDS 100 rounds COAX	Kill BMP and suppress troops within 30 seconds.

REMARKS: To satisfactorily complete this exercise, a FV team/crew must kill/suppress 4 of 6 targets and meet the time standards for 2 of 3 tasks.

Table 34

Vehicle Team/Crew Combat Exercise Summary Sheet

Stationary (Day and Night)

TARGETS:

1 moving tank
1 stationary BMP
2 moving BMPs
1 stationary BRDM
1 stationary ZSU 23-4
1 moving BRDM
14 troop silhouettes

Moving (Day and Night)

TARGETS:

1 stationary BMP
2 moving BMPs
1 stationary BRDM
14 troop silhouettes

AMMUNITION/EXERCISE) (1 repetition):

	TOW	COAX	TPT	APDS-T
Stationary (day)	1	100	80	60
Stationary (night)		100	80	60
Moving (day)		100	40	60
Moving (night)	---	100	40	60
TOTAL PER CREW	1	400	240	240

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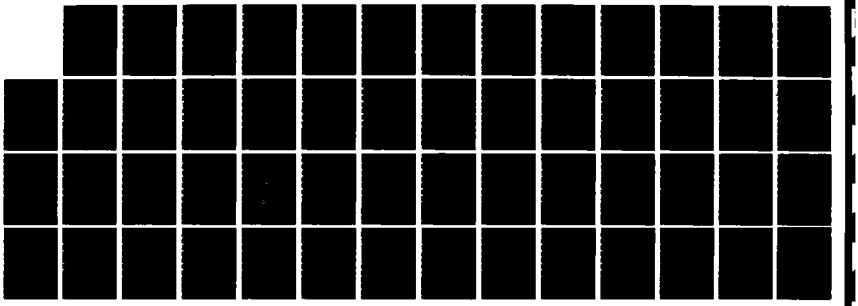

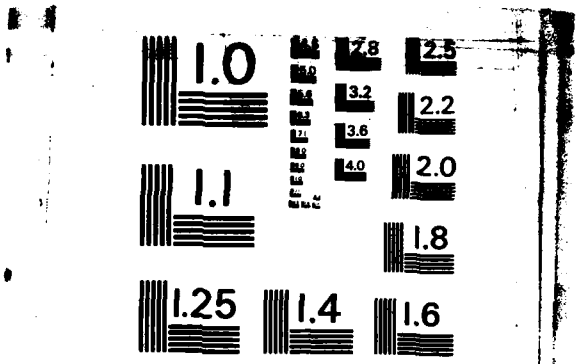

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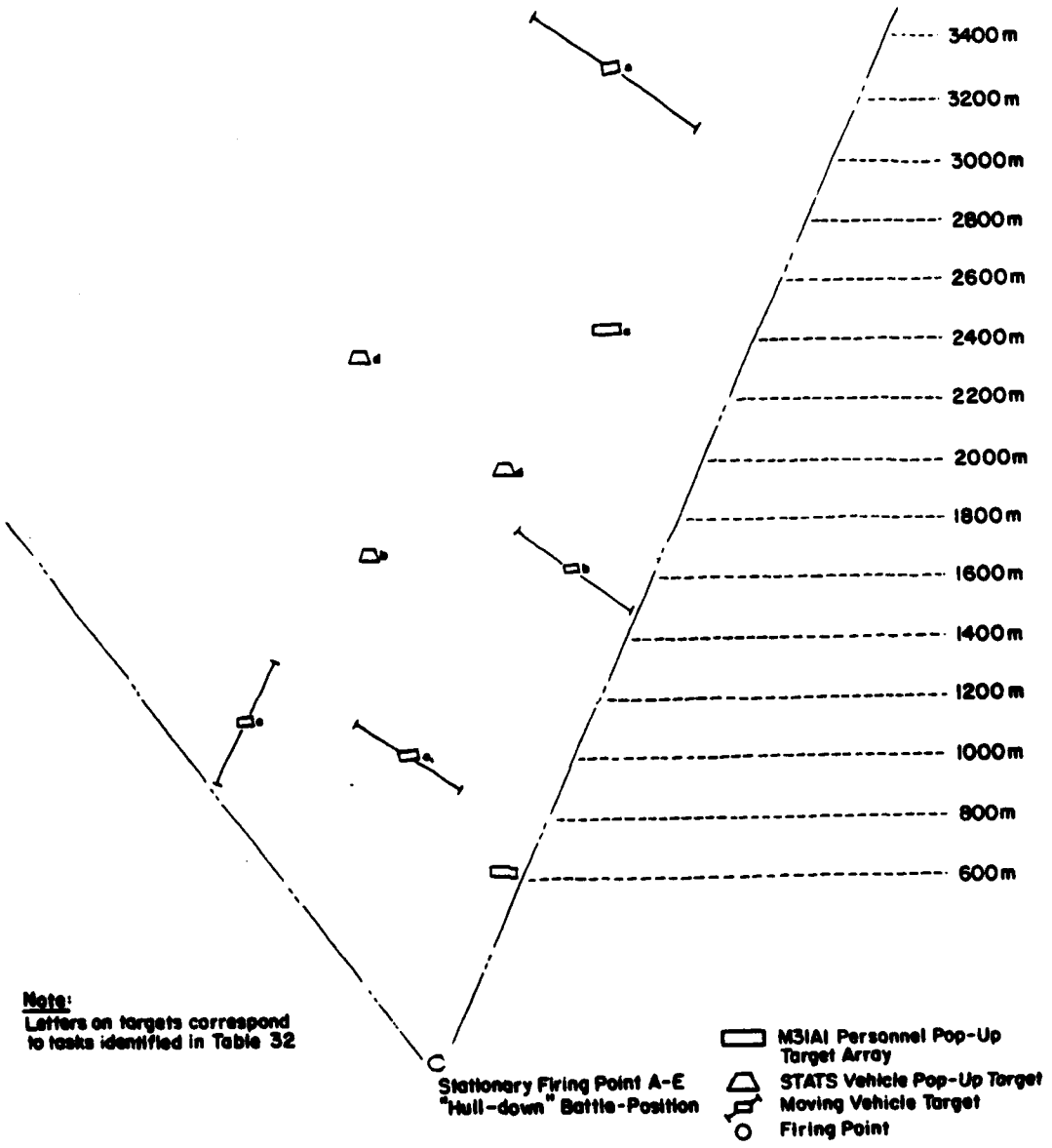

Figure 14. Vehicle Team/Crew Combat Exercise--stationary.

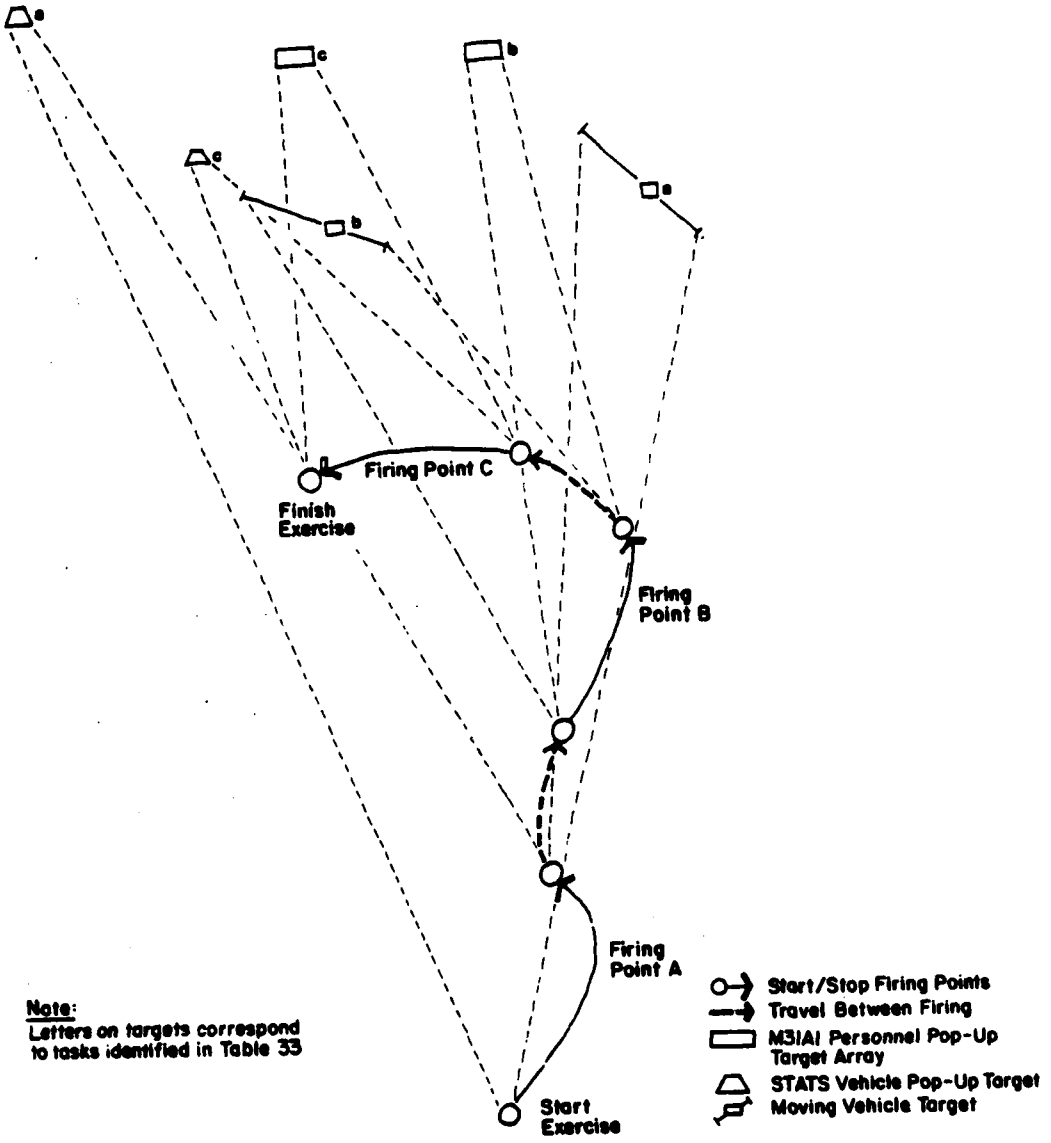

Figure 15. Vehicle/Team Combat Exercise--moving.

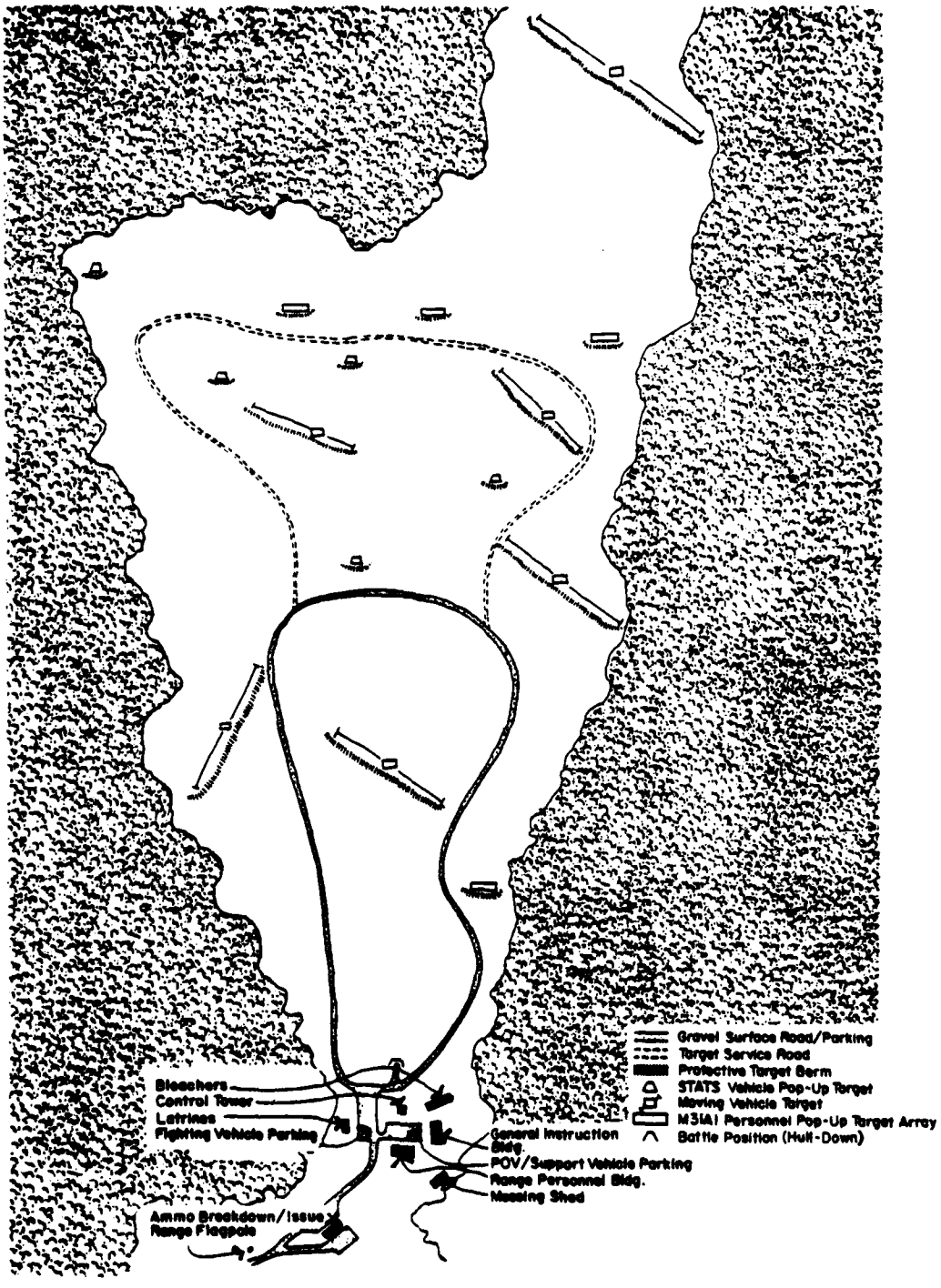

Figure 16. Vehicle/Team Crew Combat Range.

Table 35

Squad Combat Qualification Exercise (IFV Only) (Performance Objective 1; Movement to Contact--Day and Night)

Task	Conditions Targets/Situation	Ammo	Performance Standards
A Employ direct fire and firing port weapons (left bank)	1 moving BMP (1500 to 2000 m) 1 RPG-7 (150 m)	20 rounds APDS 120 rounds 5.56-mm tracer	1. Kill BMP within 15 seconds 2. Suppress RPG-7 within 15 seconds
B Employ direct fire (missile)	1 moving tank (1800 to 3750 m)	1 TOW missile or MILES	Launch missile within 15 seconds and hit target
C Employ direct fire (multiple)	1 stationary BMP (1800 to 2200 m) 1 ATGM (800 m)	20 rounds APDS 100 rounds coax	Kill BMP and suppress ATGM within 40 seconds
D Employ direct fire and firing port weapons	1 moving BMP (1200 to 1500 m) 1 troop position (150 to 200 m)	20 rounds APDS 120 rounds 5.56-mm tracer	1. Kill BMP within 15 seconds 2. Suppress troops within 15 seconds
E Employ direct fire and firing port weapons	1 troop position (400 to 600 m) 1 RPG-7 (200 m)	100 rounds coax 120 rounds 5.56-mm tracer	1. Suppress troops within 15 seconds 2. Suppress RPG-7 within 15 seconds

REMARKS: To satisfactorily complete this phase of the exercise, a squad must kill/suppress 6 of 9 targets and meet time standards for 3 of 5 tasks.

Table 36

Squad Combat Qualification Exercise (IFV Only) (Performance Objective 2; Dismounted Attack--Day and Night)

Task	Conditions Targets/Situation	Ammo	Performance Standards
A 1. Employ direct fire and dismounted infantry	1 ATGM position (1000 to 1500 m)	20 rounds TP-T	Suppress ATGM and troops within 40 seconds
2. Employ smoke grenade launchers	2 troop positions (200 to 400 m)	300 rounds 5.56-mm	
B Employ direct fire	1 stationary BMP (1400 to 1700 m)	20 rounds APDS	Kill BMP within 20 seconds
C Employ direct fire (missile)	1 stationary tank (1800 to 2400 m)	1 TOW missile or MILES	Launch missile within 15 seconds and hit target

REMARKS: To satisfactorily complete this phase of the exercise, a squad must kill/suppress 3 of 4 targets and meet time standards for 2 of 2 scored tasks.

Table 37

Squad Combat Qualification Exercise (IFV Only) (Performance Objective 3; Hasty Defense--Day and Night)

Task	Conditions Targets/Situation	Ammo	Performance Standards
A Employ direct fire: 1. 25-mm gun 2. Coax 3. M60 machinegun 4. M16 rifle 5. M203	3 stationary BMPs (500 to 1000 m) 3 RPG-7's (300 to 500 m) 2 squads dismounted infantry (100 to 300 m) 24 personnel targets	60 rounds APDS 300 rounds 7.62-mm 180 rounds 5.56-mm 6 rounds 40-mm HE	1. Kill 2 of 3 BMPs 2. Suppress all RPG-7's 3. Kill 12 of 24 personnel all within 60 seconds
B 1. React to chemical attack 2. Mount IFV 3. Withdraw from position, employing on-board smoke generator 4. Submit NBC report	N/A	N/A	1. All mask within 15 seconds. 2. Mount vehicle within 60 seconds.

REMARKS: To satisfactorily complete this phase of the exercise, a squad must kill/suppress 6 of 8 targets and meet time standards for 2 of 2 tasks.

Table 38

Squad Combat Qualification Exercise (IFV Only) (Performance Objective 4; Move to Subsequent Battle Position--Day and Night)

Task	Conditions Targets/Situation	Ammo	Performance Standards
A Employ direct fire and firing port weapons (left bank)	1 moving BRDM (1200 to 1700 m) 1 hovering Hind-D (1500 m) 1 RPG-7 (150 m)	20 rounds APDS 20 rounds TP-T 120 rounds 5.56-mm tracer	Kill BRDM and Hind-D; supress RPG-7 all within 40 seconds.
B Employ direct fire and firing port weapons (rear bank)	1 RPG-7 (300 m) 2 dismounted troops (200 m)	100 rounds coax 60 rounds 5.56-mm tracer	Suppress RPG-7 and troops within 40 seconds.
C Employ direct fire	1 stat BMP (800 to 1100 m)	20 rounds APDS	Kill BMP within 15 seconds.
D Employ direct fire and firing port weapons (right bank)	1 moving BMP (1200 to 1700 m) 1 RPG-7 (200 m) 1 troop position (800 m)	20 rounds APDS 100 rounds coax 120 rounds 5.56-mm	Kill BMP and suppress RPG-7 and troops within 40 seconds.

REMARKS: To satisfactorily complete this phase of the exercise, a squad must kill/suppress 7 of 10 targets and meet time standards for 3 of 5 tasks.

Table 39

Squad Combat Qualification Exercise Summary Sheet

TARGETS:

Performance Objective 1 (Day and Night)

1 motank
1 stationary BMP
2 moving BMPs
16 troop silhouettes

Performance Objective 2 (Day and Night)

1 stationary tank
1 stationary BMP
22 troop silhouettes

Performance Objective 3 (Day and Night)

3 stationary BMPs
30 troop silhouettes

Performance Objective 4 (Day and Night)

1 stationary BMP
1 moving BMP
1 hovering Hind-D
1 moving BRDM
18 troop silhouettes

AMMUNITION/EXERCISE:

	TOW	COAX (all 7.62-mm)	TPT	APDS-T	FPW	5.56-mm	40-mm HE
Performance Objective 1 (day and night) 1		200		60	360		
Performance Objective 2 (day and night) 1			20	20		300	
Performance Objective 3 (day and night)		300		60		180	6
Performance Objective 4 (day and night)		200	20	60	300		
TOTAL PER IFV	2	700	40	200	660	480	6

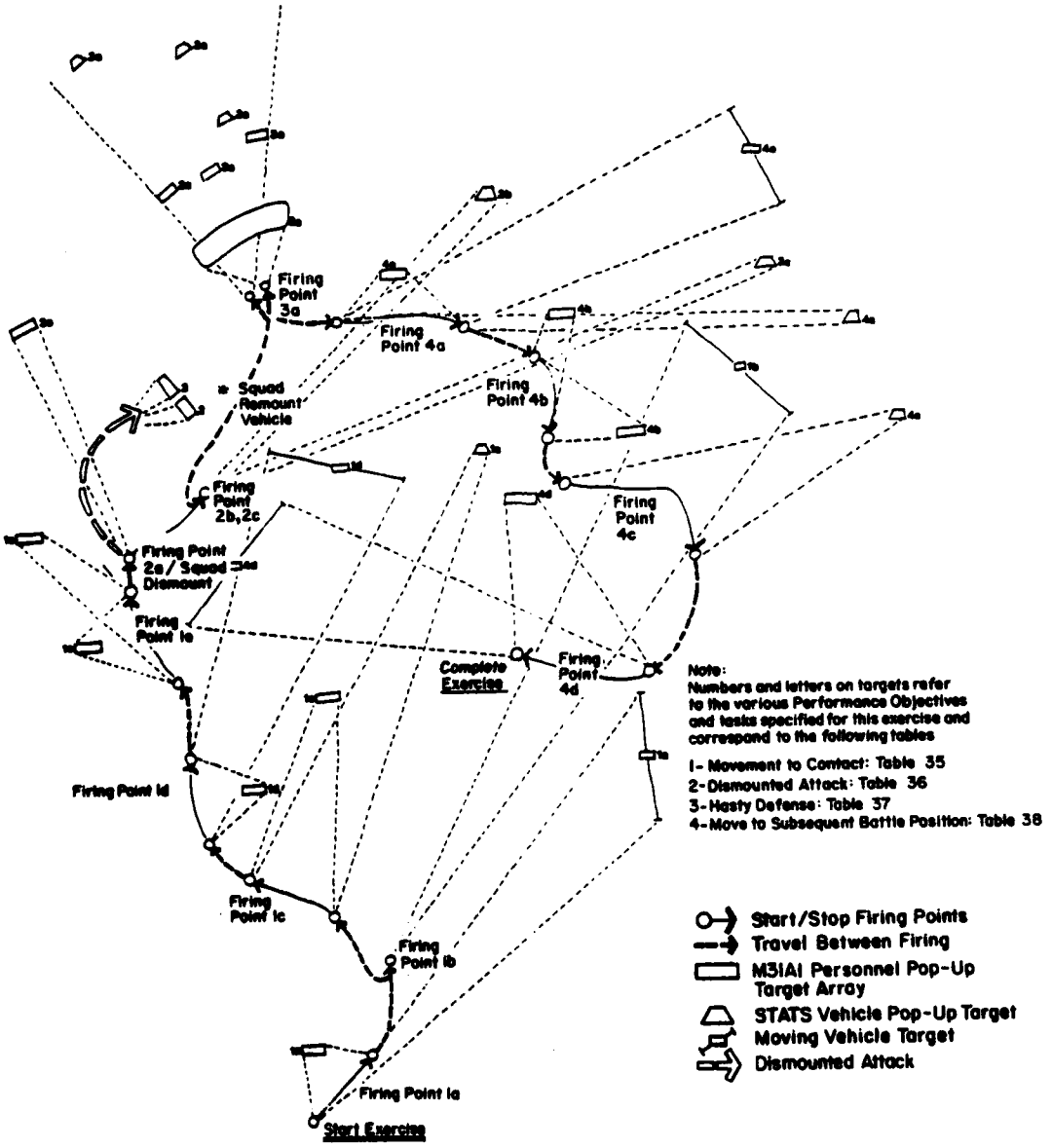

Figure 17. Squad Combat Qualification Exercise.

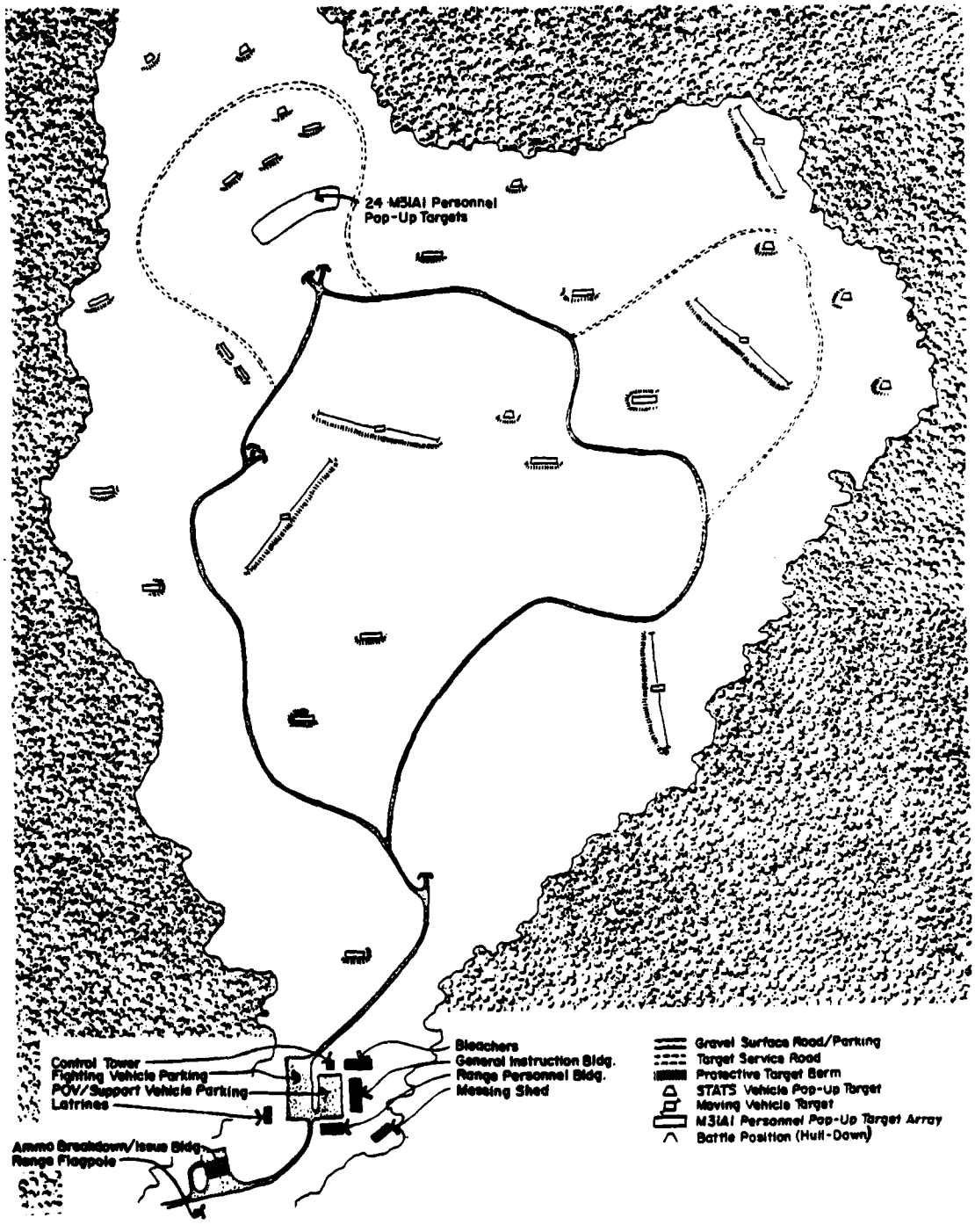

Figure 18. Squad Combat Qualification Range.

Table 40

Infantry Platoon Qualification Exercise
(Performance Objective 1; Defensive Battlerun--Day and Night)

	Task	Conditions Targets/Situation	Ammo	Performance Standards
A	Employ direct fire (multiple)	4 moving tanks (1800 to 3750 m)	4 TOW missiles or MILES	Launch missile within 15 seconds and hit all targets
B	Employ direct fire (multiple)	4 stationary BMPs (1800 to 2400 m) 2 stationary ZSU 23-4s (2000 to 2400 m)	80 rounds APDS-T 40 rounds TP-T	Kill BMPs and ZSU 23-4s within 40 seconds
C	Employ direct fire	2 moving BMPs (1600 to 2000 m) 2 stationary BRDMs (2000 to 2400 m)	40 rounds APDS-T 40 rounds TP-T	Kill BMPs and BRDMs
D	Employ direct fire	8 stationary BMPs (800 to 1200 m) 2 troop positions (700 to 900 m)	160 rounds APDS-T troops 300 rounds coax	Kill BMPs and suppress
E	Employ direct fire (multiple)	2 stationary BRDMs (1500 to 2000 m) 2 dismounted ATGM teams (1800 to 2500 m)	40 rounds TP-T 40 rounds TP-T	Both BRDMs are killed and both ATGM teams are suppressed within 40 seconds
F	Employ direct fire; dismounted team (M60 machineguns, M16 rifles, M203s)	70 dismounted troops (50 to 500 m)	400 rounds 7.62-mm 400 rounds 5.56-mm 16 rounds 40-mm HE	Kill 90 percent of troops
REMARKS: To satisfactorily complete this exercise the platoon must kill/suppress 18 of 25 targets and meet time standards for 4 of 6 tasks.				
(OPTIONAL)				
G	Employ smoke grenade launchers	Order received to withdraw, smoke grenades will be used to screen movement.	32 smoke grenades	Upon order to withdraw, smoke grenades are launched within 5 seconds; platoon withdraws using smoke to screen movement.

Table 41

Infantry Platoon Qualification Exercise
(Performance Objective 2; Offensive Battlerun--Day and Night)

	Task	Conditions Targets/Situation	Ammo	Performance Standards
A	Employ direct fire (multiple)	2 stationary BRDMs (firing missiles) (1800 to 2200 m)	40 rounds TP-T	Kill BRDMs within 30 seconds.
B	Employ direct fire (multiple)	1 stationary BMP (1200 to 1400 m) 1 moving BMP (1600 to 2000 m)	40 rounds APDS-T	Kill BMPs within 30 seconds.
C	Employ direct fire (multiple)	1 stationary BMP (800 to 1000 m)	20 rounds APDS-T	1. Kill BMPs.
		1 troop position (600 to 800 m) coax	100 rounds	2. Suppress troops.
		1 ATGM team. (1200 to 1500 m)	20 rounds TP-T	3. Suppress ATGM team. (all within 45 seconds)
D	Employ direct fire (mounted assault) (do D or E)	1 stationary BMP (150 to 300 m)	20 rounds APDS-T	1. Kill BMP within 15 seconds.
		5 three-man troop positions (100 to 200 m)	180 rounds 5.56-mm Tracer FPW	2. 90% of troop silhouettes are hit within 15 seconds.
E	Employ direct fire (dismounted assault)	1 stationary BMP (150 to 300 m)	20 rounds APDS-T	1. BMP killed within 15 seconds.
		5 three-man troop positions (100 to 200 m)	180 rounds 5.56-mm ball 200 rounds 7.62-mm	2. 90% of troop silhouettes are hit with machinegun or rifle fire within 15 seconds.
		1 bunker (150 to 200 m)	4 rounds 40-mm grenade 20 rounds TP-T 150 rounds coax	3. Bunker suppressed by 25-mm TP-T/Coax within 10 seconds. Bunker is hit with a 40-mm grenade or LAW/VIPER through the aperture within 20 seconds.

REMARKS: To satisfactorily complete this exercise, the platoon must kill/suppress 7 of 9 targets for mounted assault or kill/suppress 8 of 10 targets for dismounted assault. The time standards must be met for 3 out of 4 direct-fire tasks.

Table 42

Infantry Platoon Qualification Exercise Summary Sheet

Defensive Battlerun (Day and Night)

TARGETS:

4 moving tanks
12 stationary BMPs
2 moving BMPs
2 stationary ZSU 23-4s
4 stationary BRDMs
92 troop silhouettes

Offensive Battlerun (Day and Night)

TARGETS:

4 stationary BMPs
1 moving BMP
2 stationary BRDMs
2 bunkers
42 troop silhouettes

AMMUNITION/EXERCISE:

	Smoke Grenades	TOW	COAX (All 7.62-mm)	TPT	APDS-T	FPW	5.56-mm	40-mm HE
Defensive Battlerun (Day/Night)	32	4	700	160	280		400	16
Offensive Battlerun (Day/Night)			450	80	100	180	180	4
TOTAL PER PLATOON	32	4	1150	240	380	180	580	20

Table 43

Scout Squad Qualification Exercise
(Performance Objective 1; Defensive Battlerun--Day and Night)

Task	Condition Targets/Situation	Ammo	Performance Standards
A Employ indirect fire (optional)	4 moving tanks	As required or simulated	Process initial call for fire within 1 minute. Initial target location accuracy is within 250 m. Subsequent corrections are submitted within 15 seconds. Squad/crew request fire-for-effect (FFE) within 3 adjusting rounds. FFE impacts within 50 m of target.
B Employ direct fire (multiple)	2 moving tanks (1800 to 3500 m)	2 TOW missiles or MILES	Launch missile within 15 seconds and hit both targets.
C Employ direct fire (multiple)	2 stationary BMPs (1800 to 2400 m) 2 stationary ZSU 23-4s (2000 to 2400 m)	40 rounds APDS-T 40 rounds TP-T	Kill BMPs and ZSU 23-4s within 40 seconds.
D Employ direct fire (multiple)	2 moving BMPs (1600 to 2000 m) 2 stationary BRDMs (2000 to 2400 m)	40 rounds APDS-T 40 rounds TP-T	Kill BMPs and BRDMs within 40 seconds.
E Employ direct fire (multiple)	3 stationary BMPs (800 to 1200 m) 3 troop positions (700 to 900 m)	60 rounds APDS-T 300 rounds COAX	Kill BMPs and suppress troops within 40 seconds.

REMARKS: To satisfactorily complete this exercise, a scout squad must kill/suppress 9 of 13 targets and meet time standards for 3 of 4 scored tasks.

Table 44

Scout Squad Qualification Exercise
(Performance Objective 2; Offensive Battlerun--Day and Night)

	Task	Conditions Targets/Situation	Ammo	Performance Standards
A	Employ direct fire (multiple)	2 stationary BRDMs (firing missiles) (1800 to 2200 m)	40 rounds TP-T	Kill BRDMs within 30 seconds.
B	Employ direct fire (multiple)	1 stationary BMP (1200 to 1400 m) 1 moving BMP (1600 to 2000 m)	40 rounds APDS-T	Kill BMPs within 30 seconds.
C	Employ direct fire (multiple)	1 stationary BMP (800 to 1200 m) 1 troop position (600 to 800 m) 1 ATGM team (1200 to 1500 m)	20 rounds APDS-T 100 rounds COAX 20 rounds TP-T	Kill BMP; suppress troops; suppress ATGM (all within 45 seconds).

REMARKS: To satisfactorily complete this exercise, a scout squad must kill/suppress 5 of 7 targets and meet time standards for 2 of 3 scored tasks.

Table 45

Scout Squad Qualification Exercise Summary Sheet

TARGETS:

Defensive Battlerun (Day and Night)

2 moving tanks
5 stationary BMPs
2 moving BMPs
2 stationary ZSU 23-4's
2 stationary BRDMs
30 troop silhouettes

Offensive Battlerun (Day and Night)

2 stationary BMPs
1 moving BMP
2 stationary BRDMs
12 troop silhouettes

AMMUNITION/EXERCISE:

	TOW	COAX	TPT	APDS-T
Defense (Day and Night)	2	300	80	140
Offense (Day and Night)	___	100	60	60
TOTAL PER SECTION	2	400	140	200

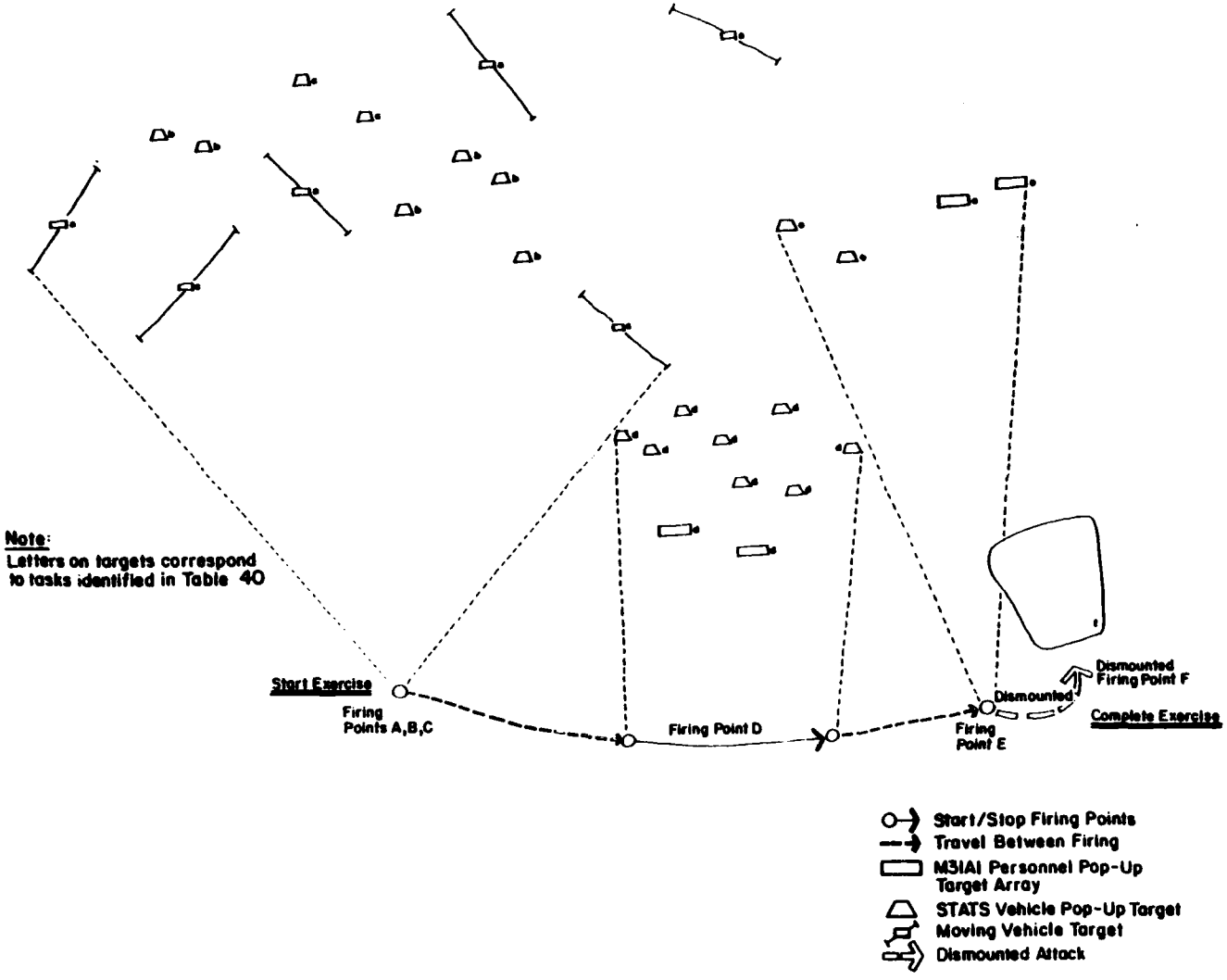

Figure 19. Platoon/Section Qualification Exercise Infantry Platoon--Defensive Battlerun.

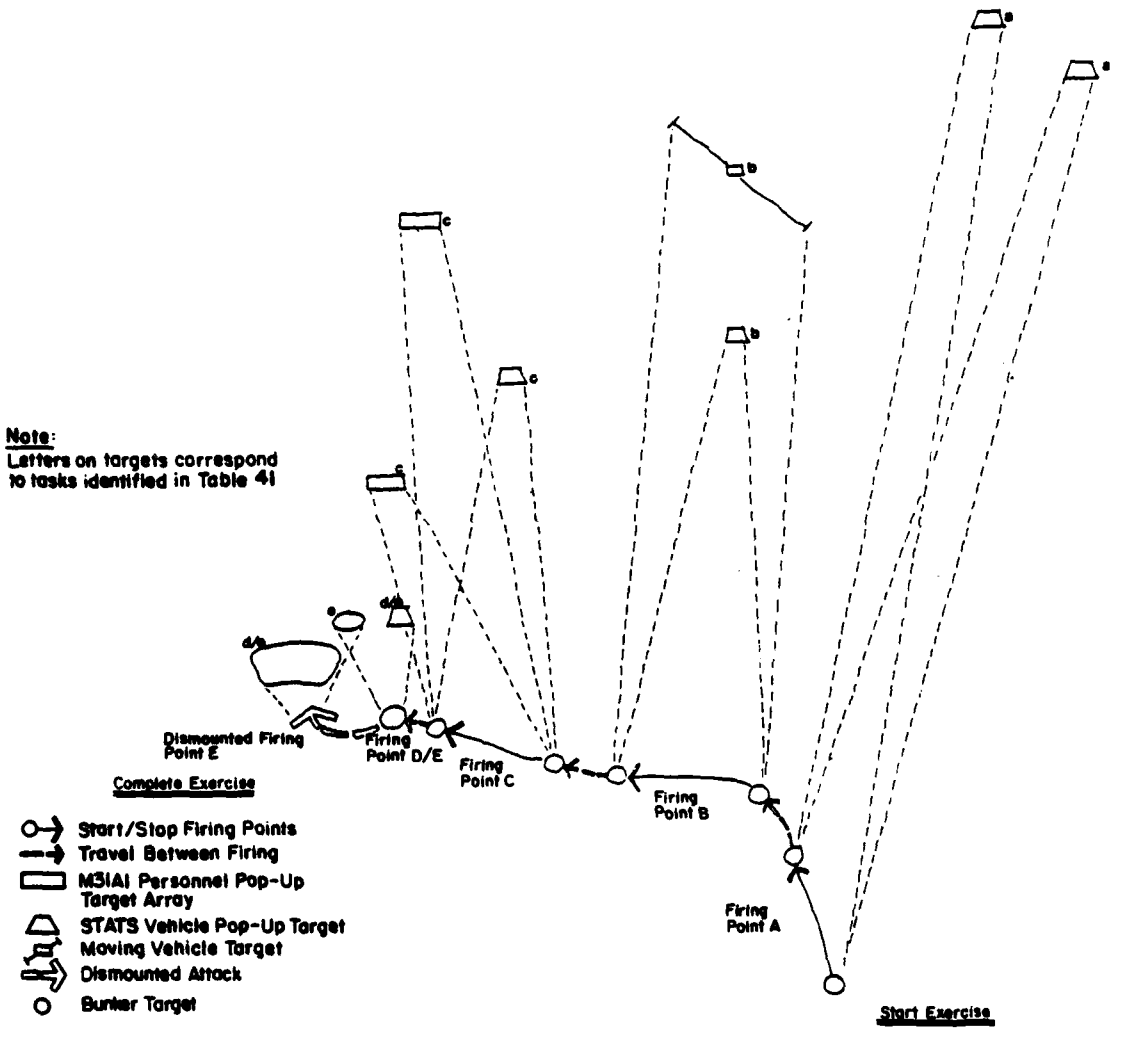

Figure 20. Platoon/Section Qualification Exercise Infantry Platoon--Offensive Battlerun.

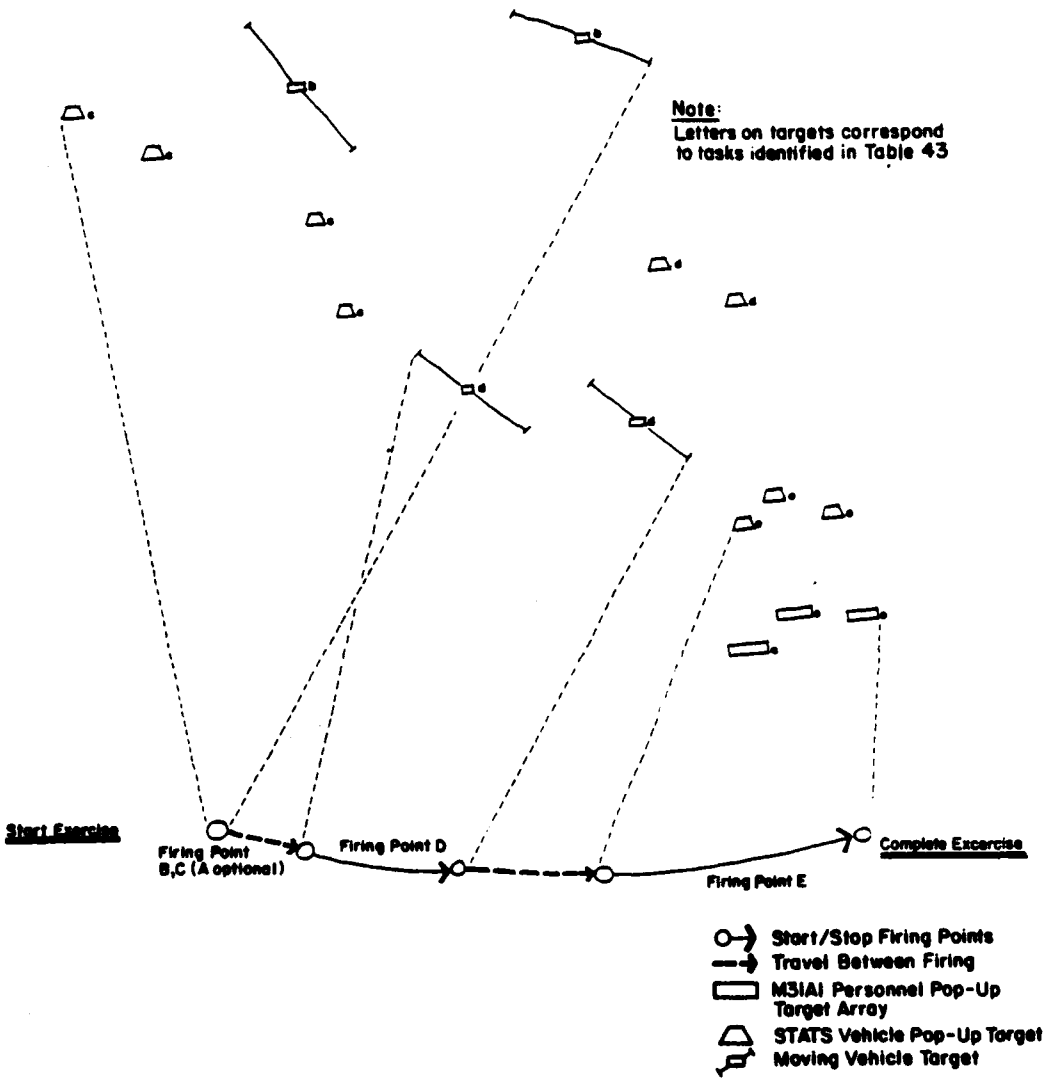

Figure 21. Platoon/Section Qualification Exercise Scout Squad--Defensive Battlerun.

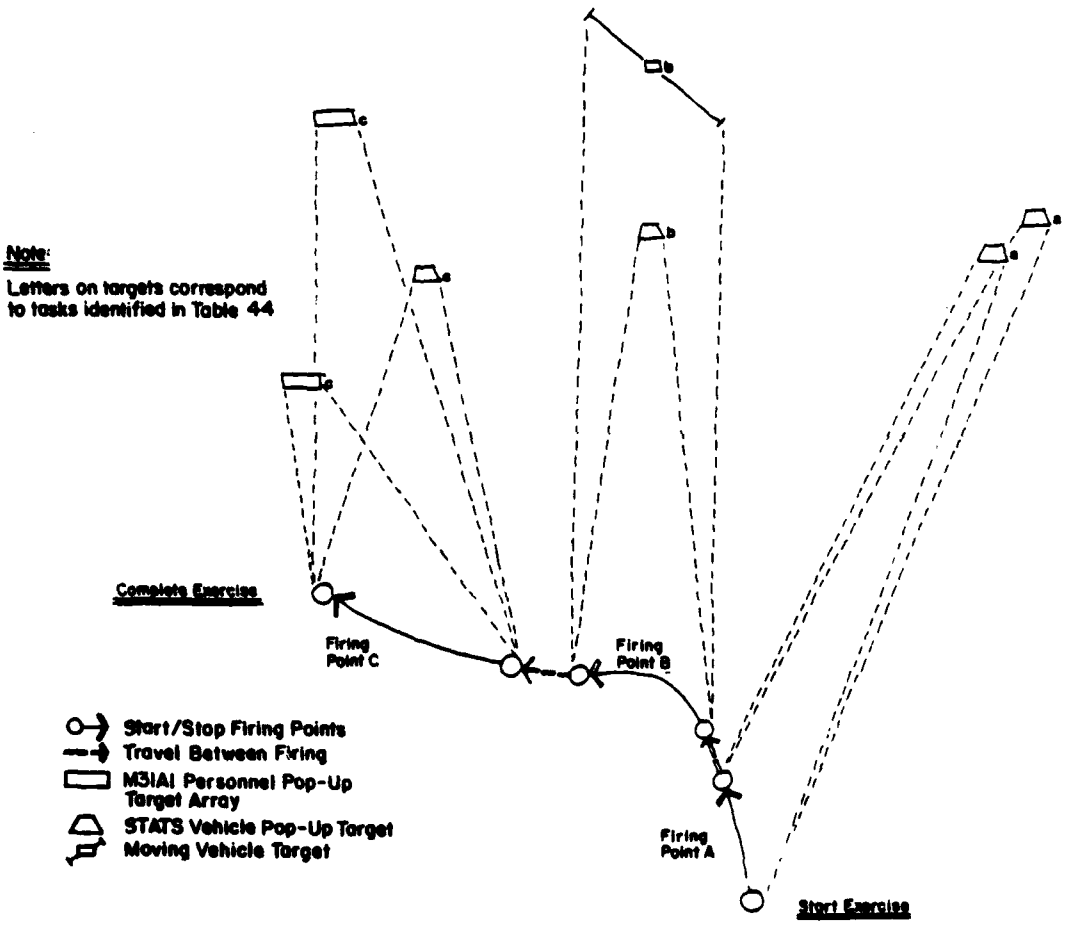

Figure 22. Platoon/Section Qualification Exercise Scout Squad--Offensive Battlerun.

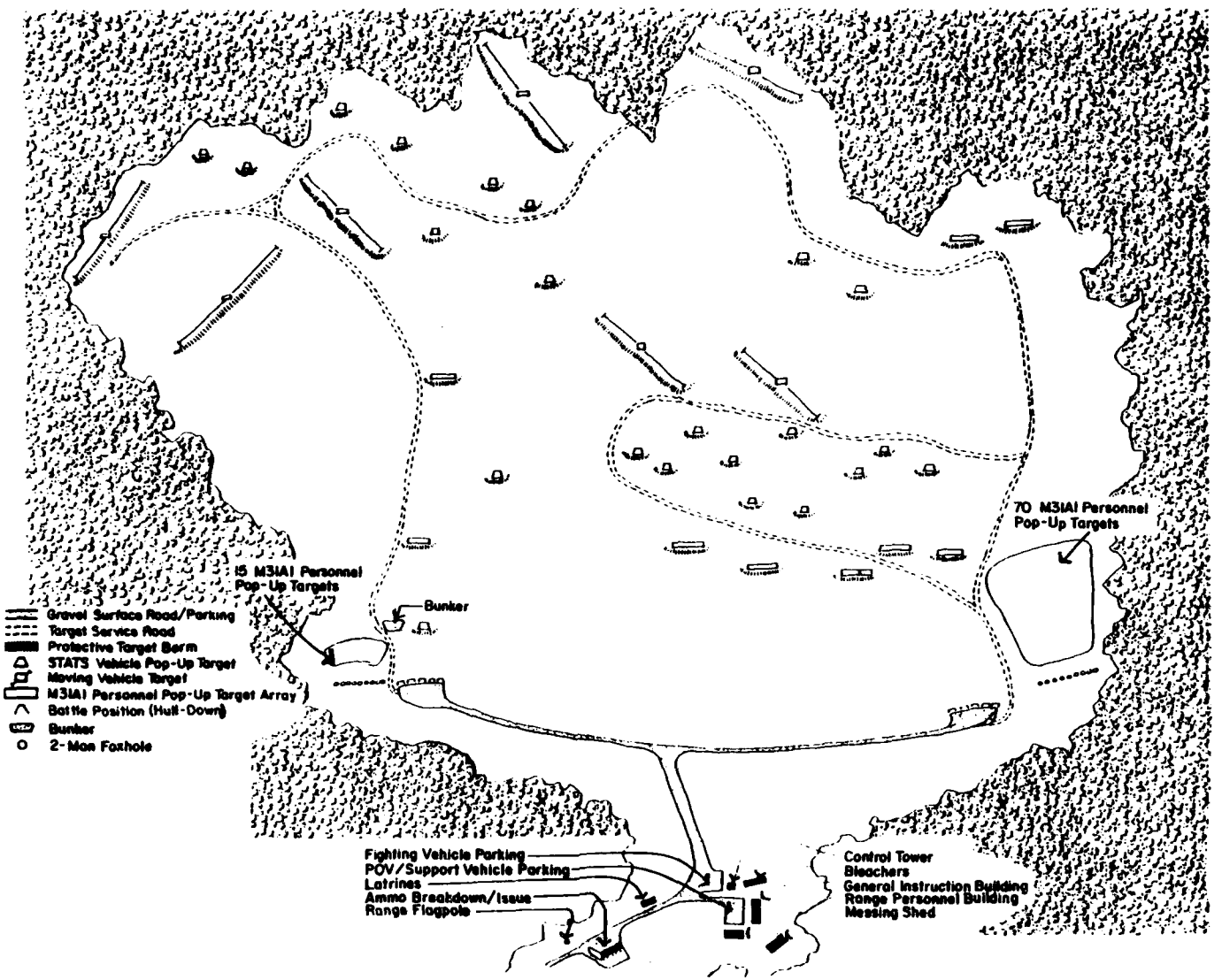

Figure 23. Platoon/Section Qualification Range.

Table 46

Typical IFV/CFV Range Facilities

Facility	Units
Land Areas	
Firing line	*
Maneuver Area	*
Target Area	*
Surface Danger Area	*
Parking Assembly Area	*
Mistire Area/Bunker	*
Overnight Holding Area	*
Structures	
Ammo Breakdown/Issue Facility	150-200 sq ft
Tower	100 sq ft
Personnel/Storage Bldg	300-800 sq ft
Mess	50 troop capacity
Latrine	200 sq ft (separate for male and female)
Bleacher	30 person
General Instruction Bldg	*
Lane Markers	*
Fan Markers	*
Helicopter Landing Area	*
Flagpole	*
Lyster Bag Frame	*
Targets	
Emplacements (for pop-up)	*
Emplacements (for moving)	*
Earthwork	
Berms	*
Utilities	
Telephone lines between tower and personnel building	*

*To be determined locally.

Table 47

Detailed Facility Data for IFV/CFV Training Ranges
(R = Requirements, C = Criteria, G = Guidance and Recommendations)

RANGE LAYOUT

General

(R) THE EXERCISES AND RANGE CONFIGURATIONS MUST MAXIMIZE THE IFV/CFV CAPABILITIES FOR FIRING ON THE MOVE AND ENGAGING MOVING TARGETS, DAY AND NIGHT.

(G) Installation commanders and their staffs must use all their imagination, resourcefulness, and ingenuity in planning and establishing their gunnery ranges so that FV units will receive the maximum benefit from challenging training.

(R) PRESENT OR PROJECTED RANGES MUST BE ABLE TO SUPPORT PRESENT AND PROJECTED UNIT DENSITIES; I.E., THE TOTAL NUMBER OF FV AND TANK BATTALIONS OR SQUADRONS THAT WILL USE THE RANGES THROUGHOUT THE TRAINING YEAR.

(G) See Chapter 5 for data on specific exercises. Table 46 summarizes typical facility requirements.

(R) RANGES SHOULD BE STRUCTURED TO PROVIDE SUFFICIENT AREA AND TARGETS FOR REALISTIC COMBAT-ORIENTED GUNNERY TRAINING.

(C) See Chapter 5 for target layouts and surface danger areas for each exercise.

(R) MAXIMUM USE OF AVAILABLE SPACE MUST BE MADE.

(G) In fitting requirements to existing terrain, take advantage of all available natural target-siting potential while considering the impact on increased logistical requirements.

(G) In some cases, targets can be relocated to better use available space on a particular site. The actual placement of a particular range and particular target arrays is an installation planning task. Constraints of available real estate must be considered.

(G) The exercise actions must be driven by threat target movement or firing simulation, or by the appearance of threat "hard" targets as the firing vehicle unmasks terrain, vegetation screens, and other obstructions.

(G) Targets can be relocated to more suitably use the space available on a particular piece of terrain.

Surface Danger Areas

(R) ALL RANGE LAYOUTS RELY ON THE NATURE OF THE EXERCISE AND THE REQUIRED SURFACE DANGER AREAS NEEDED TO ACCOMMODATE THE AMMUNITION USED IN THE EXERCISE.

(G) Surface danger areas are specified in AR 385-63 by weapon type and ammunition used.

(G) When laying out surface danger areas for the various firing points involved in a moving IFV/CFV gunnery exercise, care must be taken to insure that the danger area considers the total distance in which the fighting vehicle may move when engaging a particular target or target array, rather than just using a surface danger area for a stationary vehicle firing at a single target.

(C) Surface danger areas for the Squad/Crew Subcaliber Exercise are based on the 7.62-mm tracer and 5.56-mm FPW ammunition used in the exercise.

(C) Surface danger areas for the Squad/Crew Combat Evaluation Exercise are based on the APDS-T, TPT, 7.62-mm (441), and the TOW and/or MILES ammunition and laser engagement system used in the exercise.

(C) Surface danger areas for the Squad Combat Qualification Exercise are based upon the APDS-T, TPT, 7.62-mm (441), 5.56-mm (ball), and 5.56-mm (FPW) ammunition used in the exercise.

(C) Surface danger areas for the Section/Platoon Qualification Exercise are based on the APDS-T, TPT, 7.62-mm (441), 5.56b-mm (ball), and 5.56-mm (FPW) ammunition used in the exercise.

Maneuver Areas

(R) MANEUVER AREAS AND/OR VEHICLE TRAILS ARE REQUIRED FOR THE SECTION/PLATOON QUALIFICATION EXERCISE, SQUAD COMBAT QUALIFICATION EXERCISE, AND THE MOVING PORTIONS OF THE TEAM/CREW COMBAT EXERCISE AND THE TEAM/CREW SUBCALIBER EXERCISE.

Maneuver areas and/or vehicle trails shall be durable enough to withstand the volume of vehicle traffic, but not detract from the realism of the training exercise.

(G) The land area required for the maneuver areas and/or vehicle trails depends directly on the available terrain and the target layout at a specific installation.

PRIMARY FACILITIES

Range Control Tower

(R) ALL RANGES MUST HAVE A RANGE CONTROL TOWER TO HOUSE RANGE CONTROL PERSONNEL, COMMUNICATIONS EQUIPMENT, AND TARGET ARRAY CONTROL CONSOLES.

(C) Range control towers for the FV ranges should meet the following facility guidelines:

Location: Control towers must be sited so control personnel have a clear view of the target arrays and the FVs on the range.

Size: About 100 sq ft.

Height: The height of the control tower will vary, depending on the site-specific A tower located on a high point overlooking a range will require less physical height above ground than a tower located on a flat site.)

Utilities: The control tower must have an electrical service hook-up. The size of the service will be based on the electrical requirements of electronic target control; heating, ventilating, and air-conditioning (HVAC), and other equipment to be used in the tower. The tower must have telephone service.

Environmental Control: HVAC equipment must be used to provide adequate thermal protection for range control equipment and comfort for range personnel. An electrically powered air-conditioning unit and either an electrical resistance heating unit or an oil-fired furnace shall be provided. Forced-air or gravity-type ventilation will also be provided.

The tower must be well insulated to prevent excessive heat gain or loss and possible damage to target control equipment and HVAC equipment.

The tower must be lighted both within and at the entrance. Both normal working-condition lighting and "green-tinted" lighting (for nighttime operations) must be provided.

Special Building Features: The control tower must have glassed areas on at least three sides to allow a clear view of range operations. (Tower orientation, sun angles, glare, etc., should be considered when designing the tower and the glassed viewing areas. Design and glass placement must reflect all solar conditions occurring dawn to dusk, year-round.

The control tower must be secure against theft and vandalism of expensive and sensitive equipment. It is suggested that exterior area lighting around the tower and an intrusion detection system be used in addition to normal security measures.

The control tower must have a lightning protection grounding system to protect against equipment damage or personal injury.

The control tower must have a public address system and a 2-way radio system and antenna for communications and control of range operations.

The control tower design should include an efficient system for conveying exercise scoring results to the troop commanders and trainees on the ground.

General Instruction Building

(R) THE FV RANGE OR RANGE COMPLEXES SHOULD HAVE A BUILDING OR BUILDINGS FOR CLASSROOM INSTRUCTION BEFORE OR AFTER A TRAINING EXERCISE.

(C) When classroom or instructional buildings are provided, they should meet the following facility guidelines:

Location: Instruction buildings should be located where they will receive maximum use. When instructional facilities will be used by personnel and trainees from more than one range, the facility should be centrally located at the range complex. Siting should take into consideration ease of access by instructors and troops.

Size: The size of the instruction building depends on the number of students who will occupy it. For calculating total space needs, allow 30 sq ft per student. (This figure includes desks, circulation, lecture platform, audio-visual projection space, and coat storage.)

Utilities: Instructional facilities need standard 120/240-V electric service and telephone service.

Environmental Control: To provide thermal control, an electrical resistance heating unit or oil-fired furnace must be provided.

Adequate mechanical ventilation also must be provided; i.e., at least 30 air changes per hour.

Fluorescent lighting will be provided to a level of 70 foot-candles.

Special Building Features: Instructional buildings will meet minimum security requirements: deadlocks on entrance and egress doors and security lighting at the entrance and building perimeter.

Operable windows will be provided for natural lighting and ventilation.

A chalkboard or writing surface, tack surface, and projection screen will be provided.

Range Personnel/Storage Building

(R) ALL RANGES MUST HAVE A RANGE PERSONNEL/STORAGE BUILDING TO TEMPORARILY HOUSE RANGE CONTROL AND OPERATIONS PERSONNEL.

(C) Range personnel/storage buildings should meet the following facility guidelines.

Location: Range personnel/storage buildings should be located at each range near the range control tower. They must also be near a parking area and the main access road to the range area.

Size: The size of the building depends somewhat on the volume of operations at the range. However, on the average, 300 to 400 sq ft for the office area and 300 to 400 sq ft for the storage area should be adequate.

Utilities: The building must have standard 120/240-V electrical service and telephone service with at least two separate lines.

Environmental Control: To provide thermal control, either an electrical resistance heating unit or an oil-fired furnace must be provided.

Adequate mechanical ventilation also will be provided; i.e., an office area must have at least 30 air changes per hour. Ventilation in the storage area may be provided with gravity-type ventilation.

Office area lighting will be fluorescent and will provide a lighting level of 70 foot-candles. Storage area lighting may be incandescent and will provide 10 to 15 foot-candles (in general storage) and 75 to 100 foot-candles over workbenches.

Special Building Features: Closets for secure storage will be provided in the storage area.

Range personnel/storage buildings will meet minimum security requirements: deadlocks on entrance and egress doors and security lighting at the entrance and building perimeter.

Operable windows will be provided in office areas for natural light and ventilation.

A 6-ft/0-in. double doorway will be provided for exterior access into the storage area. A standard 3-ft/0-in. doorway will be provided for access from an office area to the storage area.

10 to 15 lineal feet of 2- to 2-1/2-ft-deep workbench surface shall be provided in the storage area.

Ammo Breakdown/Issue Facility

(R) ALL RANGES MUST HAVE A FACILITY FOR THE BREAKDOWN AND ISSUE OF AMMUNITION TO VEHICLES INVOLVED IN TRAINING EXERCISES.

(C) Ammo Breakdown/Issue Facilities should meet the following facility guidelines:

Location: The ammo breakdown/issue facility will be located at each range in such a manner that ammunition supply trucks and FVs can access it easily. It must be near a road which directly accesses the range. It must be far enough from the range and firing points so concussions or flying debris pose no danger to stored ammunition.

Size: The size of the facility depends on the amount and type of ammunition being issued to the FVs. However, 150 to 200 sq ft should be sufficient.

Special Features: The ammo breakdown/issue facility must have an off-loading dock 4 ft high for unloading ammunition from supply trucks. FVs can be loaded at ground level.

Lighting must be provided for nighttime operations and must be manually controlled so it can be switched off during training exercises.

Messing Facility

(R) ALL RANGES MUST HAVE A MESSING FACILITY TO ALLOW FOR TROOP FIELD DINING.

(C) Messing facilities should meet the following facility guidelines:

Location: The range messing facility must be easy to access for troops participating in the training exercise and vehicles transporting meals to the range. The facility must be at least 100 ft from any latrine.

Size: The messing facility must be large enough to provide stand-up dining for at least 50 troops.

Special Features: Typical standup counters may be 2 ft wide and 3 ft, 6 in. high. About 24 in. of counter space per diner should be provided. About 10 lineal feet of 2-ft-wide serving tables that are 1 ft, 6-in. high shall be provided for placing GI cans.

The messing facility should be covered during inclement weather, although it is not necessary to enclose the facility.

The messing facility should be lighted at night. Lighting must be manually controlled so it can be switched off during exercises.

Latrines

(R) ALL RANGES MUST HAVE LATRINES (BOTH MALE AND FEMALE).

(C) Latrine facilities should meet the following guidelines:

Location: Latrines should be located near the major range facilities, i.e., the range personnel/storage building and the control tower. (Latrines must be at least 100 ft from the messing area.)

Size: A typical male latrine must have 4 to 6 water closets or holes and 6 to 8 urinals or a 15- to 20-ft trough. A female latrine must have 4 to 6 water closets or holes.

Utilities: If a water supply and sanitary sewer are available, standard water closets and urinals may be used. In the absence of these, a pit-type, pump-out latrine facility may be used.

Environmental Conditions: Latrines must be adequately ventilated. Lighting should be provided for night operations.

Overnight Holding Area

(R) AT INSTALLATIONS WHERE THE FV RANGE COMPLEX IS LOCATED A GREAT DISTANCE FROM THE CANTONMENT AREA OR WHEN TROOPS AND VEHICLES ARE TRANSPORTED FROM AREA SUBINSTALLATIONS TO A MAJOR TRAINING AREA (MTA), AN AREA FOR OVERNIGHT VEHICLE STORAGE WILL BE REQUIRED.

(C) Overnight holding areas should meet the following guidelines:

Location: Holding areas should be centrally located at the range complex and be easy for FVs to access from all ranges.

Size: The area necessary for parking area or overnight FV storage shall be determined on a basis of ____ sq ft per vehicle with ____ percent added to accommodate vehicle circulation.

Special Features: The overnight holding area for FV parking may be either concrete hard-stand or a crushed stone or gravel surface. The chosen material must be able to withstand the weight and number of vehicles passing in and out of the facility.

The holding area must be enclosed with an 8-ft high security fence (chain-link fabric fence, type FE-6) with a separate gate for vehicular and personnel access.

The holding area must have a building for housing security personnel when vehicles are being stored. The security building should be about 100 to 150 sq ft and have electrical service, an HVAC system, and telephone service. The building's windows must allow a clear view of both the area entrance and the vehicle storage area.

Area lighting will be provided at the entrance to the holding area and at the perimeter fencing (for security).

Bleacher/Briefing Area

(R) ALL RANGES MUST HAVE A BLEACHER AREA TO BRIEF TROOPS AND SEAT SPECTATORS AND VISITORS.

(C) Bleacher/briefing areas shall meet the following guidelines:

Location: Bleacher/briefing areas will allow a clear view of the range and the training exercises.

Size: A typical facility will seat about 100 people. (An exact figure should be determined based on the anticipated volume of troops, spectators, and visitors.)

Special Features: The bleacher/briefing area must be covered in inclement weather. In some cases, bleacher/briefing areas have been enclosed with a metal skin and rolling doors on 3 sides, with sliding glass doors on the side facing the range. This arrangement allows the area to be used in all climates and also provides an enclosed classroom/lecture facility.

The area should have general lighting for use at night. The lighting must be manually controlled so it can be switched off during nighttime training exercises.

Table 47 (Cont'd)

Helicopter Landing Area

(R) AN AREA FOR LANDING OF EMERGENCY AIRCRAFT AND/OR MEDICAL EVACUATION AIRCRAFT MAY BE REQUIRED FOR EACH RANGE OR RANGE COMPLEX, DEPENDING ON HOW NEAR THE RANGE OR RANGE COMPLEX IS TO ASSOCIATED EMERGENCY FACILITIES AT THE INSTALLATION.

(C) Landing area criteria for the UH-1 standard medivac helicopter are as follows:

1. 20-ft square parking pad.
2. 3 percent maximum grade.
3. 10:1 departure ratio
4. Cleared area of 30-m diameter (for day) and 50-m diameter (for night).

Flagpoles

(R) EACH RANGE SHALL BE EQUIPPED WITH A FLAGPOLE.

(C) The flagpole shall be placed in a prominent position at the entrance to each range and within view of the range personnel building and the control tower. The flagpole must have a red light on top for night firing.

Heating Oil Tanks

(R) HEATING OIL TANKS MUST BE PROVIDED AT THOSE FACILITIES EQUIPPED WITH OIL-FIRED FURNACES.

(C) A typical oil tank would have an average 500 gallon capacity and may be installed either above or below grade depending upon the site specific conditions existing at the installation.

Lyster Bag Frames

(R) LYSTER BAG FRAMES WILL BE PROVIDED AT RANGE LOCATIONS WHERE A COMMERCIAL WATER SUPPLY IS UNAVAILABLE.

(C) Lyster bag frames shall be located near the messing area and range operations area. Frames shall provide a covered and protected means for hanging 2 to 3 Lyster bags.

8 AH-64 ADVANCED ATTACK HELICOPTER DATA

Weapon Training Data

Performance objectives and training tasks for the AH-64 Advanced Attack Helicopter are the same as for the AH-1, and are discussed in Chapter 5 of FM 17-40. Table 48 lists the characteristics of the AH-64 helicopter. The AH-64 is shown in Figure 24.

Armament

1. HELLFIRE missile. The HELLFIRE terminally guided missile provides the primary antitank armament for the AH-64. The missile is based on a modular design so it can carry a variety of homing seeker heads. The first missiles will be equipped with a laser-guided seeker, which requires that a laser beam be positioned accurately on the target during the terminal phase of missile flight. The beam may be provided by the AH-64 copilot/gunner, another aircraft, or a ground-based designator.

The HELLFIRE missile offers sorter flight times and increased range relative to the current TOW missile. Key missile characteristics include:

Length: 64 in.
Diameter: 7 in.
Weight: 100 lb
Warhead: shaped charge.

2. M-230E1, 30-mm Chain Gun. The M-230E1 is an externally powered single-barrel weapon mounted in a flexible turret, providing a $\pm$ 110° azimuth and +11° to -60° field of fire. A high explosive dual-purpose (HEDP) and a training practice (TP) cartridge will be the initial munitions. A high-explosive incendiary (HEI) and an armor piercing (AP) round are in development.

3. 2.75-in. Folding Fin Aerial Rocket (FFAR) Although the FFAR has been in the Army inventory for many years, as used with the AH-64, it will feature multioption fuse, improved motor, and new warheads. These include a multipurpose submunition (MPSM), an improved illumination warhead, and a screening smoke warhead.

Training Activities

Fourteen live-fire exercises which require ranges are used in aerial gunnery training. These exercises are progressive in nature, beginning with individual training for the pilot and gunner and advancing to crew, then team, and finally combined arms exercises.

The individual exercises (Tables I* through IVB) are designed to teach basic skills such as use of the sight, weapons selection, and engagement procedures.

The crew training exercises (Tables V through VIB) teach coordination between the AH-64 pilot and copilot/gunner.

The team training exercises (Tables VII through VIIIB) teach coordination and teamwork between the crews of the attack helicopter and the scout helicopter.

Training Tables IXA and IXB integrate the scout/attack helicopter team with elements of infantry, armor, artillery and other arms.

Annual Ammunition Expenditure

Table 49 lists the estimated annual ammunition expenditure for the AH-64 unit summary programs (sustained and intensified). In sustained aerial gunnery training, weapons fire is conducted quarterly. In intensified training, all firing occurs during an annual training session. Some units may fire on a semi-annual basis.

When suitable combat mission simulators are available in the field, ammunition expenditures will decrease.

Range Personnel

Table 50 lists the personnel who must be present at AH-64 live-fire ranges and their respective responsibilities.

Aircraft

Under the proposed Division 86 plan, an attack helicopter company will have seven attack helicopters and four scout helicopters. An air cavalry troop will have four attack helicopters and six scout helicopters.

Safety Fans

Definitive surface danger areas have not been established for the AH-64 weapon systems. When complete, AH-64 surface danger areas will be published in AR 385-62 and AR 385-63.

Site-Specific Danger Area Layout

For firing from hover, a surface danger zone will be superimposed over the gun-target line at each firing point. For firing on a running fire course, surface danger zones will be superimposed over each anticipated gun-target line along the course. These surface danger zones will begin at the safe-arm line and move along the course to each anticipated firing point.

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*Tables referenced in this chapter by roman numeral were taken from FM 17-40, Attack Helicopter Gunnery (DA, Washington, DC).

A range may contain several different hover firing points or a running fire course where multiple aircraft can fire simultaneously. The resultant surface danger zone will not be a single conical shaped form, but will be irregular, since it will be formed from a number of individual surface danger zones. See AR 385-63 for laser danger area layout.

Individual Training Exercises

These exercises qualify and cross-train crew members in the duties for each crew position. Gunnery tables are fired individually by the pilot or copilot/gunner. An instructor pilot occupies the second seat of the aircraft. This provides an additional measure of safety.

Individual tables are preceded by an Aerial Gunnery Skills Test which does not include live-fire. Individual tables are fired during the first quarter of the annual training cycle. Tables 51 through 56 show the amount of ammunition, mode of flight, and desired targets for each individual exercise.

Crew Training Exercises

These exercises develop the coordination needed to combine individual efforts into an efficient fighting crew. The instructor pilot supervises the firing of the crew tables from a separate helicopter. He directs the attack helicopter to move from the holding area to a firing position and then identifies the desired target. As the attack helicopter crew engages the target, the instructor pilot visually scores the exercises.

Crew gunnery tables are preceded by individual gunnery tables and are fired during the second quarter of the annual training cycle. Tables 57 through 59 list the amount of ammunition, mode of flight, and desired targets for each exercise.

Team Training Exercises

These exercises measure and evaluate the effectiveness of the scout helicopter/attack helicopter team, the basic element of the air cavalry and attack helicopter unit. While the attack helicopter(s) waits in a holding area (behind the firing area) the scout(s) goes forward to locate and identify the targets. The scout(s) then directs the aeroweapons crew(s) to the firing points from which they engage the targets. Team size may vary from two to eight aircraft. The exercise is scored by an instructor pilot who supervises from a separate aircraft.

Team tables are preceded by the crew tables and are fired during the third quarter of the annual training cycle. Tables 60 through 62 show the amount of ammunition, mode of flight, and desired targets for each exercise.

Combined Arms Training Exercises

This exercise measures and evaluates the effectiveness of the combined arms team as a system. In addition to scout and attack helicopters, these exercises may include elements of infantry, armor, and artillery as well as fixed-wing aircraft.

The Team Combined Arms (TCA) qualification should challenge all aspects of unit operations, including the tactical maneuver elements and the required activities in the logistical base. FM 17-40 recommends that Tables IXA and IXB be conducted while maintaining constant pressure on a threat array. These combined arms exercises will involve as many of the combat arms units as possible. Units will use their assets as teams and conduct a coordinated combined arms operation.

Aircrews must complete team qualification before firing TCA tables. TCA exercises are fired during the fourth quarter of the annual training cycle. Tables 63 and 64 list the firing exercises for the combined arms training. These may be modified by the unit commander in accordance with his evaluation of where targets will appear in the scenario of his unit's mission in a combat environment. The exercise is scored by an instructor pilot in separate aircraft.

Ammunition allocations for other members of the combined arms team will depend on available ammunition. Table 65 lists the allocations suggested in FM 17-40.

Facility Data

Table 66 lists typical facilities needed on an AH-64 training range. Facility requirements will vary for each range project. Many requirements must be established locally, based on local terrain, soil, use and other factors.

Figure 26 shows an idealized floating, aerial gunnery complex. This complex has four floating gunnery ranges, so named because the aircraft "floats" around the perimeter of the range (Figure 26). The aircraft moves by nap of the earth (NOE) to each firing point, engages the target, and continues around the course. At no time does the instructor pilot permit aircraft to enter the target area. Table 67 lists arming and weapons safing area, firing area, and target area data. Figure 27 shows an idealized range layout.

Metric Conversion Table

1 in.	=	25.4 mm
1 ft.	=	0.3048 m
1 $in.^2$	=	645.2 mm^2
1 $ft.^2$	=	0.092 m^2
1 MBtu	=	1.055 GJ
$(^{\circ}F-32)x0.55$	=	$^{\circ}C$

Table 48

Characteristics of the AH-64 Helicopter

SIZE

Length:

Rotor Turning: 57.04 ft

Fuselage: 49.33 ft

Width:

Wing: 17.17 ft

Cockpit: 3.96 ft

Height: 12.57 ft

Rotor Diameter: 48.0 ft

Weight: Maximum gross: 17,650 lb

FEATURE/CAPABILITIES

Crew: 1 pilot, 1 co-pilot/gunner

Flight Performance: Figure 25 presents the flight performance of the AH-64 while carrying sufficient fuel for a 1.83-hour mission.

Visionics: The Target Acquisition and Designation System (TADS) and Pilot Night Vision Sensor (PNVS) provide day/night/adverse weather target acquisition, designation and nap-of-the-earth (NOE) flight capabilities which permit attack armaments to be effectively launched from stand-off range. The TADS includes a laser rangefinder and direct-view optics.

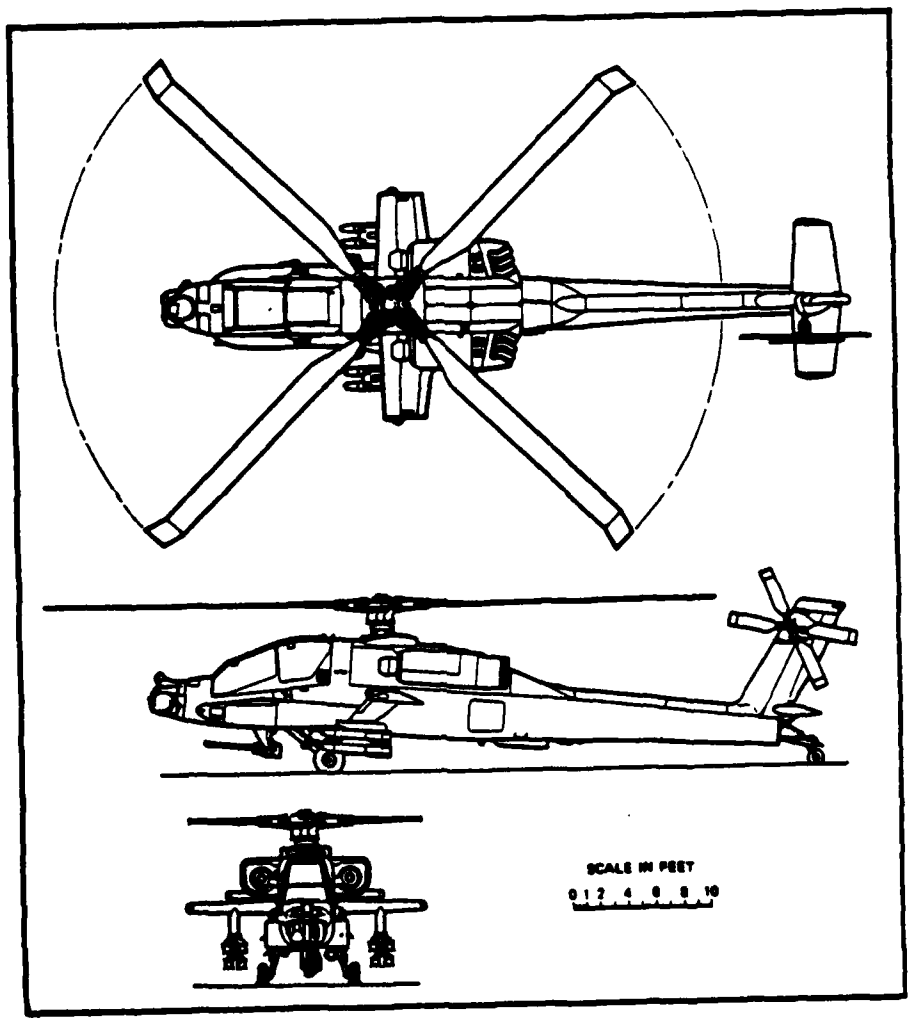

Figure 24. AH-64 Helicopter.

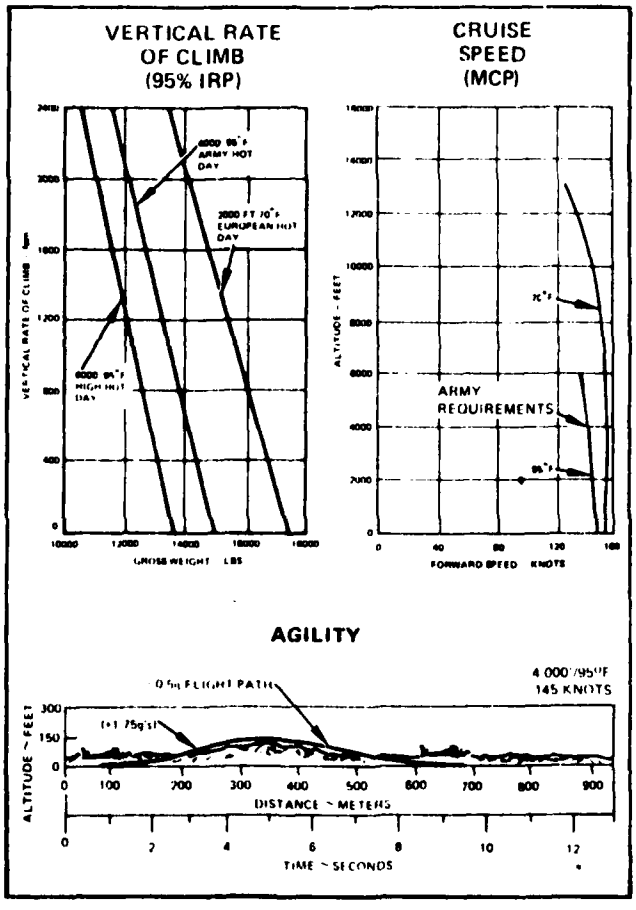

Figure 25. AH-64 Flight Performance.

Table 49

AH-64 Annual Ammunition Expenditure

	Sustained (Rounds)	Intensified (Rounds)
30-mm	2,000	1,700
2.75 FFAR	406	328
HELLFIRE missile	2	2

Table 50

Range Personnel

SUPERVISORY PERSONNEL

Title	Responsibilities
Officer in Charge (OIC)	Overall supervision and enforcement of range safety
Range Command Officer (RCO)	Control of installation ranges
Range Officer (RO)	Control of firing
Aviation Safety Officer (ASO)	Safe operation of range
Laser Safety Officer (LSO)	Insure safe lasing operation
Instructor Pilot (IP)	Conduct of training
Radio Operator/Controller	Assist RCO in traffic control
Senior Armorer	Supervise handling of armament and armament crew activities
Ammunition NCOIC	Insure safe handling and loading of ammunition

OTHER PERSONNEL

Position	Approximate Number
Fuel Handler	5 to 7
Armament/ammunition personnel	13-23
Helicopter repairmen	10-20
Target Detail	Depends on the type and number of targets

Table 51

Gunnery Table I Gunner--Individual Qualification (Day)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100	NOE		3 (stationary)	300-3000 m
	1*	NOE	1 (moving)	2700-3750 m

*Missile will only be fired for initial transition qualification.

Table 52

Gunnery Table IIA Gunner--Additional Individual Training (Day)*

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100	NOE	3 (stationary)		300-3000 m

*Need to be determined by instructor pilot/evaluator.

Table 53

Gunnery Table IIB Gunner--Individual Qualification (Night)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100		Terrain	As desired	300-3000 m

Table 54

Gunnery Table III Pilot--Individual Qualification (Day)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100		NOE	3 (stationary)	300-3000 m
	38	NOE	1 (moving)	2700-3750 m

Table 55

Gunnery Table IVA Pilot--Additional Individual Training (Day)*

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100		NOE	3 (stationary)	300-3000 m
38		NOE	3 (stationary)	300-5500 m

*Need for subsequent training is determined by *IP*.

Table 56

Gunnery Table IVB Pilot--Individual Qualification (Night)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100		Terrain	As desired	300-3000 m
	20*	Terrain	As desired	300-5500 m

*Two rockets will be illumination rounds.

Table 57

Gunnery Table V Crew Qualification (Day)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100(50)		NOE	1 (moving) 2 (stationary)	300-3000 m
	38(19)	NOE	3 (stationary)	300-5500 m

Table 58

Gunnery Table VIA Crew Additional Training (Day)*

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100(50)		NOE	1 (moving) 2 (stationary)	300-3000 m
	20(10)	NOE	3 (stationary)	300-5500 m

*Need to be determined by instructor pilot/evaluator.

Table 59

Gunnery Table VIB Crew Qualification (Night)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100(50)		NOE	1 (moving) 3 (stationary)	300-3000 m
	20(10)	NOE	3 (stationary)	300-5500 m

Table 60

Gunnery Table VII Team Qualification (Day)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100(50)		NOE	1 (moving) 2 (stationary)	300-3000 m
	38(19)	NOE	3 (stationary)	300-5500 m

Table 61

Gunnery Table VIIIA Team Additional Training (Day)*

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100(50)		NOE	1 (moving)	300-3000 m
	20(10)	NOE	3 (stationary)	300-5500 m

*Need to be determined by instructor pilot/evaluator.

Table 62

Gunnery Table VIIIB Team Qualification (Night)

30-mm Chain Gun	2.75-in. FFAR	Mode of Flight	Target Type	Range
100(50)		NOE	As desired	300-3000 m
	20(10)	NOE	As desired	300-5500 m

Table 63

Gunnery Table IXA TCA Qualification (Day)

30-mm Chain Gun	2.75-in. FFAR	HELLFIRE Missile	Mode of Flight	Target Type	Range
100			NOE	Combined arms formation supported by ZSU-23-4s* (1500 x 2000 m); dismounted infantry; 20 tanks; 12 BMPs; 2 ZSU-23-4s; 3 73-mm ATSs; 3 120-mm mortars.	2000-5500 m
	38**		NOE		
		1	NOE		

*Target array is presented only as an example.

**6 of these rockets will be smoke rounds.

Table 64

Gunnery Table IXB TCA Qualification (Night)

30-mm Chain Gun	2.75-in. FFAR	HELLFIRE Missile	Mode of Flight	Target Type	Range
100			NOE	Array	300-3000 m
	20*		NOE	Array	300-5500 m

*Two of these rockets will be illumination rounds.

Table 65

Suggested Ammunition Allocations for Combined Arms Team

Weapon System	Weapon	Suggested Number of Rounds
M-1 Tank	120-mm/105-mm maingun	6 TPT-T
	7.62-mm machine gun	200
155-mm howitzer	NA	10 per team/iteration
A-10 ground attack aircraft	Cannon, 30-mm	300 per sortie per aircraft
Infantry	7.62-mm machinegun	100
	5.56-mm M-16 rifle	25
	4.2-in. mortar	10 per team/iteration
	M-2 .50 cal machinegun	100

Table 66

Facilities Typical for AH-64 Training Ranges

Facility	Units
Land Areas	
Target Area	*
Manuever/Holding Area	
Individual and Crew Exercises	4 km^2
Team and Combined Arms Exercises	7 km^2
Firing Area	
Individual and Crew Exercises	1 x 4 k
Team and Combined Arms Exercises	2 x 4 k
Rearming and Refueling Area	*
Weapons Safing Area	*
Parking Area	*
Structures	
Control Point	*
Target Support and Storage Building	*
Targets	
Emplacements (for pop-up)	*
Emplacements (for moving)	*
Earthwork	
Berms	*

*To be determined locally

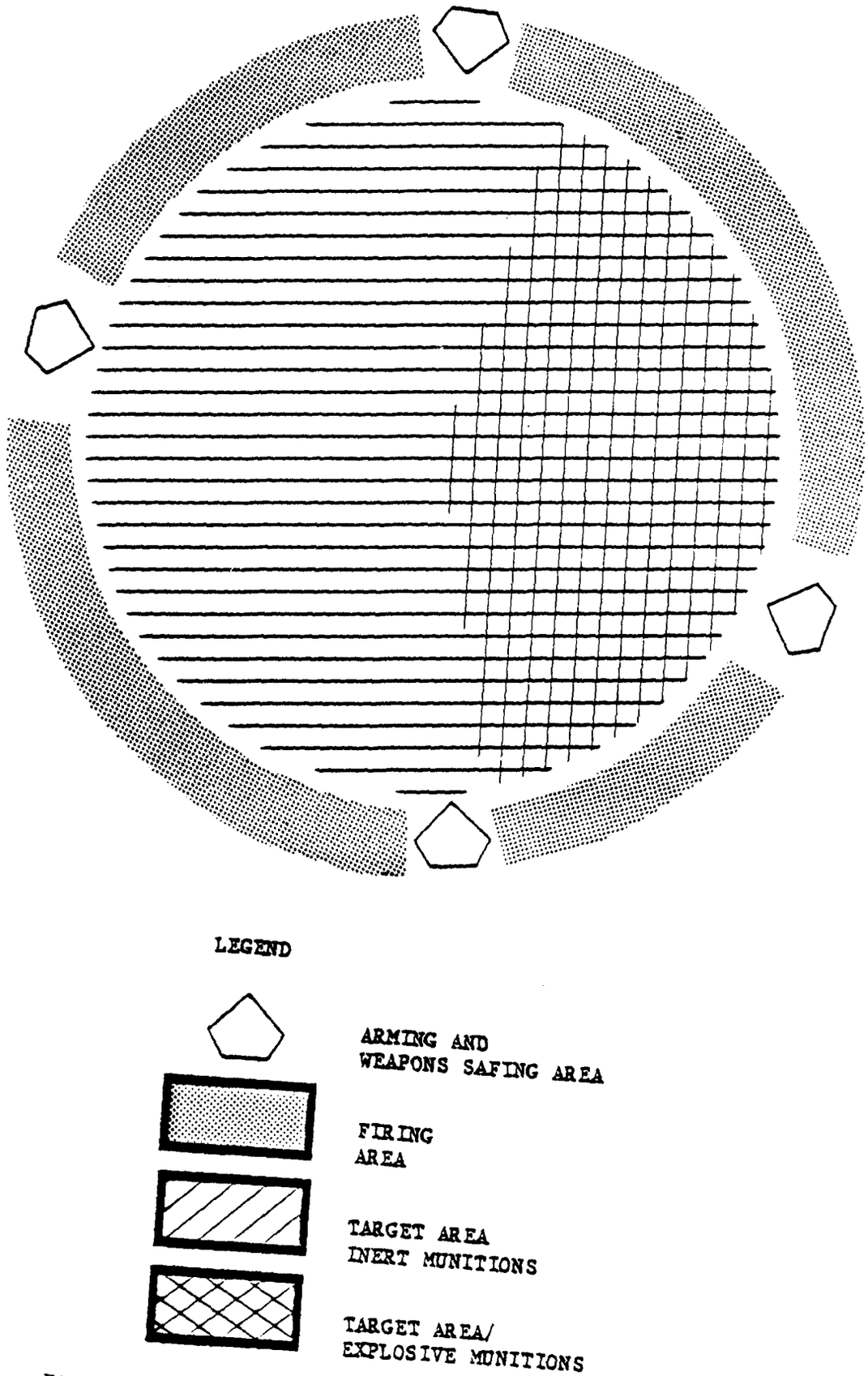

Figure 26. Idealized Floating Aerial Gunnery range.

Table 67

AH-64 Range Requirements
(R = Requirement, C = Criteria, G = Guidance)

Target Area

(G) The commander of the helicopter unit using the range can place targets at ranges and positions wherever he decides those targets will appear in the scenario of his unit's mission in a combat environment.

(C) Target locations are defined in Tables 51 through 64.

(R) A PORTION OF EACH TARGET AREA SHOULD BE EQUIPPED WITH INACTIVE TARGETS LIKE HARD STEEL VEHICLES OR IMMOBILE SILHOUETTES TO PERMIT USE OF HIGH EXPLOSIVE WEAPONS DELIVERY.

(G) High explosive warheads will destroy unprotected downrange target mechanisms. This category includes the HELLFIRE HEAT munition and the 2.75-in FFAR with HE and PMSM warheads.

(C) From 1/3 to 1/2 of the aerial gunnery range target area should be equipped with inactive targets.

(G) Chapter 5 gives guidance on target types and installation.

Manuever/Holding Area

(R) EACH AERIAL GUNNERY RANGE MUST INCLUDE A MANEUVER/HOLDING AREA BEHIND THE FIRING AREA.

(C) The maneuver/holding area must be at least 7 km^2 (for team and combined arms exercises) and 4 km^2 (for individual and crew exercises).

(G) The manuever/holding area should have open areas for emergency landings. These areas should have wheeled vehicle access.

Firing Area

(R) THE FIRING AREA MUST PERMIT THE AIRCREW TO EMPLOY THEIR WEAPONS IN A REALISTIC TACTICAL MANNER. WHEN PLANNING FIRING POINTS, THE PILOT'S TACTICAL CONCERNS MUST BE CONSIDERED AND INCORPORATED AS MUCH AS POSSIBLE.

(G) When selecting a firing point in a tactical environment, the pilot must consider:

1. Position should be at an equal or higher elevation than the target.

2. Terrain features (e.g., trees and hills) should be located behind position so that helicopter is not silhouetted on horizon.

3. Position should be in a shadow area.

4. Firing position should be located so the sun is behind or to the side of helicopter.

5. Position should be located so the effect of rotorwash on surrounding terrain (wires, leaves, snow, dust) is minimized.

6. It should be easy to maneuver to and from the firing position in the area surrounding the firing position.

7. Vegetation surrounding the firing position should allow the helicopter to hover between or beside trees.

(R) THE FIRING AREA MUST BE LARGE ENOUGH FOR AIRCRAFT PREFIRING POSITIONING.

(C) The firing area for individual and crew training must be at least 1000 m wide and 4000 m deep (length).

(G) The above criteria represent only the minimum. When possible, larger firing areas should be allotted.

(C) The firing area for team and combined arms tables must be at least 2000 m wide and 4000 m deep (length).

(G) The above criteria represent only the minimum space requirement. A width of 4000 to 5000 m is preferred.

(R) THE FIRING POSITION(S) AND CEASEFIRE LINE MUST BE PROPERLY MARKED ON THE GROUND FOR ALL FIRING EXERCISES.

(R) FIRING AREAS USED FOR THE INDIVIDUAL TRAINING EXERCISES (TABLES I THROUGH IVB) MUST HAVE THE FOLLOWING GROUND MARKINGS: START-FIRE LINE, NO-FLY LINE, AND RIGHT AND LEFT LIMITS OF FIRE.

(R) ALL GROUND MARKINGS MUST BE VISIBLE BOTH DAY AND NIGHT FROM THE FIRING CONTROL AND SCOUT AIRCRAFT.

(G) When the pilots night vision system is used, ground markings must have a thermal signature which is clearly distinct from the signature of targets.

Rearming and Refueling Area

(R) DURING REARMING PROCEDURES, AIRCRAFT MUST BE ORIENTED TOWARD AN IMPACT AREA OR AN EARTH MASS (HILL OR BERM).

(G) Where the rearming point is not adjacent to an impact area, an earth berm or hill may be used to prevent injury or property damage in the event of an accidental discharge.

(R) THE DISTANCE BETWEEN THE REARM PAD AND THE EARTH MASS SHOULD BE LESS THAN THE MINIMUM ARMING DISTANCE OF THE WEAPON.

(R) THE HEIGHT OF THE EARTH MASS MUST NOT EXCEED THE TAKEOFF CLIMB CAPABILITIES OF THE FULLY LOADED AH-64.

(C) The fully loaded AH-64 requires 10 ft of forward travel for each foot of vertical travel.

(R) REARMING AND REFUELING AREAS MUST BE FREE OF DUST, SMALL GRAVEL, MUD, LARGE ROCKS, TREE STUMPS AND SIMILAR HAZARDS.

(R) WHILE ARMED WITH LIVE MUNITIONS, ATTACK HELICOPTERS MUST NOT ALLOW WEAPONS TO BE ORIENTED TOWARD POPULATED AREAS.

(G) Ideally, the AH-64 should enter the maneuver area armed with enough munitions to complete the firing table. This allows the pilot to conduct the maneuver phase of the firing exercise with a combat load before entering the firing area.

(R) WHEN NEARBY POPULATED AREAS PRECLUDE ARMED MANEUVER, THE AIRCRAFT MST BE ARMED AFTER LEAVING THE MANEUVER AREA BUT BEFORE BEGINNING THE LIVE-FIRE PORTION OF THE TRAINING EXERCISE.

(R) THE ARMING POINT MUST HAVE WHEELED VEHICLE ACCESS.

Weapons Safing Area

(R) A WEAPONS SAFING AREA MUST BE LOCATED ON OR NEAR EACH RANGE.

(G) The rearming area may serve as the weapons safing area.

(R) THE WEAPONS SAFING AREA MUST PERMIT AIRCRAFT LANDING.

(R) THE WEAPONS SAFING AREA MUST NOT BE LOCATED IN A CONTAMINATED (DUD) AREA.

(R) EACH WEAPONS SAFING AREA MUST HAVE AN EXPLOSIVE CONTAINMENT BUNKER FOR TEMPORARY STORAGE OF MISFIRE AND HANGFIRE MUNITIONS.

(G) Bunker construction standards are given in TM 5-1300.

(G) Detailed requirements for rearming and refueling areas are given in FM 5-35. The UH-1D Iroquois (Huey) is about the same length and width (rotor turning) as the AH-64. Use UH-1D area requirements and geometrics for AH-64 planning purposes.

Table 67 (Cont'd)

Parking Area

(R) THE AIRCRAFT PARKING AREA MUST ACCOMMODATE ALL AIRCRAFT IN THE UNIT. THE NUMBER OF AIRCRAFT WILL VARY FROM UNIT TO UNIT.

(G) Requirements for aircraft parking areas are given in FM 5-35. Use UH-1D area requirements and geometrics for AH-64 planning purposes.

Harmonization Range

(G) Harmonization ranges, required for the AH-1G, are not needed for AH-64 facilities.

Earthwork

(R) THE ACTIVE TARGET AREA SHOULD BE EQUIPPED WITH NUMEROUS TARGET EMPLACEMENTS TO ALLOW TARGETS TO BE POSITIONED ACCORDING TO COMMANDER'S MANDATE.

Control Point

(R) EACH RANGE MUST HAVE A CONTROL POINT WHICH CAN BE SEEN FROM THE FIRING AREA.

(G) The control point may be a radio-equipped truck or aircraft parked on a hilltop. On level terrain, a control tower may be necessary.

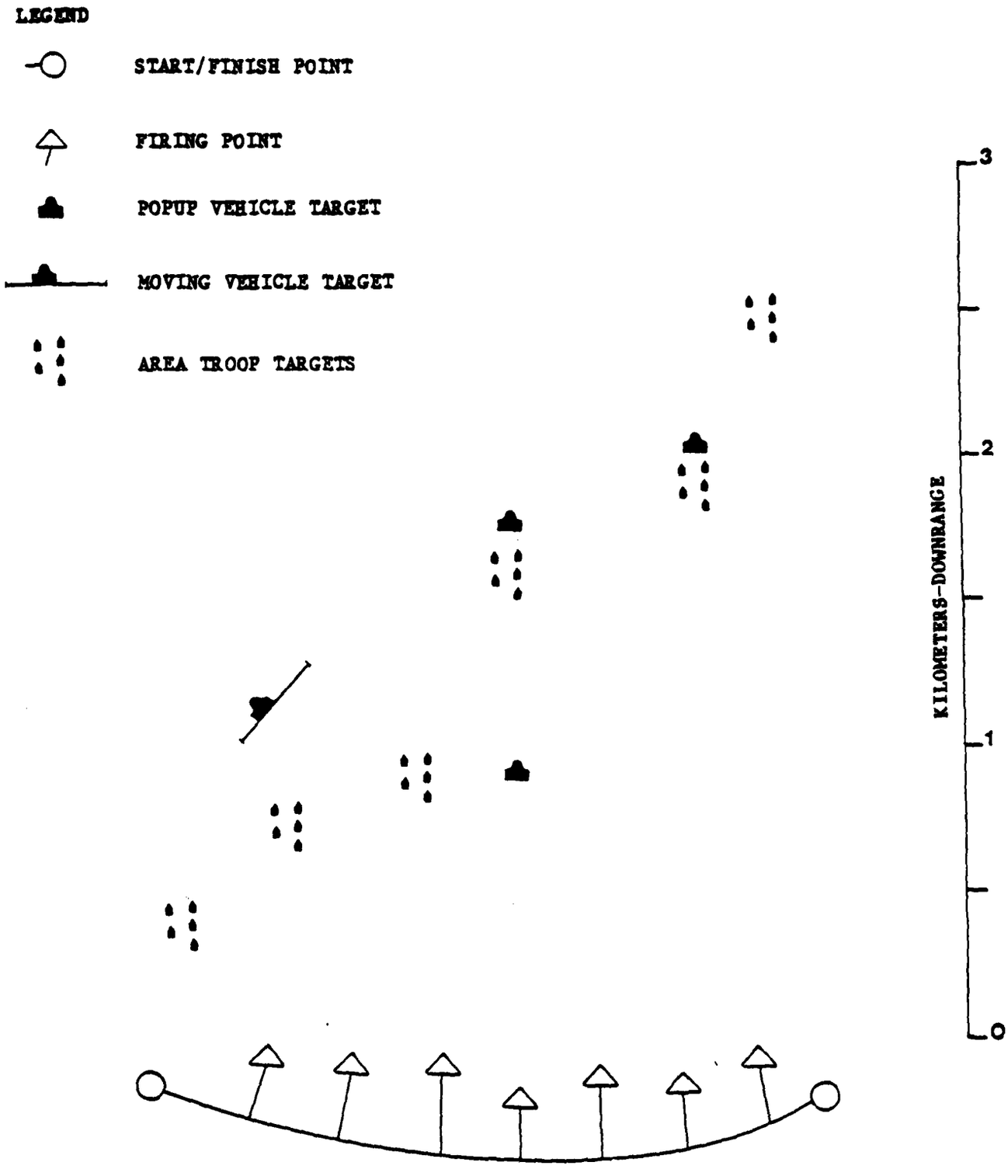

Figure 27. Idealized Aerial Gunnery Complex.

APPENDIX A:

SITE SELECTION

Considerations	Reference	Action
1. SIZE a. What is the dimensional size of the site? b. Is it physically possible to fit all required functions on the usable area?	TC 25-1 AR 210-20 AR 210-30 Installation Base Map	-Locate ranges so that range fans and surface danger areas overlap. -Land area must contain required safety fan. -Utilize unusable terrain as surface danger areas.
2. AIRSPACE a. Can training be accomplished in site airspace with present restrictions? b. Will training include weapons firing in which the maximum ordinate of fire exceeds 45 meters above ground level? c. If so, has the FAA established the airspace as a permanent or temporary restricted area or as a controlled firing area?	AR 95-50 AR 385-63 Airspace Utilization Plan	-Scale range perimeter and overlay on installation base map.
3. ADJACENT LAND USE a. What are the land uses of adjacent property? b. Do they conflict with prooosed site use? Are they complementary? c. Have noise overlays been prepared for proposed site use? d. Will noise produced on site conflict with adjacent land use? e. Will future encroachment of existing land use areas be adversely affected by proposed site use? f. Do existing land uses or future encroachment of existing land use areas create security problems for prooosed training areas?	AR 210-20 AR 420-74 Installation Base Map Reservation Plan Installation Analytical/Environment Assessment report	
4. HISTORICAL a. Did any historical events occur on or in the vicinity of the site? b. Does the site possess archaeological potential? c. Will site development adversely affect any historical or achaeological potential?	TM 5-801-1 TM 5-801-2	-Determine suitability for development
5. FLORA a. Has tree cover been mapped? Can clearing and grubbing be minimized? b. Are endannered species present? c. Do unique habitats exist on site? d. Do cropland, forest land, grazing land, and/or recreational areas exist on site which would be adversely impacted by site develnoment? e. Has ecological degradation caused by site development been considered?	AR 200-1 AR 200-10 CERL Technical Reports: N-110 N-121 General Tree-Cover Plan Installation Analytical/Environmental Assessment Report	-Locate areas least degraded by development -Site development must not disrupt timber or grazing lands.
6. FAUNA a. Are endangered or rare species present? b. Do unique habitats exist on site?	CERL Technical Reports: N-110 N-121	-Site development must not disrupt fishing areas.
7. TOPOGRAPHY a. What is the site topographic configuation? b. Has a slope analysis been prepared indicating slope types of 0-2%, 2-5%, 5-10%, 10-20%, 20-40%, 40%? c. Does slope change enough to present difficulties in circulation routes? d. Do ravines exist which would cut off portions of the site without bridging? e. Will site development require excessive cut and fill? If so, what is the nearest dumping site or source of fill material? f. Do any features worthy of conservation, such as unique outcrops, exist? g. Are snowslides or rockfalls likely?	Defense Mapping Agency Maps Installation Base Map	-Flat/lightly rolling land - best for intensive activity -Slight grades-usable for movement and activity -Steep grades-difficult to move over and line of fire must be perpendicular to high ground -Check for terrain backstops -Target areas must be visible from firing points for direct fire weapons -Seek terrain which slopes down from firing points to targets.

Considerations	Reference	Action
8. CIRCULATION a. What are the modes of transportation to be used to and from site? b. Can bridges between cantonment area and training site accommodate the highest vehicle class used in training? c. What are the existing routes to and from the site? Will training operations conflict with traffic flow? d. Are existing routes, grades, and surfaces acceptable? Are route widths suitable for vehicles and expected traffic volumes? e. What is the direction and time/distance to supporting facilities? Will fuel consumption be a problem?	FM 5-36 General Road Plan	-Determine conflicts -Assess cost/work required to alleviate conflicts -Compare routes with geology/ soil erodibility -Identify road alignment and range-use conflicts -Use of routes between ranges and ammunition supply points must not interfere with facility use.
9. HYDROLOGY a. Where are the existing swales, ditches,and channels? What is their condition and flow capacity? b. What is the general drainage pattern? c. What is the depth of water table during different seasons? d. Where are poorly drained areas? e. Is the site in a flood plain? Will it affect training? f. Is the surface or subsurface water potable? g. Is the site an aquifer recharge area?	AR 115-21 TM 5-700 FM 101-10-1 General Drainage Plan	-Danger signal: high water table or underground streams -Avoid flood plain.
10. LEGAL/SAFETY a. Has site been surveyed by a school-trained safety officer? b. Will the site require any de-dudding? c. Will it be necessary to obtain safety waivers?	AR 385-62 AR 385-63 AR 385-64	-Site development cannot infringe on public health, safety, and welfare
11. GEOLOGY a. What is the bearing capacity of the soil? b. What is the depth of bedrock? Is excessive modification necessary for construction? c. What is the existing state of compaction or settling potential? d. What is the potential for borrow-pit exploitation? e. What is the depth of topsoil? f. What is the depth frost penetration?	USGS Soil Survey TM 5-330 TM 5-332 TM 5-545 TM 5-820-4	-Danger signals: rock close to surface, soft clay, loose silt, fine water-bearing sand, newly filled dumping area, and peat or muck in large areas.
12. FIRE PROTECTION a. Will fire hazards require seasonal range closing? b. If range fires are a potential hazard, are sufficient water supplies, fire-fighting vehicles and staff, and methods of detection available? c. Can fire fighting units reach site quickly in case of accidents? d. Will controlled burning of vegetation be required?	AR 420-90 PAM 420-2	
13. UTILITIES a. Do present lines or easements exist on site? Will it be cost effective to reroute lines? b. Is there a stable water supply? Electrical? c. Do phone lines exist?	TM 5-303 TM 5-660 TM 5-700 TM 5-813-1 through TM 5-813-7 General Utilities Plan	

Considerations	Reference	Action
14. EXISTING STRUCTURES a. Are there any existing structures on site? b. Will they be retained, destroyed, or moved? c. Are cemeteries located on site?	Installation Base Map Building Information Schedule	-Examine costs for building demolition or moving -Select site without cemeteries
15. CLIMATE a. What are the sun angles for the four seasons? b. Do potential sources for glare exist on site? c. How many sunny days per year are there? d. What is the velocity and direction of unfavorable winter winds? e. What is the average annual rainfall? f. How many rainy days per year are there? g. What is the annual snowfall? h. How many days per year does snow cover the ground? i. What is the maximum accumulation? j. What are the seasonal temperature averages? k. What is the average winter day chill factor?	TM 5-785	-Check for locality's suitable orientation to the sun
16. INSPECTION Has an on-site inspection to verify findings and to assess environmental, historical, economic, and operational considerations been completed?		-Look at each site -Features not evident during research but discovered in inspection must be considered when selecting site -Identify similar problem areas -Identify key points, lines, and areas
17. UNINTENDED EFFECTS Examine possible effects of development on site and the surrounding area.	Installation Analytical/ Environment Assessment Report Future development Plans GENERAL REFERENCE: FM 5-35	-Consider land requirement for future growth.

Table A-1

Requirements Checklists

Requirements are statements about what is expected of a facility to support activities, equipment, or personnel. Requirements can be listed for an entire facility, major areas or space types, or for particular spaces or areas.

Requirements can be grouped in many ways. Of course, groups always have some overlap. Requirements vary for different spaces and activities. This list can help you find requirements for particular spaces and the activities, equipment, and personnel in them. It does not give all possible requirements; you may have to add others to suit particular uses.

Space

Requirements in this group have to do with the size, dimension, and shape of spaces.

- Critical dimensions (height, width, and length)
- Shape (rectangular, square, round)
- Clean span (minimum distance between columns or walls).

Access and Circulation

Requirements in this group involve convenient movement of people or equipment within or into a space, the control of such movement, or the movement between spaces. Visual access (seeing in or out) is included.

- Privacy/visibility factors (sound control, visual control)
- Size and type of openings (door width, height, and type; window workings, custom, etc.)
- Control of opening (having a door, locks, etc.)
- Critical distances (horizontal, vertical, for cables, etc.)
- Other functional relationships (access to a dock for forklifts, etc.)

Utilities and Waste

Requirements in this group have to do with support systems which must be built into the facility. You must list the type of system, the capacity or quantity to be handled by the system, limits on its being shut down, tolerance or variance allowed, amounts of and locations for controls, and other performance characteristics.

- Electrical service
- Water (hot or cold)
- Sanitary sewer
- Special sewer or waste system
- Solid waste system
- Special gases or fluids (compressed air, media gases, etc.)

Environmental Conditions

Requirements in this group include conditions needed for human occupancy, performance, comfort, and equipment support. You must list quantitites, capacities, controls, limits, critical locations, etc.

- Lighting (general and task)
- Sound (control, levels)
- Thermal conditions (heating and cooling temperature, cooling, temperature, humidity, air movement, and comfort ventilation)
- Air quality (gases and particulates, dilution and exhaust ventilation, ventilation for hoods and booths)
- Isolation and shielding from radiation, radio signals, etc.

Appearance, Finishes, and Image

Requirements in this group have to do chiefly with the general character of surfaces wanted for image, safety, and the morale of occupants.

Characteristics or type of wall, floor, or ceiling (static-free, washable, nonslip, color, wear and cleaning characteristics, loading or capacity like walls big enough for charts and maps or floors large enough for forklifts.)

Table A-1 (Cont'd)

Communication

Requirements in this group have to do with built-in communications features or components for which supporting wiring or equipment must be included in design.

- Telephone terminals (detailed information usually is collected later in a special telephone survey)
- "Hot" Lines
- TV terminals or receptacles for monitors or cameras
- Microphone and speaker systems

Storage

Built-in storage requirements can be within a space or be a separate space. Requirements are handled easily in standard units of measures.

- Shelving or parts bins (total linear feet, height or number of tiers, special shelf depth)
- Bulk storage (floor area needed, height limits, special dimensions, cubic volume)

Special Features

Requirements in this group include all built-in features and components not listed before.

- Security features (vaults, safes, door locks, window bars, fireproof glass, special wall construction, heavy wire screens for parts storage, fences, etc.).
- Built-in health and safety features (eye-wash fountains, emergency chemical showers, nonskid surfaces, barrier guards, etc.)
- Fire suppression or warning systems
- Lifts, cranes, hoists, elevators ramps, docks, etc.
- Vibration isolation
- Other items important for user satisfaction, morale, or performance.

APPENDIX B:

PDB FOR RANGE PROJECTS

The Project Development Brochure, both PDB-1 and PDB-2, are described in TM 5-800-3. This description is written mainly with buildings in mind. Thus, data about range projects must be added to PDB-1 and PDB-2 to explain the functional and technical requirements important for a range. This appendix suggests ways to do this.

PDB-1, Functional Requirements

1. Cover page. List a project name, and the name and telephone number of the range specialist.

2. Objective. Say why the range project is needed and what training tasks it will be used for. List current and planned use rates.

3. List of occupants. Name the units which will be using the range. List how long and how often the range will be used (by using unit or training task).

4. Space and requirements. List how much land and what support structures are needed on the range. Use units like area (land), quantity (equipment), floor space (buildings), or total length (roads). These data are used to estimate the cost and scope of the project. For each land area or support structure, list the major functional requirements which could change the project's cost and scope. (Also see Table A-1.)

PDB-1, Facility Requirements Sketch

Base this sketch on the draft range layout. Be sure the sketch shows the range relative to the overall site and nearby lands, utilities, and roads.

PDB-1, Documentation Checklist

Add any items important to the range that were left off the checklists given in Appendix A.

PDB-1, Technical Data Checklist

Add items needed to make sure data important to the range project are included.

PDB-2, Functional Requirements

1. Cover page. List a project name, and the name and telephone number of the range specialist.

2. Background information.

(a) Give the objective for the project from the PDB-1.

(b) Give the list of occupants from the PDB-1.

(c) Give a description of operations which explains briefly how the range and support areas will be used.

(d) Add any other information which will help the designer understand the project (mainly details about the project which must be part of the design).

3. Summary data. Because a range will be shared by several units, it is best to organize requirements data by land area and support structure. The "Tabulation of Net Space Needs" will give more details about the ranges, land area and support structures than were listed in the PDB-1. The "Overall Space Relationships" is a drawing (and an explanation) showing the reason behind the arrangement of land areas and support structures on the overall site. "Special Requirements" lists vital design data. "Forecasted Changes and Impacts" can be based on the PDB-1, but must include any new information.

4. Detailed data section.

(a) List the functional requirements and supporting data for each land area and support structure. Land areas may need to be broken down into smaller, named areas. Support structures may need to be broken down into rooms, work areas, storage areas, and other smaller spaces. Because a range is a shared facility, common-use or shared spaces cannot be grouped.

(b) List detailed requirements for each subdivision. Use Table A-1 as a guide to think of different kinds of requirements. Also list the people, activities, and equipment for which the subdivision is needed or that will be found on or in the subdivision.

5. Appendices. Put other information that explains new requirements and which may help the designer into appendices to the functional requirements.

PDB-2, Facilities Requirements Sketch

Update the sketch in the PDB-1.

PDB-2, Documentation Checklist

Update the documentation checklist in the PDB-1.

PDB-2, Design Data Checklist

Update and expand the technical data checklist in the PDB-1. The technical data checklist mainly listed items which could change a project's cost and scope. The design data checklist lists all technical data needed to design a project.

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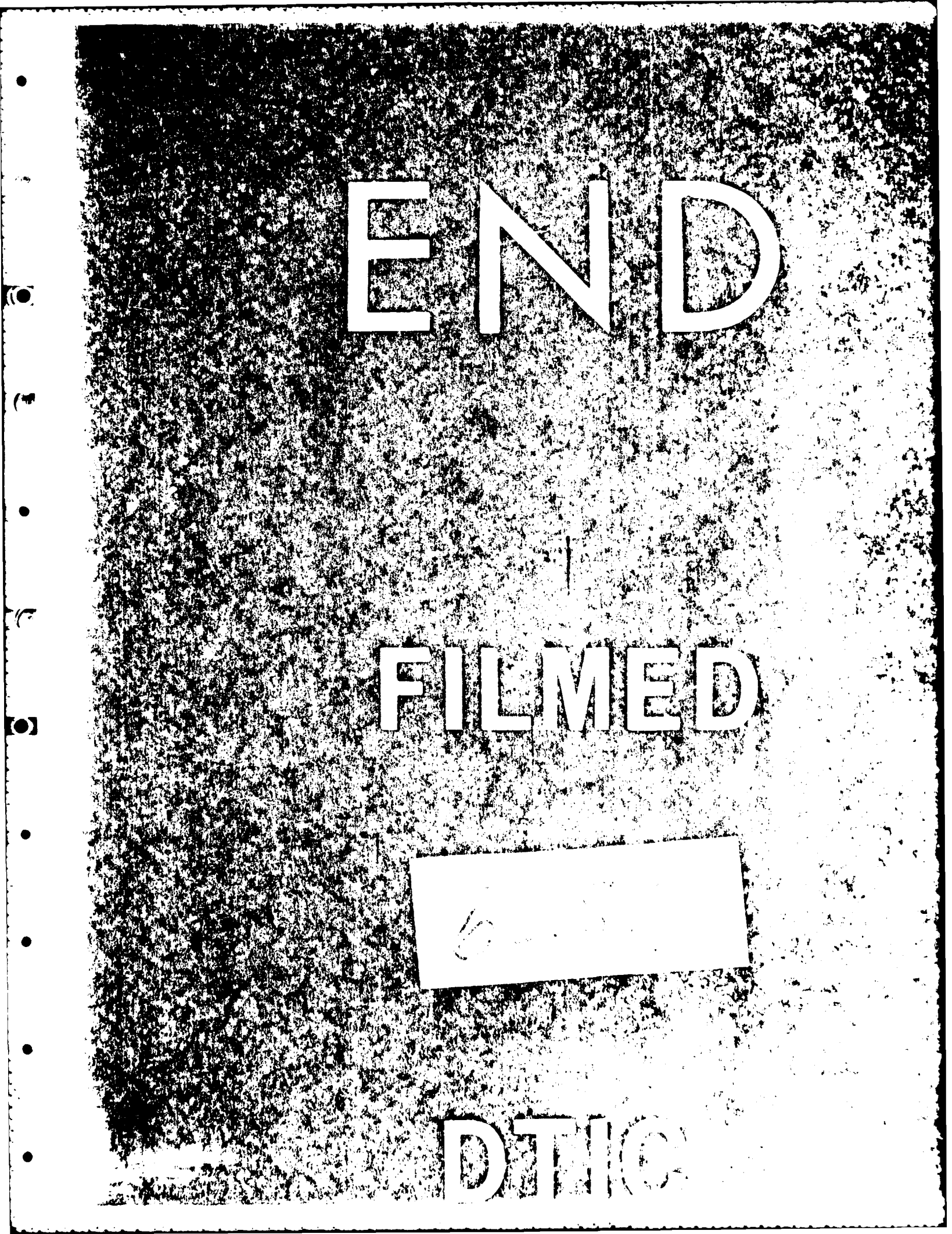
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