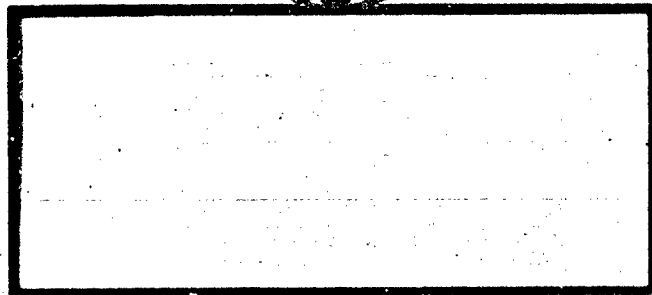


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REPORT OF PHASE I
USATECOM PROJECT NO. 8-3-7700-01E

DEVELOPMENT OF A METHODOLOGY
FOR MEASURING EFFECTS OF
PERSONAL CLOTHING AND EQUIPMENT
ON COMBAT EFFECTIVENESS OF THE
INDIVIDUAL FIELD SOLDIER

FEBRUARY 1964

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Darien, Connecticut

Prepared Under Contract DA 19-129-QM-2068
Jerrell L. Sanders, Project Officer

FOREWORD

The suitability and acceptability of clothing and personal equipment intended for general use by the U. S. Army have traditionally been evaluated in terms of specific physical characteristics. The characteristics to be measured are selected because they, at least on their face, have a high relevancy to the ultimate performance criterion, which is usually assumed to be successful performance on the battlefield. Developmental items of general equipment are normally tested against such simple factors as waterproofness, abrasive resistance, fuel consumption; or against more complex elements such as heat loss, personal comfort, service life, or maintainability. We know intuitively that these parameters are relevant to combat effectiveness, even though they may not constitute a completely comprehensive picture of the ingredients of acceptable performance. The selection of test criteria for an item, and the conduct of precise and valid tests, therefore depend largely on the judgement, technical knowledge, and experience of the responsible engineer or technologist. His work must be based on the standards for performance established by the ultimate field user, who originates the basic requirement and translates a use concept into physical characteristics. The criteria used for the selection of performance factors frequently appear to be the reliability and precision with which they can be identified and measured.

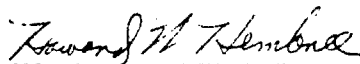
This method for evaluating the suitability of clothing and equipment has been and still is being used successfully for those many items which have simple unidimensional functions, or which have a field utility that exceeds its operational cost by a large margin. However, when it becomes necessary to make decisions involving complex trade-offs between critically needed functions and high costs in performance, the present testing methods are frequently inadequate. This is the problem which faces the clothing and personal equipment technologists today. There has been a steady increase in the needs for protection of individual soldiers as new man-made hazards are developed for use on the battlefield. Many clothing systems and personal equipments are being designed to incorporate these new needs; but with the present state of the art some of the protection required to survive in a chemical, radiological, or bacteriological environment may produce such severe physical and psychological stresses that they may actually increase the wearer's probability of becoming a casualty, through a decrease in his fighting ability. The magnitude of this possible performance decrement and the importance of making the most effective use of manpower resources leads to the conclusion that a

prime consideration in the evaluation of every piece of protective clothing or equipment must be a quantitative measure of its effect on the effectiveness of its user in combat.

The development of test methodology to make such a determination under field conditions, separately or simultaneously with an assessment of protective qualities, is the purpose of this project. A methodological research study to develop this capability was authorized by the Commanding General, U. S. Quartermaster Research and Engineering Command, in May 1962 and subsequently by the Commanding General of the U. S. Army Test and Evaluation Command in May 1963.

The problems faced in any attempt to measure such a complex element as the combat effectiveness of an individual soldier are formidable, indeed. The questions of whether the effectiveness of a soldier can be defined in measurable terms, and if so, whether reliable performance measures can be developed that would be useful in evaluating the differential effects of clothing and equipment on this factor must be answered. For this reason the study was divided into sequential phases with these questions studied early in the program.

A contract was awarded to Dunlap and Associates, Inc., to proceed with the project in June 1962. This report represents the work performed by the contractor on the first phase of this study and the plans for exploiting these results in Phase II. The progress of each phase will be published separately to permit interested agencies to comment on our efforts and provide constructive criticism. It is hoped that our attempts to utilize the physical effects on combat efficiency as a means of equipment evaluation will complement the work of other groups who are concerned with the more subjective aspects of effectiveness, such as personnel selection, leadership, reaction to stress, and training.


HOWARD W. HEMBREE, Ph. D.
Scientific Director
QM R&E Field Evaluation Agency

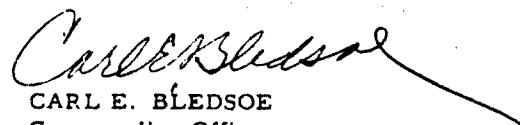

CARL E. BLEDSOE
Commanding Officer
QM R&E Field Evaluation Agency

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INTRODUCTION

This report reviews the work performed during Phase I of Contract No. DA 19-129-QM-2068, O. I. 6141. The project under contract is a three phase research effort directed toward the development of a field measurement methodology for evaluating the effects of Quartermaster clothing and protective equipment on the combat effectiveness of the individual soldier.

The report is organized into four sections as follows:

Section I summarizes the background, phases, and phase objectives of the total project with emphasis on Phase I.

Section II reviews in essentially outline form the activities performed during Phase I.

Section III reports in detail the collection, analysis and interpretation of the rating data which were gathered in Phase I and which provide the primary basis for selecting combat tasks to comprise the proposed test course.

Section IV is the Phase II research plan. This section has been prepared in a manner that allows it to be used as a separate document apart from the preceding sections of this report. The research plan outlines the initial field test situations to be studied and the major proposed research activities to be performed in Phase II.

SECTION I

PROJECT BACKGROUND AND OBJECTIVES

A. Background

The requirements for the project were initiated by the U. S. Army Quartermaster Research and Engineering Field Evaluation Agency, Fort Lee, Virginia. While many background considerations might be enumerated, the following statement presents succinctly the essentials of the problem:

Recent developments in conventional and exotic weapon systems are creating urgent needs for new types of protective clothing and devices. While this protection may enable the soldier to survive in an otherwise fatal environment, it imposes certain physical, physiological, and psychological stresses and limitations such that his ability to protect himself against other weapons, to move, or to take aggressive action may be severely limited. Thus, a critical aspect of the evaluation of these protective devices is the extent to which they reduce the soldier's operational effectiveness, even while saving his life

Howard Hembree, Ph. D.
Scientific Director
U. S. Army Field Evaluation Agency

Coupled with the above statement is the fact that presently no comprehensive, routinely applied, measurement system exists for assessing the effects of clothing and protective equipment on the combat effectiveness of the individual infantry soldier in a field test setting which reproduces, to the extent possible, the conditions and rigors of combat.

While it is neither necessary nor appropriate to devote space in this report to a discussion of the desirability and potential value of measuring the effects of personal clothing and equipment on combat effectiveness, the following quotations from General George H. Decker, retiring Chief of Staff of the Army, seemed to compel association with the requirements for the project. The remarks are from an article entitled: Design for Ground Combat Power, in Army, October, 1962, pages 35-40. General Decker is admittedly speaking as a "committee of one:"

The basic and overriding mission of the Army is to conduct successful, sustained combat operations in the land environment. The performance of this mission rests in overwhelming measure upon the functioning of the combat arms; therefore, every effort of the Army must be directed toward maintaining and supporting the combat arms in the highest state of effectiveness.

General Decker goes on to identify two principle criteria against which to evaluate the value of all studies, decisions and actions dealing with the future of the Army. They are:

First, is there a clear cut bearing on combat capability?

Second, is there a simple and direct approach to the problem of generating ground combat power?

The FEA requirement for measuring the effects of Quartermaster items on the operational effectiveness of the individual field soldier both reflects and affirms the foregoing statements.

B. Objectives

As stated in the introduction, the ultimate goal of the project is a field measurement system that will provide objective data regarding the effects of personal clothing and protective equipment on the combat effectiveness of the individual infantry soldier. The measurement methods and techniques must be sufficiently direct and reliable to permit the routine incorporation of the test program with engineering field evaluations of Quartermaster protective items.

Toward the development of the field measurement system, the project effort has been programmed in three work phases each of which has specified sub-objectives. The phases are as follows:

Phase I: Analysis and evaluation of present methods for evaluating combat effectiveness and development of a research plan.

This phase, which was scheduled as an eight month effort, had the following major sub-objectives.

1. Review of combat effectiveness studies and other related literature;
2. Formulation of a definition of combat effectiveness for the project;
3. Preparation of a research plan to guide the development of the measurement system during Phases II and III.

Phase II: Establishment of criteria of combat effectiveness and research and development of test and measurement situations.

This phase, which is programmed to cover 16 months, has the following major sub-objectives:

1. Refinement of the combat tasks that will constitute the performance criteria;
2. Development and preparation of field test situations for measuring performance in the criterion tasks;
3. Field tryout, evaluation and refinement of the test and measurement situations;
4. Preparation of a Phase III work plan to guide the tryout and validation of an integrated test system and the development and evaluation of the utility of normative data.

Phase III: Evaluations of the measurement system.

This phase, which is scheduled as a 24-month effort, has the following major sub-objectives:

1. Tryout, evaluation and final refinement of an integrated test course;
2. Collection of performance data and evaluation of utility of norms based on these data.

With regard to Phase I in particular, the sub-objectives identified above may be detailed further as follows:

1. The review of combat effectiveness studies and other related literature was to include previous studies of combat effectiveness, studies of training evaluation, descriptions of combat infantry jobs and tasks, studies of clothing and equipment effects, troop equipment preference studies, historical studies relating combat conditions and experience, conferences with cognizant military agencies concerned with relevant potential measurement areas, and conferences with officer and enlisted combat experienced personnel.

2. The formulation of a definition of combat effectiveness for the project was to be sensitive to, and/or satisfy, and/or allow for the following: specification of the dimensions of effectiveness to be measured; specification of baseline environmental and equipment conditions of measurement; quantitative measurement of both speed and output aspects of performance; combination of measurements into a composite index, if desirable; combination of individual soldier performances into a composite useful in considering unit effectiveness, if possible and if desirable.

3. The preparation of the research plan to guide the development of the measurement system during phases II and III was to include: specification of the methodology to be used in developing the criteria and test situations in Phase II; an outline of the Phase II pilot study test situations including number of test troops needed, environmental conditions, instrumentation needed, observers required, methods of data collection, and anticipated analyses; outline of the Phase III activities and validation studies.

V S H V G O X

SECTION II

PHASE I ACTIVITIES

The below listed activities summarize in outline form the major work items performed during Phase I. As a matter of convenience, the activities are grouped by time periods consistent with the quarterly progress reporting intervals of the project. The work concerned with the collection and analysis of rating data from combat veterans at Fort Benning is described in detail in Section III.

A. Work Activities During 1 July 1962 through 1 October 1962

The work on Phase I commenced on 5 July 1962, subsequent to award of the contract. The following activities were performed associated with initiation and conduct of the Phase I effort:

1. A trip was made to Fort Lee, Virginia to discuss and review the initial technical planning for Phase I. Preliminary arrangements for Phase I travel were made, the QMR & E FEA library was visited to obtain pertinent project references, and the accelerated clothing wear and testing courses were seen.
2. Trips were made to the Infantry School, Ranger School, and HUMRRO unit at Fort Benning, Georgia and to the U. S. Naval Medical Field Research Unit at Camp Lejeune, North Carolina. Information was gathered on the tasks of combat infantry, the conditions under which tasks will/may be performed, proficiency measures, and existing ranges and field testing conditions.
3. Literature reviews were initiated in the areas of: criterion development; field measurement techniques applicable to infantry; dimensions of infantry performance; evaluation of training effectiveness; effects of special clothing and equipment on performance. An ASTIA bibliography was requested and received relevant to the foregoing.
4. Preliminary descriptions of the missions, mission phases, and tasks performed by combat infantry in a rifle squad in these mission phases were prepared. Analysis and examination of the mission-occurrence frequency and apparent importance of these tasks was initiated.

5. Planning and arrangements were made to visit the Combat Developments Experimentation Center at Fort Ord, California and to observe infantry in the conduct of individual and squad training exercises at Fort Benning, Georgia.

B. Work Activities During 1 October 1962 through 1 January 1963

1. A trip was made to the Combat Developments Experimentation Center at Fort Ord, the Hunter-Liggett Military Reservation, and the Presidio of Monterey. Information was gathered on field measurement techniques for the evaluation of infantry performance, the environmental and control conditions under which performance measurements have been/ are being made, and considerations related to the simulation of stress.

2. A trip was made to the Ranger Department at Fort Benning, Georgia. Interview and rating data concerning the relevance and importance of tasks in combat and critical combat experiences were obtained from a sample of officer and enlisted combat veterans. Field observations were made of day and night training problems for familiarization purposes.

3. Statistical reduction and analyses of the rating data obtained at Fort Benning were planned, initiated and completed. Further analyses of combat tasks were initiated toward the identification of those tasks in which performance will be measured in Phase II.

4. Documents were received and reviewed concerning future doctrine and the battlefield of the future. Preparation of a memorandum summarizing the anticipated effects of future warfare as they relate to the measurement of performance in important combat tasks was initiated.

5. A preliminary definition of combat effectiveness as it relates to the project was prepared.

6. Reading was continued in the areas of criterion development, field measurement techniques applicable to infantry, evaluation of infantry training proficiency, and future Army developments that may affect the relative importance of combat tasks or the conditions under which performance is measured.

7. Arrangements were made to visit Fort Lee in mid-January to review the progress of the project to date and discuss the content of the Phase II and Phase III research plan.

C. Work Activities During 1 January 1963 through 4 March 1963

1. The further reduction and analyses of the rating data obtained from combat veterans at Fort Benning were completed. A selected list of the ten most important combat tasks likely to be affected by Quarter-master clothing and protective equipment were identified. These tasks will constitute the preliminary sample of criterion tasks in which the performance of individual field soldiers will be measured.
2. A trip was made to Fort Lee to review the rating data and the results of the analyses. The broad outline for the content of the Phase II research plan was established. A general discussion of criterion development considerations was also conducted.
3. A draft of the Phase II research plan was prepared with guidance from the FEA staff at Fort Lee.
4. A second trip was made to Fort Lee to review and discuss the contents of the research plan, Phase II scheduling, and anticipated initial activities in Phase II.
5. The comments and suggestions of the FEA staff were incorporated into a finalized research plan to guide the Phase II effort.
6. Work on Phase I officially terminated on 4 March 1963.

SECTION III
RATING DATA AND PRELIMINARY STATEMENT
OF CRITERION TASKS

This section reviews the collection, analysis and interpretation of rating data gathered from a small sample of combat veterans during Phase I. These data are further reduced to a limited number of the most important combat tasks which are likely to be affected by personal clothing and protective equipment. It is these selected tasks which provide the nucleus of the combat activities to be studied in Phase II and which are anticipated to be the primary structure of the eventual integrated field measurement system.

A memorandum reviewing the implications of future doctrine on the performance of combat tasks and the anticipated measurement system is not included in this final report. Since the memorandum references classified documents, restricted handling would be necessary. It was considered undesirable to restrict the distribution or use of this report. The memorandum was submitted to the FEA staff in January 1963.

As an aid to over-viewing and referring to portions of this section, the following organization exists:

- A. Background
- B. Sample of Raters, Interview Format, Combat Tasks, Nature of the Rating Data Collected
- C. Results of Ratings (Importance, Frequency, Difficulty)
- D. Statistical Analyses of Ratings and Interpretations
- E. Further Analyses of Tasks and Identification of Tasks to be Measured in Phases II and III
- F. Definition of Combat Effectiveness

A. Background

It was recognized from the outset of the project that measurement of performance in the ultimate criterion situation would not be feasible. That is, it was neither possible to exert necessary experimental control

nor possible to collect measurement data on the relationships among clothing and protective equipment, individual performance, and success in defeating the enemy under various terrains, durations and conditions of engagement in actual combat. It was felt, however, that defeat of the enemy in actual combat was dependent upon the performance by individuals of assigned/required tasks throughout an engagement. Thus, the utility of any proximal criterion of combat effectiveness would be heavily dependent in part upon the relevancy of the tasks selected in which to measure performance and the conditions under which performance in these tasks was measured.

It was thus further realized from the initiation of the project, and with increasing emphasis as time progressed, that the determination of what tasks to measure performance in was a problem area of fundamental importance to the project and the eventual utility of the proposed measurement system. This was not to say nor imply that the measurement of performance in any eventually selected combat tasks would be an easier or less important problem to be researched and resolved. Rather, a logical first critical problem needing attention was the determination of what tasks to measure performance in. There was also the additional problem of reducing the apparent large number of combat activities into a sufficiently small sample such that the measurement of performance might be economically and practically undertaken and with some degree of assurance that a representative sample of the most relevant tasks had been included.

In summary of the thinking up to this point, it was felt that the combat effectiveness of the individual soldier is realized, to a major extent, by how well he performs those tasks required in combat. An initial problem needing resolution in order for the project to develop a meaningful measurement system was to identify on the one hand what tasks the line infantryman does perform, and on the other hand the relative contribution of these tasks to combat effectiveness. The latter determination of relative importance was necessary because of the apparent large number of infantry combat tasks. Any practical and efficient approach to a measurement system must of necessity concern itself with a sample of these tasks. Ideally, this sample should consist of those relevant tasks which contribute the most to combat effectiveness.

The next problem was then how to establish the relevance and relative importance of infantry tasks in the actual combat situation. After deliberation, it was decided to interview and collect rating data about infantry tasks from professional soldiers with combat experience. There were two primary reasons for using ratings by combat veterans:

1. Professional soldiers with combat experience constitute, in our opinion, the best qualified group to judge the relevance and relative importance of tasks in combat.

The occurrence and relative importance of tasks in combat can only be judged by a man who has been in combat. Professional soldiers, by nature of their training and daily activities, would, as a group, tend to have thought about, reflected on, and both consciously and unconsciously analyzed their combat experience more than might be expected of a sample of discharged combat veterans.

2. The use of a rating procedure would permit us to systematically and uniformly sample opinions.

It was felt that the final selection of tasks for evaluation in Phase II should reflect the most important, relevant, combat activities averaged over the range of combat situations that had been experienced and might generally be again anticipated. If combat veterans could agree on (reliably rate) what tasks were most important, this would permit the combining of rating data and also provide a needed basis for selecting tasks.

In interviewing and collecting the actual rating data, as described in the next part of this section, we were interested also in familiarizing ourselves with what types of information might be obtained from combat veterans and determining whether the planned procedures for making the ratings were satisfactory.

B. Sample of Raters, Interview Format, Combat Tasks, Nature of Rating Data Collected

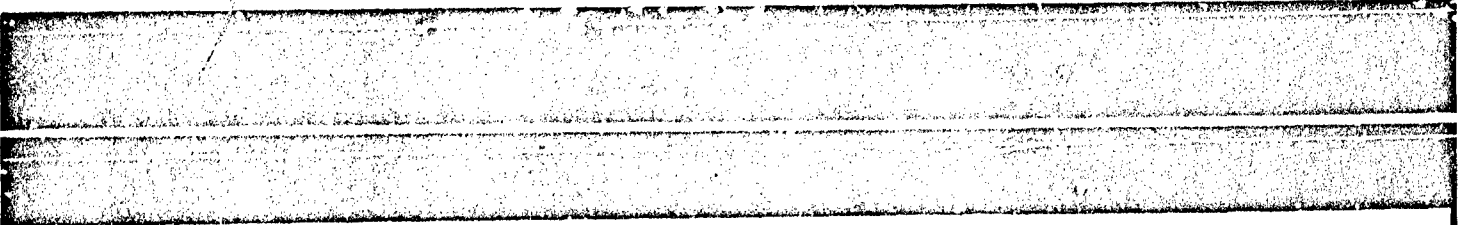
The sample of combat veterans who were interviewed and who provided the actual ratings to be described presently were all professional soldiers assigned at the Ranger Department, U. S. Army Infantry School, Fort Benning, Georgia. A total of twelve combat veterans were interviewed and asked to perform the several rating tasks. A biographical data sheet, shown in Figure 1, was completed on each person in the initial part of an interview session. Based on this biographical data and additional information obtained during the interviewing, two persons were eliminated from the sample. In both cases, the reason for their elimination was limited or peripheral combat experience. The men had been in a combat zone, and while the opportunity for engagement was always present, actual engagement and contact was minimal. The characteristics of the ten people (five officers and five enlisted men) comprising the actual sample are shown in Table 1.

It may be noted in Table 1 that the minimum number of years of active military service in the sample is 16. Six of the ten people had 20 or more years of total individual service. Perhaps of even greater significance, six of the ten people had combat experience in two wars.

In our opinion, while the sample size is limited, the people comprising the sample are from among the best qualified that might be obtained. The men are not only long term professional soldiers with broad combat experience, some in two wars, but they are also characterized by the following two features:

1. Four of the five officers had at least part of their combat experience as enlisted platoon leaders. Three of them received combat promotions and subsequently experienced combat as officers. The fourth person, while not promoted during wartime, saw combat both as an enlisted man and then as an officer in Korea.

2. As a result of their training assignments at Fort Benning, and because the Ranger Department at Fort Benning shares responsibility for the development of infantry tactics and doctrine, these men are a select (and selected by the Army) sample of specialists. It is our feeling that, as a group, these men are particularly thoughtful, of considerably above average intelligence, and unusually articulate concerning combat and infantry effectiveness.



Biographical Information

Name: _____ Grade: _____ Age: _____

Present Unit Assignment: _____ Date: _____

Assignment in Unit: _____

Date of Rank: _____ Length of Service: _____

Education: _____

Combat Experience Place	Dates	Rank at time	Unit Assigned	Type of Assignment

Invasions or Amphibious Landings Place	Dates	Rank at time	Unit Assigned	Type of Assignment

Service (Military) Schools Attended Course	Length	Place	When Graduated

Special Military Skills	
Airborne Special Training Other	Ranger

Decorations: _____

Figure 1. Biographical Information Sheet Sample

Table 1. SUMMARY OF BIOGRAPHICAL INFORMATION
ON RATER SAMPLE (N=10)

Subject No.	Rank	Age	Total Years of Service	Combat Experience			Special Skills and Schools			
				WW2 Europe	WW2 Pacific	WW2 Korea	Airborne Ranger Course	Advanced Command Course	Staff College	
1	Lt. Col.	43	21			X		X		
2	Lt. Col.	44	21	X		X		X		
3	Lt. Col.	40	22		X		X	X		X
4	Maj.	42	18		X	X		X		
5	Maj.	39	20		X	X		X		X
6	M/Sgt.	41	23	X			X			
7	M/Sgt.	36	18	X			X			
8	M/Sgt.	39	22	X			X		X	
9	M/Sgt.	37	16	X						
10	M/Sgt.	38	19		X				X	

The actual interview format is shown in Figure 2. An essentially standardized interview procedure was used. Initially, the purposes of the interview were explained and then the biographical data questions were completed. Subsequently, when at least partial rapport could be considered established, the prepared questions regarding critical combat experiences were asked. Finally, interviewees performed the ratings of combat tasks. On an average, it required approximately two hours to conduct the interview and collect the rating data on each subject. The range of times was from approximately one and one-half to two and one-half hours.

With regard to the rating of tasks, decks of prepared 3 x 5 cards, each deck containing 41 combat tasks were used. The 41 tasks are shown in Figure 3. A majority of the tasks were developed prior to the interview trip to Fort Benning from the following sources:

- FM 21-75 Combat Training of the Individual Soldier and Patrolling
- FM 7-15 Infantry, Airborne Infantry and Mechanized Infantry Rifle Platoons and Squads
- FM 3-5 Tactics and Techniques of Chemical, Biological and Radiological (CBR) Warfare
- FM 31-15 Operations Against Irregular Forces
- HUMRRO Research Memo: Critical Combat Skills, Knowledges and Performance Required of the 1962 Light Weapons Infantryman (Mos. 111.0). 1961, Subtask Rifleman I
- Professional Soldiers and Combat Veterans at the Combat Developments Agency and Ranger Department, Ft. Benning, Georgia.
- Former Soldiers and Combat Veterans on the Professional Staff of Dunlap and Associates.

Interviewees were asked to rate each of the 41 tasks on three dimensions:

Frequency of occurrence in combat

The purpose of this interview is to ask your help in assisting us to identify the most important activities that a light weapons infantry soldier performs in combat.

As you know, we are here as representatives of QM R&E FEA at Ft. Lee. Our purpose, in working for Fort Lee, is to assist them to develop a field testing program to determine the effects of QM clothing and protective equipment on the combat efficiency of the individual soldier.

We plan to develop a test program which measures how well a soldier can perform those tasks that are most important in combat.

We hope to learn from you -- and other combat veterans -- which tasks are most important in combat

Before we ask you to answer specific questions, we would like to get some biographical information about you.

-- Fill Out Data Sheet --

TURNING now to some of our questions -- as you look back on your combat experiences (during those periods when contact with the enemy was imminent or in progress):

1. What are the most difficult conditions under which you have had to fight? (Situational, environmental, terrain, etc.)
2. Would you please describe for me one or two instances in which you were able to advance rapidly in the face of the enemy, or quickly take an objective or successfully repel an enemy assault or counter-attack. (We're interested in unusual, critical experiences that seem to stand out in your memory).

Figure 2. Interview Format

3. Would you please describe for me one or two instances in which your advance was halted, or you had to withdraw temporarily, or where the enemy was able to inflict unusually severe casualties. (Again, we are interested in unusual, critical experiences that seem to stand out in your memory.)

-- Do Ratings --

4. Rate tasks on the basis of: Frequency of Occurrence and/or the Amount of Time Spent in a Task during Combat Conditions.
5. Rate tasks on the basis of: Difficulty to Perform by a Light Weapons Infantryman in Combat.
6. Rate tasks on basis of: Importance to Combat Effectiveness -- i. e., Defeating the Enemy in Combat.

Figure 2. (Con't.)

- | | |
|--|--|
| 1. Plan Operation | 23. Use Battle Drill |
| 2. Perform Reconnaissance
(Observe, detect, locate,
identify terrain features) | 24. Splice Communications Wire |
| 3. Hand to Hand Combat | 25. Police Communications Wire |
| 4. Use Hand Signals | 26. Use Touch Signals |
| 5. Carry Messages | 27. Use Pyrotechnic Signals |
| 6. Load/Unload Supplies | 28. Use Grenades |
| 7. Drive Vehicle | 29. Prepare, Adjust, Arrange
Combat Load |
| 8. Use First Aid | 30. Carry, Load, Paddle Assault
Boat |
| 9. Use Map | 31. Construct Shelters, Emplace-
ments, Trenches |
| 10. Use Compass | 32. Construct Hasty Fighting
Positions |
| 11. Maintain Orientation | 33. Construct Obstacles -- (Lay
wire, roadblocks) |
| 12. Load (Reload Weapons) | 34. Remove Obstacles -- (Cut
wire, remove roadblocks) |
| 13. Clear Fields of Fire | 35. Observe, Detect, Locate,
Identify Hostile Targets |
| 14. Maneuver | 36. Use Concealment and
Camouflage |
| 15. March/Move | 37. Lay, Detect, Neutralize
Mines, Booby Traps, Warn-
ing and Illuminating Devices |
| 16. Use Radio/Telephone | 38. Maintain Clothing and Personal
Equipment |
| 17. Use Cover | 39. Practice Personal Hygiene and
Field Sanitation |
| 18. Use CBR Equipment | 40. Prepare Ammunitions |
| 19. Lay Communication Wire | 41. Carry Supplies or Ammunition |
| 20. Prepare Rations | |
| 21. Fire Weapon | |
| 22. Maintain Weapon | |

Figure 3. 41 Combat Tasks

Difficulty of performing task under combat conditions

Importance in combat -- (importance to defeating the enemy)

The thinking underlying our asking for ratings on each of these three dimensions was as follows. While primary interest was focused on the relevance and relative importance of these tasks, it was anticipated that a large number of tasks would be judged as being important. Since, as mentioned earlier, it was also realized that the eventual measurement system could not measure everything, it was hoped that the dimensions of frequency of occurrence and difficulty could subsequently be used to help reduce the sample of important combat tasks. Importance being equal, it would seem more sensible to measure the effects of personal clothing and equipment in those combat tasks which a soldier must perform more frequently. Also, the more "difficult" tasks might be those which would be more sensitive to clothing and equipment effects.

In making the ratings, an interviewee went through the entire deck of 41 cards and completed the ratings on one dimension before proceeding to the next dimension. The rating task was of a comparative nature. Each task was considered relative to the other task against five defined categories. The actual categories that people were asked to assign the cards to are shown in Figure 4.

The sequence in which the interviewees performed the ratings was purposely ordered so that by the time a subject judged "importance," he had already seen each task (and the entire deck) twice. Thus a man judged the tasks first in terms of their frequency of occurrence in combat, then on their difficulty to perform under combat conditions, and finally on the basis of importance to defeating the enemy. It was also felt that by asking people to rate the tasks against each dimension separately, as opposed to a simultaneous multidimensional scaling, the reliability of the resulting data would be enhanced. To ask people to simultaneously evaluate the tasks against several dimensions, especially where an unequal weighting of the dimensions in the composite was desired, seemed too complex a task for people to fully comprehend, follow, and provide reliable data.

FREQUENCY OR TIME CONSUMED

Rating Categories

1	Among the Least Frequent or Least Time Consuming Combat Tasks
2	Of Less than Average Frequency or Less than Average Amount of Time Spent in Performing these Combat Tasks
3	Of Average Frequency or an Average Amount of Time Spent in Performing these Combat Tasks
4	Of Above Average Frequency or an Above Average Amount of Time Spent in Performing these Combat Tasks
5	Among the Most Frequent or Most Time Consuming Combat Tasks

Figure 4. Rating Categories

DIFFICULTY

Rating Categories

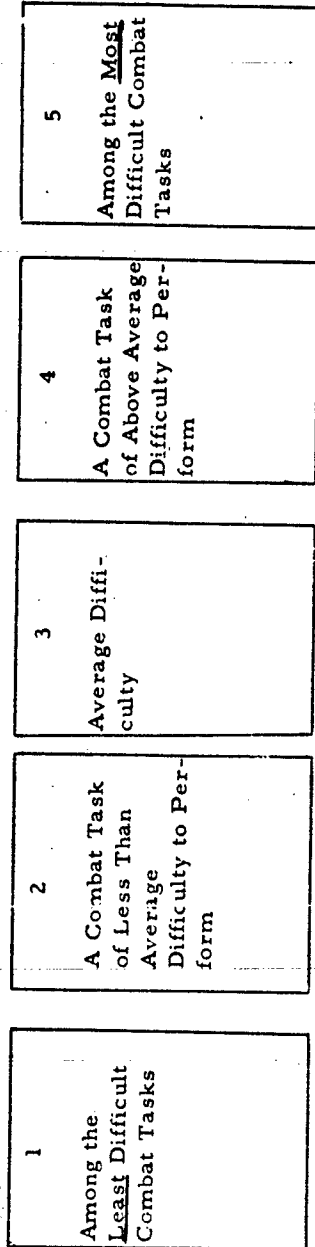


Figure 4. (Continued)

IMPORTANCE

Rating Categories

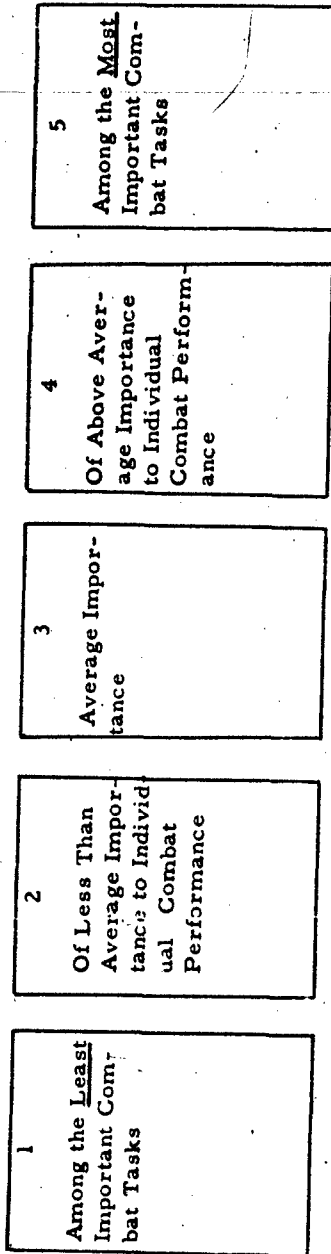


Figure 4. (Continued)

It should be mentioned that multiple decks of cards containing the tasks were used to speed the interviewing. When a man finished sorting the cards on one dimension, he was asked to move to a second table and given another deck with which to perform the sorting on the next dimension. This allowed the interviewer to record the results from one sorting while the rater proceeded with the next.

While making each sorting, raters were allowed to change the position of a task card at any time. They were encouraged also to ask the interviewer if there was doubt about the definition or extent of the activity implied by any task statement.

The rating data thus obtained represent the relative ratings of tasks into categories perceived as being equal by the interviewees.

It should also be mentioned that interviewees were asked to comment on the completeness of the tasks contained in the decks of 3 x 5 cards. As a result of their suggestions, task statements number 40 and 41 arose.

The attempt was also made initially to have interviewees rate the tasks on a fourth dimension; namely, into piles of "related combat tasks." What we were attempting to determine was whether or not combat veterans could group the tasks into categories related on the basis of content, i. e., the tasks thus associated seemed to involve the same types of activities in the eyes of the interviewees. The intent, in making this rating, was to assess the possible independence and/or relatedness of the tasks that comprise combat effectiveness. (This may be viewed as an effort to establish a sort of a priori factorial structure using combat veterans to identify clusters of related combat tasks.) In practice, it proved so difficult for people to understand what was required of them, and the results from the first few interviewees were so divergent, that it was decided not to continue the effort for the remaining interviews.

C. Results of Ratings (Importance, Frequency, Difficulty)

The results of the ratings are shown in Tables 2 through 10. For each dimension of the rating task, the data are presented for officers and enlisted men combined, officers alone, and enlisted men alone. The statistical analyses presented in the next part of this section justify the combination of the data from officers and enlisted men.

Table 2.

IMPORTANCE

Officers and Enlisted Men Combined
(N=10)

<u>Task</u>	<u>Median</u>	<u>Q</u>
1 Plan Operation	4.9	.1
2 Perform Reconnaissance	4.9	.1
11 Maintain Orientation	4.9	.1
14 Maneuver	4.9	.1
22 Maintain Weapon	4.8	.5
35 Observe, Detect, Locate, Identify Hostile Targets	4.8	.5
8 Use First Aid	4.7	1.1
9 Use Map	4.7	.5
21 Fire Weapon	4.7	.5
12 Load (Reload) Weapon	4.5	.5
32 Construct Hasty Fighting Positions	4.5	.6
15 March/Move	4.3	.6
23 Use Battle Drill	4.3	.5
28 Use Grenades	4.3	.6
10 Use Compass	4.2	1.1
17 Use Cover	4.2	.5
36 Use Concealment and Camouflage	4.2	1.0
39 Practice Personal Hygiene and Field Sanitation	4.2	1.0
16 Use Radio/Telephone	4.0	1.0
31 Construct Shelters, Emplacements, Trenches	4.0	1.0
38 Maintain Clothing and Personal Equipment	3.9	.8
4 Use Hand Signals	3.8	.6
13 Clear Fields of Fire	3.8	.8
37 Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	3.5	1.1
40 Prepare Ammunitions	3.5	1.3
41 Carry Supplies and Ammunition	3.5	.5
27 Use Pyrotechnic Signals	3.3	.8
3 Hand to Hand Combat	3.2	1.3
19 Lay Communication Wire	3.1	.6
5 Carry Messages	3.0	1.3
29 Prepare, Adjust, Arrange Combat Load	3.0	1.1
33 Construct Obstacles	3.0	1.1
34 Remove Obstacles	3.0	1.1
18 Use CBR Equipment	2.8	1.3
20 Prepare Rations	2.7	1.0
7 Drive Vehicle	2.5	1.0
24 Splice Communications Wire	2.5	.6
30 Carry, Load, Paddle Assault Boat	2.5	1.5
6 Load/Unload Supplies	2.0	1.0
26 Use Touch Signals	2.0	1.1
25 Police Communication Wires	1.8	1.0

Table 3.

IMPORTANCE
Officers (N=5)

Task		Median	Q
9	Use Map	5.0	.0
1	Plan Operation	4.9	.3
10	Use Compass	4.9	.3
11	Maintain Orientation	4.9	.3
12	Load (Reload) Weapons	4.9	.5
14	Maneuver	4.9	.3
21	Fire Weapon	4.9	.3
22	Maintain Weapon	4.9	.5
2	Perform Reconnaissance	4.7	.5
8	Use First Aid	4.7	1.8
15	March/Move	4.7	.8
16	Use Radio/Telephone	4.7	1.3
23	Use Battle Drill	4.7	.5
28	Use Grenades	4.7	.5
32	Construct Hasty Fighting Positions	4.7	.8
35	Observe, Detect, Locate, Identify Hostile Targets	4.7	.5
39	Practice Personal Hygiene and Field Sanitation	4.7	.8
40	Prepare Ammunitions	4.5	1.3
17	Use Cover	4.3	.5
36	Use Concealment and Camouflage	4.3	.8
13	Clear Fields of Fire	4.0	1.3
27	Use Pyrotechnic Signals	4.0	1.3
29	Prepare, Adjust, Arrange Combat Load	4.0	1.3
31	Construct Shelters, Emplacements, Trenches	4.0	1.0
37	Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	4.0	1.3
38	Maintain Clothing and Personal Equipment	4.0	.8
30	Carry, Load, Paddle Assault Boat	3.8	1.8
34	Remove Obstacles	3.8	1.0
41	Carry Supplies and Ammunition	3.5	.9
4	Use Hand Signals	3.3	1.3
19	Lay Communication Wire	3.3	1.0
33	Construct Obstacles	3.3	1.3
3	Hand to Hand Combat	3.0	1.5
5	Carry Messages	3.0	1.5
18	Use CBR Equipment	3.0	2.0
24	Splice Communications Wire	3.0	1.3
25	Police Communications Wire	2.8	1.3
7	Drive Vehicle	2.0	1.0
6	Load/Unload Supplies	1.3	.8
20	Prepare Rations	1.3	1.3
26	Use Touch Signals	1.3	1.0

Table 4.

IMPORTANCE
Enlisted Men (N=5)

<u>Task</u>	<u>Median</u>	<u>Q</u>
2 Perform Reconnaissance	5.0	.0
1 Plan Operation	4.9	.5
11 Maintain Orientation	4.9	.5
14 Maneuver	4.9	.3
35 Observe, Detect, Locate, Identify Hostile Targets	4.9	.3
8 Use First Aid	4.7	.8
22 Maintain Weapon	4.7	.5
21 Fire Weapon	4.3	.5
32 Construct Hasty Fighting Positions	4.3	.8
12 Load (Reload) Weapons	4.1	.3
9 Use Map	4.0	.5
15 March/Move	4.0	.5
17 Use Cover	4.0	.8
23 Use Battle Drill	4.0	.5
31 Construct Shelters, Emplacements, Trenches	4.0	1.3
36 Use Concealment and Camouflage	4.0	1.0
4 Use Hand Signals	3.9	.3
16 Use Radio/Telephone	3.9	.3
28 Use Grenades	3.8	.8
38 Maintain Clothing and Personal Equipment	3.8	1.0
39 Practice Personal Hygiene and Field Sanitation	3.8	1.0
13 Clear Fields of Fire	3.7	.8
41 Carry Supplies or Ammunition	3.5	.9
3 Hand to Hand Combat	3.3	1.3
5 Carry Messages	3.0	1.0
10 Use Compass	3.0	1.0
19 Lay Communication Wire	3.0	.5
27 Use Pyrotechnic Signals	3.0	.5
37 Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	3.0	1.3
40 Prepare Ammunitions	3.0	.8
20 Prepare Rations	2.9	.5
6 Load/Unload Supplied	2.8	1.0
33 Construct Obstacles	2.8	1.0
7 Drive Vehicle	2.7	1.0
18 Use CBR Equipment	2.7	.8
24 Splice Communications Wire	2.3	.5
26 Use Touch Signals	2.3	.8
29 Prepare, Adjust, Arrange Combat Load	2.3	.8
30 Carry, Load, Paddle Assault Boat	2.3	1.0
34 Remove Obstacles	2.0	1.3
25 Police Communications Wire	1.7	.5

Table 5.

FREQUENCY

Officers and Enlisted Men Combined
(N=7)

<u>Task</u>	<u>Median</u>	<u>Q</u>
2 Perform Reconnaissance	4.8	.5
31 Construct Shelters, Emplacements, Trenches	4.8	1.0
32 Construct Hasty Fighting Positions	4.8	.5
15 March/Move	4.6	.5
17 Use Cover	4.6	1.0
4 Use Hand Signals	4.3	1.0
11 Maintain Orientation	4.3	1.0
12 Load (Reload) Weapons	4.3	1.0
35 Observe, Detect, Locate, Identify Hostile Targets	4.3	1.0
22 Maintain Weapon	4.0	1.0
33 Construct Obstacles	4.0	1.5
36 Use Concealment and Camouflage	4.0	1.5
13 Clear Fields of Fire	3.9	.5
28 Use Grenades	3.9	.5
9 Use Map	3.8	1.0
23 Use Battle Drill	3.8	1.0
10 Use Compass	3.7	.5
8 Use First Aid	3.3	1.0
16 Use Radio/Telephone	3.3	1.0
21 Fire Weapon	3.3	1.5
39 Practice Personal Hygiene and Field Sanitation	3.3	1.0
41 Carry Supplies or Ammunition	3.3	.6
14 Maneuver	3.2	1.0
38 Maintain Clothing and Personal Equipment	3.1	.5
37 Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	3.0	2.0
5 Carry Messages	2.6	1.0
20 Prepare Rations	2.7	.5
29 Prepare, Adjust, Arrange Combat Load	2.5	.8
40 Prepare Ammunitions	2.5	.9
1 Plan Operation	2.3	1.5
26 Use Touch Signals	2.1	.5
6 Load/Unload Supplies	2.0	1.0
19 Lay Communication Wire	2.0	1.0
27 Use Pyrotechnic Signals	2.0	1.0
34 Remove Obstacles	2.0	1.5
30 Carry, Load, Paddle Assault Boat	1.4	.5
7 Drive Vehicle	1.2	.5
24 Splice Communications Wire	1.2	.5
3 Hand to Hand Combat	1.1	.0
25 Police Communications Wire	1.1	.0
18 Use CBR Equipment	1.0	.0

Table 6.

FREQUENCY

Officers (N=3)

<u>Task</u>	<u>Median</u>	<u>Q</u>
2 Perform Reconnaissance	5.0	.0
31 Construct Shelters, Emplacements, Trenches	5.0	.0
33 Construct Obstacles	5.0	.0
9 Use Map	4.8	.5
11 Maintain Orientation	4.8	1.0
15 March/Move	4.8	1.0
37 Detect, Lay, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	4.8	2.0
10 Use Compass	4.3	.5
13 Clear Fields of Fire	4.3	.5
22 Maintain Weapon	4.3	.5
4 Use Hand Signal	4.0	1.0
12 Load (Reload) Weapons	4.0	1.5
17 Use Cover	4.0	1.5
21 Fire Weapon	4.0	1.5
28 Use Grenades	4.0	1.0
32 Construct Hasty Fighting Positions	4.0	1.0
35 Observe, Detect, Locate, Identify Hostile Targets	4.0	1.0
36 Use Concealment and Camouflage	4.0	1.5
38 Maintain Clothing and Personal Equipment	4.0	1.0
41 Carry Supplies or Ammunition	4.0	1.0
14 Maneuver	3.3	1.0
23 Use Battle Drill	3.3	1.0
39 Practice Personal Hygiene and Field Sanitation	3.3	1.0
6 Load/Unload Supplies	3.0	1.5
8 Use First Aid	3.0	1.5
16 Use Radio/Telephone	3.0	1.5
20 Prepare Rations	3.0	1.5
29 Prepare, Adjust, Arrange Combat Load	3.0	1.5
5 Carry Messages	2.3	1.5
1 Plan Operation	2.0	2.0
7 Drive Vehicle	2.0	2.0
19 Lay Communication Wire	2.0	1.0
24 Splice Communications Wire	2.0	1.0
27 Use Pyrotechnic Signals	2.0	2.0
34 Remove Obstacles	2.0	2.0
40 Prepare Ammunitions	2.0	2.0
26 Use Touch Signals	1.8	.5
25 Police Communications Wire	1.3	1.0
30 Carry, Load, Paddle Assault Boat	1.3	.5
3 Hand to Hand Combat	1.0	.0
18 Use CBR Equipment	1.0	.0

Table 7.

FREQUENCY

Enlisted Men (N=4)

<u>Task</u>	<u>Median</u>	<u>Q</u>
32 Construct Hasty Fighting Positions	5.0	.0
17 Use Cover	4.8	.8
2 Perform Reconnaissance	4.5	.5
4 Use Hand Signals	4.5	.9
12 Load (Reload) Weapons	4.5	.9
15 March/Move	4.5	.5
35 Observe, Detect, Locate, Identify Hostile Targets	4.5	1.3
11 Maintain Orientation	4.0	.8
23 Use battle Drill	4.0	.8
31 Construct Shelters, Emplacements, Trenches	4.0	1.4
36 Use Concealment and Camouflage	4.0	1.4
28 Use Grenades	3.8	.4
8 Use First Aid	3.5	.9
13 Clear Fields of Fire	3.5	.9
16 Use Radio/Telephone	3.5	.9
22 Maintain Weapon	3.5	1.3
10 Use Compass	3.2	.4
14 Maneuver	3.2	.8
5 Carry Messages	3.0	1.1
9 Use Map	3.0	.8
21 Fire Weapon	3.0	1.1
41 Carry Supplies or Ammunition	3.0	.0
39 Practice Personal Hygiene and Field Sanitation	3.0	1.0
38 Maintain Clothing and Personal Equipment	2.8	.8
40 Prepare Ammunitions	2.8	.5
1 Plan Operation	2.5	1.1
20 Prepare Rations	2.5	.5
26 Use Touch Signals	2.5	.9
33 Construct Obstacles (lay wire, roadblocks)	2.5	1.3
37 Lay, Detect, Neutralize Mines, Booby Traps Warning and Illuminating Device	2.5	1.6
29 Prepare, Adjust, Arrange Combat Load	2.3	.5
19 Lay Communication Wire	2.0	.8
34 Remove Obstacles (cut wire, remove roadblocks)	2.0	1.1
27 Use Pyrotechnic Signals	2.0	1.0
6 Load/Unload Supplies	1.5	.5
30 Carry, Load, Paddle Assault Boat	1.5	.5
3 Hand to Hand Combat	1.2	.4
7 Drive Vehicle	1.0	.0
18 Use CBR Equipment	1.0	.0
24 Splice Communications Wire	1.0	.0
25 Police Communications Wire	1.0	.0

Table 8.

DIFFICULTY

Officers and Enlisted Men Combined

(N=9)

<u>Task</u>		<u>Median</u>	<u>Q</u>
1	Plan Operation	4.8	1.0
2	Perform Reconnaissance	4.8	.5
11	Maintain Orientation	4.6	.5
35	Observe, Detect, Locate, Identify Hostile Targets	4.6	.8
37	Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	4.6	.5
3	Hand to Hand Combat	4.1	.8
23	Use Battle Drill	3.9	.3
9	Use Map	3.8	1.0
30	Carry, Load, Paddle Assault Boat	3.8	.8
34	Remove Obstacles	3.7	.8
8	Use First Aid	3.6	1.0
33	Construct Obstacles	3.6	.5
14	Maneuver	3.4	.5
10	Use Compass	3.3	1.5
36	Use Concealment and Camouflage	3.3	1.0
39	Practice Personal Hygiene and Sanitation	3.3	.8
31	Construct Shelters, Emplacements, Trenches	3.1	.5
18	Use CBR Equipment	3.0	1.5
25	Police Communication Wires	3.0	1.5
32	Construct Hasty Fighting Positions	3.0	.5
38	Maintain Clothing and Personal Equipment	3.0	.5
15	March/Move	2.8	1.3
13	Clear Fields of Fire	2.7	1.3
21	Fire Weapon	2.7	1.3
16	Use Radio/Telephone	2.6	.5
17	Use Cover	2.6	.8
22	Maintain Weapon	2.6	.5
41	Carry Supplies and Ammunition	2.5	.5
5	Carry Messages	2.3	1.0
29	Prepare, Adjust, Arrange Combat Load	2.2	.5
19	Lay Communications Wire	2.2	.5
24	Splice Communications Wire	2.1	1.0
28	Use Grenades	2.0	1.0
4	Use Hand Signals	1.9	.8
40	Prepare Ammunitions	1.9	.4
27	Use Pyrotechnic Signals	1.8	.5
12	Load (Reload) Weapon	1.7	.8
26	Use Touch Signals	1.7	.8
7	Drive Vehicle	1.4	1.0
6	Load/Unload Supplies	1.3	.8
20	Prepare Rations	1.3	.5

Table 9.

DIFFICULTY
Officers (N=5)

<u>Task</u>	<u>Median</u>	<u>Q</u>
11 Maintain Orientation	4.9	.5
2 Perform Reconnaissance	4.7	.5
9 Use Map	4.7	.8
35 Observe, Detect, Locate, Identify Hostile Targets	4.7	.8
37 Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	4.7	.8
3 Hand to Hand Combat	4.0	.8
10 Use Compass	4.0	1.5
23 Use Battle Drill	4.0	.5
33 Construct Obstacles	3.9	.3
30 Carry, Load, Paddle Assault Boat	3.8	1.3
34 Remove Obstacles	3.8	.8
14 Maneuver	3.7	.5
39 Practice Personal Hygiene and Field Sanitation	3.7	.8
1 Plan Operation	3.3	1.0
15 March/Move	3.3	1.0
18 Use CBR Equipment	3.3	.8
32 Construct Hasty Fighting Positions	3.3	.5
36 Use Concealment and Camouflage	3.3	1.0
31 Construct Shelters, Emplacements, Trenches	3.1	.5
25 Police Communication Wires	3.0	1.3
38 Maintain Clothing and Personal Equipment	3.0	.5
41 Carry Supplies and Ammunition	3.0	.8
23 Use Grenades	2.8	1.3
16 Use Radio/Telephone	2.7	.8
21 Fire Weapon	2.7	1.0
22 Maintain Weapon	2.7	.8
29 Prepare, Adjust, Arrange Combat Load	2.3	.8
8 Use First Aid	2.3	1.0
19 Lay Communications Wire	2.3	.8
24 Splice Communications Wire	2.3	1.0
4 Use Hand Signals	2.0	1.3
5 Carry Messages	2.0	1.5
17 Use Cover	2.0	1.0
26 Use Touch Signals	2.0	1.3
40 Prepare Ammunitions	2.0	1.1
27 Use Pyrotechnic Signals	1.7	.5
6 Load/Unload Supplies	1.3	.8
7 Drive Vehicle	1.3	.8
13 Clear Fields of Fire	1.3	1.0
12 Load (Reload) Weapon	1.1	.3
20 Prepare Rations	1.1	.3

Table 10.

DIFFICULTY

Enlisted Men (N=4)

<u>Task</u>	<u>Median</u>	<u>Q</u>
1 Plan Operation	5.0	.0
2 Perform Reconnaissance	4.8	.8
3 Hand to Hand Combat	4.5	.9
35 Observe, Detect, Locate, Identify Hostile Targets	4.5	.9
37 Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	4.5	.5
11 Maintain Orientation	4.2	.4
36 Use Concealment and Camouflage	4.0	1.4
8 Use First Aid	3.8	.8
23 Use Battle Drill	3.8	.4
30 Carry, Load, Paddle Assault Boat	3.8	.4
13 Clear Fields of Fire	3.5	1.3
34 Remove Obstacles	3.5	1.3
21 Fire Weapon	3.5	1.5
9 Use Map	3.2	.4
14 Maneuver	3.2	.8
17 Use Cover	3.0	.8
31 Construct Shelters, Emplacements, Trenches	3.0	1.1
33 Construct Obstacles	3.0	1.1
38 Maintain Clothing and Personal Equipment	3.0	.8
39 Practice Personal Hygiene and Field Sanitation	3.0	1.1
5 Carry Messages	2.5	.5
10 Use Compass	2.5	1.3
12 Load (Reload) Weapon	2.5	.9
16 Use Radio/Telephone	2.5	.5
22 Maintain Weapon	2.5	.5
32 Construct Hasty Fighting Positions	2.5	.5
25 Police Communication Wires	2.5	1.5
29 Prepare, Adjust, Arrange Combat Load	2.2	.4
15 March/Move	2.0	1.1
19 Lay Communication Wire	2.0	.8
24 Splice Communications Wire	2.0	1.1
27 Use Pyrotechnic Signals	2.0	.8
41 Carry Supplies and Ammunition	2.0	.8
7 Drive Vehicle	2.0	1.0
4 Use Hand Signals	1.8	.4
28 Use Grenades	1.8	.4
40 Prepare Ammunitions	1.8	.4
20 Prepare Rations	1.5	1.3
26 Use Touch Signals	1.5	.5
6 Load/Unload Supplies	1.2	.3
18 Use CBR Equipment	1.2	1.1

In the tables, the median and Q-values for each combat task, as judged by the indicated sample, are presented. The median is a measure of central tendency, and it reflects the rating which represents a midpoint of the indicated sample. The Q-value, or semi-interquartile range, is a measure of dispersion about the median. The median value for an item will be high when a majority of the raters considered the task to be among the most important, the most difficult, or the most frequently performed. A high Q-value indicates that the ratings of people were rather spread-out or varied concerning where a particular item belonged; conversely, a low Q-value indicates that people were in close agreement about the importance, difficulty or frequency of a task.

In actually tabulating the results of the ratings, numeric values of 1 through 5 were assigned to the five rating categories for each dimension. The determination of median and Q-values was performed using a class interval of 1.0 to represent each rating category value; e. g., category 1 = .5 through 1.4, category 2 = 1.5 through 2.4, etc. through category 5 = 4.5 through 5.4. While the sample size was small, it was desired to differentiate among items to the extent that the data on given tasks differed; the median thus offered an appropriate statistic for the frequently skewed results, and the Q-value allowed for an estimate of how well raters agreed concerning a particular task.

D. Statistical Analyses of Ratings and Interpretations

Statistical analyses of the ratings were performed in order to evaluate two aspects of the obtained data: 1) the extent of within group agreement -- among officers as a group and among enlisted men as a group; and 2) the extent of between group agreement -- between officers and enlisted men.

The average agreement among officers as a group and among enlisted men as a group was determined using Kendall's Coefficient of Concordance.¹ This is a non-parametric statistic which expresses the degree of association among several rankings or ratings of the number of things (objects) being considered. In the present case, it is an index of inter-rater reliability-- the extent to which the specified groups tended to agree among themselves. The results are shown in Table 11.

¹ See Siegel, S. Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill, 1956, pages 229-238.

Table 11. Average Agreement ¹ (Inter-Rater Reliability) Among Officers as a Group and Enlisted Men as a Group

	Officers	Enlisted Men
Importance	$r_w = .52^{**}$	$r_w = .59^{**}$
Frequency	$r_w = .70^{**}$	$r_w = .68^{**}$
Difficulty	$r_w = .52^{**}$	$r_w = .54^{**}$

** All significantly different from $r = .00$
at $p < .01$.

¹

Determined using Kendall's Coefficient of Concordance (r_w) and corrected for tied ranks. r_w is non-parametric. When tied ranks are extensive, r_w must be corrected to avoid artificial attenuation of the obtained value.

As indicated in Table 11, all of the obtained coefficients were significantly different from zero. That is, there was positive agreement among the ratings of officers and among the ratings of enlisted men for each of the three dimensions. The likelihood that coefficients of the obtained magnitude might be attributable to chance occurrences is less than one time in one hundred with this size sample.

These findings are interpreted as follows:

The obtained coefficients of over-all agreement among the officers and among the enlisted men are considered satisfactory. All are significantly different from zero, and the agreement among both officers and enlisted men with respect to task frequency is particularly high -- when one considers the differences in combat experience among the individuals that comprise each of the groups.

The obtained coefficients indicate that the raters understood the nature of each of the rating tasks and that in general they used the same basis in making their ratings.

The foregoing results permitted us to use the officer ratings as a group and the enlisted ratings as a group in order to examine the extent of agreement between these two groups. The agreement between the median rank values assigned to the combat tasks by officers and enlisted men was determined using Spearman's Rank-Order Correlation Coefficient.¹ The rank-order correlation coefficient, like the coefficient of concordance, is a non-parametric measure of agreement. The results for each dimension of the rating task are shown in Table 12. All of the coefficients are positive and significantly different from zero.

The obtained correlations were then stepped-up using the Spearman-Brown Prophecy Formula² to estimate the reliability of the composite ratings resulting from combining the rating data from both officers and enlisted men. The resulting stepped-up correlations are shown in Table 13.

¹ See Siegel, S. *op.cit.*, pages 202-213.

² Guilford, J. P. Fundamental Statistics in Psychology and Education. McGraw-Hill, New York, 1956, pages 452-453.

Table 12. Agreement Between the Median Rank Values Assigned to Tasks by Officers and Enlisted Men¹

Importance	$r_s = .78^{**}$
Frequency	$r_s = .69^{**}$
Difficulty	$r_s = .68^{**}$

** All significantly different from $r = .00$ at $p < .01$.

¹ Degree of agreement determined using Spearman's Rank-Order Correlation Coefficient (r_s) and corrected for tied ranks. r_s is non-parametric. When extensive ties exist, a correction must be applied to avoid artificial attenuation of the obtained value of r_s .

Table 13. Agreement Between the Median Rank Values Assigned to Tasks by Officers and Enlisted Men Stepped-Up¹ to Estimate the Reliability of the Composite Rank Values

Importance	$r = .88$
Frequency	$r = .82$
Difficulty	$r = .81$

¹ Spearman-Brown formula used to estimate the reliability of the composite rank values assigned to tasks for the combined officer and enlisted ratings.

These findings concerning the extent of between group agreement are interpreted as follows:

The degree of agreement and the reliability of the composite rank values is considered extremely satisfactory -- especially in the light of the small sample, the variation that could arise due to differences in grade/rank of the raters, and the variation that could arise from the different combat exposures of the raters (Europe vs. Korea, etc.). The good agreement between officers and enlisted men supports combining their data and using the resulting composite rank values to assist in selecting tasks for measurement.

Perhaps most important for the present project, the obtained degree of reliability indicates that combat-experienced professional soldiers can agree on what combat tasks are the more important, frequent, and difficult to perform. This agreement does provide a good foundation for the project effort. Reliability does not guarantee task relevance; however, it does permit us to select for measurement those tasks which the best qualified raters agree are relevant.

E. Further Analysis of Tasks and Identification of Tasks to be Measured in Phases II and III

The next problem was how to reduce the large number of tasks, judged to be important in combat, to a practical number for research and study in Phase II. Our procedure was essentially as follows. It should be noted that these steps, while subjective for the most part, were performed systematically and deliberately.

First, as shown in Figure 5, we took the composite officer and enlisted ratings on importance and drew a cut-off line below those tasks which received a composite rating less than 3.5. It will be remembered that a numeric value of 3.0 was originally assigned to the rating category of "tasks of average importance," and a value of 4.0 to those tasks "of above average importance." Thus, a composite rating of 3.5 or above indicates those tasks which 50 per cent or more of the composite sample

Task	Mdn.	Q
1 Plan Operation	4.9	.3
2 Perform Reconnaissance	4.9	.3
11 Maintain Orientation	4.9	.3
14 Maneuver	4.9	.3
22 Maintain Weapon	4.8	.4
35 Observe, Detect, Locate, Identify Hostile Targets	4.8	.4
8 Use First Aid	4.7	1.1
9 Use Map	4.7	.5
21 Fire Weapon	4.7	.5
12 Load (Reload) Weapon	4.5	.6
32 Construct Hasty Fighting Positions	4.5	.7

15 March/Move	4.3	.6
23 Use Battle Drill	4.3	.5
28 Use Grenades	4.3	.6
10 Use Compass	4.2	.9
17 Use Cover	4.2	.5
36 Use Concealment and Camouflage	4.2	.8
39 Practice Personal Hygiene and Field Sanitation	4.2	.8
16 Use Radic/Telephone	4.0	.7
31 Construct Shelters, Emplacements, Trenches	4.0	.9

38 Maintain Clothing and Personal Equipment	3.9	.7
4 Use Hand Signals	3.8	.7
13 Clear Fields of Fire	3.8	.8
37 Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	3.5	1.0
40 Prepare Ammunitions	3.5	1.0
41 Carry Supplies and Ammunition	3.5	.7

27 Use Pyrotechnic Signals	3.3	.8
3 Hand to Hand Combat	3.2	.9
19 Lay Communication Wire	3.1	.5
5 Carry Messages	3.0	1.0
29 Prepare, Adjust, Arrange Combat Load	3.0	1.1
33 Construct Obstacles	3.0	.9
34 Remove Obstacles	3.0	1.3
18 Use CBR Equipment	2.8	1.0
20 Prepare Rations	2.7	1.0
7 Drive Vehicle	2.5	.9
24 Splice Communications Wire	2.5	.7
30 Carry, Load, Paddle Assault Boat	2.5	1.3
6 Load/Unload Supplies	2.0	.9
26 Use Touch Signals	2.0	.3
25 Police Communication Wires	1.8	.8

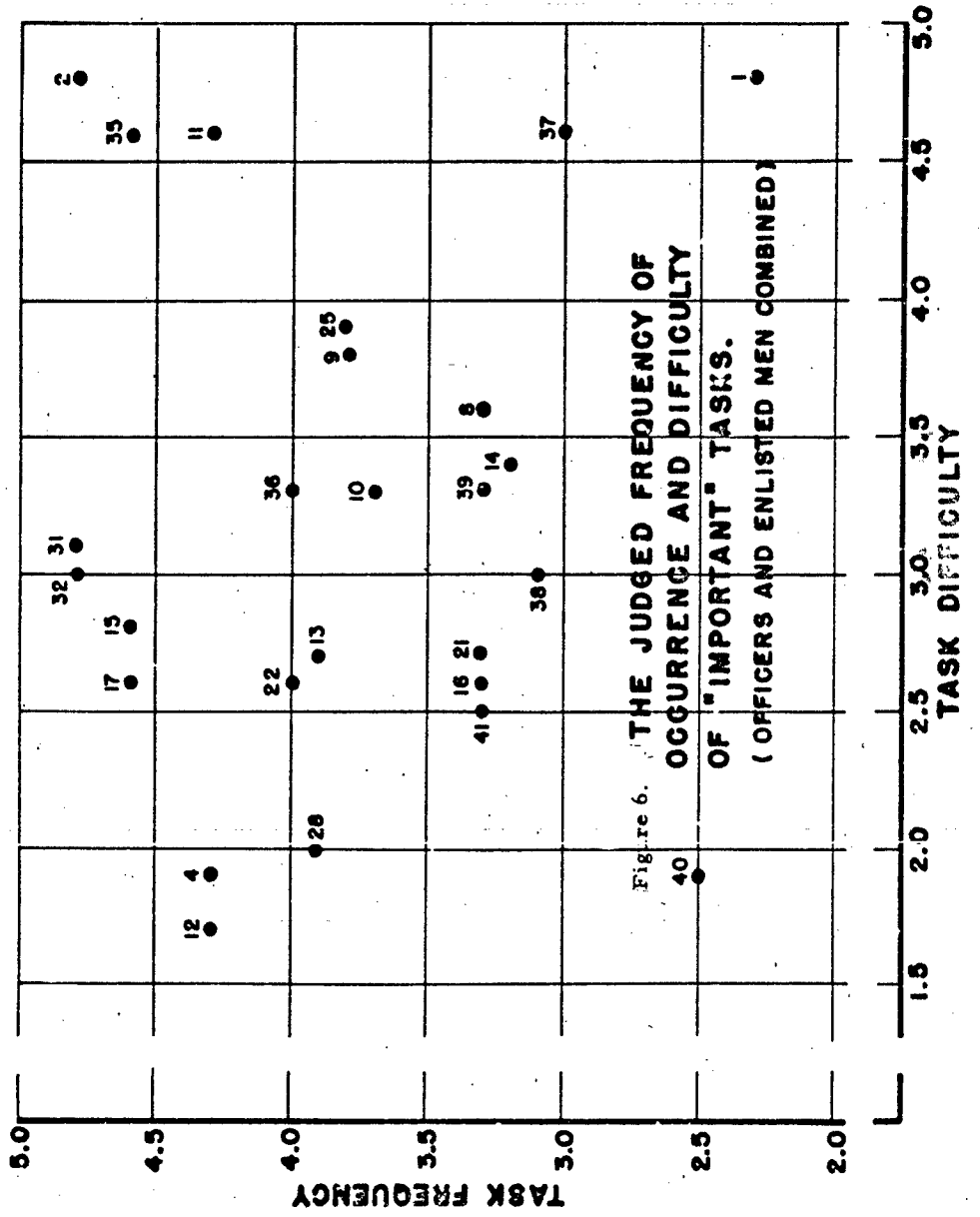
Figure 5. Importance Groupings, Officers and Enlisted Men Combined (N = 10)

considered to be of above average importance to defeating the enemy in combat. For convenience in working with these more important combat tasks, we also drew lines, as shown in Figure 5, below the composite ratings of 4.5 and 4.0. We identified these three groupings, again for convenience and as will be discussed presently, using Roman numerals I, II, and III to represent composite ratings from 4.5 to 4.9, 4.0 to 4.4 and 3.5 to 3.9 respectively.

It may be of interest to note, with regard to Figure 5, that all of the tasks which received a group composite rating of 3.5 or above by the enlisted men appear in the 26 tasks above the indicated cut-off line. There were four tasks to which the officers, as a group, assigned values above 3.5 which do not appear in the 26 more important tasks above the cut-off. These tasks were:

<u>Task No.</u>	<u>Description</u>	<u>Composite Officer Rating Value</u>	<u>Composite Enlisted Rating Value</u>
27	Use Pyrotechnic Signal	4.0	3.0
29	Prepare, Adjust Arrange Combat Load	4.0	2.3
30	Carry, Load, Paddle Assault Boat	3.8	2.3
34	Remove Obstacles	3.8	2.0

As a next step, working now only with those important tasks with composite ratings of 3.5 and above, a bivariate plot of the judged composite frequency of occurrence and difficulty was prepared as shown in Figure 6. The object here was to examine graphically how the more important combat tasks were distributed with regard to the judged frequency of occurrence and difficulty in combat. As a further aid to examining relative task frequency and difficulty values, the difficulty and frequency categories shown in Figure 7 were established.



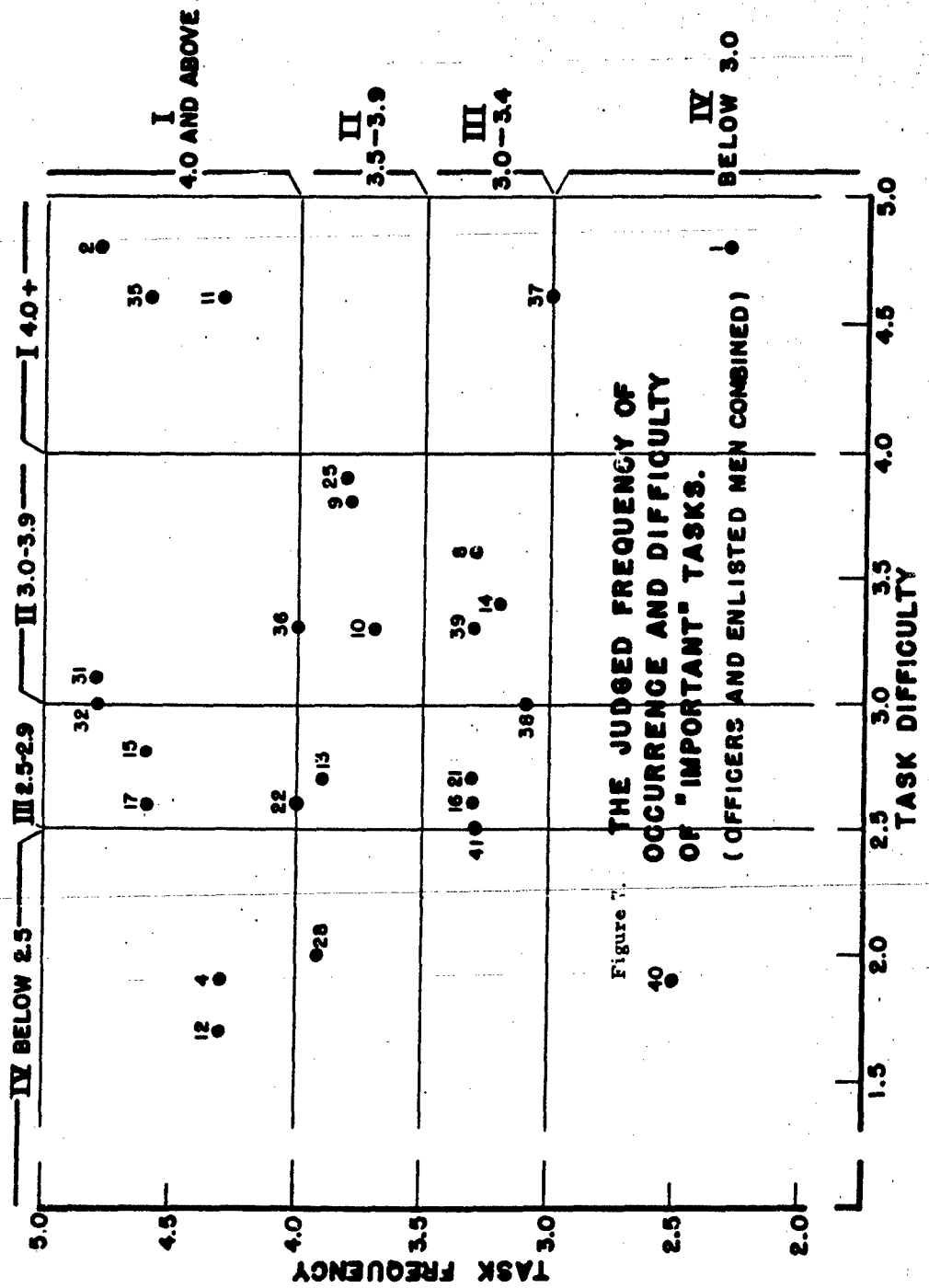


Figure 7. THE JUDGED FREQUENCY OF OCCURRENCE AND DIFFICULTY OF "IMPORTANT" TASKS. (OFFICERS AND ENLISTED MEN COMBINED)

In both Figures 6 and 7, the number directly above the black dot indicates the task number. The 26 more important combat tasks were then listed again, by their importance categories, with the assigned frequency and difficulty categories as indicated in Figure 7. This relisting with categories for each dimension is shown in Figure 8.

The problem at hand was still how to reduce the large number of important combat tasks to a number practical for measurement research and development in Phase II. At an earlier time in the project, criteria for selecting tasks for measurement and criteria for selecting measures, as shown in Figures 9 and 10, had been developed independently. It was decided to prepare an evaluation form which would permit the systematic consideration of each task against each of the criteria. The form shown in Figure 11 was thus prepared as a next step. The 26 tasks were listed in order by categories, and the criteria were indicated across the top of the form. The project leader and the senior project staff member then independently evaluated the tasks against the criteria. In making the evaluations, the categories shown in Figure 8 were the basis for establishing the relative importance, difficulty and frequency of occurrence for each task. Subsequent to completing the evaluation form, the two project members discussed their decisions and differences. The results of these activities was the rejection of nine tasks from further consideration at this time. The tasks that were rejected and their reasons for being rejected are shown in Figure 12.

As a result of the preceding activities, the more important combat tasks were now reduced to the seventeen tasks shown in Figure 13. Seventeen tasks were still too large a number to practically consider for Phases II and III. A further reduction was thus performed as indicated in Figure 14. The essential features of this reduction were:

- a. Fire weapons and the loading and reloading of weapons were combined; it was anticipated that these two tasks could sensibly be measured in a single, field testing situation.
- b. Construct hasty fighting positions and the construction of more deliberate, permanent emplacements were also combined, for similar reasons.

	Task No.		Frequency Category	Difficulty Category
I	1	Plan Operation	IV	I
	2	Perform Reconnaissance	I	I
	11	Maintain Orientation	I	I
	14	Maneuver	III	II
	22	Maintain Weapon	I	III
	35	Observe, Detect, Locate Identify Hostile Targets	I	I
	8	Use First Aid	III	II
	9	Use Map	II	II
	21	Fire Weapon	III	III
	12	Load (Reload) Weapon	I	IV
	32	Construct Hasty Fighting Position	I	II
	II	15	March/Move	I
23		Use Battle Drill	II	II
28		Use Grenades	II	IV
10		Use Compass	II	II
17		Use Cover	I	III
36		Use Concealment and Camouflage	I	II
39		Practice Personal Hygiene	III	II
16		Use Radio/Telephone	III	III
31	Construct Shelters, Emplacements, Trenches	I	II	
III	38	Maintain Clothing and Personal Equip- ment	III	II
	4	Use Hand Signals	I	IV
	13	Clear Fields of Fire	II	III
	37	Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices	III	I
	40	Prepare Ammunitions	IV	IV
41	Carry Supplies and Ammunition	III	III	

Figure 8. Frequency and Difficulty Categories of the 26 Most Important Combat Tasks

Criteria for Selecting Tasks for Measurement

1. Relevant -- (to present and future combat infantry).
2. Important -- (combat success is importantly affected by performance in these tasks).
3. Occur Frequently in Infantry Missions
4. Occur Frequently to Individual Squad Members
5. Occur to a Number of Squad Members
6. Do Not Require Special Troop Training -- In order to test clothing and equipment, regular infantry troops can be used as subjects (part of the regular training and/or repertoire of replacement ((16 weeks basic)) infantry).
7. Relatively Independent of Other Tasks already Selected for Measurement
8. Have Face Validity -- Most people think that this task should be related to combat effectiveness.
9. Susceptible to Measurement (see Criterion for Selecting Measures).
10. Quartermaster Clothing and Protective Equipment will/may be expected to affect performance in this task.

Figure 9. Criteria for Selecting Tasks for Measurement

Criteria for Selecting Measures

1. Objective -- (free from observer bias)
2. Quantitative -- (indicating the degree of impairment, if any, in combat performance)
3. Reliably Observed and Recorded
4. "Sensitive" to Protective Clothing and Equipment Differences
5. Permit for Group Testing
6. Uncomplicated --
 - a. Obtainable without dependence upon a lot of electronic equipment with imperfect reliability;
 - b. Obtained measures can be converted into interpretable, meaningful terms with a minimum of statistical or numeric computations.

Figure 10. Criteria for Selecting Measures

	Relevant	Important Now & Future	Will be Affected by	Clothing and Equipment	Occur Frequently in	Missions	Occur Frequently to	Squad Members	Occur to a Number of	Squad Members	No Special Training	Required	Has Face Validity	Susceptible to	Measurement	Relatively Independent	of Other Tasks	Difficult	Decision
Plan Operation																			
Perform Reconnaissance																			
Maintain Orientation																			
Maneuver																			
Maintain Weapon																			
Observe, Detect, Locate,																			
Identify, Hostile Targets																			
Use First Aid																			
Use Map																			
Fire Weapon																			
Load (Reload) Weapon																			
Construct Hasty Fighting																			
Position																			
March/Move																			
Use Battle Drill																			
Use Grenades																			
Use Compass																			
Use Cover																			
Use Concealment and																			
Camouflage																			
Practice Personal Hygiene																			
Use Radio/Telephone																			
Construct Shelters, Em-																			
placements, Trenches																			
Maintain Clothing and																			
Personal Equipment																			
Use Hand Signals																			
Clear Fields of Fire																			
Lay, Detect, Neutralize																			
Mines, Booby Traps,																			
Warning and Illuminating																			
Devices																			
Prepare Ammunitions																			
Carry Supplies and																			
Ammunition																			

Figure 11. Format for Evaluating Tasks
Against Selection Criteria

**Tasks Rejected on the Basis of the
Pre-Determined Criteria for Selecting Tasks**

<u>Task</u>	<u>Reason</u>
Plan Operation	1, 2, 4
Maintain Orientation	1
Maintain Weapon	1
Use First Aid	1
Use Map	1
Use Battle Drill	3, 4
Practice Personal Hygiene	1
Maintain Clothing and Personal Equipment	1, 4
Prepare Ammunitions	2, 3

Reasons:

1. Performance, in all probability, will not be affected by clothing and protective equipment.
2. Among the least frequently occurring combat tasks.
3. Doubtful that performance will be affected by clothing and protective equipment.
4. Susceptibility to measurement doubtful with regard to pre-determined criteria.

Figure 12. Tasks Rejected on the Basis of the
Pre-Determined Criteria for Selecting
Tasks

**The Seventeen Tasks Remaining After
Rejection of those Tasks not Meeting Selection Criteria**

- . Perform Reconnaissance
- . Maneuver
- . Observe, Detect, Locate, Identify Hostile Targets
- . Fire Weapon
- . Load (Reload) Weapons
- . Construct Hasty Fighting Positions

- . March/Move
- . Use Grenades
- . Use Compass
- . Use Cover
- . Use Concealment and Camouflage
- . Use Radio/Telephone
- . Construct Shelters, Emplacements, Trenches

- . Use Hand Signals
- . Clear Fields of Fire
- . Lay, Detect, Neutralize Mines, Booby Traps, Warning and Illuminating Devices
- . Carry Supplies and Ammunition

**Figure 13. The Seventeen Tasks Remaining After
Rejection of Tasks not Meeting Selection
Criteria**

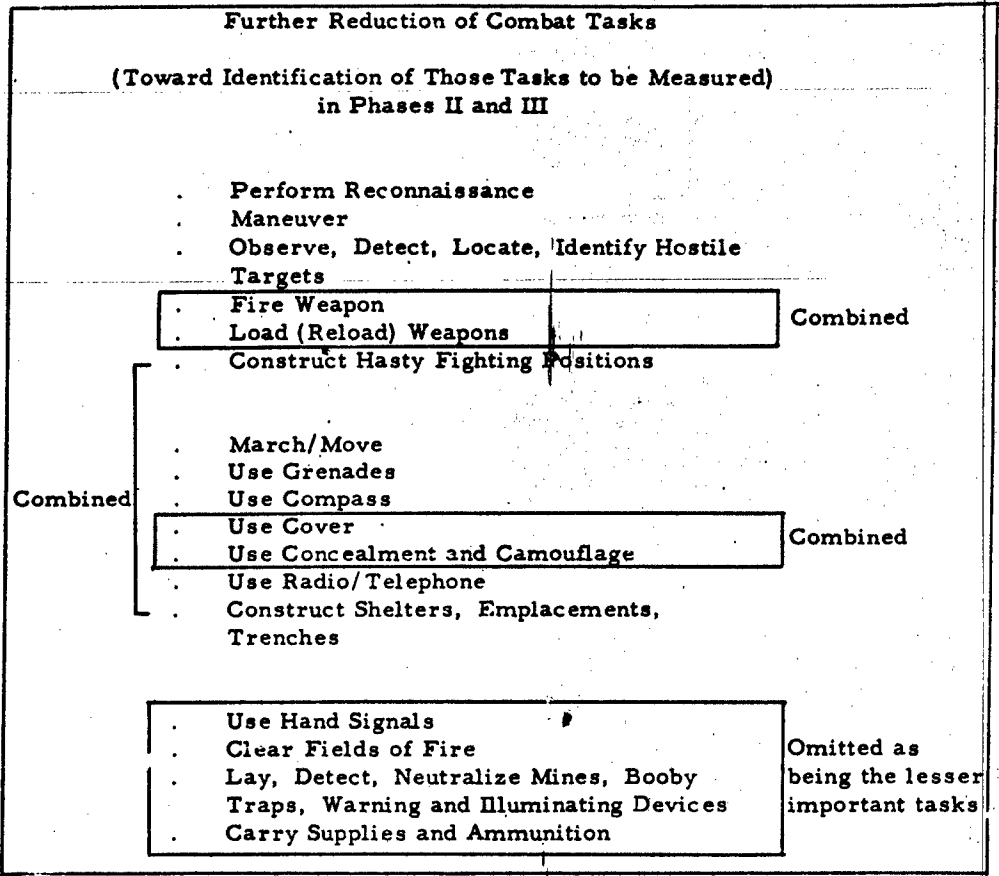


Figure 14. Further Reduction of Combat Tasks

- c. Use cover and the use of concealment and camouflage were combined, again for reasons similar to (a) above.
- d. The tasks of use hand signals, clear fields of fire, detect and neutralize mines and booby traps, and carry supplies and ammunition were all omitted because they were relatively less important than the other tasks contained in the listing.

We thus arrived at the ten combat tasks shown in Figure 15. These ten tasks constitute the tasks to be researched in Phase II and around which the Phase II research plan is developed. In Figure 15, the tasks have been broken out into GENERAL TASKS I and II, and SPECIAL TASKS. The Roman numerals correspond to the importance categories of the tasks. The special tasks are so identified because it appears that: 1) performance in these tasks will only be affected by a limited number of clothing and protective equipment items, and 2) the measurement of performance in these tasks may possibly be accomplished by incorporating them within the field test settings of the general tasks.

F. Definition of Combat Effectiveness

The following discussion presents the rationale underlying the operational definition of combat effectiveness as developed for this project.

The project is concerned with the combat effectiveness of the individual infantry soldier. Specifically, the project is directed toward the field measurement of the effects of quartermaster clothing and protective equipment on combat effectiveness. To carry the clarification a bit further, the project is not concerned with the effect of tactics, training proficiency, or the destructive potential of weapons; yet all of these conditions are relevant to the combat effectiveness of the individual soldier.

We can look at the project goal from a slightly different point of view. That is, the project is concerned with the field measurement of the suitability of quartermaster clothing and protective equipment as it affects individual combat effectiveness. The distinction between this statement and that above is as follows.

**The Ten Combat Tasks Selected
For Measurement in Phases II and III**

General Tasks:

I Perform Reconnaissance

Maneuver

Fire and Load Weapons

Construct Fighting Positions (Hasty
and Defensive)

II March/Move

Use Grenades

Use Cover, Concealment (and
Camouflage)

Special Tasks:

Observe, Detect, Locate Identify
Hostile Targets

Use Compass

Use Radio/Telephone

Notes:

I = The most important combat tasks (4.5+ rating)

II = The next most important combat tasks (4.0-4.4)

Special

**Tasks = Those in which performance will be affected
primarily by face masks, hoods, gas masks,
and other limited, specific clothing items.**

**Figure 15. The Ten Combat Tasks Selected for
Measurement in Phases II and III**

It appears, upon reflection, that there are two, somewhat different underlying problem-areas involved in assessing the effects of quartermaster clothing and equipment on combat effectiveness. Both of these problem-areas are important; however, only one may be resolvable. For the present project, fortunately, the resolvable problem-area may be the most important, at least at this time. The two problem-areas are:

(1) What is the relative contribution of quartermaster clothing and equipment to the total combat effectiveness of the individual? Answers to this question require that one determine on the one hand the total combat effectiveness of the individual and on the other hand the differential contributions to combat effectiveness of such factors as weapon destructive capability, physical fitness of the individual, communications or signal capability, transportation/ mobility capability, and clothing and protective equipment. Identifying all of the factors in combat effectiveness and the relative contribution of each may or may not be a problem-area which can be satisfactorily resolved. Resolution, however, is not seen as being critical in any way for the present project; the performance data resulting from this project may, however, be of eventual value in relation to the first problem.

(2) The second problem-area is: What is the effect of quartermaster clothing and protective equipment on the performance of those tasks which the infantryman performs in combat? From the standpoint of combat effectiveness, answers to this question are certainly meaningful -- for combat effectiveness is something which is realized as a result of the performances of the infantryman in those tasks required by the combat situation. Further, from the standpoint of clothing and equipment design, this is seemingly a more practical problem-area than the first. Here the field evaluator may directly concern himself with the measureable effects of clothing and equipment on performance -- clothing and equipment differences need not be confounded with or masked by variation arising from tactics, weapons, leadership, etc.

Simply stated, the immediate objective is to provide the infantryman with the best clothing and protective equipment. The best clothing and protective equipment is that which: (a) enhances performance in those tasks important in combat; (b) gives the best protection against that for which it was designed; and (c) is durable and can be provided to the infantryman when and as he needs it.

It is the second problem-area -- the suitability of clothing and equipment as they affect the performance of important combat tasks-- that is seen as the prime concern of the project. Our definition of "combat effectiveness" for project purposes is thus purposely limited and operational. "Combat effectiveness", as used for this project, refers to a composite of the performances of the individual infantryman in those tasks which are both important in combat and also likely to be affected by clothing and protective equipment under conditions representative of the combat situation.

SECTION IV
RESEARCH PLAN

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I. INTRODUCTION

The research activities described in the following pages identify and structure the work to be performed in Phase II. The objective has been to prepare a research program which will lead to an effective and practical field measurement system for evaluating the nature and extent of any degradation or facilitation in the performance of important combat tasks attributable to Quartermaster clothing and equipment.

The planning is as specific as it seems either reasonable or possible to be at this time. It is anticipated that the activities performed in the later stages of Phase II will be modified by earlier experiences and findings. In reading the subsequent sections in this plan, it should be borne in mind that the research effort is directed toward developing and proving out each test situation. While we have attempted to indicate the nature of initial experimental test settings, these situations are preliminary and unproven. They constitute a starting point for the research toward developing accurate, efficient and practical field measurement situations, and eventually an integrated test course, of important combat infantry tasks.

In overview, Phase II may be broken out into four activity groups:

1. Further Refinement of Important Combat Tasks

This effort will consist in a broader and more extensive study of the significant combat tasks that were identified during the Phase I study.

2. Research and Development of Field Test Situations for Measuring Performance in Important Combat Tasks

This work area will consist of development and evaluation of field measurement situations for the following important combat tasks: march/move; construct hasty fighting positions; maneuver; fire and reload hand-held weapons; reconnaissance, concealment and cover; and several other important tasks in which performance will be affected primarily by specific clothing items. The research evaluations and refinement of these test situations will be the prime effort in Phase II.

The specific outputs of the research will be the definition of the following for each combat task: test situational tasks and procedures; conditions of measurement; measures to be taken and when; data collection/recording procedures and instrumentation; data reductions and analyses to be performed; briefing and practice requirements for test troops and observer-controllers; and any other pertinent test implementation requirements such as course preparation, check-out or maintenance considerations.

It is anticipated that these test development activities will physically commence early in Phase II and may continue throughout almost the entire allotted Phase II time.

3. Definition of an Integrated Test Course

After the individual combat task test situations have been refined, they will be integrated into a total measurement system that will reflect the extended demands made on the line infantryman in combat. The measurement situations will be arranged and sequenced to provide data reflecting performance trends in important combat tasks as output is sustained. The integration will consider practical economies concerning test course use and maintenance and efficient programming of test personnel, both subject troops and observer-controllers.

If feasible, the integrated combat test course will be given at least limited tryout in Phase II. This tryout is contingent, of course, upon a number of items which include: the rate of success in developing effective individual test situations; time and cost constraints of preparing and instrumenting the final test situations as an integrated course; programming for and the training of a total complement of observer-controllers; and the scheduling of combat-ready test troops.

4. Phase II Report

At the completion of Phase II, a report will be prepared describing the work performed. This report will include, but not be limited to, the following:

- a review of the development activities and findings for the individual test situations and the integrated combat performance course,

- the description of recommended configurations for the test situations and integrated course with procedures for operation and data processing, and
- the statement of a work plan for Phase III and the utilization of the test course during Phase III.

Phase III

No specific work outlines have been developed at this time for Phase III. It may be stated that Phase III will involve essentially two major kinds of activities:

- Final evaluations and refinements of the situations, measures, and data collecting/processing procedures as an integrated combat performance course;
- Collection of extensive performance data under standard course conditions. These data will be used to examine the feasibility of developing normative data to serve as the actual criteria against which results from subsequent field tests of clothing and equipment may be evaluated.

II. FURTHER REFINEMENT OF IMPORTANT COMBAT TASKS

A. Purposes of this Work

The purposes of this work are twofold:

- (1) To provide an independent check on the ranking of important combat tasks for comparison with the Phase I results;
- (2) To provide additional data permitting for the assignment of relative weights (in relation to the criterion) to the important combat tasks.

B. Procedure

At this time, it is planned that rating data will be collected from two major samples hereafter referred to as Sample I and Sample II.

Sample I, which will constitute the primary effort, will provide data on the relative ranking of combat tasks. Sample II, which will be considerably smaller and which will utilize the results from Sample I (and Phase I), will provide data on the relative weighting of a limited selection of the most important combat tasks.

Sample I will consist of 90 combat veterans broken out as follows:

- 30 combat veterans - World War II, Europe
- 30 combat veterans - World War II, Pacific
- 30 combat veterans - Korea

Within each group of 30, 20 will have experienced combat primarily as enlisted personnel and 10 will have been line officers. This will allow for a comparison of the ratings from enlisted versus officer line personnel. Since enlisted combat experience is considered the more relevant for our test program, a greater number of enlisted veterans will comprise each sample.

In order to insure a final, usable sample of qualified veterans, it is proposed that 135 veterans be identified to initially perform the ratings. Thus, within each combat theatre, 45 veterans will perform the ratings. Forty-five people in each group will allow a margin of 10 additional enlisted men and 5 additional officers.

Hopefully, our sample can be made-up from people who are professional soldiers and still on active duty. Their combat experience must have been as line infantry. We will collect biographical information about each subject to serve as a basis for including or rejecting an individual for the sample. The biographical information will include the places and duration of combat, assignment in the company, and decorations. While we may make our criterion more stringent based upon further reflection, the minimum requirements for including an individual will be: (a) a CIB; (b) combat experience to exceed 2 months with a line rifle company.

Collection of ratings will use the triad comparison method. This method has been shown to be as reliable as the paired-comparison technique and requires one third the number of comparison cards as a complete paired-comparison. Since the use of the triad comparison technique requires that the number of things to be rated be an odd number and evenly divisible by three in order to properly generate the triads, we will use as tasks the 27 most important tasks as established by the combined officer and enlisted ratings in Phase I.

The selection of the 27 most important tasks as the number to be rated represents a compromise. Even using the triad comparison approach, 27 tasks will mean that each rater will have to consider separately 117 sets of three tasks. The number of sets of three increases exponentially as the number of tasks is increased. Since the triad comparison technique requires that the number of items to be rated be an odd number and evenly divisible by three, the more inclusive alternatives would be to ask combat veterans to rate 33 or 39 tasks. Thirty-three (33) and 39 tasks respectively would require that 176 and 247 sets of tasks be rated. These latter numbers seem both excessive and probably unnecessary, since our primary interest is to identify the ten to fifteen most important tasks and compare their rank-order with the Phase I results.

For planning purposes, it is estimated that about two man-weeks of clerical time will be required to produce the triad comparison booklets,

biographical data forms and instruction sheets. . If the rating data are reduced by hand (rather than machine), approximately six man-weeks of statistical clerk time will be required.

Sample II, which will provide additional data on the relative weighting to be given to important combat tasks, will require a sample of 20 combat veterans. These 20 people will be our best qualified combat veterans and will be drawn from those individuals comprising Sample I. The 12 or 15 most important combat tasks, as established from a comparison and combination of results from Phase I and Sample I ratings, will be judged by each person in Sample II. The judgments will involve placing each of the selected tasks into categories such that the resulting data fall on a defined interval scale. This will permit the determination of the magnitude of any consistently perceived differences among the most important combat tasks.

C. Analysis

The following analyses are planned at this time.

Sample I will be analyzed to determine:

1. An estimate of individual rater self-consistency;
2. The average within group agreement;
3. The average between group agreement;
4. The meaning of between group differences;
5. The extent of differences between composite rank values with those from Phase I;
6. The effect, if any, arising from differences established in Step 4 upon the proposed measurement system.

Sample II will be analyzed to establish the consistency of the data among the raters. If there is acceptable agreement, any defined, differential, rater-determined weightings will be assigned to the tasks.

III. MARCH/MOVE

1. Research Objective

The objective of the research is to develop a field test situation which will yield accurate and reliable data concerning the effects of clothing and protective equipment on the infantryman's ability to march and move for an extended period of time over roads and cross country trails.

The desirable features which the field test situation should have include:

- require extended road and cross country travel,
- allow for repeated measurement of the effects of clothing and equipment on an infantryman's ability to move and respond throughout the distance to be travelled.

2. Preliminary Measurement Situation

The primary purposes of the research are the following:

- to determine and refine procedures that will enable observers to accurately and reliably make the intended measurements,
- to determine what measures to include in the final test situation,
- to establish the best "mix" of road and cross country trails, and double time and walk periods,
- to establish the over-all length of the course,
- to determine what procedures will result in an efficient programming of troops through the course consistent with other test course requirements.

The initial research situation will involve a squad of combat ready troops, in column by fire teams, moving a total distance of 10 miles. Movement will be both along roads and over cross-country trails. At scheduled periods the squad will move at double time as well as walk.

During each half hour interval, a signal (such as the firing of a blank pistol) will occur in a random fashion. When this signal occurs, the squad will be required to break formation and rapidly take prone positions off the road or trail. There will be a ten minute break every hour. During this ten minute break, the men will be required to doff certain specified equipment. At the end of approximately 2 miles and 8 miles, troops will construct hasty fighting positions on signal starting from their prone positions off the road or trail. At the end of 5 miles, the troops will traverse a maneuver course. (The maneuver course and the construction of hasty fighting positions are described separately.)

During preliminary development and refinement of the test situation, it is planned that each squad member will be accompanied by an observer who will collect certain performance data, as discussed in the next section. Each group going through the course will also be accompanied by a senior controller who will be responsible for initiating tasks according to a predetermined program.

3. Measures

It is intended initially to collect the following data which will be studied and modified/refined further as appropriate:

- . Response time -- elapsed time from signal to taking a prone position at side of road or trail.
- . Response time trend -- as a function of distance travelled over the course.
- . Equipment doffing and donning times -- for specific equipment items during ten minute breaks.
- . Equipment doffing and donning time trends -- as a function of distance travelled over the course.
- . Distance travelled per unit of time (walking, double time, and over-all).
- . Recording of critical events.

4. Number of Subjects

One rifle squad (11 men) should prove adequate for initial test development purposes.

5. Number of Data Collectors

Among the specific purposes of the test development effort will be the determination of efficient data collection procedures consistent with accurate and precise measurement. At this time, the preliminary planning anticipates the need for twelve (12) data collectors: a senior controller who will initiate the performance of sub-tasks, and one observer for each squad member who will record response times, equipment donning and doffing times, and other measures as described with regard to the construction of hasty fighting positions and the maneuver course.

6. Training of Subjects

Subjects will be briefed concerning the nature of the course, the conditions they will encounter, and the required manner of response to signals.

7. Training of Data Collectors

One of the purposes of the Phase II research effort will be to determine the nature and extent of training/practice needed by observer personnel and the requirement for equipment or procedural modifications to support the collection of data.

Presently, it is estimated that a briefing session and several practice sessions in coordinating the running of tasks and taking time measures will suffice.

8. Number of Observations

The Phase II research effort will determine the number of time measures that must be taken for each sub-task in order to yield a reasonably precise measure of performance.

Initially, approximately 10 independent measures will be available on each subject for:

- . rate of movement,
- . response time to "take cover"

and approximately 5 independent measures will be available of equipment doffing and donning time.

9. Data Recording Instrumentation

The only equipment anticipated at this time to control the test situation and support the measurement of performance are:

- . one signal pistol
- . twelve stopwatches

10. Data Analysis and Processing

Preliminary data analysis will require: frequency distributions with descriptive statistics of elapsed time data and rate of movement data; and plots of performance trends over time.

11. Need for Data Processing Equipment

No equipment beyond desk calculators should be required for preliminary evaluation of the test situation and obtained measurement data.

12. Additional Considerations

Additional research items that should be considered in the test development program include:

- . A determination of the effects, if any, of temperate climate weather and temperature extremes on performance in this combat task;
- . A determination of the nature and extent of any learning effects associated with initial or repeated course exposure that would necessitate procedural or other controls in ultimate test course use.

IV. CONSTRUCT HASTY FIGHTING POSITIONS

1. Research Objective

The objective of the research is to develop a field test situation which will yield accurate and reliable data concerning the effects of clothing and protective equipment on the infantryman's ability to construct hasty fighting positions.

The desirable features which the field test situation should permit include:

- . repeated measurements of task performance,
- . indication of the effects on performance of sustaining the activity,
- . indication of the trends of this performance associated with the continued maintenance of activity in other relevant combat tasks.

2. Preliminary Measurement Situation

During the initial period of research the following will be examined:

- . how to accurately and reliably measure rate of excavation,
- . what equipment/measurement aids are needed by observers to collect the data,
- . what soil preparation and maintenance activities are needed to insure proper experimental control,
- . how to efficiently program any necessary soil preparation and maintenance activities.

At this time it is planned to have the troops dig hasty fighting positions (unimproved foxholes) twice during the march/move task segment. Initiation of the intrenching task will be signalled by the detonation of a simulated charge. This signal will occur after approximately 2 miles and 8 miles from the start of the march/move task segment, and while the troops are in the prone position off the road or trail.

Procedurally, each squad member will be accompanied by an observer who will, at pre-determined times and upon signal, measure the area excavated. Each squad will also be accompanied by a senior controller who will be responsible for initiating and halting the intrenching according to program.

3. Measures

It is intended initially to collect the following data:

- . Amount of excavation -- area measures of the extent of foxhole excavation. This measure will be taken initially at 5 minute intervals. On signal from the senior controller (by whistle) the troops will cease digging and measures will be made by observers.
- . Trend in excavation performance over time.
- . Recording of critical incidents.

The accuracy and precision of these data will be studied during the research phase and modifications or changes will be made as appropriate.

4. Number of Subjects

One rifle squad (11 men) should prove adequate for initial test development purposes.

5. Number of Data Collectors

Among the specific purposes of the test development effort will be the determination of efficient data collection procedures consistent with accurate and precise measurement. At this time, the preliminary planning anticipates the need for twelve (12) data collectors: a senior controller who will initiate and periodically halt the performance of the intrenching task, and one observer for each squad member who will record that squad member's performance.

6. Training of Subjects

Subjects will be briefed concerning the type of open, unimproved foxhole to dig, the purposes of the program and the conditions they will encounter.

7. Training of Data Collectors

One of the purposes of the Phase II research effort will be to determine the nature and extent of training/practice needed by observers and the requirement for equipment or procedural modifications to support the collection of data.

At this time, it is estimated that a briefing session and several practice sessions in coordinating the running of the task and taking measures will suffice.

8. Number of Observations

The Phase II research effort will determine the number of excavation measures required in order to yield reasonably stable measurement of part-task and total performance trends.

Initially, between 3 to 6 measures of amount of excavation will be available on each subject for both test situations.

9. Data Recording Instrumentation

The equipment required at this time to control the test situation and take measures of performance are as follows:

- . eleven tape measures
- . simulated explosive charges
- . a whistle
- . one stopwatch.

10. Data Analysis and Processing

Preliminary data analysis will require frequency distributions with descriptive statistics of amount excavated and plots of performance trends over time.

11. Need for Data Processing Equipment

No equipment beyond desk calculators should be required for preliminary evaluation of the test situation and obtained measures.

12. Additional Considerations

Other research items that should be considered in the test development program include:

- An empirical evaluation of the reliability with which observers can measure the area excavated. This may be accomplished in the preliminary test tryouts by requiring that more than one observer measure each foxhole area and subsequently determining the extent of disagreement among separate, independent measures. Thus, for example, when the whistle is sounded to cease digging, an observer will first measure the performance of his primary subject and then also measure the excavated area for one or more adjacent positions.
- Attention needs to be given to the comparability of the soil in order to allow both for repeated measurements and the simultaneous, multiple testing situation. It may be desirable for observer personnel to point out/indicate the place where their respective test troops should prepare the fighting position. Adequate control may dictate the necessity of preparing and maintaining specific areas as a test site.
- A determination of the effects, if any, of temperate climate weather and temperature extremes on performance in this combat task.

V. MANEUVER

1. Research Objective

The objective of the research is to develop a field test situation which will yield accurate and reliable data concerning the effects of clothing and protective equipment on the infantryman's ability to maneuver -- i. e., to run, jump, climb and crawl.

The desirable features which the field test situation should incorporate include:

- permit measurement of performance in each task segment (or event),
- allow for repeated measurement of performance in each task segment (or event),
- require rapid movement through the course.

2. Preliminary Measurement Situation

The initial period of research will be used to determine the following:

- procedures and supporting equipment that will enable observers to reliably and accurately collect desired measurements,
- the length, nature and specific features of each course event,
- an optimal sequencing of events in the light of the physical demands on subjects and data collection requirements,
- procedures that will efficiently program troops through the course.

At this time it is proposed that a preliminary maneuver course be prepared which will consist of the following five events, each of which will be repeated twice:

- a. 100-yard dash across an open area; this event will be broken down into two (2) 50-yard dashes. A man will start from a prone position and run 50 yards to a designated covered position and again take a prone position. Performance in each 50-yard segment will be measured separately.
- b. 25-foot rope ladder, which subject is to climb and descend.
- c. 100-yard obstacle course, requiring changes in direction, two obstacles to scale, and an open pit jump. The open pit jump will occur at the end of the obstacle course. Measurement will be made of how far the man was able to jump, measured to the nearest 1/4 foot.
- d. 25-foot overhead rope or ladder to traverse hand over hand.
- e. 50 to 75-yard crawl; under barbed wire and over/around other obstacles.

Procedurally, subjects will traverse the course as individuals, in a staggered sequence and starting from a designated point. A senior controller will have responsibility for starting each subject. Observer-recorders will be located at the end of each event to record performance and start each subject onto the next event.

The need for repeating each event depends primarily upon the degree of agreement between the separate measurements of performance in that event. It may be anticipated that some subjects will "get off to a bad start," trip, fall, lose their balance, etc. while performing a specific event. Multiple measurements of performance will result in a more precise composite estimate of performance -- to the extent that such unusual occurrences are both random and do happen. If agreement is good between repeated measurements, perhaps a satisfactory alternative will be to note the unusual occurrence and ask an individual to repeat just that particular event. The initial research in this task will concern itself in part with this problem.

3. Measures

Initially the following data will be collected which will be studied and modified as appropriate:

- . elapsed time to complete each event comprising the course,
- . distance jumped in the obstacle course jump event,
- . record of inability to complete an event and other critical occurrences,
- . total time over the 10 events will be considered as a possible composite performance measure. (Attention will be given to performance variability in order to insure proper unit weight to each event.)

4. Number of Subjects

One rifle squad (11 men) should be adequate for initial test development purposes.

5. Number of Data Collectors

Among the specific purposes of the test development effort will be the determination of efficient data collection procedures consistent with accurate and precise measurement. At this time, it is anticipated that thirteen (13) data collectors will be required: a senior controller (starter) and one observer-recorder at the end of each event to record performance.

6. Training of Subjects

Subjects will be briefed concerning the nature of the course and the conditions they will encounter.

7. Training of Data Collectors

One of the purposes of the Phase II research effort will be to determine the nature and extent of training/practice needed and the requirement for additional equipment or procedural modifications to support the collection of data.

At this time it is estimated that a briefing session and a few practice sessions in running subjects through the course and collecting the data will suffice.

8. Number of Observations

As discussed somewhat in section 2, part of the research effort in Phase II will be directed toward determining the number of measurements needed to yield reasonably precise estimates of performance.

Presently, it is planned to take two measures of performance in each event for each subject.

9. Data Recording Instrumentation

- It is anticipated that twelve (12) direct-reading elapsed time clocks may be required. For initial test development purposes, this number could be reduced to six (6). These clocks should read in minutes and hundredths (tenths) of a minute. They should be capable of being started from a remote position and stopped at another position. Probably a few spares should be available.
- At least initially, paper and pencil data collection forms will be used.

10. Data Analysis and Processing

Preliminary data reduction and analysis will require frequency distributions with descriptive statistics of elapsed time data by events.

11. Need for Data Processing Equipment

No equipment beyond desk calculators should be required for preliminary evaluation of the test situation and obtained measurement data.

12. Additional Considerations

- Initially, it is intended to inform subjects of their time to complete each event as a means of increasing motivation.
- A determination of the effects, if any, of temperate climate weather and temperature extremes on performance in this task should be made.

VI. FIRE AND RELOAD

1. Research Objective

The objective of the research is to develop a field test situation which will yield accurate and reliable data concerning the effects of clothing and protective equipment on the infantryman's ability to fire and reload his weapon.

The desirable features which the field test situation should satisfy include:

- . use live firing,
- . require rapid delivery of fire and reloading,
- . permit measurement of performance in different firing and reloading positions,
- . require shifting of fire,
- . allow for performance measurement in a dynamic/movement situation -- as opposed to a static, range firing situation,
- . permit automatic recording of performance data.

2. Preliminary Measurement Situation

As an initial research situation and as a point of departure, the field setting discussed below is planned at this time. It should be noted that preliminary development and research may proceed with a smaller number of targets and modified target areas than is described below. Among the express purposes of the research will be to determine the following:

- . which measures can be reliably made,
- . which of these measures to include in the final measurement situation,

- . what instrumentation will allow for efficient data collection and economy of equipment cost, installation, and maintenance,
- . how to arrange efficiently targets and firing areas within the course,
- . what procedures will result in the more efficient programming of people through the course consistent with other test course requirements.

The over-all measurement situation envisioned at this time is a live firing course containing six target areas. Each of the six target areas will consist of eight targets, with four targets located on either side of a circumscribed path. Within each group of four targets located to one side, two targets will be placed at 100 meters and two will be placed at 250 meters from the path. The targets per se will be standard pop-up devices with silhouettes. Initial appearance of a target will be controlled from an observation tower. Targets will be set to fall (retract) when hit. Pairs of targets at the same target area will be linked electrically so that when a popped-up target is hit and falls, its associated target will appear immediately.

Procedurally, a test subject will move slowly along the path with his weapon in a ready position. He will be scanning the areas on either side of the path. Suddenly, a target will appear and "fire." The simulated firing of the target is included in order to minimize the effects of variations in target detection time on the performance data to be collected. Upon appearance of the target, the test subject will open fire as rapidly and accurately as possible from either an offhand or a prone position. The firing position that a subject is to take will be predetermined, and subjects will be told at the start of each course segment which position to take. Delivery of fire on a target will be maintained until that target is hit and falls, whereupon fire will be shifted to an associated target which will then have appeared. At each position, the alternating pop-up of targets will continue each time a target is hit until the subject has fired two clips. The clips will be reduced and consist of five rounds each. Thus, at each position a subject will fire a total of ten rounds and also will be required to reload. This sequence will be continued until a subject has fired at each of the six target areas.

At this time, it is intended that three of the target areas will require a subject to fire offhand, and three will require him to fire from a prone

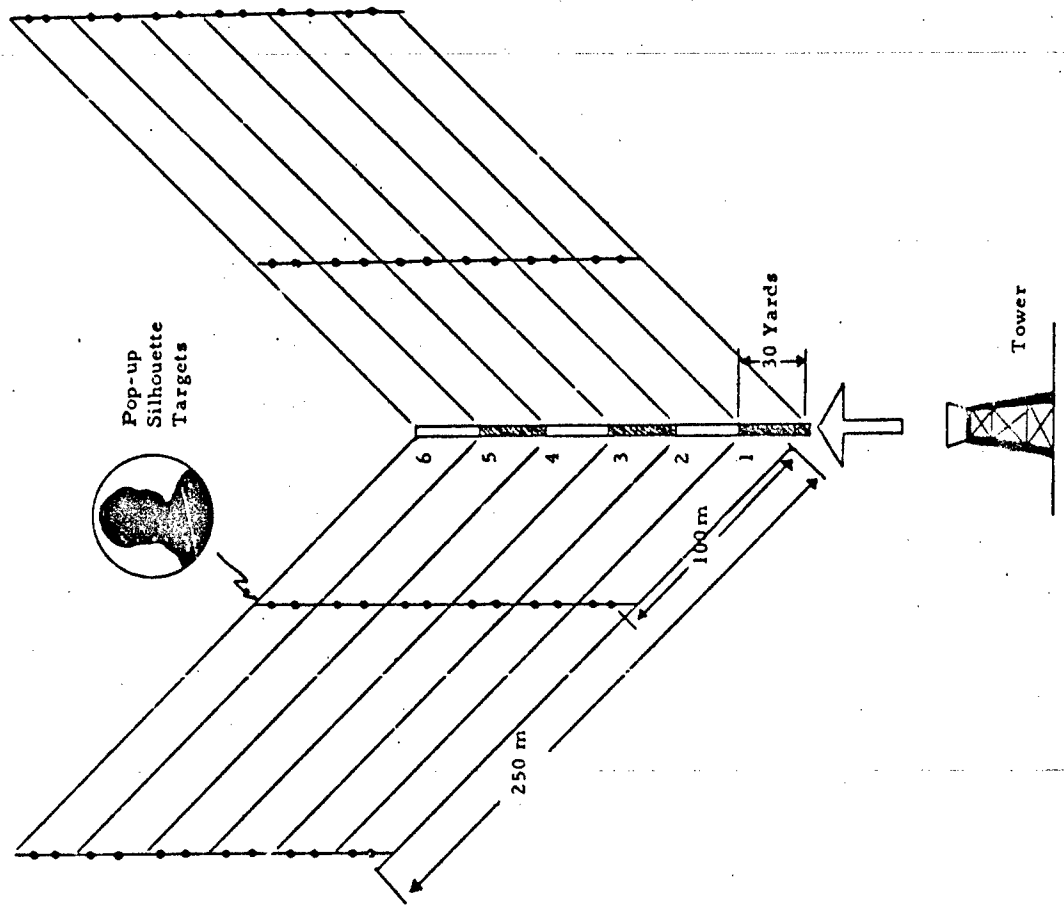
position. Within each subgroup of three target areas fired at from the same firing position, the arrangement of pairs of targets linked electrically will be: one position in which both are near targets (100 meters), one position in which both are far targets (250 meters), and one position in which alternately one target is near and the second is far (or vice versa).

The figure shown on the next page illustrates the preliminary course concept. Individuals will traverse the course accompanied by a safety officer who will also assist in the collection of certain performance data, as discussed further under "Data Recording Instrumentation." It may be noted that the firing path is divided into six 30-yard segments. Targets corresponding to each segment will appear as a test subject moves through the particular section of the course path.

3. Measures

It is intended initially to collect data allowing for the following performance measures to be studied and/or refined further as appropriate:

- . Firing response time -- time to fire first round following target appearance.
- . Effective firing response time -- time to fire first round into the target following target appearance.
- . Average effective firing response time -- average elapsed time between rounds fired into a target.
- . Rate of fire -- total time to fire each clip divided by number of rounds.
- . Accuracy of fire -- number of effective rounds at each target area.
- . Reloading response time -- elapsed time to reload weapon.
- . Recording of critical events.
- . Possible development of an index combining rate of firing, accuracy, and target distance.



4. Number of Subjects

One rifle squad (11 men) should prove adequate for initial test development purposes.

5. Number of Data Collectors

A minimum of three data collectors will be required: two observation tower personnel and one ground observer. One of the tower personnel will serve as senior course controller and will program the appearance of targets in accordance with a predetermined schedule and the location of a subject on the course. The second tower person will assist the senior controller and will monitor the time and event recorder. This recording unit will initially be the primary means of data collection and is discussed further below. The ground observer will serve the dual roles of safety officer and data collector. As a data collector, this person will press a response button connected to the time and event recorder when a test subject makes certain overt acts or when a particular defined event occurs.

6. Training of Subjects

Subjects will be briefed concerning the nature of the course, the conditions they will encounter, and the firing positions which they should use.

7. Training of Data Collectors

One of the purposes of the Phase II research effort will be to determine how observer personnel may be used most efficiently, the nature and extent of training/practice needed, and the requirement for additional equipment or procedural modifications to support the collection of data.

At this time, it is estimated that a briefing session and several practice sessions in running subjects through the course and collecting data should suffice.

8. Number of Observations

The Phase II research effort will have as another objective the determination of how many rounds must be fired under each test condition in order to yield a reasonably precise estimate of performance.

It may be necessary, depending upon preliminary data, to increase the number of rounds fired under a given condition and/or replicate a given test condition.

Under the present preliminary schedule, ten rounds will be fired at each target area, and three target area positions will each yield data on offhand and prone firing positions.

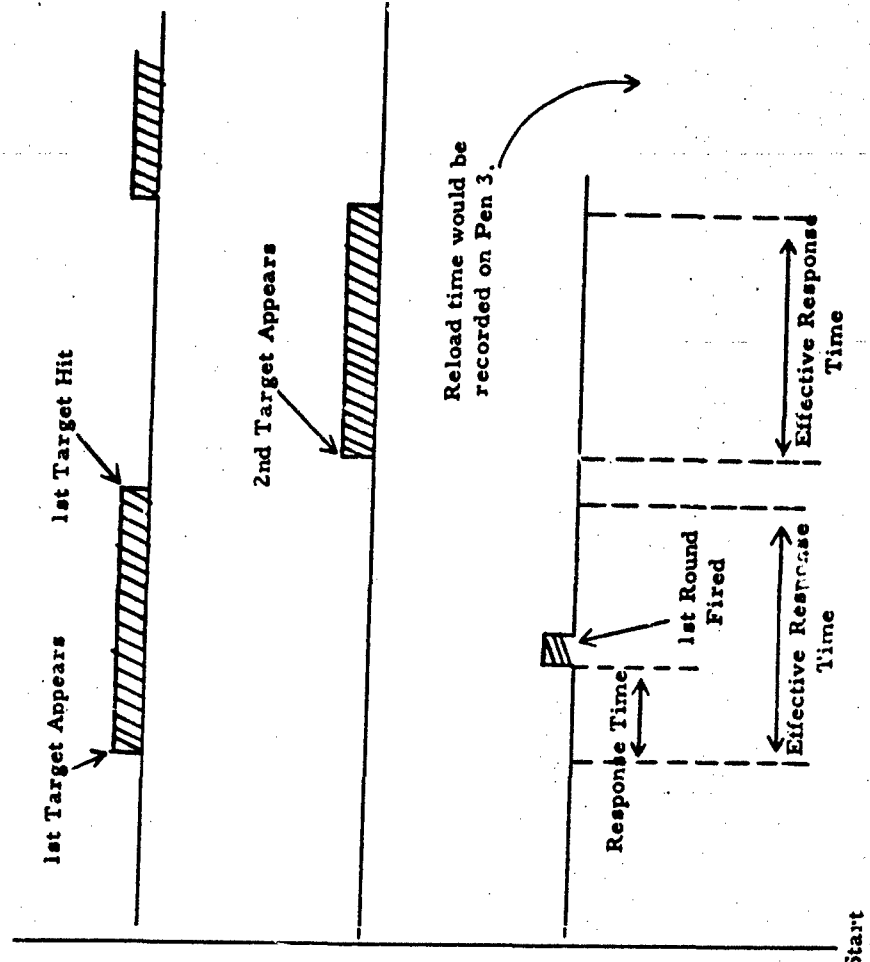
Six independent measures of reload time will be available, three each while firing offhand and from a prone position.

9. Data Recording Instrumentation

The primary data recording equipment needed for development of the test situation is a multi-pen time and event recorder. (Three styli may be adequate.) As shown in the figure below, this recorder will record for each subject at each firing position the following information:

- . time first target appeared
- . time first round fired*
- . time first effective round fired -- first target hit
- . time associated (second) target appeared
- . time second target hit
- . subsequent target appearance and effective response time
- . time last round in clip fired*
- . time new clip loaded and round in receiver*

* Asterisked times will be signaled to the recorder by the ground observer. It is anticipated that the other times may be recorded by direct signaling from the target devices themselves.



10. Data Analysis and Processing

Preliminary data reduction and analysis will require frequency distributions with descriptive statistics and trend plots of response times, effective response times, accuracy, rates of fire, and reload times.

11. Need for Data Processing Equipment

No equipment beyond desk calculators should be required for preliminary evaluation of the test situation and obtained measurement data.

12. Additional Considerations

Additional research items that should be considered in the test development program include:

- A determination of the need/desirability of analyzing firing accuracy in terms of the dispersion pattern or place of target impact. This determination may be made by analyzing the degree or pattern of dispersion on actual targets and comparing these data with the number of effective rounds fired to establish whether any additional useful performance data may be provided.
- A determination of the effects, if any, of temperate climate weather and temperature extremes on performance in this combat task.
- A determination of the nature and extent of any learning effects associated with initial or repeated course exposure that would necessitate procedural or other controls in ultimate test course use.

VII. USE GRENADES

1. Research Objective

The objective of the research is to develop a field test situation which will yield accurate and reliable data concerning the effects of clothing and protective equipment on the infantryman's ability to throw hand grenades.

The desirable features which the field test situation should incorporate include:

- . permit the measurement of performance in a dynamic/movement situation,
- . require that grenades be thrown rapidly,
- . permit performance measurement for different throwing distances,
- . permit performance measurement for different types of targets,
- . allow for repeated measurements of individual performance.

2. Preliminary Measurement Situation

The field setting discussed below is planned at this time as the initial research situation. It should be noted that modified target areas may be used in the early stages of the development. The early phases of the research will determine the following:

- . procedures and supporting equipment that will enable observers to reliably and accurately collect the desired measurements,
- . an efficient arrangement of target areas within the course,
- . instrumentation required/desirable to promote efficient collection/recording of data consistent with economies in equipment cost, installation and maintenance,

procedures that will program the troops efficiently through the course consistent with other test course requirements.

The over-all measurement situation envisioned at this time is a prepared course consisting of three target areas. Two of the target areas, which will be essentially identical, will simulate the use of grenades against a field emplacement. The third target area will require that grenades be thrown toward a vertical target area, as in the street fighting situation where grenades must be thrown into doorways and windows.

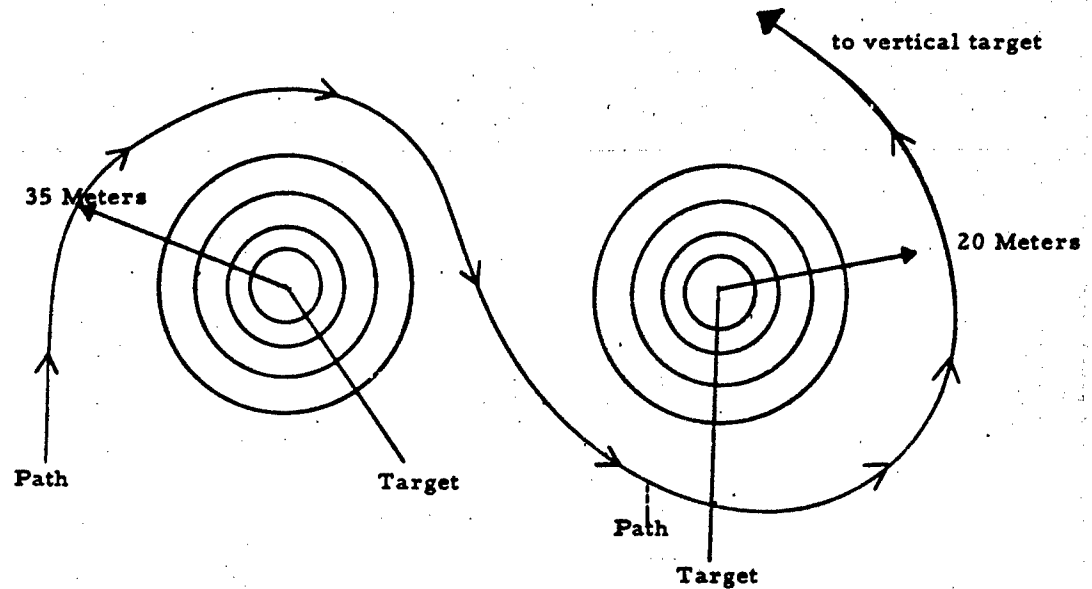
In the case of the two field-emplacement target areas, a machine gun simulator will be positioned in the center of each area. This machine gun will appear and "fire" on signal from an observation tower. Individuals will move along circumscribed paths having radii of 35 and 20 meters respectively from the center of each of these areas. When the simulated machine gun appears and fires, test subjects will be required to throw a grenade at the objective as rapidly and accurately as possible. Firing will occur randomly three times for each target area. This portion of the test situation will thus provide three measurements of the speed and accuracy of grenade throwing for two distances -- 20 and 35 meters.

The central target areas for the foregoing simulated field-emplacement situations will each be measured in circular fashion starting with a "bulls eye" of 5-foot radius and increasing to a radius of 20-feet in 5-foot increments. The scoring rings will not be visible to test subjects. The latter may be achieved by slight depressions in the terrain surface which are marked in a plane visible only to observers located in the tower.

The vertical target area will be somewhat analogous to the baseball pitching booth found in amusement parks. From a designated position approximately 15 meters from the objective, test subjects will throw three grenades into a target area. The target area will have a rectangular window-sized "bulls eye." Rectangular areas of increasing size will surround the "bulls eye" area for scoring purposes. The target area will be constructed to allow for detonation of the grenade charges and still permit performance scores to be recorded. For example, a series of chutes may extend from the scoring rectangles. The following figure depicts a plan view of the preliminary course concept.



Observation Tower



3. Measures

Initially, the following data will be collected which will be refined/modified as appropriate.

- . Throwing response time -- time from "firing" of the machine gun simulator to grenade detonation,
- . Accuracy of grenade throwing for the different target areas,
- . Recording of critical occurrences and events.

4. Number of Subjects

One rifle squad (11 men) should prove adequate for initial test development purposes.

5. Number of Data Collectors

At this time, it is anticipated that six (6) data collectors will be required to program people through the course and collect the desired measurement data. Three of these people will be located in a course observation tower. The remaining three people will be ground controllers. The division of labor among data collectors, envisioned at this time, is as follows:

- . The senior course controller, who will be located in the tower, will "start" each person through the course and program the "firing" of the machine gun simulator in accordance with a predetermined schedule.
- . Two tower observers -- one will mark grenade detonation time and spot the impact area, and the second observer will record the data.
- . Two safety monitors who will alternately start and accompany individuals through the course.
- . A ground observer/recorder who will record performance at the vertical target area.

6. Training of Subjects

Subjects will be briefed concerning the nature of the course and the conditions they will encounter.

7. Training of Data Collectors

One of the purposes of Phase II will be to determine how observer personnel may be used most efficiently, the nature and extent of training/practice needed, and the requirement for additional equipment or procedural modifications to support the collection of data.

At this time it is estimated that a briefing session and several practice sessions in running subjects through the course will suffice.

8. Number of Observations

Part of the research effort in Phase II will be directed toward establishing the number of grenades that must be thrown at each target to yield a reasonably precise estimate of performance under the specified condition.

At this time, it is planned to record the following data for each individual: three measures of the accuracy of grenade throwing for each target area - the 35-meter and 20-meter field emplacement targets and the vertical street fighting target; and three measures of the speed of response in grenade throwing for each of the two field emplacement targets.

9. Data Recording Instrumentation

At this time, the only instrumentation anticipated for preliminary course evaluation will be a direct-reading elapsed time clock. (A single channel time and event recorder could be substituted for the clock.)

10. Data Analysis and Processing

Preliminary analysis will require frequency distributions with descriptive statistics of the speed and accuracy of performance in each of the course events.

11. Need for Data Processing Equipment

No equipment beyond desk calculators should be required for preliminary evaluation of the test situation and obtained measurement data.

12. Additional Considerations

- . Preliminary testing will consider what effects, if any, environmental conditions (weather, temperature) have on performance. Those environmental factors which are significantly related to performance should be considered for inclusion in additional test situations.
- . Preliminary testing will also investigate the nature and extent of any learning effects associated with repeated course exposure that would necessitate procedural or other controls for ultimate test course use.

VIII. RECONNAISSANCE; COVER AND CONCEALMENT

1. Research Objective

The objective of the research is to develop a field test situation which will yield accurate and reliable data concerning the effects of clothing and protective equipment on the infantryman's ability to move quickly and quietly using concealment and cover and perform those activities characteristic of a reconnaissance task.

The desirable features which the field test situation should incorporate include:

- . require extended movement,
- . require maintenance of orientation,
- . require that care be taken to avoid detection,
- . require observation of an objective area.

2. Preliminary Measurement Situation

As an initial research situation and as a point of departure, the field setting discussed below is planned at this time. Among the express purposes of the research will be to determine the following:

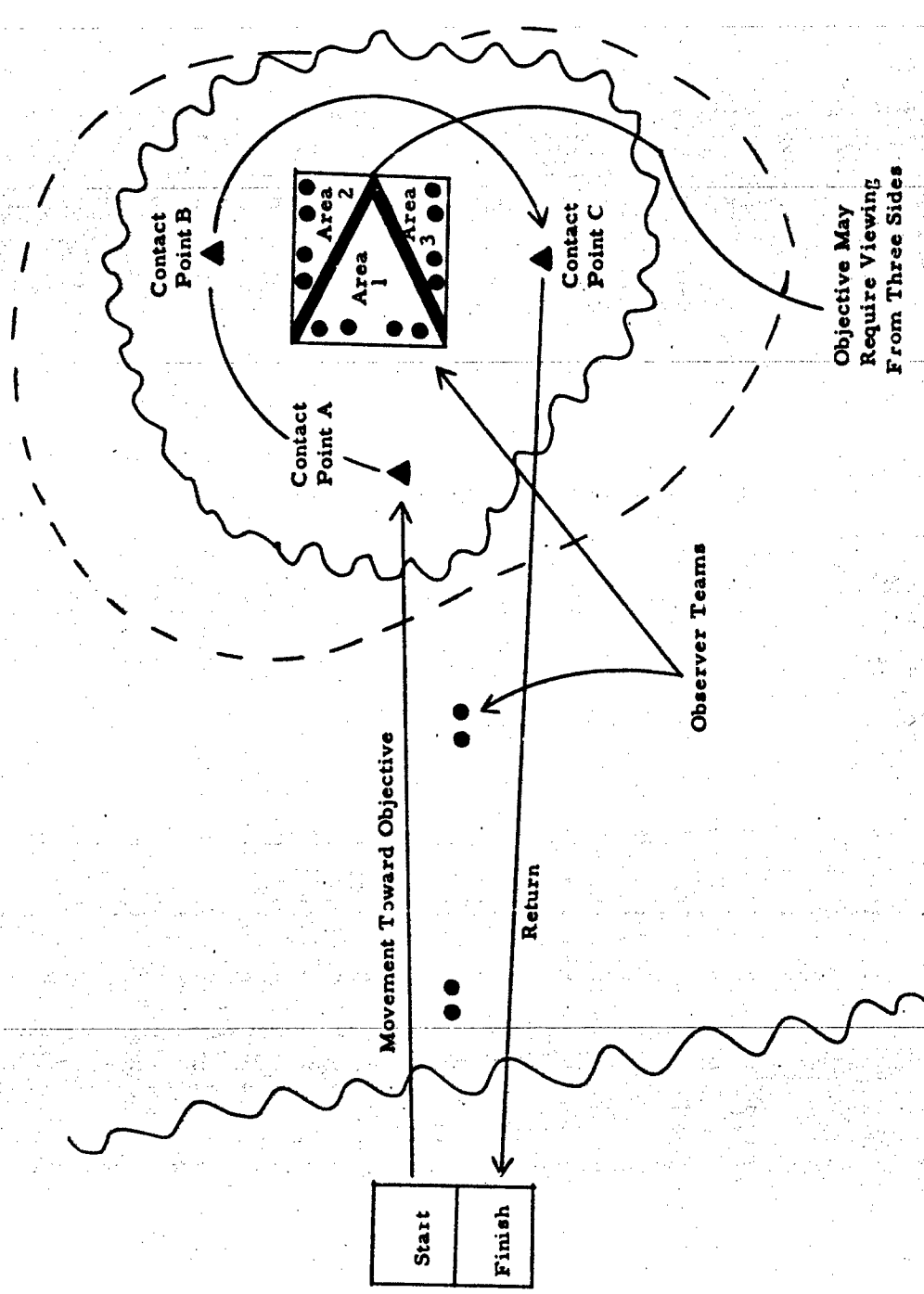
- . can the intended measures be reliably made by observers,
- . what supporting equipment and/or procedures are necessary/desirable to facilitate the collection of data,
- . how can the test situation be programmed to most efficiently evaluate individual performance,
- . how can the test situation be best integrated into the over-all field test course.

The preliminary measurement situation envisioned at this time is a piece of terrain containing a three-sided, prepared objective area. The objective area may be located in a clearing or other setting such that the

approaches from any direction are open terrain with virtually no natural means of concealment within closer than approximately 20 meters of the objective. As shown in the sketch on the next page, the three sides of the objective area will constitute essentially separate sub-objectives and be so designed that observation of each side will require a test subject to move to that side of the objective area. Within each sub-objective, various numbers and types of weapons and other equipment will be located.

Procedurally, a test subject will start from a designated point at a fixed distance (possibly 1000 meters) from the objective area. He will be briefed on the nature of his mission and what general route he is to take to the objective area. The subject will then move out toward the objective and contact point "A." All movement will be as quickly and quietly as possible and using natural concealment to avoid detection. As part of the initial briefing, subjects will know that evaluators have been positioned to detect their presence and the extent to which they reveal (make a target of) themselves. At contact point "A," a subject will perform an overt act so that the time of his arrival may be accurately recorded. (Possibly a field phone located at each contact point will be a feasible method for subjects to indicate arrival and departure.) Still using concealment, the subject will then move about as necessary to scan and survey sub-objective area "1". His task will be to note and record the types and numbers of weapons and equipment in that area. After completing his surveillance of area "1," the test subject will return to contact point "A" to indicate this fact. He will then move-out, still using concealment and proceeding as quickly and quietly as possible, to contact point "B" where the foregoing activities will be repeated for sub-objective area "2." This procedure may be repeated a third time at sub-objective area "3." From contact point "C", the test subject will return to either the starting point or some other designated area.

With regard to the number of sub-objective areas to be surveyed by each subject on a course run, the primary determinant will be the reliability of the measurement data collected. As discussed somewhat further below, if there is good agreement between the separate performance measures from two of the sub-objective areas, there should be no need to require the observation of a third area. One of the initial research concerns in this test situation will be to evaluate the reliability of data reflecting the ability of subjects to move quickly and quietly, avoid detection, and make accurate observations.



At this time, it is intended that two 2-man observer teams will be located in each sub-objective area and also among the main route between the start-finish point and contact points "A" and "C." Each observer team in a sub-objective area will survey approximately half of the terrain in their area -- from their front to their adjacent boundary. The "en route" observer teams will survey the general areas corresponding to both outbound and inbound patrol routes. The tasks of observer personnel will be to detect and record each time a test subject can be seen and the duration of this exposure. In order to enhance the alertness of observer teams and promote the reliability of the resulting data, two procedures are planned: a) team personnel will rotate, on half-hour intervals, between the two jobs of observing/scanning and data recording; b) as each subject moves between course contact points, the appropriate observer team will be alerted.

Observer teams will initially operate essentially as follows. One team member will continuously scan his field of responsibility. When a test subject is detected, the observer will mention this to his teammate who will record the time of sighting. The observer will continue to monitor the movements of a test subject and indicate when the subject disappears from view. The time of disappearance will also be recorded. In this manner, it will be possible to collect data reflecting the frequency and duration of exposure for each subject.

Among the more important research items will be the accuracy and precision with which observers can perform their tasks. One alternative for evaluating observer performance is to locate a motion picture camera at an observer's position and make film recordings of the scene. The processed film may then be viewed independently by additional two-man teams. A comparison of performance by the "field" and "film" groups will allow for an estimate of the degree of accuracy and precision associated with the field observation technique.

3. Measures

It is intended at this time to collect data which will allow for the following performance measures to be studied and/or refined as appropriate:

- . movement time between start/finish and contact points,
- . time to survey objective areas,

- . total time to traverse course,
- . accuracy of observation,
- . frequency of exposure while moving between contact points,
- . frequency of exposure while surveying objective areas,
- . duration of exposure while moving between contact points,
- . duration of exposure while surveying objective areas.

4. Number of Subjects

One rifle squad (11 men) should prove adequate for initial test development purposes.

5. Number of Data Collectors

At this time it is anticipated that as many as seventeen (17) data collectors/observers may be required: four data collectors/observers at each of the three sub-objective areas; two data collectors/observers at each of the two en route observation positions; and a senior course controller who will start subjects on the course, possibly receive calls from contact points, and also possibly alert appropriate observer teams. The need for four data collectors at each sub-objective area may not be necessary, depending upon the reliability and accuracy with which a single team of observers can collect the desired data. This point represents another Phase II research item. It may also be possible, depending upon the determination of how to most efficiently program people through the course, for observer teams to cover more than one sub-objective area. For example, the observers at area "1" might easily move to area "3," unless another test subject is en route to contact point "A."

6. Training of Subjects

Subjects will be briefed concerning the general nature of the test situation, the terrain they will encounter, the general routes they are to take, the location of contact points, and the types of observations they are to make at objective areas.

7. Training of Data Collectors

One of the express purposes of the Phase II research effort will be to determine how observer personnel may be used most efficiently and the nature and extent of training/practice needed to properly collect the necessary data.

At this time, it is estimated that a briefing session and several practice sessions should suffice.

8. Number of Observations

The research effort will have as another objective, and as indicated earlier, the determination of whether two, three or possibly additional sub-objective areas need to be included to reliably measure individual performance. There is a further problem, somewhat dependent upon the resulting solution to the preceding item, of how best to integrate this reconnaissance/concealment and cover test situation into the over-all course. Ideally, at this time, it seems most desirable -- as is planned for the live firing and grenade throwing situations -- to evaluate daily the effects of clothing and protective equipment on an individual's ability to move quickly and quietly, avoid detection, and make observations.

Under the present preliminary schedule, using three sub-objective areas to be surveyed, one pass through the course will yield: four separate measures of movement time between contact points, frequency of exposure while moving between contact points, and duration of exposure while moving between contact points; and three separate measures of accuracy of observation, frequency of exposure while making observations, and duration of exposure while making observations.

9. Data Recording Instrumentation

The primary data collection/recording equipment needed for development of the test situation are:

- . six direct reading chronometers -- or some other means of visually displaying time at a minimum of six observer team positions,
- . a movie camera with wide angle lens,
- . six pair of binoculars.

10. Data Analysis and Processing

Preliminary data reduction and analysis will require frequency distributions with descriptive statistics, trend plots, and selected estimates of agreement for the measures indicated in section 3.

11. Need for Data Processing Equipment

Film processing and viewing equipment (one projector) and desk calculators will be required for initial reduction and evaluation of test data.

12. Additional Considerations

Additional research items that should be considered in the test development program include:

- A determination of the effects, if any, of temperate climate weather and temperature extremes on performance in this combat task;
- A determination of the nature and extent of any learning effects associated with initial or repeated course exposure that would necessitate procedural or other controls in ultimate test course use.

IX. PRELIMINARY CONCEPT FOR AN INTEGRATED PERFORMANCE COURSE

The following concept for an integrated combat performance course is of necessity very preliminary in nature. The final development of an integrated course is dependent upon prior research and development of the constituent, individual test situations. An efficient arrangement and sequencing of test events, from both performance measurement and economic standpoints, requires that essentially finalized configurations, measures, time requirements and other details of the individual test situations be available for consideration. The integrated test course will itself require developmental tryouts and refinement.

Notwithstanding the foregoing statements, in any development program it is frequently of value and interest to look ahead and attempt to anticipate what the program outcomes might be at a present instant in time. Particularly where a certain general end-product is desirable, this looking ahead or anticipating allows for an assessment of whether the program may be expected to develop a product approximating that which seems desirable.

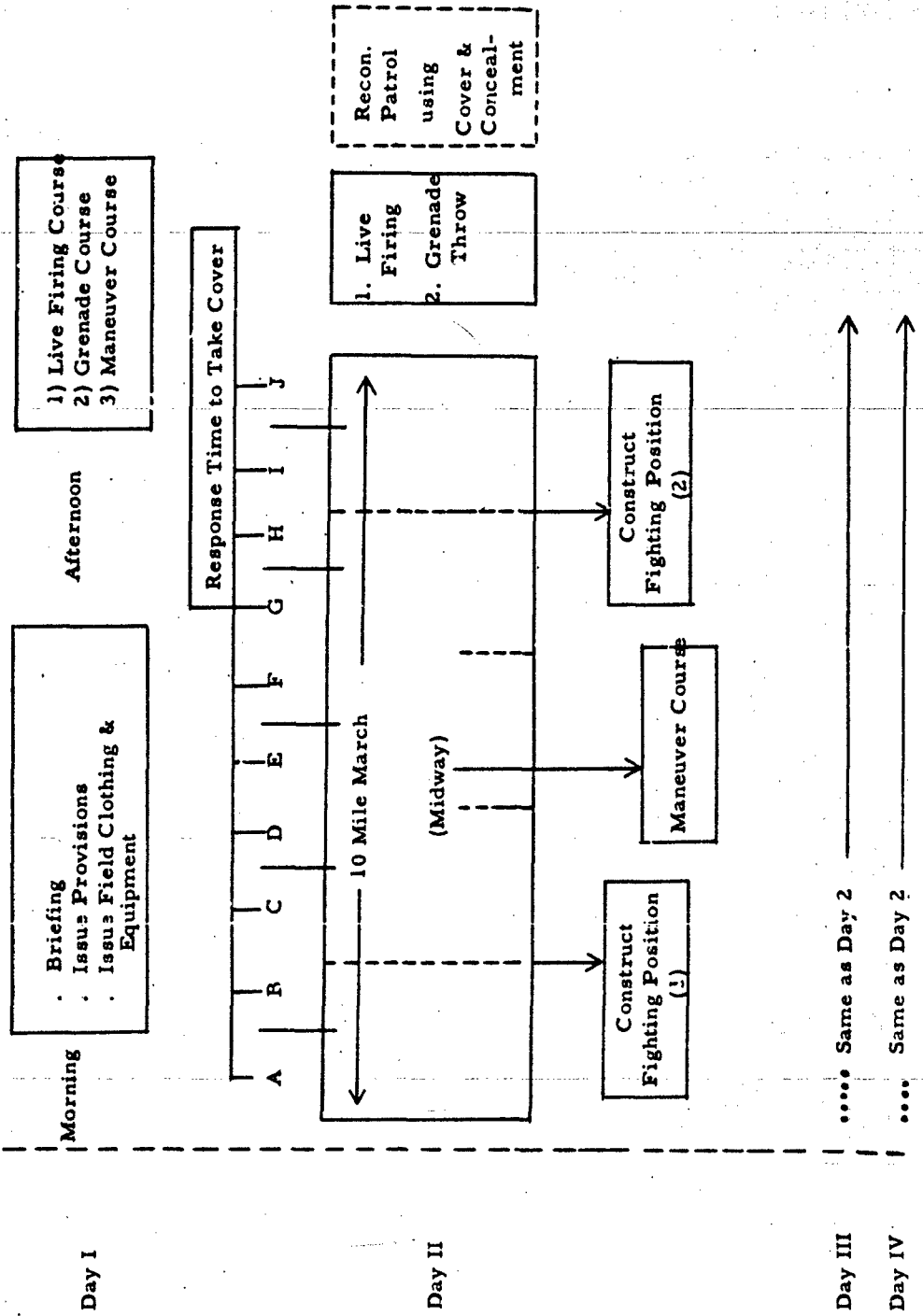
Again, the following concept is preliminary. It is not the only combination of test events that might be conceived at this time; it may not be the most efficient and/or economical arrangement of test events. It is offered as one of the more interesting alternatives which might be anticipated at this time.

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The infantry soldier in combat is required to sustain performance for prolonged periods of time. From a measurement point of view, protective equipment and clothing differences may be more pronounced as activity is extended. Thus for reasons of (1) relevance to the ultimate criterion situation and (2) sensitivity of measurement, it is considered desirable that the test program be integrated into a series of task-measurement situations which extend over several days.

At this time, a continuous three and one-half day test exercise, as schematized in the below figure, suggests itself. The individual test situations referred to in the discussion have already been described in the preceding sections of this plan.

Concept for Integrated Test Program



Looking at the figure on the previous page and each day of the test program, the main features of the integrated program would be as follows:

Day 1 The morning of Day 1 to be spent in: (a) briefing the combat ready test squad about the exercises, and (b) issuing provisions and field clothing and equipment for the next three days and nights.

During the afternoon of Day 1, each of the test troops to perform on:

- a) the live firing and reload course;
- b) the grenade course;
- c) the maneuver course.

These measurements would serve as baseline data against which to interpret the subsequent performances of the troops both individually and collectively.

Day 2 Early on the morning of Day 2, the squad of troops, in column by fire teams, would commence the 10-mile movement over roads and cross-country trails. During the course of this movement, a number of measurement events would be programmed. Once during each half-hour interval, the troops would be required to rapidly take prone positions off the road or trail. The signal for taking this action would be the firing of a blank pistol by a senior observer-controller. Response times would be recorded to indicate the elapsed time between signal occurrence and when each man reached a prone position off the trail. Ten minute rest breaks would be scheduled each hour. During the rest breaks, on signal, the troops would doff and later re-don certain equipments. Doffing and donning times would be recorded. The distance travelled during each time interval would also be recorded to permit determining rates of

movement. Twice during the movement, at the end of 2 miles and 8 miles respectively, the troops would construct hasty fighting positions. Following a requirement to take prone positions off the road, a simulated charge would be detonated. This would be the signal for the troops to start intrenching. At five-minute intervals during the digging, the senior controller would blow a whistle as a signal for the troops to cease digging. Observers would then measure the area excavated. Intrenching would then be resumed again on signal from the senior controller.

Approximately half-way (5 miles) through the movement, the troops would be required to individually traverse a maneuver course. This prepared course would provide time measures for each individual's ability to: dash across open areas; climb and descend a rope ladder; traverse an obstacle course requiring rapid changes in direction of movement, the scaling of low obstacles, and jumping across an open pit; traverse an overhead rope or ladder; and crawl under barbed wire and over/around obstacles.

At the end of the 10 mile movement, the troops would then perform on the live firing course and the grenade throwing course. The live firing course would permit for repeated, individual measures of the accuracy of firing and the speed of reloading from both prone and off-hand firing positions. The course itself would require movement, rapid response and shifting of fire. The grenade course would also involve a dynamic setting in which the speed and accuracy of grenade throwing will be measured using live grenades with reduced charges. Toward an efficient use of the course, one fire team might be engaged on the live firing course while the second was on the grenade course. The teams would change after completing their respective events.

Finally, if time permitted during each day, individuals would be required to reconnoiter a prepared objective-area moving as quickly and quietly as possible.

Performance measures would include the accuracy of observation, the speed of movement, and the goodness with which concealment and movement with stealth have been performed.

The troops would then bivouac for the night and maintain normal security.

Days 3 and 4 would repeat the regimen of Day 2.

X. SPECIAL TASKS

- . Observe, detect, locate, identify hostile targets
- . Use compass
- . Use radio/telephone

The above important combat tasks have been placed in the category of "special tasks" because it is anticipated that the infantryman's performance in these tasks will be affected by only a limited number of specific clothing items such as headwear and/or gloves.

No special test situations are proposed for these special tasks at this time. The philosophy is that performance in these tasks may be achieved by adaptation or slight modification of the primary test situations described on the preceding pages.

The following are preliminary illustrations of how each of the above special tasks might be incorporated into the already proposed test situations.

Observe, Detect, Locate, Identify Hostile Targets

One approach to measuring the effects of facemasks, hoods, gas masks, and other headwear on performance in this task would be to essentially exchange the test troop and observer-controller activities in the proposed reconnaissance, cover and concealment test situations. Thus, test troops could be located at the observer positions and have as their task that of detecting, observing and identifying both personnel and vehicular targets. The personnel and vehicular targets would be programmed to move over prescribed routes, at scheduled rates of movement, and at predetermined distances from test troop/observer positions.

The live firing/reload course and the grenade course would also reflect in part the effect of headgear on the speed of detection under those particular course conditions.

Use Compass

Use of the compass might easily be incorporated into either or both the march/move situation or the reconnaissance, cover and concealment

test situation. Here, for example, the added task would be for test troops to make sightings on specific landmarks or targets from predetermined positions. The speed and accuracy with which the sightings were made would be recorded.

Use Radio/Telephone

The effect of particular clothing and protective equipment on the ability to use field communications equipment could be examined in a manner similar to that just described for use of the compass. In either or both the march/move situation or the reconnaissance, concealment and cover situation, test troops would be required to send and receive certain standard messages under controlled conditions from predetermined positions. Measurements would be made of the time to send/accept messages, the accuracy of the message recorded or received at a specific destination, and possibly the judged quality of the transmission/reception against certain controlled noise backgrounds.

XI. PRELIMINARY TIME SCHEDULE FOR PHASE II

The time schedule shown on the next page represents a preliminary cut at sequencing and allocating time to the various Phase II activities. One of the first steps in Phase II will be to examine this schedule in the light of equipment and instrumentation needed to implement each course and the lead times anticipated for course preparation. This review and detailed planning will be done in conjunction with the Project Officer and his staff. The review and any resulting schedule changes will in all probability not interfere with the further refinement of combat tasks which is scheduled concurrently.

In looking over the preliminary time schedule, the following points may be noted:

- . Phase II will cover a total period of 16 months.
- . The time allocated to the further refinement of combat tasks is concurrent with the initiation of the research and development work on the individual field test situations. The further refinement work will not delay the primary Phase II effort.
- . Research and development work on the individual test situations has been scheduled throughout 14 months in Phase II.
- . The sequence in which the individual test situations are to be evaluated is based upon the estimated relative lead times required to obtain equipment and prepare the course areas.
- . The first two months in Phase II have been allocated primarily to detailed planning and preparations for the research and development of the individual test situations. Planning and test course preparations will continue until the physical tryouts of each test situation have been completed (shown in the preliminary schedule as March 1964).
- . Two months for physical testing and data collection have been allotted to each test situation. This two-month period consists of one month in which physical testing has been scheduled for only a particular test situation, and one month of overlap with one other test situation.

PHASE II PRELIMINARY TIME SCHEDULE

Phase II Activities	1963												1964					
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J		
1. Further Refinement of Combat Tasks				+++														
2. Research and Development of Individual Field Test Situations																		
. Planning and Preparations																		
. March/Move				+++														
. Construct Fighting Positions					+++													
. Maneuver Course						++												
. Grenade Course								++										
. Reconnaissance, Concealment and Cover									++									
. Firing and Reload Course										++								
. Special Situations											++							
3. Definition of Integrated Combat Test Course																		
4. Phase II Report																		



One month, as shown by the Plus (+) signs, has been formally scheduled for data reduction in the march/move, hasty fighting positions, and maneuver test situations. Two months have been allotted for data reduction associated with the grenade throwing, reconnaissance-cover-concealment, and the fire and reload test courses.

Initiation of formal planning for the integration of the individual tests has been set for February 1964 -- at which time scheduled physical testing will hopefully have been completed in all of the individual test situations including the fire and reload course.



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<p>AD</p> <p>Headquarters, U. S. Army Quartermaster Research and Engineering Field Evaluation Agency, Fort Lee, Virginia</p> <p>DEVELOPMENT OF A METHODOLOGY FOR MEASURING EFFECTS PERSONAL CLOTHING AND EQUIPMENT ON COMBAT EFFECTIVENESS OF THE INDIVIDUAL FIELD SOLDIER by A. Gruber, J. Wm. Dunlap, G. DeNittis, 1964. 119p. illus., tables. Unclassified Report (TECOM 8-1-7700-01E)</p> <p>This report was prepared for the Quartermaster Research and Engineering Field Evaluation Agency by Dunlap and Associates, Inc., Danvers, Connecticut, under Department of the Army contract DA 19-129-QM-2068. It reviews the work performed during Phase I of a three phase research effort directed toward the development of a measurement methodology for evaluating the effects of personal clothing and protective equipment on the combat effectiveness of the individual soldier. The report is organized into four sections: (1) a summary of the project background, phases, and phase objectives; (2) a review of the literature; (3) a description of the methodology used; (4) a summary of the data collected; and (5) a summary of the results. The research plan includes the initial field test situations and major research activities to be performed in Phase II.</p>	<p>UNCLASSIFIED</p> <p>1. Industry Combat Effective-ness 2. Field Measurement Metho-dology 3. Effects of Clothing on Per-formance</p> <p>I. A. Gruber II. J. Wm. Dunlap III. G. DeNittis IV. Title V. Series VI. TECOM Project No. 8-1-7700-01E (Contract DA 19-129-QM-2068)</p>	<p>Accession No.</p> <p>Headquarters, U. S. Army Quartermaster Research and Engineering Field Evaluation Agency, Fort Lee, Virginia</p> <p>DEVELOPMENT OF A METHODOLOGY FOR MEASURING EFFECTS PERSONAL CLOTHING AND EQUIPMENT ON COMBAT EFFECTIVENESS OF THE INDIVIDUAL FIELD SOLDIER by A. Gruber, J. Wm. Dunlap, G. DeNittis, 1964. 119p. illus., tables. Unclassified Report (TECOM 8-1-7700-01E)</p> <p>This report was prepared for the Quartermaster Research and Engineering Field Evaluation Agency by Dunlap and Associates, Inc., Danvers, Connecticut, under Department of the Army contract DA 19-129-QM-2068. It reviews the work performed during Phase I of a three phase research effort directed toward the development of a measurement methodology for evaluating the effects of personal clothing and protective equipment on the combat effectiveness of the individual soldier. The report is organized into four sections: (1) a summary of the project background, phases, and phase objectives; (2) a review of the literature; (3) a description of the methodology used; (4) a summary of the data collected; and (5) a summary of the results. The research plan includes the initial field test situations and major research activities to be performed in Phase II.</p>	<p>UNCLASSIFIED</p> <p>1. Industry Combat Effective-ness 2. Field Measurement Metho-dology 3. Effects of Clothing on Per-formance</p> <p>I. A. Gruber II. J. Wm. Dunlap III. G. DeNittis IV. Title V. Series VI. TECOM Project No. 8-1-7700-01E (Contract DA 19-129-QM-2068)</p>
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