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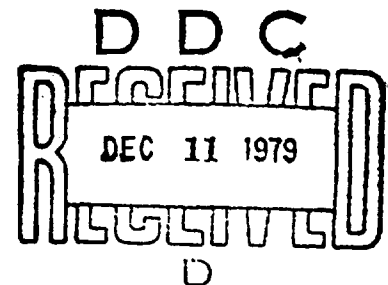
ANALYSIS OF TANK CREW PERFORMANCE REQUIREMENTS FOR MULTIPLE-TARGET ENGAGEMENTS

Elmo E. Miller
General Research Corporation

and

John F. Hayes
Army Research Institute for the Behavioral and Social Sciences

ARI Field Unit-USAREUR



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10 Elmo E. Miller John F. Hayes
General Research Corporation

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Army Research Institute for the Behavioral and Social Sciences

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Submitted by:
William W. Haythorn, Chief
ARI Field Unit-USAREUR

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ANALYSIS OF TANK CREW PERFORMANCE REQUIREMENTS FOR MULTIPLE-TARGET ENGAGEMENTS

1.0 BACKGROUND

✓ This report presents the results of a task analysis of the performances required of a tank crew in accomplishing the revised Tank Crew Qualification Course set up by 7th Army Training Command at Grafenwoehr. This course was recently revised to increase the threat representation of the qualification course.

In conjunction with this revision the ARI Field Unit-USAREUR was requested to develop a training program that would lead to high level performance on this course and be capable of being conducted at home station to the maximum extent possible. This is an especially important consideration in the USAREUR environment where local training terrain is very limited, access to live firing areas is largely restricted to one or two periods a year, and there is a need to insure that tank gunnery skills are maintained at a high level at all times, not just several times a year.

➤ As a first step in the development of such a program, an analysis of the performance requirements of the revised Table VIII was conducted. These were broken down into the major engagements comprising Table VIII and standards set for each engagement. A functional analysis was conducted of the tasks to derive the components of each and the interactions among them. Finally training standards for each component were derived. This procedure provides a multiple dimensional analysis that will support training development and permit training to be organized along either functional or operational dimensions. - 6 pgs

There are several important parameters bounding this training development effort that rather rigidly define its goals and structure. The specific criterion for this training is the new Table VIII as defined in USAREUR Reg 305-704. Training is to be developed that specifically leads to tank crew qualification on that course. Other skills are not to be addressed. It is recognized the current Table VIII does not tap all required gunnery skills; however, the guiding philosophy for this program is to train only what can be objectively tested and to train to standards. It is recognized that this limits the range of tasks to be covered in training to a smaller population that covered in other programs. It is also recognized that the nature of the criterion will change. Table VIII is limited in terms of known gunnery requirements by real world constraints such as funds, terrain, and state-of-the-art device sophistication. Over time this will change and such changes will have to be reflected in training program modifications.

Another feature of the resultant training program is that it is to be a diagnostic program, that is, one that starts with the criterion task and permits performance thereon to prescribe required training. This imposes specialized requirements on the task analysis to insure that the basis for diagnosis is present in the task descriptions to

permit the transition from evaluation to training.

The training program is also to be designed so that training can be accomplished at facilities other than major training areas. In USAREUR all tank qualification firing is done at Grafenwoehr training area. Units typically spend several weeks at Grafenwoehr training on preliminary gunnery tables (i.e. 4-7) immediately prior to gunnery qualification, which constitutes a major portion of their gunnery training. By providing subtask objectives and standards along with training programs that do not require live firing to determine proficiency it is intended to accomplish two goals:

- To provide a basis for sustainment of tank crew gunnery skills at a consistently high level.
- To reduce the time required at MTA for tank gunnery, permitting increased attention to other required skills during that time, and more frequent live firing.

The resultant program from such a prescribed effort, then, will be necessarily limited in application to units operating against the defined criterion under the defined constraints. A further parameter of this effort is that it deals with the M60A1AOS tank only. Thus this program will be only one module, albeit a model one, of an overall tank gunnery program for USAREUR. By having validated task standards, however, training can be managed on the basis of achievement or non-achievement of the standards rather than progression based on elapsed time or the next occurring event.

2.0 GENERAL DESCRIPTION OF REVISED TABLE VIII

The critical characteristic of Table VIII is multi-target engagements. This firing table is defined by USAREUR Reg 350-704 (Draft of 10 May 1976 is the current basis of analysis). The training to be designed is to qualify crews on this table.

Table VIII stresses both speed and accuracy of target engagement, but does not prescribe method (except for safety and minimal administrative requirements). It is thus a performance, rather than process specification. What is desired is the smooth, rapid performance that is characteristic of an athlete. Such performance in virtually any skill requires much repetitive practice, even overlearning (i.e., beyond the period of apparent improvement). Such highly practiced skills are also most resistant to disruption from emotional stress and forgetting.

The performance criteria are also designed to be easily understood, and to be obviously relevant. Complicated formulas were to be avoided, even if they might more accurately assess some nuance of skill.

From the regulation, three distinct (but implicit) levels of priority may be inferred: critically important, important, and discretionary. These are defined as follows:

Critically important. These aspects of performance are reflected directly in the scoring, and also are likely to be a basis of criticism during the critique. (Excerpted from the regulation in Appendix A.) These include target effect (accuracy), first round hits, average time to open. (Total time on the range potentially affects score, but rarely does in fact.)

Important. These are performances of the tank that are likely to be covered in the post-firing critique, even though they are not reflected in the scoring criteria (e.g. firing on a low-threat before a high-threat target in an engagement). These bear a direct and obvious relation to mission performance. Note that these performances of the tank are observable from the outside.

Discretionary. These are performances of crew members inside the tank: the method of performing, including language used, optical instruments used, and type of aiming correction applied to second rounds.

It may be noted (under "Critically Important") that the scoring does not reflect the speed of getting off second rounds, except in total time to negotiate the course. This is theoretically an inappropriate incentive, possibly encouraging crews to dally on the second round. In fact, this does not seem likely to have an appreciable effect upon time, because crews have no incentive to delay unduly. The authors of the

regulation (personal communication) reasoned that time for the second round reflected too many imponderables to be a practicable criterion. Their assumptions will be checked in experience with the firing table, particularly Research Task 3.

The "discretionary" category is also significant here because there is considerable latitude given the crew in method of engagement (i.e., all matters internal to the tank, such as language used or reticle chosen), and this latitude must be reflected in the task analysis, in what it covers, and in what it is not concerned with. This kind of latitude, of course, is distinctly atypical of many military performances in peacetime.

The crew is also given some latitude in using the allocated ammunition, especially for the main gun. Two rounds of main gun ammunition are allocated for each corresponding target. In any particular engagement, main gun rounds will be of the same type, and if there is a first round hit on the first target, there is an extra round for the second or third, which is additional incentive for first round hits. Also, the crew may opt to use more than two rounds for the first target. There may be some transfer of the ammunition allocated across engagements, but these options are very limited, because different types are generally involved, and there are restrictions on type of ammunition for a given target because of safety and possible destruction of moving target mechanisms.

3.0 GENERAL FUNCTIONAL ANALYSIS: TABLE VIII ENGAGEMENT PARADIGMS

Certain functional operations apply in every engagement, and these are described here. These include establishing expectations beforehand, determining threat and mode of engagement for each target, and the general operations involved in each engagement.

First, each engagement should be conceived as an instance of a set (or type) of engagement. Thus, each engagement involves a choice among alternatives (decision making) rather than simply running off a fixed procedure. This is analogous to a math student learning to work a class of problems, rather than the answer to a particular problem, with the particular numbers involved.

3.1 Expectations

Before the engagements begin, the crew, especially the TC, establishes expectations about what they will encounter there, and these govern their training and their performance. Insofar as these expectations match the expected battlefield conditions in important respects, preparation for the tables will be directed appropriately.

The significant advance of the current Table VIII over previous tests, of course, is the expectation of multiple targets. It is still run without other friendly tanks, with the rest of the platoon simulated only to a minimal degree. However, subsequent tables are to be added to cover platoon engagements.

There are numerous inferences the TC and crew can make about the specific configuration of the course, from previous experience with the course, from talking with other crews, and from observing others running parts of the course. These inferences may be collated with the published Reg 350-704 describing each of the engagements, so as to identify most of the specifics of each engagement. When crews are told to preload a particular kind of main gun ammunition, this allows them to determine their institute pop-up targets so as to vary the course from one run to the next, which may alleviate some of the above problems by introducing more surprise into the situations. Some degree of surprise can go a long way in making the performance a decision making process, rather than a matter of running off fixed procedures.

From study of the regulation, a TC and crew can also infer that they will not encounter a missile threat, and, therefore, need not expect to decide between a missile threat and a tank threat. The regulation states "All troops will be assumed to be armed with RPG-7. All BRDMs will be assumed to have no anti-tank capability." (p. A-4). However, since no troops are closer than 400-600 meters, the RPG-7 can be assumed to be totally ineffective.

The only explicit threat comes from tank targets. However, during the critique a crew may be criticized for exposing their vehicle unnecessarily to a generalized, unknown missile threat (e.g. stopping in the open during daylight).

There are other relatively minor limitations common to target range operation. The targets do not really return fire. Drivers face a limited variety of terrain. There is only target detection and no real identification, since all (simulated) vehicles in the given sector are assumed to be hostile.

3.2 Decision elements

Determination of sequence and mode of engagement are routines that recur in each engagement. Thus, these processes may be considered sub-routines that will be part of the general and specific engagement formulations.

These elements should be kept to a minimum, or organized so as to be processed readily, because very limited time is available, and because TCs, in fact, only seem to need to consider the major factors.

3.3 Threat capabilities

The TC and crew open first on the target that poses the greatest immediate threat. Since there is no missile threat among the targets in Table VIII, this will always be a tank, assumed to be a T62. It is not possible, however, to simply sum the threat factors in order to determine sequence of engagement because degree of threat and immediacy are not directly comparable. Where immediacy and degree of threat are opposed, the general rule seems to be to open with the immediate threat, counting upon a quick kill to enable them to engage the other threat. But there is no precise formula or algorithm for combining the factors, and Table VIII was designed so as not to present any such fine discriminations.

The following are major factors:

(1) Range. This is generally the determining factor, on the basis of probability of being hit on the first round.

(2) Direction of gun tube. If the gun tube of the threat tank is pointing in another direction, it will take several seconds to traverse, and own tank can engage another threat in the meantime. Also, the threat tank may not have detected own tank, especially if he is buttoned up.

(3) Limitations of threat weapon systems. This factor may occasionally override the above factors. The T62 has severely limited ability to depress or elevate its gun, so that even a close tank might be discounted in favor of another target. The T62 also can only reload slowly, so that if a threat tank has just fired, it is not an immediate threat, regardless of the direction of its gun.

3.4 Probability of hit (threat vulnerability)

Theoretically one should choose to open with the threat that is more vulnerable, other things being equal. Actually, this seems hardly to be considered, except to re-emphasize the same factors as above. The most important factor generally in hit probability is range, and that would only put extra weight on this factor in consideration of range above. It might be a factor if the threat were in defilade (not in this table).

Probability of hitting the target is also relevant in selecting the mode of engagement (below), because more accuracy is required for more difficult targets. Thus, if the target is at a greater range, or is moving, or is in hull defilade, then own tank is more likely to use precision gunnery and/or stop briefly.

3.5 Mode of engagement

This is the chosen weapon system and method of employment, but it also reflects target type (especially whether hard or soft). These are the major response choices facing the tank crew after choosing a target:

- (1) Main gun
 - (a) Battlesights, stationary
 - (b) Battlesights, moving
 - (c) Precision, stationary
 - (d) Precision, moving
- (2) Coax machine gun
 - (a) area target
 - (b) point target
- (3) Caliber .50 machine gun

(a) area target

(b) point target

First, category interactions should be noted. The caliber .50 machine gun can be aimed independently of the other two weapon systems, and fired concurrently with either. While the coax and main gun can fire concurrently, they must be aimed at the same point.

When employing the main gun, the TC must decide whether to use precision gunnery or battlesights. Although the battlesights method involves a particular aiming point, (center of base of visible mass) the critical factor is that the TC does not use his optical range finder and computer, which would automatically adjust the aiming point of the gunners periscope (but not the telescope). In deciding to use the battlesight method, the TC must first roughly estimate range unaided, to determine whether the target is approximately within range of 1100 meters (for HEAT) or 1600 meters (for SABOT), which is the range at which the ammunition will hit the aiming point, if all equipment is adjusted properly. Even if the TC should be somewhat in error in his range estimate, the error is not likely to be serious: Targets nearer than the range indexed will be hit because the round will hit high, but the trajectory will not carry it over the target, if aiming is accurate. If the target is farther, the round will fall short and second round adjustment (burst on target) is simple, quick, and accurate. Experienced tank commanders are apt to "fudge" on the aiming point a little (which is within their discretion) depending on the estimated range, because they can be reasonably sure that their estimate is not far wrong. For instance, if they estimate the range as 1100 meters with HEAT, they could raise the aiming point a little to try for a probable first round hit (rather than "base of target") confident that the target could not be around 500-600 meters (which is the only case in which the round might go over). Similarly, they might also aim a little higher for targets appearing somewhat beyond 1100 meters. When the target appears well under the maximum range for battlesights, there is little need for the precision method, because of the relatively flat trajectory, and because of the increased target size (in terms of mils). At closer ranges, the use of the rangefinder becomes trivial, unless its use takes appreciable time or another Cal .50 engagement is delayed.

Within the machine gun modes of engagement, a distinction was made between area targets and point targets. This distinction is more critical with the Caliber .50 because it is not a stabilized system, and hence cannot engage point targets satisfactorily while moving, although area targets can be engaged on the move providing the terrain being traversed is not too rough. The coax machine gun, being a stabilized system, can

engage either point or area targets while moving.¹

Perhaps the most significant thing about the above list of response options is the distinctions it does not make; it is a much shorter list than is usual for task analyses of crew duties. For instance, Kraemer, et al.², in distinguishing conditions and levels of engagement, generated 1,699,616 combinations which they reduced to 225 by eliminating those that "did not make sense." That is still many more than are represented in the revised Table VIII. It is highly desirable here to keep the response types minimal because rapid choices are critical and because subsequent analyses may thus be simplified. It is only necessary to make distinctions which reflect the kind of action performed, not those which reflect the degree of difficulty or time required.

3.6 Multi-target engagement paradigm

The contingencies of multi-target engagement are diagramed in Figure 1. Two concurrent processes are distinguished: firing and maneuvering.

3.6.1 Firing. The following points elaborate the considerations involved, keyed by number to the box involved.

(1) The TC is the one most likely to detect the target, but another crew member may detect and pass along the information on the intercom. This would alert the other crew members, who may begin preparing for their required action for that kind of target.

(2) The TC formulates an immediate action plan, which includes, as a minimum, the choice of first target, and mode of engagement. TC chooses

¹It should be noted that the distinction between area and point targets is not a distinction of mode of engagement, as are the other categories. Rather, it often influences the choice of which machine gun to employ, or whether or not to stop the vehicle. The other modes of engagement, although distinguished by weapon system and method of use, also reflect target type and difficulty.

²Kraemer, R. E., Boldovici, J. A., and Boycan, G. G. Job objective for M60A1AOS Tank Gunnery. Army Research Institute Research Memorandum 76-9, April 1976.

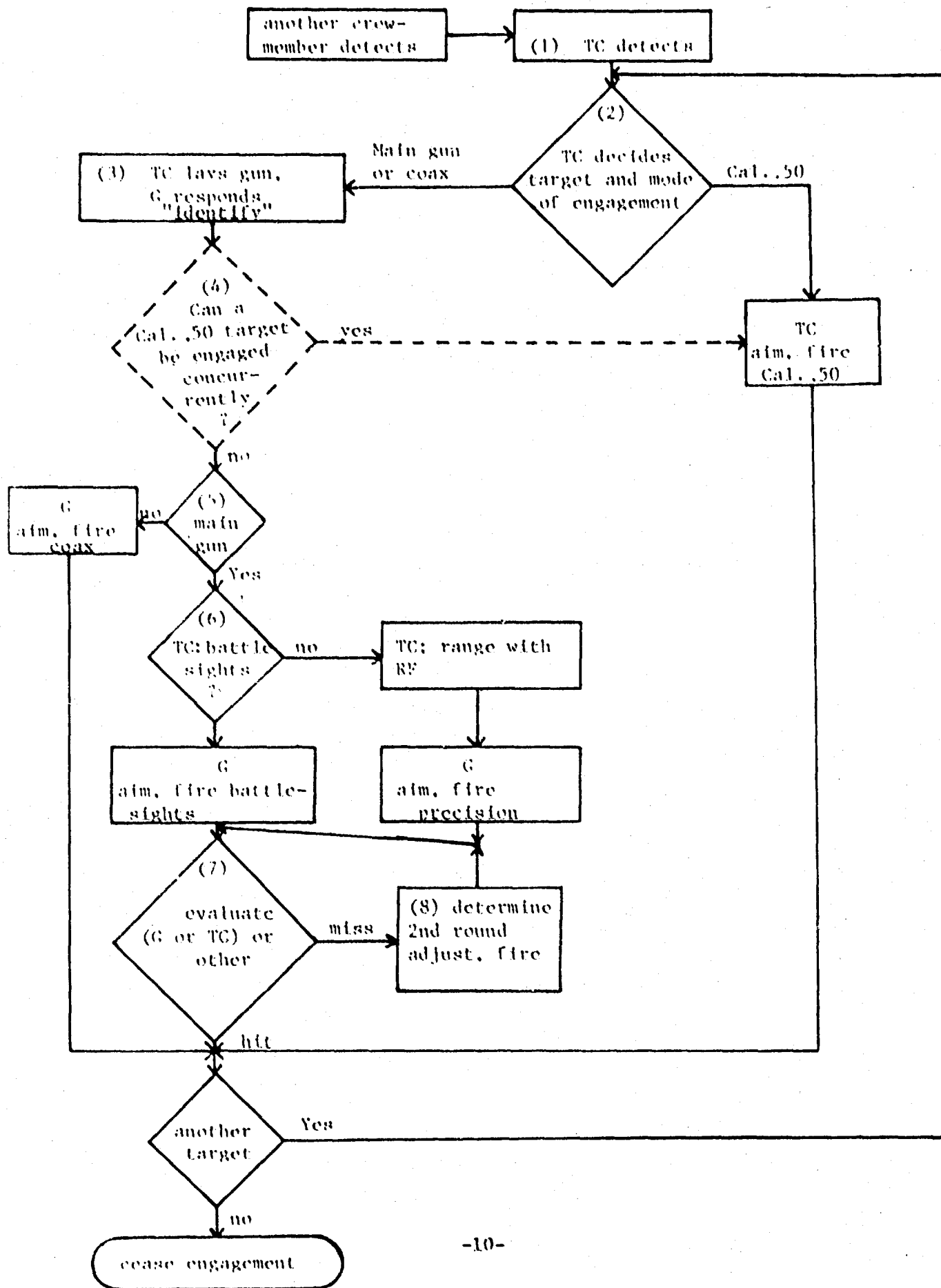


Figure 1. Multi-Target Engagement Paradigm

target by asking whether there is one very high threat target, and engaging that one. He is not expected to make fine discriminations concerning degree of threat (e.g., between a tank at 1000 meters range, gun tube pointed directly at him, and another tank at 800 meters with gun tube pointed a few miles away). Table VIII has been designed to avoid such fine choices, as potential sources of argument.³ The TC generally will have some plans concerning subsequent targets, but he is not required to do so.

(3) Either main gun or coax are laid approximately on the target by the TC using his controls. Mechanically, either the TC or Gunner can perform these and subsequent actions without the other, although the gunner is severely limited in vision. The TC verbally designates the mode of engagement at this time, either explicitly (e.g. "coax") or by implication (e.g. "Sabot" would imply main gun). But only the TC is in a position to use the rangefinder. When the gunner announces "Identify" he assumes responsibility for engaging the target.

(4) If the gunner is well trained and if the engagement is "battle-sights" ("precision" would require TC to use the rangefinder), the TC has the option of leaving the original target to the gunner, and firing the Cal .50 concurrently.

This decision box is drawn with a dotted line because it does not follow the flow chart methodology, strictly speaking. If the TC decides to engage a target with the Cal .50, the gunner will also continue to engage the other target. In that case, the TC, in effect, becomes a separate processor, analogous to assigning the Cal .50 function to another computer.

(5) The gunner selects coax or main gun on the basis of TCs original order (in 2 above) and type of target.

(6) TC ranges with rangefinder, if so stated, in his previously announced plan (under 2 above).

(7) Evaluation of whether the target was hit is normally a duty of the gunner, sometimes with help from the TC. If missed, the gunner also notes any evidence of the kind of miss (e.g. short) so as to make an adjustment, sometimes with help from the TC. The TC may cease engaging

³ It might be advantageous to have such close choices, without calling either choice "wrong", but only criticizing inordinate delay in making a choice. Confronted with such close decisions, with highly aversive overtones, people often "clutch up" and make no response at all, or make an inappropriate combination response that accomplishes nothing. Through practice, the TCs might learn to overcome this tendency.

that target even though not hit, but normally would not do so, unless he is out of ammunition allocated for the target.

(8) The gunner, under command of the TC, applies a correction and fires again. The crew, at its discretion may apply any method of correction it judges appropriate, or combination of methods. Burst on target (BOT) is appropriate only if the first round is sensed.

The determination of second round adjust may be elaborated as shown in the subroutine in Figure 2. This subroutine is for the case of battlesights gunnery (which is similar to, but somewhat more complicated than precision adjustments).

First, assume both vehicles stopped, which is the simple, basic case:

1. If the impact of the round is sensed, burst on target is the most accurate and fastest.

2. If there are any clues from the round or tracer about where the round went, these indicate whether to "drop" or "add", and may sometimes be relevant to the amount of correction (although tracer and round observation are tricky). Note that changes in azimuth are not considered because they are unlikely; not only is the trajectory curve primarily vertical, but also the target is much longer (or wider) than it is high.

3. If there are no clues about the path of the first round, one must choose between "over" and "short", because the correction must be made one way or the other. If it were short, there would have been a fairly good chance of sensing impact, but not if it were over. Therefore, it is more likely to have been over, and the better chance is to adjust fire assuming it was over.

However, another attractive alternative is to use the rangefinder and computer for the second round (especially if the first round was battlesights, which might account for the inaccuracy). The time taken will not affect the score appreciably, and ranging can be done while loading and aiming.

- 4 & 5. The currently recommended method of correction in range is target form rather than "Standard Range Change" (TC 17-12-3). This is not merely a change in language, but has geometric rationale. Assuming that the first round aiming was the best available, and that nothing has happened in the meantime to change that, the most likely area⁴ of passing

⁴ Area in the plane that is at right angles to the line of sight.

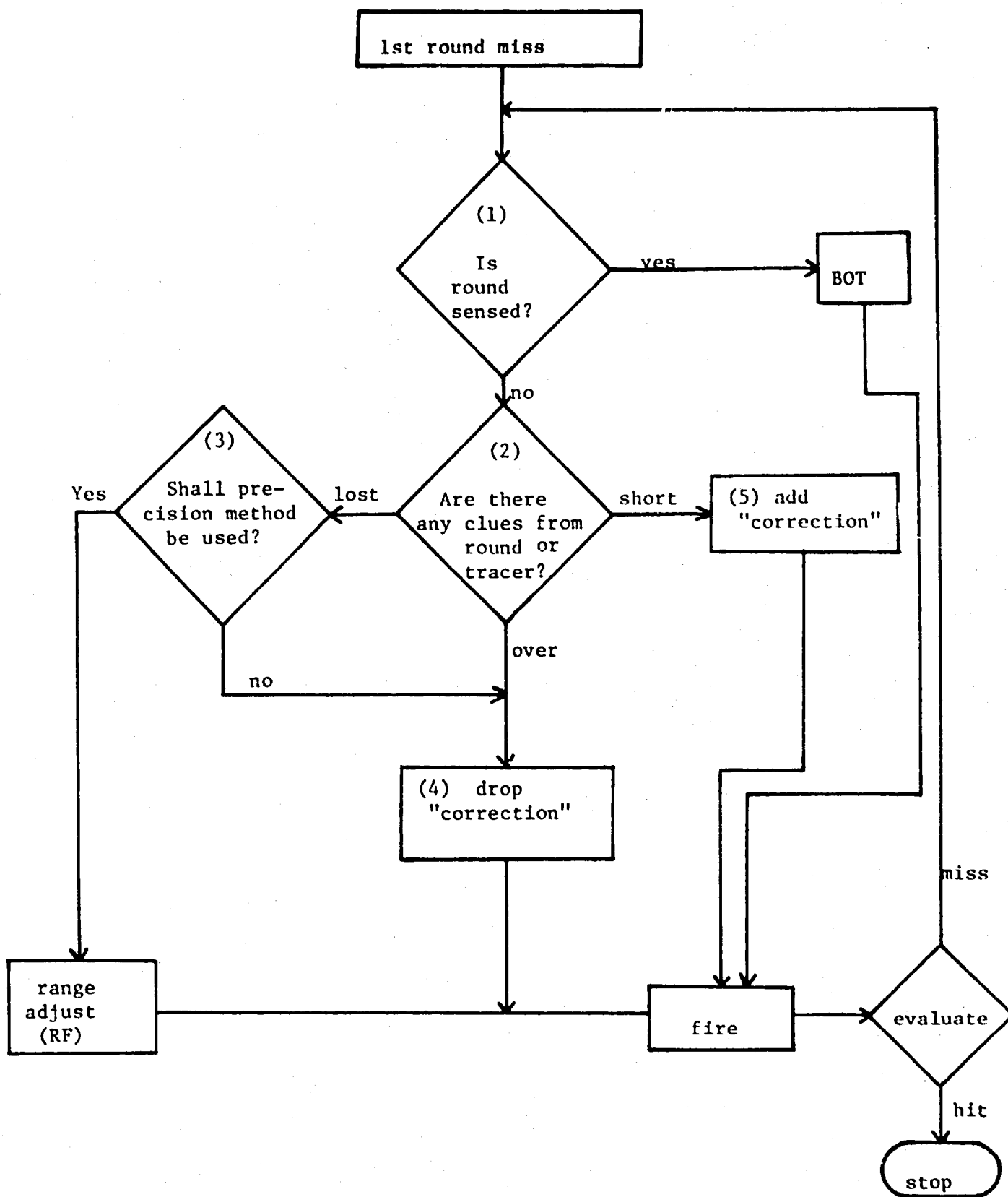


Figure 2. Second Round Adjust

the target is a near miss. Therefore, the best correction is to place that area of the sight picture over the target. There are two kinds of correction in terms of target form that could be argued with some cogency: 1/2 target form, and one target form.

If one assumes that the miss was negligible (i.e., "just a hair"), then by correcting by one half target form, one places that point on the center of mass. This correction is also favored if one is reasonably sure that the miss was no more than 1/2 the target height.

If one is not at all confident of the first round aiming, one might apply a full target form correction, because that places the target miss area over the target for the second round. This correction is especially attractive when dropping, because if the round should fall short, third round correction would be comparatively simple. Probably skillful and knowledgeable gunners, left to their own discretion, would make some compromise correction, perhaps considering also other factors.

Target and/or own tank moving. Although the same paradigm applies, it is complicated considerably by vehicular motion, especially by target motion. As the sight picture changes between firing and impact, BOT becomes impracticable. The sight picture at firing is more dubious because it was only momentary; therefore, any correction measured from the original aiming point is doubly tenuous. (This applies to all "drop" or "add" corrections.) Also, the assumption that azimuth was correct is more tenuous with movement, particularly with moving targets, because of the difficulty of estimating the proper lead.

All of these factors and arguments tend to make precision engagement much more attractive on the second round, by decreasing the feasibility of the other alternatives.

3.6.2 Maneuvering. Maneuvering strategy (Figure 3) is dependent upon the mode of engagement, as well as the tactical situation. It is performed by the driver under the command of the TC, who monitors the action. The TC must divide his attention between this supervision and other duties, and drivers can save him this burden if they know, and are allowed to anticipate, the TC's decisions. There is no particular sequence dependency between the maneuvering and firing programs.

(1) This judgment must be made, not only for the first target, but for subsequent targets in the engagement.

(2) The defilade option is tenable only if there is defilade available. Otherwise, they must resort to continued movement.

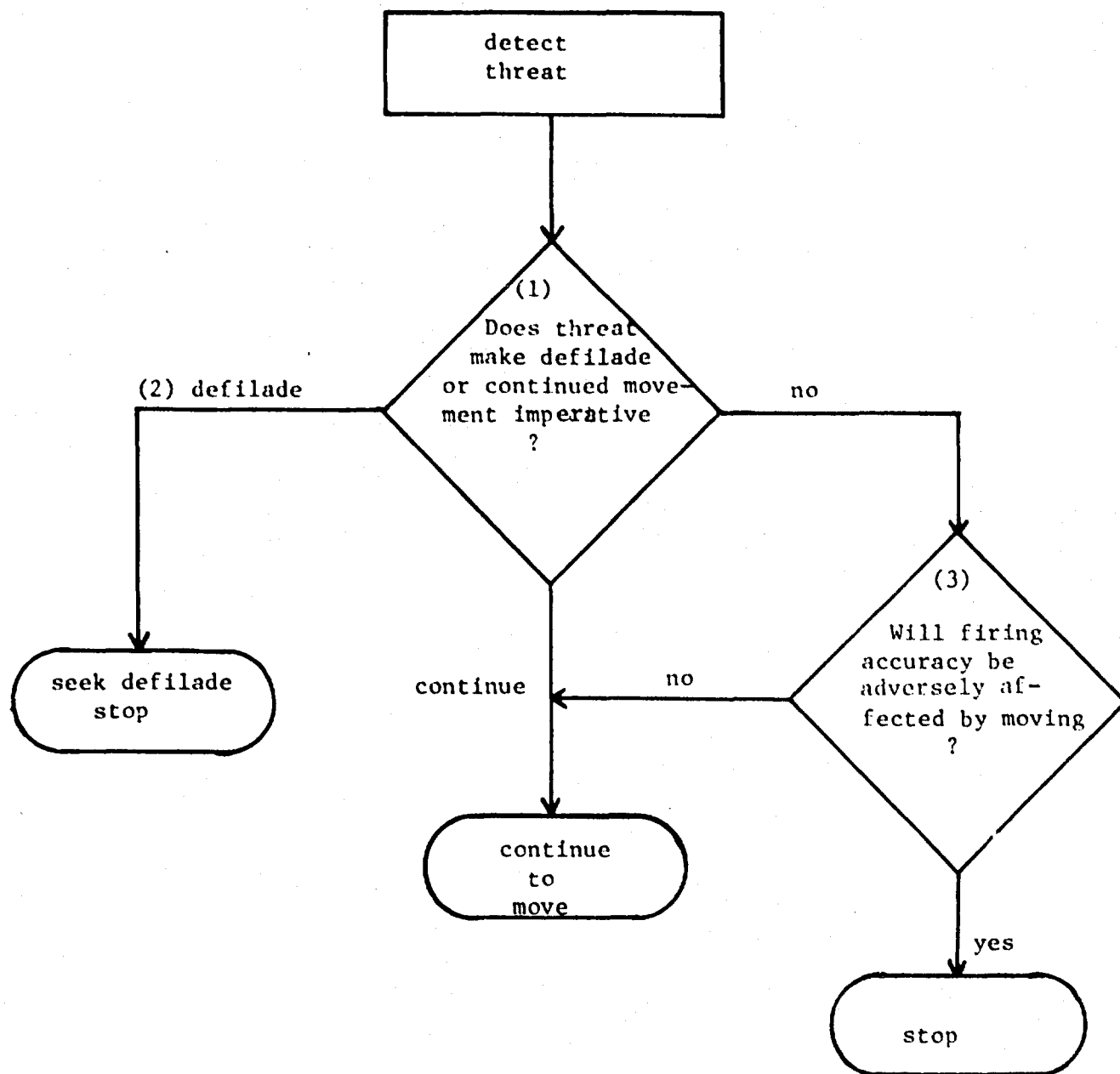


Figure 3. Maneuvering Sub-routine.

(3) Like (1) this must apply to all targets. The driver gets clues from the TC on the first target via his commands. He may also get explicit commands for him (e.g. "driver stop") if the TC has sufficient time.

There are two modes of engagement that are affected greatly by motion even with the stabilized sight: (a) Main gun, precision method⁵, and (b) Cal .50, point target. In addition, Cal .50, area target engagements are somewhat affected, but not so badly that such firing is infeasible.

The effect upon battlesights accuracy is minimal, resulting from some loss of gun system accuracy, and some interference with skilled movements of the crew. However, many crews probably will opt to stop, because of lacking confidence in their skill with the stabilized mode, and because of limited incentives to keep moving during those tables.

3.7 Time saving (without losing accuracy)

The preceding analysis implies certain categories of ways to save time:

(1) Rapid individual functioning. The TC decision making seems especially apt to cause delays, because there are so many functions involved.

(2) Overlapping functions.

(a) Anticipation of TCs decisions by crew. This requires a well trained crew, alert to the cues used by their TC, and able to duplicate his decision making process. Also, the TC may anticipate steps in engaging the next target in a multi-target engagement.

(b) Engaging two targets at once. Possible when one of the targets is engaged with the Cal .50.

(3) Firing while moving. This requires skill, confidence, and consequently, practice.

All these ways of saving time can be facilitated by having a minimum number of decision elements, and a clearly articulated decision process (program) by the TC. Then there can be a minimum number of response types, rather than numerous, vague imponderables.

⁵ The precision method is more affected than battlesights because it is more often used at greater ranges, and because the rangefinder is blurred by the vibration from motion.

3.8 Particular Engagements of Table VIII

This section describes how a tank crew might apply the general paradigms to the particular engagements. Currently, they can apply the particular multi-target engagement types they know from USAREUR Reg 350-704, and probably even infer the sequence of engagement. Later, when pop-up targets require them to prepare for general types, they can practice the very few "type" engagements that are implied by the few threat and response options defined in the preceding section.

A crew is required to "button up" on one engagement, chosen by their unit, and employ NBC techniques (i.e., gas masks, etc.) on one engagement of their choice. Presumably, most crews would chose to use these methods on the simpler engagements (stationary targets, closer ranges, machine guns rather than main gun) to the extent that they can infer which engagements these are in the sequence

The task sequence follows that of Appendix A, where the conditions and standards are described.

Daylight engagements:

"Engage stationary troops and a stationary BRDM." Threat: neither of these targets are an appreciable threat at the range involved. The preferred mode of engagement, according to the instructors interviewed, would be to engage the truck with the coax (stabilized) and the troops (area target) with the Cal .50, without stopping. (The Cal .50 should not be used on a point target, BRDM, while moving because it is not stabilized.) That would minimize time and vulnerability to other weapon systems that might be present. The individual target difficulty is low, so that a skilled crew could be reasonably sure of hitting. However, crew skill would have to be higher for engaging the two targets simultaneously, and there would be great advantage in having this type of engagement planned and practiced so that the driver knows that he is supposed to continue moving unless commander otherwise. This mode of engagement is highly unlikely under the current regulation, because time to engage the second target is not reflected in the scoring.

An alternate mode of engagement is to engage the troops with the coax (stabilized) as the tank comes to a smooth halt, and then immediately engage the BRDM with the Cal .50. Stopping should be brief, especially if no defilade can be found. Coordination and individual skill are not so critical as in the above case, but more critical than in the case below.

Another alternative is to stop for engaging both targets, preferably with the coax engaging the troops (because more rounds of ammunition are

allocated). This would be satisfactory if a defilade position can be found. However, stopping in the open is subject to criticism in the critique, and this mode is more time-consuming than either of the above options.

2. "Engage multiple (2) moving targets." Threat: both targets are threats. If only one target had its gun tube pointing toward own tank, that would be the greatest threat. Otherwise, the closest would be the greatest threat, and therefore the one to engage first. If the terrain would allow one target to go into defilade, that might also be considered.

Preferably both would be engaged with "battlesights," main gun. Also, both targets should be engaged on the move, unless defilade is available. The ranges involved, however, are toward the far limits of battlesights gunnery, and less confident crews might stop and use precision engagement, especially on second rounds; the severity of criticism for such action is likely to depend upon the individual who conducts the critique.

Whatever the mode of engagement, the time and accuracy are very likely to depend upon the crews having previously defined this class (type) of situation and practiced it.

3. "Engage two stationary tanks and one stationary truck." Threat: only the tanks are threats. They are high threats, because they are frontal, and presumably the gun tubes are pointed at own tank. The nearer one is a substantially greater threat because of accuracy at that range. The nearer one should be engaged with "battlesights," on the move (stabilized). The other target is beyond battlesights range and must be engaged precision from the halt, preferably from the best defilade available. If the initial steps of the precision engagement are conducted while halting, the time at a halt while that threat is present can be minimal.

The stationary truck would then be engaged from the halt with Cal. .50.

4. "Engage threat tank platoon (3 tanks)." The near tank (1400 meters) is distinctly the greatest threat, and should be engaged first, battlesights, while moving and seeking defilade. Then the other two targets would be engaged precision, from the halt.

Night engagements:

1 & 2. "Engage a stationary tank utilizing range card data." These are each single target engagements of essentially the same type. They are used to test skill in performing the range card procedures as described in Fm 7-21, Chapter II (June 1975 Draft). There is no particular time stress.

3. "Engage stationary troops and a stationary truck." This is exactly like Daylight Engagement 1, except that darkness reduces vulnerability of own tank. They might fire while moving to save time, but would not be criticized for stopping.

4. "Engage multiple (2) moving targets." This is exactly like Daylight Engagement 2, except that darkness reduces own tank vulnerability. These are appreciably more difficult targets than in 3 above, and with minimal vulnerability, the tank should stop to get maximum accuracy. The choice between battlesights and precision is discretionary.

4.0 TABLE VIII FUNCTIONAL SUBTASKS

This section describes the functional subtasks involved in the engagements of Table VIII. The proposed training objectives for major subtask functions are specified, including both terminal and enabling objectives. They are further analyzed into subfunctions in order to facilitate training development and management (e.g., who does what functions, and under what conditions.) The basis of each task division will be explained at the beginning of each section.

4.1 Basic Engagement

Herein are described the performances required for the basic daytime engagements. It is divided into (1) acquiring target groups, and (2) firing on each target, in order to limit the number of combinations to a manageable number of tasks.

4.1.1 Target Acquisition

Subtask: TC, loader or driver will detect a 2 or 3 target group, announce the types and locations to the TC; the TC will determine engagement sequence and mode of engagement (as defined above) and assign the targets to the gunner, employing standard commands and laying main gun tube approximately on each target.

Conditions: Targets shall be of the following types and ranges:

1. Tank, either moving or stationary, range between 1,000 and 2,000 meters.
2. Troops (area target) between 400 and 900 meters.
3. Point target vehicle (e.g., truck) either moving or stationary, range between 400-900 meters.

Ammunition shall be preloaded. The general target location is known, but the crew must detect the precise location and configuration against terrain background.

Standards: No low threat target shall be engaged before a high threat target. The first target shall be assigned within 7 seconds of exposure, and subsequent targets within 3 seconds of cease fire on previous target. The task is considered completed when the gunner announces "identify." An alternate termination point (for some practice conditions) is when the target appears within the reticle (circle) on the gunner's infinity sight. (This will also place it within the field of view of his periscope.)

For training purposes, the acquisition subtasks may be subdivided temporally into detection and assignment (below), on the basis of who performs the function, and the kind of environment or simulation required.

4.1.1.1 Target group detection

Anyone in the crew may detect the target group, and announce it to the TC. Four seconds are allowed. Natural environment with realistic targets or rather realistic simulation is required for practice.

4.1.1.2 Target assignment

After target detection, the TC determines engagement sequence and lays gun tube (approximate). Three seconds are allowed for first target. This subtask terminates when the gunner announces "identify." An alternate termination point (for some practice conditions) is when the target appears within the reticle (circle) in the gunner's infinity sight.

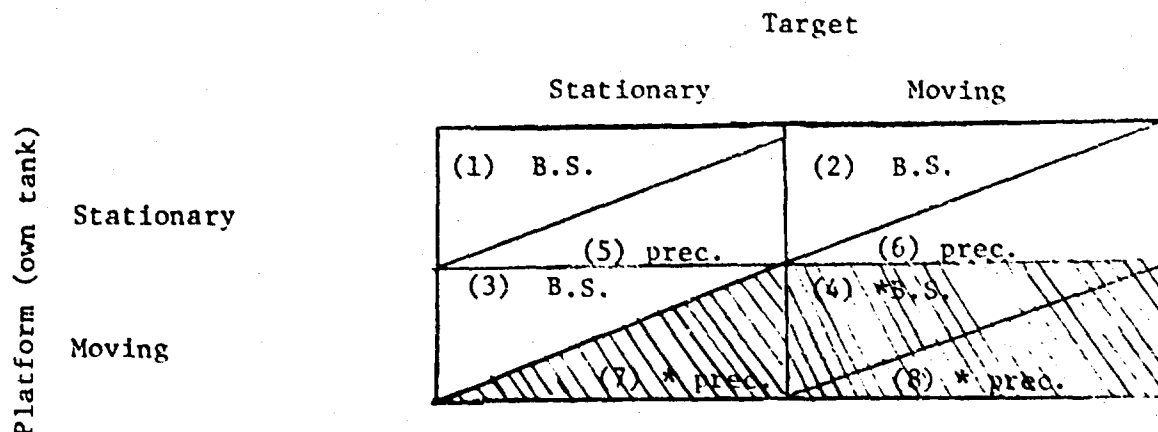
For practice of this subtask the terrain need not be simulated with great realism, except for the range estimation function to determine whether battlesights gunnery is feasible.

4.1.2 Firing

These are the tasks for each weapon system operator (gunner or TC). Concurrent tasks for loader and driver are described in the section after this one.

4.1.2.1 Main gun

The skills to be practiced with the main gun vary significantly for five recommended conditions, as defined below, and therefore may be considered five separate (but highly related) subtasks, and each should be practiced to criterion.



*not generally recommended. (see below).

In all subtasks below, HEAT OR SABOT will be preloaded, preindexed, and BS range preindexed.⁶ Tasks begin when gunner announces "Identify." (termination of the target assignment tasks).

(1) Subtask: The gunner under supervision of the TC, will aim and fire the main gun using BS technique. Subsequent round may be fired using the precision method.

Conditions: Platform and target stationary. Target range 1000-1500 meters.

Standards: First round hit $p=.70$.⁷ Second round (if needed) hit $p=.80$. Opening time 3 seconds (after target assignment).

(2) Subtask: The gunner, under supervision of the TC, will aim and fire the main gun using BS technique. Subsequent rounds may be fired using the precision method.

Conditions: Platform stationary, target moving. Target range 1000 to 1500 meters.

Standards: First round hit $p=.50$. Second round (if needed) hit $p=.60$. Opening time 3 seconds (after target assignment).

(3) Subtask: The gunner, under supervision of the TC, will aim and fire the main gun using the BS technique. Subsequent round may be fired using the precision method, and tank may be stopped.

Conditions: Platform moving, target stationary. Target range 1000 to 1500 meters.

⁶ One should not infer a direct relationship between number of tasks and the importance of the function. For example, there are fewer main gun firing tasks than machine gun tasks, but firing the main gun is undoubtedly more important in training and will consume more time.

⁷ The standards for main gun rounds are stated in probabilities rather than number of hits so that they can be adapted to test runs of various lengths. For "dry" firing the TC may interpret any given probability as that which could be expected of a reasonably skillful gunner under those conditions, and hence, his gunner can be said to pass if the TC could find no fault with gunner's aiming as he views it through the TC periscope.

Standards: First round hit $p=.40$. Second round (if needed) hit $p=.70$. Opening time 3 seconds (after target assignment).

(4) The probability of hitting a moving target from a moving platform at these ranges is so low that it would be prudent to stop briefly when firing. Thus, this task would be converted to task (2). Also, to train on this task to a reasonable standard of accuracy would require an inordinate amount of time, so that the other more critical tasks are apt to be neglected.

(5) Subtask: The gunner will aim and fire the main gun using the precision method. TC will concurrently range using RF.

Conditions: Target stationary, platform stationary. Target range 1000-2000 meters.

Standards: First round hit $p=.70$ (1000-1500 meter range) or $p=.40$ (1500-2000 meter range). Second round (if needed) hit probabilities are approximately the same. Opening time 5 seconds (after target assignment).

(6) Subtask: The gunner will aim and fire the main gun using the precision method. TC will concurrently range using RF.

Conditions: Target moving, platform stationary. Target range, 1000-2000 meters.

Standards: First round hit $p=.50$ (1000-1500 meter range) or $p=.30$ (1500-2000 meter range).⁸ Second round (if needed) hit probabilities are approximately the same. Opening time 5 seconds (after target assignment).

(7&8) It is generally recommended that, if using the rangefinder is advisable for accuracy, then it is also worth stopping for accuracy. This is especially true of greater ranges (1500-2000 meters) where hit probability from a moving platform is very low. Also the vibration from moving makes the ranging optics ineffective, so as to preclude this mode of engagement.

4.1.2.2 Coax machine gun

Area targets require different technique from point targets. For area targets, the technique is also affected by platform motion. Also, area targets do not move, but point targets may move. For point targets, movement of either platform or target requires lead as well as concentrated fire. The stabilization makes it feasible to fire the coax at point targets while moving (unlike the Cal. .50) although platform motion does make the task more difficult. In consideration of those factors, the following are distinguished as subtasks:

⁸ Not encountered in Table VIII.

		Target		
Platform	Stationary	Area	point stationary	point moving
	Moving	(1)	(2)	(3)
		(4)	(5)	(6)*

*not generally recommended (see below)

(neither task 3 nor task 6 are encountered in Table VIII)

The subtask begins when TC completes rough lay (within reticle circle.)

- (1) Subtask: The gunner will fire on an area target with the coax.

Conditions: Platform stationary, range 400-900 meters.

Standards: 3/5 area coverage with 100 rounds. Open within 2 seconds (after target assignment).

- (2) Subtask: The gunner will fire on a point target with the coax.

Conditions: Platform and target stationary, range 400-900 meters.

Standards: Target effect with 100 rounds. Open within 2 seconds (after target assignment).

- (3) Subtask: The gunner will fire at a point target with the coax.

Conditions: Platform stationary, target moving. Range 400-900 meters.

Standards: Target effect with 100 rounds. Open within 2 seconds (after target assignment).

(4) Subtask: The gunner will fire on an area target with the coax.

Conditions: Platform moving, range 400-900 meters.

Standards: 3/5 area coverage with 100 rounds. Open within 2 seconds (after target assignment).

(5) Subtask: The gunner will fire at a point target with the coax. (Technique will be similar to task 3, in that it involves both concentrated fire and maintaining a lead.)

Conditions: Platform moving, target stationary. Range 400-900 meters.

Standards: Target effect with 100 rounds. Open within 2 seconds (after target assignment).

(6) The difficulty of hitting a moving target from a moving platform, even with a stabilized system, is sufficiently great so that this is generally not a prudent mode of engagement. It is better to stop briefly, making it subtask 3. Also, training to reasonable standards would take inordinately long.

4.1.2.3 Cal. .50

The following conditions are distinguished as subtasks:

		Target		
		Area	point stationary	point moving
Platform	Stationary	(1)	(2)	(3)
	Moving	(4)	(5)*	(6)*

*not generally recommended (see below)

(neither subtask 3 nor subtask 6 is encountered in Table VIII).

- (1) Subtask: The TC will fire on area target with the Cal. .50.

Conditions: Platform stationary, range 400-800 meters.⁹

Standards: 3/5 area coverage with 50 rounds. Open within 2 seconds after decision and weapon pointing near target.

- (2) Subtask: The TC will fire on a point target with Cal. .50.

Conditions: Platform and target stationary, range 400-900 meters.

Standards: Target effect with 50 rounds. Open within 2 seconds after decision to engage, platform stationary, and weapon pointing near target.

- (3) Subtask: The TC will fire on a point target with the Cal. .50.

Conditions: Platform stationary, target moving. Range 400-900 meters.

Standards: Target effect with 50 rounds. Open within 2 seconds after decision to engage, vehicle stopped, and weapon pointing near target.

- (4) Subtask: The TC will fire on area target with the Cal. .50.

Conditions: Platform moving, range 400-900 meters.

Standards: 3/5 area coverage with 50 rounds. Open within 2 seconds after decision and weapon pointing near target.

(5&6) Since the Cal. .50 is not a stabilized system, platform motion makes tracking more difficult, to such an extent that it is dubious practice generally to engage point targets while moving if other modes of engagement are feasible.

(7) This mode of engagement is generally not recommended for Table VIII (and therefore does not constitute a requirement) because it is preferable to employ the stabilized coax or come to brief stop, and because the high degree of skill to achieve comparable accuracy would be unnecessarily stringent.

⁹ Although the range of this weapon is considerably greater it is not required for Table VIII, and accuracy at extended ranges would be an unnecessarily stringent standard for present purposes.

4.1.3 Concurrent tasks for loader and driver

The loader and driver perform their basic tasks during engagement (described below) subordinated to the engagement modes (described above).

4.1.3.1 Loader

Subtask: The loader will reload the main gun for subsequent rounds with the same kind of ammunition as for the initial round of each engagement and announce "up", standing clear of the main gun as it is fired, until TC announces cease fire.

Conditions: none

Standards: Round loaded and "up" within 3 seconds of initial firing.

4.1.3.2 Driver

Subtask: The driver will seek defilade as available. He will continue moving or stop smoothly in response to orders of the TC. At the option of his TC, he will anticipate from the announced mode of engagement whether to stop or continue moving, according to a schedule pre-arranged with his TC, unless ordered otherwise in particular instances. The following schedule is suggested:

Main gun, battlesights: continue moving for first round, then stop.

Main gun, precision: Stop.

Coax: Continue moving unless target moving. Stop for moving target.

Cal. .50: Continue moving.

Night: Stop under all conditions.

Conditions: none

Standards: Within 2 seconds of relevant part of TC command, initiate response.

4.1.4 Contingency subtasks

These are subtasks that are not normally performed, but must be under certain circumstances (generally a malfunction of one of the subsystems) either by fixing it or resorting to an alternate system. Not all possible subtasks of this category are described, but rather only those that occur

frequently, and thus bear a demonstrable relation to mission performance.

4.1.4.1 Corrective action

(Subdivided by weapon system).

4.1.4.1.1 Main gun

Subtask: In the event of a misfire, the crew will apply three triggers. Then they will wait two minutes (only if there is a hot tube) rotate the round, lay on target again and attempt to fire.

Conditions: misfire

Standards: complete misfire procedure in 15 seconds, or, in the case of a hot tube, 3 minutes.

4.1.4.1.2 Coax machine gun

(1) Subtask: Immediate action. Loader will recharge weapon and gunner will try again to fire it.

Conditions: weapon does not fire.

Standards: Completed within 5 seconds of stoppage.

(2) Subtask: Secondary corrective action. Loader will charge the weapon, lift the cover, check the feed tray (if there is a jammed round use extraction tool to remove it), close the cover. Gunner will try again to fire it.

Conditions: immediate action (above) does not reduce the stoppage.

Standard: complete within 10 seconds of unsuccessful immediate action (25 seconds if there is a jammed round.)

(3) Subtask: Change barrels. Loader will change barrels on the coax.

Conditions: above action does not reduce stoppage or hot barrel requires change.

Standards: within 5 seconds after command, or after above alternatives have been tried.

(4) Subtask: Disassemble, assemble. Loader will disassemble and assemble the coax machine gun, locating any malfunction.

Conditions: Coax that does not fire, and does not clear with recharging and attempted refire.

Standards: four minutes or less.

4.1.4.1.3 Cal. .50 machine gun

(1) Subtask: Immediate action. TC will recharge weapon and try again to fire it.

Conditions: weapon does not fire.

Standards: Completed within five seconds of stoppage.

4.1.4.2 Alternate method of performance

These should be developed so that the crew can perform if the other instruments malfunction, or if for any reason it is desired to go to an alternate mode.

4.1.4.2.1 Alternate sight

Subtask: The crew will engage a hard target with the main gun with the gunner using his telescope.

Conditions: Primary sight or computer is inoperable. Platform stationary, target stationary. Range 1000-1500 meters.

Standards: First round hit $p=.60$. Second round hit $p=.70$. Opening time 5 sec after target assignment.

4.1.4.2.2 Rangefinder (RF) inoperative

Subtask: The crew will engage a hard target with the main gun, with the TC estimating range.

Conditions: RF optics inoperative, target stationary, own vehicle stationary, range 1000-1500 meters.

Standards: First round hit $p=.30$. Second round (if needed) hit $p=.50$. Opening time 5 sec (after target assignment.)

4.1.4.2.3 TC fires main gun

Subtask: The TC fires main gun at a target from his position.

Conditions: Target moving, platform stationary. Range 1000-1500 meters. Assume gunner cannot identify, or for some other reason TC needs to fire.

Standard: First round hit $p=.40$. Second round (if needed) $p=.50$.
Opening time 5 seconds (after target assignment and decision made.)

4.2 Special Variations of Basic Engagement Methods

The crews must be able to perform their functions under special conditions, particularly at night and under special environments.

4.2.1 Night Operations

Crew must be able to prepare and use a range card as well as conduct regular engagements at night.

4.2.1.1 Prepare and Use a Range Card

4.2.1.1.1 Preparation

(Not encountered in Table VIII).

Subtask: The crew, under supervision of the TC will prepare a range card and stake out a firing position.

Conditions: Range 1000-1500 meters.

Standards: 30 minutes

4.2.1.1.2 Firing from Range Card

Subtask: Move into staked position and use range card to fire on target at night under illumination by direct white light or IR. (covered above under "4.0 Engagement tasks").

4.2.1.2 Engage multiple targets at night. (Covered below, under "5.0 Operational tasks").

4.2.2 Special environments

4.2.2.1 NBC

Subtask: One multi-target engagement will be selected and conducted crew wearing protective masks. (Covered below, under "5.0 Operational tasks").

4.2.2.2 Buttoned up

Subtask: One multi-target engagement will be selected and conducted with all hatches closed. (Covered below under "5.0 Operational tasks").

4.3 Critical subskills (enabling objectives)

Certain skills may be analyzed out of the total task and trained separately on lower cost equipment or under more feasible circumstances. Listing these will be useful for developing interviews concerning current training practices, and for developing subskill training. However, the conditions and standards are not needed at this time, and they often depend upon the task simulation chosen for training; hence, they are not included here.

4.3.1 Detection of target groups (TC, loader, driver)

4.3.2 Range estimation (TC)

Accuracy sufficient to determine whether target is within BS range. Also, great accuracy of estimation is desirable so that crew may operate without RF when it is inoperative or when extreme haziness renders RF ineffective. Standards for such estimation would depend upon doctrine, which has not been established.

4.3.3 Target tracking

4.3.3.1 Gunner and TC (Main gun, coax)

4.3.3.2 TC (Cal..50)

4.3.4 Firing simulation, main gun (Gunner and TC) including dry firing and subcaliber firing

4.3.5 Ranging with RF (TC)

4.3.6 Subsequent round adjustments (Gunner, sometimes with assist from TC)

This category includes all of the techniques for aiming subsequent rounds if the first round does not destroy the target. These techniques are discussed here, rather than under firing the main gun, because they are discretionary techniques (methods) rather than functions (the adjustment to be achieved). Consideration of these techniques also is complex because they are highly contingent on the outcome of the previous round (not only whether it destroyed the target, but also the kind of clues it produced, including impact and tracers, and whether these were sensed by the gunner or by the TC.) The important adjustment techniques are burst on-target (BOT) and target form (TF). The older "standard range change" method is somewhat less accepted by authorities today (e.g., FM17-12). The gunner should also be able to respond correctly to standard corrections in terms of mils and range. (If using the telescope, which has a ballistic reticle.)

The gunner and TC should also be experienced in going to an alternate mode of engagement (particularly precision after battlesights) when the round is lost or doubtful.

4.3.7 Loading main gun (loader)

4.3.8 Driver tactical response (driver)

Seeking defilade, maintaining stable platform, stopping or continuing to move in anticipation of commands.

4.3.9 Communication within the tank (all crew members)

4.3.10 Night operations

Particularly driving with IR (driver) and general duties under reduced lighting (all crew members).

4.3.11 Procedural drills

These may divide mission performance various ways, so that the cues from the natural environment are omitted or minimally simulated. These are especially effective early in training, in preparation for practice with more complete simulation.

4.4 Critical preparatory operations (off the gunnery course)

These are to be justified in terms of their contributions to mission performance (i.e., accounting for a substantial incidence of failures on the course) and hence are discussed last (even though they are the first to be performed).

4.4.1 Main gun adjustments (crew under direction of TC)

4.4.1.1 Boresighting main gun

4.4.1.2 Zeroing main gun

4.4.2 Coax (loader)

4.4.2.1 Boresight and zero

4.4.2.2 Disassemble, assemble

4.4.2.3 Load

4.4.3 Cal. .50 (TC)

- 4.4.3.1 Boresight and zero
- 4.4.3.2 Disassemble, assemble
- 4.4.3.3 Load
- 4.4.4 Adjust track (Crew under supervision of TC)
- 4.4.5 Synchronize fire control systems (TC, drew on synchronization ramp)
- 4.4.6 Pre-combat checks, start vehicle (crew).

5.0 OPERATIONAL TASKS COMPRISING TABLE VIII

For purposes of performance testing of crews, the whole Table VIII may be considered as a task, or divided into the component engagements. When considered one task, the published standards apply. However, when each engagement is considered a task, certain adjustments must be made. Most apparent is the need to adjust total hits and average time to open, so as to be applicable to single engagements. Also, the special environments (NBC, buttoned up) must be applied to particular engagements. Finally, meeting the standards requires repetition of each engagement, because isolated engagements are unreliable measures of performance (i.e., they depend too much upon chance.)

Before considering the task descriptions for each engagement, one should be cautioned against interpreting them too literally as functional (i.e., diagnostic) categories. Unsatisfactory performance on an engagement may indicate a need for practicing that engagement, or a need for practicing some component skill, or both. Skill diagnosis is discussed in section 5-2.

The following are component engagement tasks of Table VIII:

5.1 Task. Engage multiple machine gun targets (troops, BRDM) with both the coax and the Cal. 50 during daylight.

Conditions.

(1) Targets: One infantry squad (10 type E) tactically dispersed, at 400-600 meters.

One BRDM (without missile capability) at approximately 750 meters.

(2) Ammunition. 100 rounds of 7.62 mm, 50 rounds of Cal..50 allocated, preloaded (for each engagement).

(3) Firing tank motion: Initially moving

(4) Initiation of engagement: Upon issuance of command by platoon leader.

Standards.

(1) Time: Open within six seconds. Total time 40 seconds or less.

(2) Effect: 3/5 area coverage on troops. Target effect on BRDM.

Functional Components¹⁰

Target Acquisition (4.1.1)
Coax machine gun (4.1.2.2)
Cal. 50 (4.1.2.3)
Corrective action, Coax (4.1.4.1.2)
Correction action, Cal. .50 (4.1.4.1.3)

5.2 Task. Engage multiple (2) moving tank targets with the main gun during daylight.

Conditions.

(1) Targets: One tank panel (flank) moving perpendicular to the line of sight. One tank panel (frontal) moving directly toward or away from firing tank. Both concealed before engagement, with movement started simultaneously. Range 1100-1400 meters, speed 10-15 mph.

(2) Ammunition: 3 rounds, allocated, first round preloaded (for each engagement.)

(3) Firing tank motion: Initially moving. Should stop to engage.

(4) Initiation of engagement: Upon command of platoon leader or activation of main gun blast simulator near target.

(5) Other. All crew members will wear protective masks for 30 seconds prior to and during engagement.

Standards.

Successful engagement:

(1) Time. Open within 8 seconds.

(2) Effect. Both targets hit.

Task standard. Two successful engagements out of three.

¹⁰ After each engagement task the functional components (subtasks) from section 4.0 are referenced. The concurrent tasks of loader and driver (4.1.3.1) and 4.1.3.2) are applicable to all eight engagement tasks and therefore are not mentioned explicitly.

Functional Components:

Target acquisition (4.1.1)

Main gun: (2) BS or (6) precision (4.1.2.1)

Corrective action, main gun (4.1.4.1.1)

Special environments, NBC (4.2.2.1)

5.3 Task. Engage multiple (2) tank targets with the main gun and one BRCM with Cal. 50 during daylight.

Conditions:

(1) Targets. One tank panel (frontal) at 1400 meters. One tank panel (frontal) at 1900 meters. One truck (without missile capability) at 700 meters. All targets will be concealed prior to engagement.

(2) Ammunition. 3 rounds main gun allocated, first round preloaded. 50 rounds Cal. .50 allocated, preloaded (for each engagement).

(3) Firing tank motion. Initially moving.

(4) Initiation of engagement. Upon command of platoon leader or activation of main gun blast simulator near a target.

(5) Other. All hatches will be closed and crew members will wear protective masks 30 seconds prior to and during engagement.

Standards:

Successful engagement.

(1) Time. Open within 8 seconds.

(2) Effect. All targets hit.

Task standard. Two successful engagements out of three.

Functional Components

Target acquisition (4.1.1)

Main gun: (1) BS, (3) BS, moving cr (5) precision (4.1.2.1)

Cal. .50 (4.1.2.3)

Corrective action, main gun (4.1.4.1.1)

Corrective action, Cal. .50 (4.1.4.1.3)

Special environment, NBC and Buttoned up (4.2.2)

5.4 Task. Engage multiple (3) tank targets with the main gun during daylight.

Conditions:

(1) Targets. One tank panel (frontal) at 1400 meters. Two tank panels (frontal) at 1900 meters. All targets concealed before engagement, displayed simultaneously.

(2) Ammunition. 5 rounds main gun allocated, first round preloaded (for each engagement).

(3) Firing tank motion. Initially moving. Required to fire first round moving, may stop subsequently.

(4) Initiation of engagement. Upon command of platoon leader or main gun blast simulator near target.

(5) Other. All hatches will be closed 30 seconds prior to and during engagement.

Standards:

Successful engagement.

(1) Time. Open within 8 seconds.

(2) Effect. All targets hit.

Task standard. Two successful engagements out of three.

Functional Components

Target acquisition (4.1.1)

Main gun: (3) BS, moving and (1) BS or (5) precision (4.1.2.1)

Corrective action, main gun (4.1.4.1.1)

Special environments, buttoned up (4.2.2.2)

5.5 Task. Engage one stationary tank target with the main gun utilizing the range card to direct lay technique, at night under direct white searchlight illumination.

Conditions:

(1) Target. One tank panel (frontal) selected from seven or more, distributed at ranges of 1000-1200 meters. These will be represented on prepared range card.

(2) Ammunition. 2 rounds main gun, first round preloaded (for each engagement.)

(3) Firing tank motion. Stationary. Moved into prepared, staked position prior to engagement.

(4) Initiation of engagement. Preparatory phase (in which data are applied to the fire control system) is initiated when prepared data for one target is given and upon command. (After the data are applied to the gun, the TC reports to the platoon leader.) The engagement itself is initiated when searchlight is turned on the target tank.

(5) Other. All crew members will wear protective masks for 30 seconds prior to and during engagement.

Standards:

Successful engagement.

(1) Time. Data applied within 25 seconds. Open within 5 seconds of illumination.

(2) Effect. Target hit.

Task standard. Five successful engagements out of six, with two first round hits.

Functional Components

Target acquisition (4.1.1)

Main gun: (5) precision (4.1.2.1)

Corrective action, main gun (4.1.4.1.1)

Firing from range card (4.2.1.1.2)

Special environments, NBC (4.1.2.2.1)

5.6 Task. Engage one stationary tank target with the main gun, utilizing the range card to direct lay technique, at night under direct IR searchlight illumination.

Conditions:

(1) Target. One tank panel (frontal) selected from seven or more, distributed at ranges of 1000-1200 meters. These will be represented on prepared range cards.

(2) Ammunition. 2 rounds main gun, first round preloaded (for each engagement.)

(3) Firing tank motion. Stationary. Moved into prepared, staked position prior to engagement.

(4) Initiation of engagement. Preparatory phase (in which data are applied to the fire control system) is initiated when prepared data for one target are given and upon command. (After the data are applied to the gun, the TC reports to the platoon leader.) The engagement itself is initiated when IR light is turned on the target tanks.

(5) Other. All crew members will wear protective masks for 30 seconds prior to and during engagement.

Standards:

Successful engagement.

(1) Time. Data applied within 25 seconds. Open within 5 seconds of IR illumination.

(2) Effect. Target hit.

Task standard. Five successful engagements out of six, with two first round hits.

Functional components

Target acquisition (4.1.1)

Main gun: (5) precision (4.1.2.1)

Corrective action, main gun (4.1.4.1.1)

Firing from range card (4.2.1.1.2)

Special environments, NBC (4.2.2.1)

5.7 Task. Engage multiple machine gun targets (troops, BRDM) with both the coax and the Cal. 50 at night.

Conditions:

(1) Targets. One infantry squad (10 type E) tactically dispersed, at 400-600 meters. One BRDM, (without missile adaptability) at approximately 750 meters. Both artificially illuminated.

(2) Ammunition. 100 rounds of 7.62 mm, 50 rounds of Cal..50 allocated, preloaded (for each engagement.)

(3) Firing tank motion: Initially moving.

(4) Initiation of engagement: Upon issuance of command by platoon leader.

Standards:

- (1) Time. Open within six seconds. Total time 40 seconds or less.
- (2) Effect: 3/5 area coverage on troops. Target effect on BRDM.

Functional Components

Target acquisition (4.1.1)
Coax machine gun (4.1.2.2)
Cal. 50 (4.1.2.3)
Corrective action-coax (4.1.4.1.2)
Corrective action-Cal. 50 (4.1.4.1.3)
Engage Multi-targets night (4.2.1.2)

5.8 Task. Engage multiple (2) moving tank targets with the main gun at night.

Conditions:

(1) Targets. One tank panel (flank) moving perpendicular to the line of sight. One tank panel (frontal) moving directly toward or away from firing tank. Both at 1100-1400 meters, speed 10-15 mph, under direct illumination by searchlight.

(2) Ammunition. 3 rounds allocated, first round preloaded (for each engagement.)

(3) Firing tank motion. Initially moving. Should stop to engage.

(4) Initiation of engagement. Upon target illumination.

(5) Other. All crew members will wear protective masks for 30 seconds prior to and during engagement.

Standards:

Successful engagement.

(1) Time. Open within 8 seconds.

(2) Effect. Both targets hit.

Task standard. Two successful engagements out of three.

Functional Components

Target acquisition (4.1.1)

Main gun: (2) BS or (6) precision (4.1.2.1)

Corrective action, main gun (4.1.4.1.1)

Special environments, NBC (4.2.2.1)

5.9 Methods of determining training needed

The purpose of the task analysis is to provide the basis for design of a training program. This requires a functional analysis into more basic skill categories that are common to several engagements (e.g., firing the main gun using the battlesights technique), so that the skills may be practiced separately, if need be (specified above, as "sub-task training.") Such sub-task training is generally very efficient in terms of time and resources required. Total performance was divided into engagements for convenience of testing and training, but that is not to be considered a functional analysis because each engagement involves several basic functions in common with other engagements. This section is to relate total performance to the underlying skills, thus serving as a bridge between operational tasks and functional subtasks.

The detailed procedures for prescribing sub-task training will be specified subsequently in the training design, but that is beyond the scope of the present report. However, it may help to clarify the sub-task categories if the reasons for the functional analysis are understood.

If a crew does not meet the standards for some of the engagements, there are several possibilities concerning what kind of practice is needed. The most obvious is more practice of the particular engagement(s) on which the crew did not meet standards. Or there may be a repetition of the test, because it is possible that even good crews may sometimes fail to meet the standards in some instances (i.e., all tests have some degree of unreliability.) Repeating the test also serves to increase practice on the engagement, so these options have similar practical consequences.

On the other hand, the pattern of test performance may indicate other kinds of difficulties. If the crew only has trouble when special conditions are introduced (e.g., when wearing protective masks), that would indicate that more practice is needed under those conditions. If the crew fails to meet the standard whenever a particular weapon system and technique is involved (e.g., main gun, battlesights) that would indicate more practice is needed on that sub-task (as specified above.)

Sometimes the kind of shortcoming may indicate needed sub-task training. If accuracy is low, then either the gunner may need further practice or the TC may need practice ranging. Generally slow performance may

indicate the need for procedural drills. Specific lags in performance may be attributed to particular crew members (e.g., a long interval between initiation and the gunner's "identify" is likely to be attributable to the TC, either in target detection, decision making, or target assignment and rough lay of the gun.) At other times it may be apparent that either the driver or loader need more practice of their functions because of their mistakes or slow performance.

The more glaring the deficiency in performance of an engagement, the more likely the need for the simple-conditions of sub-task training.

If there is some doubt about the need for subtask training, and one can test on the particular functions, applying the task conditions and standards, as long as one is training to standards, there will be no serious inefficiency.

Sometimes the background factors of a crew or individual should be considered in prescribing subtask training, particularly when that background may cast doubt on their capabilities (e.g., inexperience). All crews are likely to need periodic retraining on some skills, especially on contingency tasks (i.e., malfunctions that are somewhat probable but may not occur naturally often enough to provide sufficient practice.

APPENDIX A

TRAINING AND EVALUATION OUTLINE TANK CREW

Excerpts from USAREUR Reg. 350-304; Tasks, conditions and standards for firing Tables VII and VIII A & B.

7. General.

a. All tank targets will be assumed to be T-62 tanks. All troops will be assumed to be armed with RPG-7. All BRDMs will be assumed to have no anti-tank capability.

b. Crews will not be informed as to the nature of their next target but will be told by the Control Officer what type of main gun ammunition to load. Target acquisition is a crew function.

c. Targets will be engaged in descending order of lethality to the firing crew and tank. Failure to do so will be critiqued to the crew.

d. Firing vehicles will be required to seek defilade as available. Failure to do so will be critiqued to the crew.

e. Crews are authorized to leave the course road to occupy a defilade firing position.

f. Crews will be required to fire one engagement "buttoned up" during Table VIIA.

g. Crews will be required to fire one engagement while wearing the protective mask under simulated NBC environmental conditions.

h. If the firing vehicle is AOS equipped, one engagement will be fired "on the move". The first round must be fired while moving, and subsequent rounds, if required, may be fired from the halt.

i. One Range Card engagement (HEP-T) will be fired "buttoned up".

TRAINING AND EVALUATION

UNIT: Tank Crew M60/M60A1/M60A1 (AOS)

MISSION: Tank/Anti-Tank Tables VIIA & VIIIA

TASK	CONDITIONS	TRAINING/EVALUATION STANDARDS
Engage Stationary Troops and a Stationary BRDM	One infantry squad (10 E type) tactically dispersed at approximately 400-600 meters and one BRDM at approximately 750 meters. 100 rounds of 7.62mm and 50 rounds of Cal. .50 are allocated	GREEN Main Gun Hits ≥ 9 1st Rd Hits ≥ 7 Opening Time = 10 seconds or less (avg) Machine Guns: minimum of 3/5s coverage on all troop targets and/or all BRDMs are hit
Engage multiple (2) moving tanks	Two moving tank panels are located at 199-1400 meters. Crew is told to preload TPDS-T. Four rounds TPDS-T are allocated	AMBER Main Gun Hits ≥ 7 1st Rd Hits ≥ 5 Opening Time = 20 seconds or less (avg) Machine Guns: minimum of 3/5s area coverage on all troop targets and/or all BRDMs are hit
Engage two stationary tanks and one stationary truck	One stationary tank (frontal) is located at 1400 meters and one stationary tank (frontal) is located at 1900 meters. One stationary truck (panel) is located at 700 meters. Crew is instructed to preload one round of HEAT-T. Four rounds of HEAT-T and 50 rounds of Cal. .50 are allocated.	RED Main Gun Hits < 7 1st Rd Hits < 5 Opening Time > 20 seconds avg
Engage a "Threat" tank platoon (3 tanks)	One stationary tank is located at 1400 meters, two stationary tanks are located at 1900 meters in "overwatch". Crew is instructed to preload HEAT-T. Six rounds of HEAT-T are allocated.	

TRAINING AND EVALUATION

UNIT: Tank Crew M60/M60A1/M60A1 (AOS)

MISSION: Tank/Anti-Tank Tables VIIB & VIIIB

TASK	CONDITIONS	TRAINING/EVALUATION STANDARDS
Engage a stationary tank utilizing range card data	One stationary tank is located at 1200 meters Unit must prepare a staked firing position and a range card. The crew must occupy the position and engage the target vehicle utilizing the range card data. 2 rounds of HEAT-T are allocated.	GREEN Main Gun Hits ≥ 9 1st Rd Hits ≥ 7 Opening Time = 10 seconds or less (avg) Machine Guns: minimum of 3/5s coverage on <u>all</u> troop targets and/or all BRDMs are hit
Engage a stationary tank utilizing range card data	One stationary tank is located at 1000 meters Unit must prepare a staked firing position and a range card. The crew must occupy the position and engage the target vehicle utilizing range card data. The same firing position may be used for this and the previous engagement. 2 rounds of HEP-T are allocated.	AMBER Main Gun Hits ≥ 7 1st Rd Hits ≥ 5 Opening Time = 20 seconds or less (avg) Machine Guns: minimum of 3/5s area coverage on <u>all</u> troop tgts and/or all BRDMs are hit
Engage stationary troops and a stationary truck	One infantry squad (10 E type), tactically dispersed, is located at 700 meters. White light or indirect illumination may be used. 100 rounds of 7.62mm and 50 rounds of Cal. .50 are allocated.	RED Main Gun Hits < 7 1st Rd Hits < 5 Opening Time > 20 seconds avg
Engage multiple (2) Moving tanks	Two moving tank (T-62) panels are located at 100-1400 meters Crew is told to preload HEAT-TPT. 4 rounds of HEAT-TPT are allocated.	