

A Comparative Evaluation of M1 Tank Procedure Guides

Stephen L. Goldberg Army Research Institute

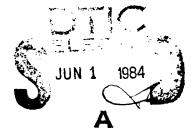
Charlotte H. Campbell Human Resources Research Organization

ARI Field Unit at Fort Knox, Kentucky

THE FILE COPY

AD-A141 794





U. S. Army

Research Institute for the Behavioral and Social Sciences

September 1983

Approved for public release; distribution unlimited.

84 06 01 004

U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON Technical Director L. NEALE COSBY Colonel, IN Commander

Research accomplished under contract for the Department of the Army

Human Resources Research Organization

Technical review by Daniel R. Tufano Richard B. Modjeski

NOTICES

DISTRIBUTION: Primary distribution of this report has been made by ARI.

Please address correspondence concerning distribution of reports to: U.S.

Army Research Institute for the Behavioral and Social Sciences, ATTN:

PERI-POT, 5001 Eisenhower Avenue, Alexandria, Virginia 22333.

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research institute for the Behavioral and Social Sciences.

NOTE: The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

UNCLASSIFIED SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)

REPORT DOCUMENTATION	READ INSTRUCTIONS BEFORE COMPLETING FORM		
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER	
Research Report 1342			
4. TITLE (and Subtitle)		5. TYPE OF REPORT & PERIOD COVERED	
A COMPARATIVE EVALUATION OF M1 TA	Research Report		
GUIDES	6. PERFORMING ORG. REPORT NUMBER		
7. AUTHOR(a)	8. CONTRACT OR GRANT NUMBER(+)		
Stephen L. Goldberg (ARI) and Cha Campbell (Human Resources Researc	MDA-903-80-C-0223		
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
Human Resources Research Organiza 1100 S. Washington St. Alexandria, VA 22314	tion	2Q263743A794	
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE	
U.S. Army Research Institute for	the Behavioral	September 1983	
and Social Sciences 5001 Eisenhower Avenue, Alexandri	a, VA 22333	13. NUMBER OF PAGES 80	
14. MONITORING AGENCY NAME & ADDRESS(II dillorer	nt from Controlling Office)	15. SECURITY CLASS. (of this report)	
		UNCLASSIFIED	
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
te premiumou eta truput dal alla Bassall		<u> </u>	

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, If different from Report)

18. SUPPLEMENTARY HOTES

 ${\tt Technical\ quality\ of\ this\ research\ monitored\ by\ Stephen\ L.\ Goldberg.}$

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Job aids Ml training Procedural tasks

28. ABSTRACT (Continue on reverse olds if necessary and identify by block number)

The purpose of this research was to evaluate Ml tank procedure guides developed by the Army Research Institute as aids in performance of procedural tasks. Twelve tasks, three for each of the four crew positions, were tested among 27 soldiers completing initial training at Fort Knox and 35 soldiers in Ml crews at Fort Hood. Soldiers used either the tank operator's manual (TM), the ARI procedure guides, or the TM checklist during task performance. Criterion measures included performance accuracy, measured as percent of steps passed and as GO or NO GO for the task as a whole, and time to (Continued)

DD 1 400 72 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Date Entered)

Item 20 (Continued)

locate tasks in each job aid. Overall, performance using the procedure guides was as accurate as performance using the TM or the checklist. Time required to locate procedures in the procedure guides was less than was required by the TM and not different from the time required by the checklist. Soldiers' comments indicated that the procedure guides would be well received by Ml crewmembers. In order to be effective, use of the guides during task performance must be introduced in training as soon as task familiarity using the TM is achieved. Command emphasis in units would then have to require continued use of the guides in performance of noncombat procedural tasks.

UNCLASSIFIED

11 SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

A Comparative Evaluation of M1 Tank Procedure Guides

Stephen L. Goldberg Army Research Institute

Charlotte H. Campbell Human Resources Research Organization

Submitted by
Donald F. Haggard, Chief
ARI Field Unit at Fort Knox, Kentucky

Approved as technically adequate and submitted for publication by Harold F. O'Neil, Jr., Director Training Research Laboratory

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333

Office, Deputy Chief of Staff for Personnel Department of the Army

September 1983

Army Project Number 2Q263743A794 Armor Training and Performance

ARI Research Reports and Technical Reports are intended for sponsors of R&D tasks and for other research and military agencies. Any findings ready for implementation at the time of publication are presented in the last part of the Brief. Upon completion of a major phase of the task, formal recommendations for official action normally are conveyed to appropriate military agencies by briefing or Disposition Form.

The Army Research Institute-Fort Knox has been working toward solution of training and performance problems that result from the Army's acquisition of sophisticated new weapon systems. The research has focused on the development and fielding of the Ml "Abrams" tank. Problems in personnel selection and assignment, individual and crew training, and training and performance in units are being investigated.

The Ml "Abrams" tank requires crewmen to perform a number of long procedural tasks to prepare for and secure after combat operations. The primary document for information on performance of these tasks is the tank operator's technical manual, TM 9-2350-255-10. The TM is to be used in training and as an aid in performing tasks in operational units. In operational testing of the Ml, it was observed that many preoperational tasks were not being performed correctly and the TM was frequently not being used. Features of the TM, such as its large size, its being designed for novice performers, and its detailed task descriptions, could have contributed to these problems. Also, since there is only one TM per tank, the TM cannot be used by crewmen who must simultaneously power up their stations.

Ml procedure guides were designed to provide Ml crewmen with a job aid that they could use to perform the procedural tasks necessary to prepare for and secure from combat operations. The procedure guides present sufficient information for armor crewmen who have been previously trained to perform Ml tasks. The guides are grouped by duty station and use a flow chart format to handle decision making and recursive operations. In operational settings the procedure guides are each packaged in plastic binders to protect them from the dirt and grease of the tank work environment. Each page is inserted in a plastic cover to allow pages to be replaced as changes are made.

This report describes an evaluation of the Ml procedure guides against the operator's technical manual and a checklist produced by the tank's developer with respect to performance that results from their ease of use.

EDGAR M. JOHNSON

Technical Director

ANG EN MAIL

Avail 1

1:715

A COMPARATIVE EVALUATION OF M1 TANK PROCEDURE GUIDES

EXECUTIVE SUMMARY

Requirement:

Evaluate M1 tank procedure guides by comparison to the operator's technical manual (TM) and the TM checklist as aids in performance of noncombat procedural tasks.

Procedure:

Performance tests of 12 procedural tasks were administered to soldiers just completing initial Ml training at Fort Knox and to soldiers assigned to Ml tank crews at Fort Hood. Soldiers used the TM, the TM checklist, or the procedure guide as a job aid during the test of each task. Criterion measures included pass/fail ratings on task steps, GO/NO GO scores on each task as a whole, and time required by soldiers to locate tasks in each job aid.

Findings:

Performance using the procedure guides was as accurate as performance using the TM or the TM checklist. Time required to locate procedures in the guides was less than was required by the TM, and not different from the time required by the checklist. Soldiers' comments indicated that the physical construction of the guides, the arrangement and presentation of procedures, and the fact that the guides are crew station specific would make the guides acceptable to Ml crewmembers.

Utilization of Findings:

Results of this research effort indicate that further implementation of the procedure guides and long-term evaluation in Ml armor units should be effected. Use of the guides for task performance must be introduced in training as soon as task familiarity using the TM is achieved. Command emphasis in units would then have to be given to continued use of the guides as aids to performance of noncombat procedural tasks.

PROCEDENG PAGE PLANE-NOT FELICED

A COMPARATIVE EVALUATION OF M1 TANK PROCEDURE GUIDES

\sim	***	ΈN	m ^

Pac	ge
INTRODUCTION	1
OBJECTIVES	3
PROCEDURES	3
RESULTS	4
Performance Accuracy	4 4 7
DISCUSSION	7
TECHNICAL SUPPLEMENT	11
	11 13
REFERENCES	25
APPENDIX A. SAMPLE PAGE FROM PROCEDURE GUIDE: POWER UP GUNNER'S STATION	-1
B. EXPERIMENTAL DESIGN DIAGRAMS	-1
C. DATA COLLECTION MATERIALS	-1
D. ANALYSIS OF VARIANCE SUMMARY TABLES FOR PERFORMANCE ACCURACY (PERCENT PERFORMANCE MEASURES PASSED) D	-1
E. ANALYSIS OF VARIANCE SUMMARY TABLES FOR PERFORMANCE ACCURACY (GO/NO GO)	-1
LIST OF TABLES	
Table 1. Tasks selected for testing	11
 Means and standard deviations of performance accuracy (percent performance measures passed) on driver, loader, and gunner tasks by test location	14
3. ANOVA results (F and p) for performance accuracy measured as percent performance measures passed	15

CONTENTS (Continued)

	,	Page
Table 4.	Numbers of soldiers scoring GO on tasks by job aid and location or crewmember	17
5.	ANOVA results (\underline{F} and \underline{p}) for performance accuracy measured as GO/NO GO	18
6.	Months of experience assigned to each crew position among soldiers at Fort Hood	18
7.	Means and standard deviations of performance accuracy (percent performance measures passed) by experienced and not experienced soldiers	19
8.	ANOVA summary (\underline{F} and \underline{p} values) of experienced and not experienced soldiers on performance accuracy (percent performance measures passed) for driver, loader, and gunner tasks	20
9.	Means, standard deviations, and numbers tested on locate time test by test location	21
10.	ANOVA results (\underline{F} and \underline{p}) for locate time tests	22
11.	Pairwise differences in locate times among job aids by task .	23
	LIST OF FIGURES	
Figure 1.	Mean accuracy (percent performance measures passed) for tasks using technical manual (TM), procedure guide (PG), or checklist (CL)	5
2.	Percent of soldiers performing tasks correctly (GO) using technical manual (TM), procedure guide (PG), or checklist (CL)	6
3.	Time required to locate tasks in technical manual (TM), procedure guide (PG), or checklist (CL)	8

A COMPARATIVE EVALUATION OF MI TANK PROCEDURE GUIDES

INTRODUCTION

The Ml Abrams tank is a complex system that incorporates many technological improvements within its mechanical and fire control systems. Its laser rangefinder, lead angle sensor, thermal imagery sighting system, and ballistic computer are all designed to improve the tank's firing accuracy and to simplify its combat operation. The gunner has only to place his reticle on the target; there is no need to aim off to compensate for cant, target movement, or wind speed Range determination is fast and accurate. The crew can see targets through battlefield obscuration and can fire accurately on the move. But there is a price to be paid for the benefits of automated combat systems. Although the Ml tank is simpler to operate in combat than its predecessor, the M60Al tank, the tasks required to power up, power down, and check operations of the Ml's system are longer and more complex than comparable tasks on the M60Al (Black & Kraemer, 1981). Training emphasis and appropriate documentation are required to ensure accurate performance of preoperation and postoperation tasks.

In the early stages of Ml fielding, there have been indications that procedural tasks are not being performed accurately. During the tank's Operational Test III (OT III), soldiers were tested on 11 procedural tasks after new equipment training (Maitland, Robinson, Butler, & Reynolds, 1981). None were performed correctly by at least 80% of the soldiers tested. The average rate of successful performance for these tasks was 44%.

The source of task documentation available during OT III, which was used in new equipment training, was the MI tank operator's technical manual, TM 9-2350-255-10 (referred to as the TM). The TM is formatted using Skill Performance Aid (SPA) guidelines. Tasks are highly proceduralized. Each task description contains a verbal description of each task step and a series of illustrations. The TM has been carefully checked for accuracy, thoroughness, and ability to guide performance. It has all the characteristics of a very good reference for task information, but it seems to have some potential problems that could preclude its use as a job aid to guide task performance in operational settings.

Problems with the TM's size, organization, and availability could be limiting its effectiveness. The use of SPA formatting in describing tasks has resulted in a very large manual. The TM is about 3 inches thick and has over 800 pages, making it cumbersome to use in a tank work environment. Crewmen have trouble keeping it open on their laps. It is particularly unwieldy when one must turn back and forth between pages. The number of tasks that require performers to choose between alternative steps and therefore go from one point in the task description to another and then back is such that page flipping would be frequent.

The organization of the TM may also pose some problems. Tasks are organized according to crew position, in a roughly operational sequence, but are only listed in the index, not in the table of contents, making tasks often difficult to locate in the manual.

A major problem that hampers use of the TM in operational settings is that only one copy is issued per tank. Since each of the four crewmembers has preoperation and postoperation tasks to perform, either soldiers will have to take turns with the manual, or three soldiers will be doing tasks without the aid of the manual. Given the length and complexity of Ml procedural tasks, crewmen will have difficulty relying on their memories to produce adequate task performance (Goldberg, Drillings, & Dressel, 1981). That soldiers must try to rely on their memories and not on task documentation might be a contributing factor to their poor performance on procedural tasks at OT III.

A procedural checklist designated TM 9-2350-255-CL was developed along with the technical manual. The checklist was intended to supplement the TM as a quick reference for performing common tasks during normal and emergency operations. It is only 48 pages long and small enough to fit in the soldier's pocket. But it too has drawbacks. The checklist does not use the same organization as the TM, and it has no index. As a result, it may be difficult to find a task in the checklist after learning the task using the The checklist is written at a much lower level of detail than the operator's manual, and in many instances warnings and cautions given in the TM are not present in the checklist. The checklist also greatly simplifies some tasks. For example, in describing a computer self-test, the checklist lists only the steps that would be followed when all systems are operating properly. It does not tell the soldier what steps would have to be taken if one or more systems failed the self-test, or even tell what the indicators of a failed self-test are. And no illustrations or table of contents are provided.

The impetus for the Army Research Institute's development of a set of job aids or procedure guidelines for the MI tank was the poor performance on conducting procedures noted at OT III and the potential problems discussed above with the available documentation. The procedure guides build on recommendations by Dalzell and Harrison (1980) that a checklist should be provided for each tank crewmember. The ARI procedure guides provide a separate job aid for each crew station and cover the tasks at each station that are required to prepare the tank for combat and secure the tank after operations.

Many of the more complex Ml tasks were not readily adaptable to common checklist formats that simply list task steps due to the many decisions that crewmembers are required to make during performance of Ml tasks. To overcome this problem, an innovative algorithmic format was developed to incorporate these decisions. This format is similar to flow chart diagrams. At each decision point, the soldier is asked a question concerning the phase of operation, environmental conditions, status of lights or switches, etc. Based upon the soldier's answer, the appropriate succeeding steps are identified. Appendix A contains an example of the task formatting found in the procedure guides.

The guides were designed to include only information necessary to perform tasks. Symbols are used to indicate decision points, warnings, cautions, and where lights should be lit up. The TM task terminology is used and the performance steps are the same, in action and sequence, as those in the TM. Additionally, a table of contents is included. Illustrations of the instrument panels are provided in the back of each guide.

Like the checklist, the procedure guides were designed as supplements-not replacements--for the TM. If a situation that was not covered in the guide occurred, the soldier would be expected to refer back to the TM for a complete task description. Furthermore, initial task training would use the TM. Soldiers, after learning task terminology and location of equipment and acquiring a basic understanding of procedures, would begin to use the procedure guides for routine performance of tasks.

Thus three formats had been prepared to aid soldiers in performing procedural, noncombat tasks. Each format had been checked for accuracy. The TM contained the most information, including procedures for all four crew stations and complete troubleshooting guidance, but as a consequence was bulky and awkward to use. The checklist also contained procedures for all four stations, but was considerably condensed, possibly to the point of ineffectiveness.

The procedure guides were designed to overcome the perceived problems with the TM and TM checklist. They were formatted to accommodate the complexity of Ml tasks and covered only one crew station in each guide. The availability of the guides, their presentation style, and their completeness should provide crewmen with an accessible source of helpful information. The capability of the procedure guides to produce accurate task performance in comparison to that produced by either the TM or TM checklist will in part determine their relative worth as job performance aids.

OBJECTIVES

The objective of this research was to compare the effectiveness of the Ml procedure guides to the TM in aiding tank crewmen in performance of procedural tasks. Effectiveness of the TM checklist was also compared to the TM and procedure guides. Because the TM is the aid on which all Ml soldiers have trained and with which they are most familiar, performance of the tasks using the TM is the benchmark against which the value of the checklist and procedure guides is measured. Judgments on the effectiveness of the procedure guides rest in part on a comparison of soldier performance produced by the checklist, guides, and TM.

PROCEDURES

Soldiers at Fort Knox, KY, and Fort Hood, TX, performed Ml procedural tasks aided by either the tank operator's manual TM 9-2350-255-10, the Ml task checklist TM 9-2350-255-CL, or the ARI-developed Ml procedure guides. At Fort Knox, the 27 soldiers participating in the research were just completing Ml tank One Station Unit Training (OSUT). At Fort Hood, they were crewmembers of nine Ml crews (35 soldiers) in an operational Ml battalion. At Fort Knox, soldiers were tested only on driver, loader, and gunner tasks. At Fort Hood, drivers, loaders, and gunners likewise performed tasks from those three crew positions. In addition, tank commanders and gunners performed tank commander tasks. At ach crew station, each soldier performed three tasks, each task with a different job aid. Job aids were rotated across soldiers and between tasks.

The data collected were time and accuracy measures of performance for a sample of Ml tasks. Time measures onsisted of time to locate the procedure in the job aid and time to perform the task. Task performance accuracy ratings consisted of GO or NO GO scores on total task performance and for each step within a task. Prior to performing tasks using the job aids, soldiers worked through a short study guide to familiarize themselves with the checklist and procedure guides. Time measures on locating tasks in each job aid were then collected separately from time measures of task performance.

RESULTS

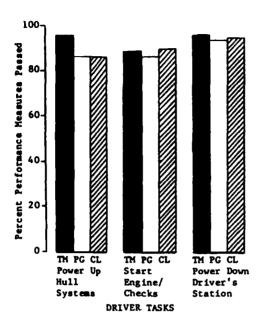
Performance Accuracy

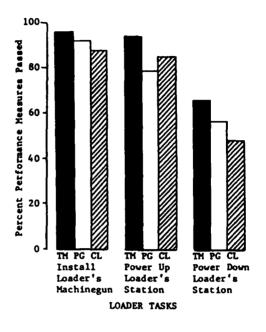
Accuracy was first examined in terms of the percent of task steps performed correctly for each task using each job aid; test location was included as a factor for statistical control. Figure 1 presents this information for tasks at the four crew stations. Analysis of these results showed that the job aid used had a significant effect on performance accuracy for only one task, Perform Thermal Imagery Sight (TIS) Checkout. For this task the checklist produced poorer performance than both the TM and the procedure guides. There was no difference in performance of this task between soldiers using the TM and the procedure guide.

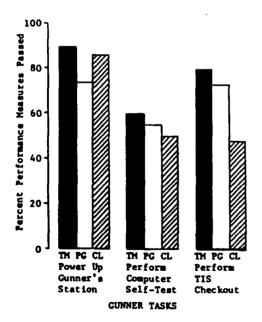
While most soldiers could complete most task steps correctly, the GO rate, or rate at which soldiers successfully completed tasks, was generally low. Figure 2 shows the percentage of soldiers who successfully completed each task as a function of the job aid they used. Gunner and tank commander tasks in particular had low rates of successful performance. The gunner tasks Perform Computer Self-Test and Perform TIS Checkout had one and two soldiers successfully perform them regardless of job aid used. Install Commander's Weapon was not performed correctly by any of the gunners or commanders, and Power Down Commander's Station was performed correctly by only three soldiers, all commanders. One loader task, Power Down Loader's Station, also had only one successful performance regardless of job aid. Of the remaining tasks, the job aid used made a difference in performance for two tasks, Power Up Driver's Station and Power Up Loader's Station. In both cases using the TM produced greater numbers of soldiers performing correctly.

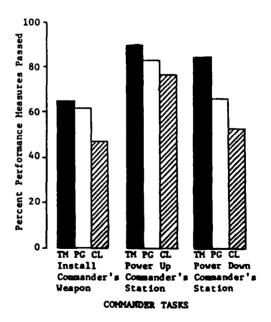
Performance Time

Performance times were recorded for all tasks, but the data were not analyzed due to the generally low levels of acceptable performance of the tasks for all of the job aids. Given that most soldiers made errors on most tasks, there was no clear or consistent way to determine what the times included. Times might have been long because soldiers were thorough and methodical, or because they were very incompetent. Times might be short because soldiers were quick and proficient, or because they did not perform most of the task steps. With so few soldiers demonstrating equivalent acceptable performance, comparison of performance times is meaningless.

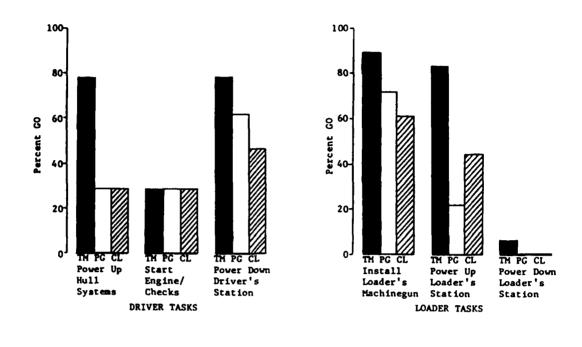








 $\frac{\text{Figure 1. Mean accuracy (percent performance measures passed) for tasks}}{\text{using technical manual (TM), procedure guide (PG), or checklist (CL).}}$



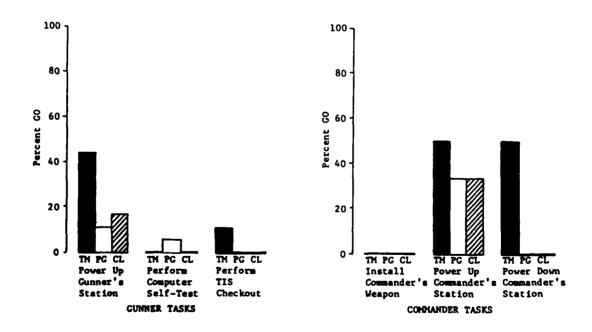


Figure 2. Percent of soldiers performing tasks correctly (GO) using technical manual (TM), procedure guide (PG), or checklist (CL).

Time to Locate Tasks in Job Aids

The time required to locate tasks in the three job aids is diagrammed in Figure 3. On all but two tasks (Power Up Driver's Station and Power Up Gunner's Station) the procedure guides elicited shorter times than the TM. In comparing the TM and the checklist, for nine tasks the TM required more time, for two tasks (Power Up Loader's Station and Perform Computer Self-Test) they required the same time, and for one task (Power Up Commander's Station) the checklist took longer. For only two tasks (Power Up Loader's Station and Power Up Commander's Station) were the procedure guides and checklist times different, both requiring more time in the checklist.

DISCUSSION

On the whole, the ARI Ml procedure guides produce task performance as accurate as that produced by either the TM or TM checklist. These performances, however, were alarmingly low, especially for the more complicated gunner tasks, regardless of aid. This suggests that soldiers did not have a mastery of the tasks at the time of testing and reinforces the argument for stressing use of job aids both in training and on the job.

There were some indications that soldiers were not totally comfortable with the symbols and abbreviations used in the procedure guides. For example, some soldiers did not recognize CCP as meaning computer control panel, or D as the symbol for drive on the transmission control, although both symbols are also used in the TM. And some soldiers did not know how to use the diamond symbol as a decision point to determine the steps to follow to adjust the commander's weapon. A more thorough introduction to the guides including hands on practice requiring understanding of the various symbols could improve performance with the guides.

Other errors made by soldiers are attributable to two sources: Soldiers were not proficient on the tasks at the time of testing, and the procedure guides and checklist do not contain sufficient detail for the non-performer. For example, turning the domelight off and checking fuel levels are somewhat more complex, in both action and system response, than the bald statement of the steps indicates; accordingly, soldiers using the less detailed checklist and quides did not complete all the actions required.

An observation that came out of conducting the research is that soldiers were not performing tasks completely. A logical explanation may be that soldiers are not required by either their trainers or supervisors to pay close attention to detail and perform tasks by the book. With aids being unavailable, for the most part, in the field soldiers must do the best they can to get equipment operating. Under these conditions, steps that either protect or ensure the equipment is working accurately are likely to be left out. When soldiers are then put in a test situation such as they experienced here, it is possible that the same unrigorous approach is adopted even though they have use of a job aid. Poor performance demonstrated here on the TIS checkout task may in part explain why that system has failed as frequently as it has. In order to improve performance with the job aids, their use will have to be introduced early in training and performance accuracy stressed to a high degree.

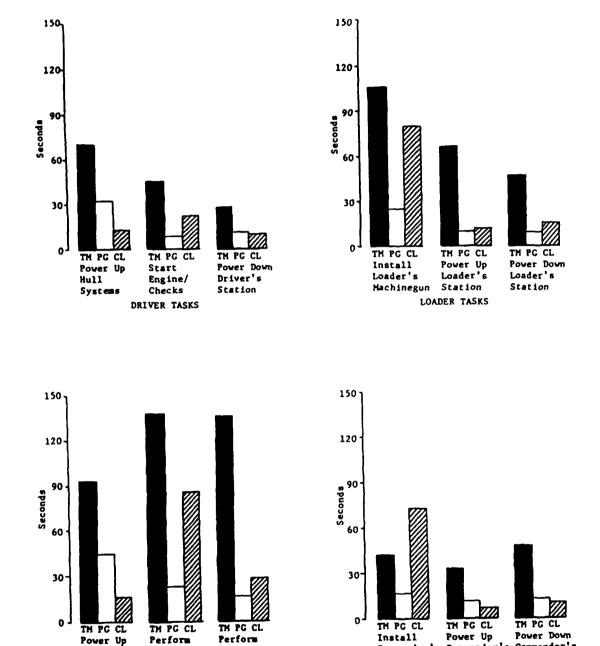


Figure 3. Time required to locate tasks in technical manual (TM), procedure guide (PG), or checklist (CL).

Gunner's

Station

Computer

GUNNER TASKS

Self-Test

TIS

Checkout

Commander's

Weapon

Commander's

Station

COMMANDER TASKS

Commander's

Station

Past research has shown that the use of job aids in training can produce acceptable levels of proficiency in fewer trials (Scott, McDaniel, & Braby, 1982), and that crewmen are likely to use job aids if they perceive the aids as accurate and helpful (Maier & Kessler, 1975). During this research effort, soldiers commented that they liked many of the features of the procedure guides: that guides are crew station specific, are easy to use because the book lies flat, are water resistant and sturdy enough for constant use, and are easy to read and to locate information in. Soldiers reported that the checklist was too insubstantial to hold up under steady use. For both the checklist and the guides, soldiers lamented the lack of illustrations, but this may be due in part to their low levels of task familiarity.

In summary, the procedure guides produced performances that were no less accurate than performance using the TM or TM checklist. Initial reactions indicate that the procedure guides had a distinct appeal among soldiers. In order to be effective, the guides would have to be introduced in training shortly after tasks are taught with the TM. Command emphasis in units would then have to require continual use of the guides in performance on noncombat procedural tasks. Further testing of the procedure guides should take place after their implementation in operational units, to determine usage and user acceptance.

TECHNICAL SUPPLEMENT

METHOD

Subjects

Data were collected at Fort Knox and Fort Hood. At Fort Knox the subjects were 27 soldiers who had just completed Ml One Station Unit Training (OSUT). At Fort Hood the subjects were 35 soldiers who were crewmembers of nine Ml tanks (one crew had only three crewmembers on the day of testing).

Task Selection

Three tasks were tested for each of the four tank crew positions. The criteria for selection of tasks were that the tasks be represented in all three job aids and that they all be testable within 2 hours in a motor pool (or similar) environment. The tasks selected are listed in Table 1. The technical manual (TM) for the Ml tank operator was used as the primary reference in developing hands-on tests of the tasks.

Table 1
Tasks Selected for Testing

Crew Position	Tasks				
Driver	Power Up Hull Systems				
	Start Engine and Make After Start Checks				
	Shut Down Engine, Power Down and Secure Driver's Station				
Loader	Install Loader's Machinegun				
	Power Up Loader's Station				
	Power Down Loader's Station				
Gunner	Power Up Gunner's Station				
	Perform Computer Self-Test				
	Perform TIS Checkout				
Tank Commander	Install Commander's Weapon				
	Power Up Commander's Station				
	Power Down Commander's Station				

Performance Tests

The data to be collected consisted of time and accuracy measures of performance on each task. The time measures were additionally broken down

into two components: time to locate the procedure in a job aid and time to perform the task using the job aid. The test of time to locate tasks required soldiers to look up tasks in the three job aids and to tell the scorer when he found the task. Time to perform was obtained along with measures of performance accuracy during hands-on tests of each task.

Design

One version of the locate time test was administered to each of the 27 soldiers at Fort Knox and the 27 drivers, loaders, and gunners at Fort Hood. Each soldier had to locate the three tasks for the driver in one job aid, the three tasks for the loader in a second job aid, and the three tasks for the gunner in a third job aid. A slightly different version of the locate time test was administered to the nine commanders at Fort Hood. This version required them to look up all three commander tasks in each of the three job aids.

The performance tests for the nine driver, loader, and gunner tasks were administered to 27 soldiers at Fort Knox and 27 drivers, loaders, and gunners at Fort Hood. Each soldier used all three job aids at each crew position station, one for each of the three tasks at that crew position. The design was a series of balanced incomplete blocks with repeated measures, replicated for each of the three crew positions.

The three tank commander tasks were tested among only the nine gunners and nine tank commanders at Fort Hood. Each of the three tasks was tested with a different job aid for each soldier; the design was a simple repeated measures Latin square.

All three data collection designs are illustrated in Appendix B.

Procedure

At Fort Knox, soldiers were tested in groups of three. After an initial briefing which provided an overview of the testing and Privacy Act information, soldiers were given a short written study guide requiring them to use the procedure guide and the TM checklist to answer questions. The purpose was to give them an opportunity to examine and become somewhat familiar with the two job aids. The same familiarization was not provided for the TM, because soldiers had used the TM throughout training. The locate time test was then administered to the three soldiers.

Each soldier then went to one of the three crew position stations for the three performance tests for that crew position. Scorers recorded time and performance accuracy on the scoresheets as the soldier performed the tasks with the appropriate job aid.

At Fort Hood, soldiers reported for testing in groups of four (intact tank crews), and testing proceeded in a similar fashion, with the tank commander also completing the study guide and the locate time test. After the driver, loader, and gunner were tested, the gunner and the tank commander were tested on the tank commander tasks.

All data collection materials are presented in Appendix C.

RESULTS

Performance Accuracy

Accuracy data (percent of performance measures passed) on the driver, loader, and gunner tasks (see Table 2) were first analyzed by means of an analysis of variance (ANOVA). Test location and group (representing which of the three aid/task combinations by which a soldier was tested; see Table B.2) were between-subjects factors; and job aid, crew position, and task within crew position were within-subjects factors. The job aid by task interaction is partially confounded with group, and the job aid by task by location interaction is partially confounded with the location by group interaction. (The design is similar to Winer's (1971, p. 727) Latin square Plan 9, modified to accommodate the fourth variable, task, nested under one of the within-subjects variables, crew position.) The ANOVA summary table is contained in Appendix D. All main effects except group are significant, and all within-subjects interaction terms except for the job aid by task by location term are significant.

Interpretation of the ANOVA proved to be somewhat beyond the capabilities of normal reasoning; the small number of subjects (54) relative to the total degrees of freedom (485) gave rise to suspicions that the analysis was predicting error variance. Therefore the design was broken down into nine ANOVAs, each job with job aid as the factor of interest and test location as a between-subjects factor for statistical control.

The commander tasks were analyzed using a separate analysis of variance. Because the commander tasks were tested only at Fort Hood, using assigned gunners and tank commanders, the ANOVA had four factors: job aid, task, crewmember, and row (the job aid for each task). The ANOVA summary table is also included in Appendix D. The crewmember difference was significant, as was the task effect. For consistency of interpretation with the driver, loader, and gunner tasks, the ANOVA was separated into three separate ANOVAs, with crewmember (gunner or tank commander) as a statistical control variable.

To correct for the inflated experimental error rate due to the separate analyses, the protection levels for the driver, loader, and gunner tasks were set at .005 and .001, for effective values of approximately .05 and .01, respectively. The significance levels for the tank commander tasks were set at .017 and .003, corresponding to significance levels of about .05 and .01. In the discussions that follow, the effective levels (.05 or .01) are reported. The ANOVA is summarized in Table 3.

The only effects that influenced performance accuracy were job aids on Perform TIS Checkout and Power Down Commander's Station, and location in Power Down Loader's Station and Perform Computer Self-Test. Pairwise tests of differences between job aids on Perform TIS Checkout indicated that the checklist produced performance accuracy that was about 31% lower than performance with the TM and about 24% lower than with the procedure guides; the guide and TM did not differ. On Power Down Commander's Station, performance

Means and Standard Deviations of Performance Accuracy (Percent Performance Measures Passed) on Driver, Loader, and Gunner Tasks by Test Location

			OX (N-9)	PT. HO	OD (N-9)	TOTAL		
		Nean	Standard	Hean	Standard	Mean	Standard	
TASK	JOB AID	Percent	<u>Deviation</u>	Percent	Devistion	Percent	Deviat ion	
Power Up	TH	97.04	6.37	94.81	9.83	95.92	8.36	
Hull -	Proc. Guide	88.89	6.29	85.19	15.00	87.04	11.65	
Systems	Checklist	91.11	8.31	82.96	14.44	87.04	12.47	
Start	TH	92.75	4.58	85.51	14.05	89.13	11,06	
Engine/	Proc. Guide	93.24	8.23	84.06	15.74	86.65	13.37	
Checks	Checklist	89.86	7.94	89.37	11.06	89.61	9.63	
Power Down	TH	94.44	9.56	98.89	3.14	96.67	7.46	
Driver's	Proc. Guide	94.44	10.66	94.44	4.97	94.44	8.32	
Station	Checklist	95.56	4.97	94.44	6.85	95.00	6.01	
Install	TH	98.15	5.24	94.44	15.71	96.30	11.86	
Loader's	Proc. Guide	92.59	15.93	90.74	11.42	91.67	13.89	
Machinegun	Checklist	96.30	10.48	79.63	18.89	87.96	17.40	
Power Up	TM	90.48	22.34	98.41	4.49	94.44	16.59	
Loader's	Proc. Guide	85.71	13.47	71.43	24.28	78.57	20.89	
Station .	Checklist	84.13	12.50	85.71	26.94	84.92	21.02	
Power Down	TH	71.11	15.95	60.00	23.57	65.56	20.88	
Loader's	Proc. Guide		9.42	40.00	24.94	36.67	25.16	
Station	Checklist	62.22	11.33	34.44	12.57	48.33	18.33	
Power Up	TM	92.93	7.14	85.86	13.63	89.39	11.44	
Gunner's	Proc. Guide	81.82	14.21	64.65	26.57	73.23	22.97	
Station	Checklist	88.89	3.78	82.83	20.30	85.86	14.91	
Perform	TM	63.64	18.68	56.57	23.77	60.10	21.67	
Computer	Proc. Guide		20.00	34.34	17.55	54.55	27.61	
Self-Test	Checklist	53.54	14.50	45.45	16.03	49.50	15.81	
Perform	TM	78.70	10.48	80.56	18.52	79.63	15.08	
TIS	Proc. Guide	74.07	13.51	71.60	19.89	72.84	17.05	
Checkout	Checklist	41.05	17.70	55.86	24.27	48.46	22.49	
	•		FT. H					
	•	GUNNER	IS (N=3)	COMMAND	ERS (N-3)		TAL	
Install	TM	58.33	14.83	72.22	11.95	65.28	15.15	
Commander's	Proc. Guide		16.08	76.39	10.39	61.81	19.90	
Weapon	Checklist	51.39	16.78	41.67	5.89	46.83	13.48	
Power Up	TH ·	86.67	9.43	93.33	9.43	90.00	10.00	
Commander's	Proc. Guide		0.00	86.67	18.86	83.33	13.75	
Station	Checklist	66.67	9.43	86.67	18.86	76.67	17.95	
Power Down	TH	68.52	10.48	100.00	0.00	84.26	17.40	
Commander's	Proc. Guide		12.00	70.37	13.86	65.74	13.77	
Stat ion	Checklist	48.15	9.44	57.41	10.48	52.78	11.00	

Table 3

ANOVA Results (F and p) for Performance Accuracy Measured as Percent Performance Measures Passed

				TASK			
Source	Power Up Hull df Systems		Start Engine/ Checks	Power Down Driver's Station	Install Loader's Mach'gun	Power Up Loader's Station	Power Down Loader's Station
Job Aid	2	3.72	<1	<1	1.49	2.82	3.94
Aid x Loc.	1 2 48	2.33 <1	3.33 <1	<1 <1	3.51 1.39	<1 1.45	23.09** ^a 1.78
			TASK				
		Power Up Gunner's	Perform Computer	Perform TIS	-		
Source	<u>df</u>	Station	Self-Tes	t Checkou	<u>t</u>		
Job Aid	2	4.41	1.29	13.34*	c .	•	
Location	1	4.67	11.82*b				
Aid x Loc. Error	2 48	<1	4.13	1.00			
			TASK				***
				Power	-		
		Install	Power U				
		Cmdr's	Cmdr's	Cmdr'			
Source	<u>df</u>	Weapon	Station	Stati	<u>on</u>		
Aid	2	2.28	1.09	9.31*	*d		
Crewmember	1	2.13	2.27	7.75*	*e		
Aid x Crm. Error	2 12	2.20	<1	1.53			

^{*}p < .05 (effective) *p < .01 (effective)

a Knox-Hood=24.08(%), \underline{t} (48)=4.81, p < .01

b Knox-Hood=18.52(%), \underline{t} (48)=3.44, \underline{p} < .05

TM-Proc. Guide=6.79(%), \underline{t} (48)=1.07, \underline{p} not significant TM-Checklist=31.17(%), \underline{t} (48)=4.91, \underline{p} < .01 Proc. Guide-Checklist=24.38(%), \underline{t} (48)=3.84, \underline{p} < .01

d Mi-Proc. Guide=18.52(%), \underline{t} (12)=2.53, \underline{p} not significant TM-Checklist=31.48(%), \underline{t} (12)=4.29, \underline{p} < .05 Proc. Guide-Checklist=12.96(%), \underline{t} (12)=1.77, \underline{p} not significant

using the TM was superior by about 31% to performance aided by the checklist, but no difference was detected between the procedure guides and either the TM or the checklist. On both tasks where location was significant, the Fort Knox soldiers performed better than the Fort Hood soldiers by about 24% on Power Down Loader's Station and by more than 18% on Perform Computer Self-Test.

It may be argued that the true test of a job aid is not whether its use produces more accurate performance, but whether it more often produces perfect performance. To test the point, each soldier's score on each task was converted to a GO, or 1, if all performance measures were passed, and otherwise to NO GO, or 0. (This also has the effect of reducing extraneous variance in percent scores due solely to the wording of the scoresheet, e.g., the decision to test checking switches by setting two switches to the incorrect position would produce two performance measures which test one step requiring the checking of perhaps seven or eight switches.) The numbers of GO and NO GO are reported in Table 4.

The GO/NO GO data on the driver, loader, and gunner tasks were first analyzed using the same design described earlier. The four-factor ANOVA (Appendix E) yielded significant main effects for job aid, for crew position, and for task within crew position, and a significant aid by task interaction, but the aid by task by location interaction was also significant, precluding a simple interpretation of the job aid and task results.

Likewise, the commander tasks were analyzed in one ANOVA, which resulted in significant crewmember, aid, and task as well as a crewmember by task interaction and a three-way interaction for aid, task, and crewmember. The GO/NO GO data were therefore analyzed by means of separate ANOVAs, using significance levels of .005 and .001 again for driver, loader, and gunner tasks and .017 and .003 for commander tasks. Five tasks (Power Down Loader's Station, Perform Computer Self-Test, Perform TIS Checkout, Install Commander's Weapon, and Power Down Commander's Station) were not analyzed because so few scores of GO were recorded (one for each of the first two tasks; two for the TIS tasks; none for Install Commander's Weapon; and three, all for commanders using the TM, on Power Down Commander's Station). The ANOVA F and p values are reported in Table 5.

The tests on these analyses indicate that the job aids had different effects on GO/NO GO performance for only two tasks: Power Up Hull Systems and Power Up Loader's Station. On the first of these, users of the TM outstripped both procedure guide and checklist users; nearly three times as many TM users scored GO as did users of either of the other aids. On the second task, the difference was due to performance, with the TM compared to the procedure guide; almost four times as many soldiers using the TM scored GO.

Performance Accuracy Among Experienced and Inexperienced Crewmembers

Because the amount of experience as driver, loader, and gunner varied widely among Ml crewmembers at Fort Hood (see Table 6), a final set of analyses compared performance accuracy (percent of measures passed) of soldiers with no experience or less than 1 month experience assigned to a crew position with performance of soldiers who had been assigned to the position

Numbers of Soldiers Scoring GO^a on Tasks by Job Aid and Location or Crewmember

TASK	JOB AID	FT. KNOX	FT. HOOD	TOTAL
Power Up	TM	7	7	14
Hull	Proc. Guide	i	4	5
Systems	Checklist	3	2	5
	TH	2	•	5
Start	Proc.Guide	4	3 1	5
Engine/ Checks	Checklist	2	3	5
CHECKS	CHECKLISE	2	,	,
Power Down	TM	6	8	14
Driver's	Proc.Guide	7	4	11
Station	Checklist	5	5	10
Install	TH	8	8	16
Loader's	Proc.Guide	7	6	13
Machinegun	Checklist	8	3	11
Power Up	TM	7	8	15
Loader's	Proc.Guide	3	1	4
Station	Checklist	2	6	8
Power Down	TM	1	0	1
Loader's	Proc.Guide	ō	ō	ō
Station	Checklist	Ö	0	0
Power Up	TM	4	4	8
Gunnner's	Proc.Guide	ì	i	2
Station	Checklist	ō	3	3
Perform	TM	0	0	0
Computer	Proc.Guide	i	Ö	i
Self-Test	Checklist	ò	Õ	ò
5001-1000	0110000000	Ū	-	-
Perform	TH	0	2	2
TIS	Proc.Guide	0	0	C
Checkout	Checklist	0	0	0
			FT. HOOD	
		CUNNERS	COMMANDERS	TOTAL
Install	TH	0	0	0
Commander's	Proc. Guide	Ö	0	0
Weapon	Checklist	0	0	0
Power Up	TM	ı	2	3
Commander's	Proc. Guide	Ö	2	ž
Station	Checklist	Ö	2	2
Power Down	TM	o	3	3
Commander's	Proc. Guide	ŏ	ó	ő
Station	Checklist	ŏ	ŏ	ŏ
	`	-		

^{*}Esch task x aid x location cell has nine soldiers; each task x aid x crewmember cell has three soldiers.

				TASK		
Source	<u>df</u>	Power Up Hull Systems	Start Engine/ Checks	Power Down Driver's Station	Install Loader's Mach'gun	Power Up Loader's Station
Job Aid	2	7.36* ^a	<1	1.04	2.05	9.30** ^t
Location	1	<1	<1	<1	3.89	<1
Aid x Loc.	2	1.18	1.39	1.52	2.27	2.70
Error	48					
		TASK Power Up		Ī	TASK ower Up	
		Gunner's		C	mdr's	
Source	<u>df</u>	Station	Source	<u>df</u> s	tation	
Job Aid	2	3.35	Job Aid	2	<1.	
Location	1	< 1	Crewmembe	r I	6.25	
Aid x Loc.	2	< 1	Aid x Crm	. 2	<1	
Error	48		Error	12		

^{*}p <.05 (effective)

Months of Experience Assigned to Each Crew Position Among Soldiers at Fort Hood

,		Driver	Loader	Gunner
No Experience (< 1 month)	N	13	13	16
Experienced	N	12	14	8
(≥1 month)	Mean (Months) S.D. (Months)	6.6 4.2	7.5 5.9	5.9 4.3

^{**}p <.01 (effective)

a TM-Proc. Guide=.500, t (48)=3.32, p < .05. TM-Checklist=.500, t (48)=3.32, p < .05. Proc. Guide-Checklist=0.00

b TM-Proc. Guide=.500, \underline{t} (48)=4.26, \underline{p} < .01 TM-Checklist=.389, \underline{t} (48)=2.713, \underline{p} not significant Proc. Guide-Checklist=-.222, \underline{t} (48)=1.55, \underline{p} not significant

a month or longer. Performance summaries are in Table 7. In the nine separate analyses (summarized in Table 8), with job aid and experience as factors, no differences were significant.

Means and Standard Deviations of Performance Accuracy
(Percent Performance Measures Passed) by Experienced and
Not Experienced Soldiers

		EXI	ERIENCED	NOT EXPERIENCED			
			Standard			Standard	
TASK	JOB AID	Mean	Deviation	M	Hean	Deviation	K
Pover Up	TH	90.67	11.62	5	100.00	0.00	4
Hull	Proc. Guide	89.33	15.55	5	80.00	12.47	4
Systems	Checklist	73.34	6.66	2	86.67	13.98	5
Start	TH	89.13	6.52	2	78.26	14.02	5
Engine/	Proc. Guide	77.39	17.91	5	92.39	5.65	4
Checks	Checklist	90.43	7.48	5	88.05	14.21	4
Power Down	TH	100.00	0.00	5	97.50	4.33	4
Driver's	Proc. Guide	95.00	5.00	2	96.00	4.90	5
Station	Checklist	94.00	8.00	5	95.00	5.00	4
Install	TH	90.00	20.00	5	100.00	0.00	2
Loader's	Proc. Cuide	93.33	8.17	5	87.50	13.82	4
Machinegun	Checklist	79.16	18.16	2	80.00	19.44	7
Power Up	TH	100.00	0.00	2	97.14	5.72	7
Loader's	Proc. Guide	68.57	20.99	5	57.14	28.57	2
Station	Checklist	82.86	34.28	5	89.28	11.84	4
Power Down	TM	70.00	17.89	5	47.50	23.85	4
Loader's	Proc. Guide	30.00	15.81	2	48,00	27.86	7
Station	Checklist	42.00	7.48	5	30.00	10.00	2
Power Up	TH	90.91	9.09	2	84.42	14.34	7
Cunner's	Proc. Guide	86.36	4.55	3	49.09	24.12	4
Station	Checklist	84.09	27.56	4	81.82	11.50	5
Perform	TM	65.91	29.72	4	49.09	13.61	5
Computer	Froc. Guide	50.00	4.55	2	29.87	17.32	7
Self-Test	Checklist	50.00	4.55	3	36.36	15.21	4
Perform	TH	93.06	4.17	3	67.78	15.27	4
715	Proc. Guide	65.97	23.84	4	76.11	14.55	5
Checkout	Checklist	43.06	12.50	2	59.53	25.54	7

Note. - Soldiers are defined as experienced with respect to a crew position if they are or have been assigned to the position for one month or longer.

Performance Time

Performance times were recorded for all tasks but were not analyzed because there was no clear or consistent way to determine what the times implied. A soldier was permitted as much time as he wanted to perform the task and was prompted only when he asked for help, when he was about to do something that presented an immediate danger to people or equipment, or when he stalled. Thus the times might be long because the soldier was thorough and

methodical or because he was very incompetent; times might be short because the soldier was quick and proficient or because the did not perform most of the task steps. One approach might have been to analyze the performance times for all cases of perfect task performance, but there were so few such cases that no analysis was done.

Table 8 ANOVA Summary (F and p values) of Experienced and Not Experienced Soldiers on Performance Accuracy (Percent Performance Measures Passed) for Driver, Loader, and Gunner Tasks

		TASK							
Source	df	Power Up Hull Systems	Start Engine/ Checks	Power Down Driver's Station	Install Loader's Mach'gun	Power Up Loader's Station	Power Down Loader's Station		
Job Aid	2	2.46	< 1	1.06	1.42	4.48	2.36		
Experience	1	< 1	< 1	< 1	< 1	< 1	< 1		
Aid x Exp.	2	1.46	1.59	< 1	< 1	< 1	1.70		
Error	19								
			TASK						
		Power Up	Perform	Perform					
		Gunner's	Computer	TIS					
Source	<u>df</u>	Station	Self-Test	Checkout		,			
Job Aid	2	1.67	1.42	2.99					
Experience	1	2.72	3,48	< 1					
Aid x Exp.	2	1.41	< 1	1.71					

Locate Time Tests

Error

19

The locate time test results were recorded in seconds. In cases where soldiers could not (or would not) find the task, the missing value was replaced by a score equal to the highest obtained score for the condition (job aid by task) plus one-half of the standard deviation for obtained scores in the condition. This penalty score was used on the assumption that the soldier could have found the procedure if he had continued searching and that he would have required more time than all soldiers who did find the procedure. An analysis of variance was performed to determine whether missing scores were randomly distributed across tasks, job aids, and locations or crewmembers, or whether they were associated with particular aids or tasks; none of the factors or interactions was significant.

The means, standard deviations, and number tested for the locate time test are presented in Table 9. Twelve ANOVAs were performed. For each of the driver, loader, and gunner tasks, job aid was the factor of interest, and test location was a factor for statistical control only. The three

Table 9 Means, Standard Deviations, and Numbers Tested on Locate Time Test by Test Location

			FT. KNOX (N-9) FT. BC	OOD (N-9)	TOTAL		
		Mean	Standard	Mean	Standard	Hean	Standard
TASK	JOB AID	(Seconds)	<u>Deviation</u>	(Seconds)	Deviation	(Seconds)	Deviation
Power Up	TH	64.88	70.44ª	77.89	58.01	71.38	64.85
Mull	Proc. Guide	19.11	8.28	45.64	51.99°	32.38	39.52
Systems	Checklist	11.44	8.52	13.67	14.73	12.56	12.08
Start	TH	36.67	29.56	52.78	29.31	44.72	30.52
Engine/	Proc. Guide		4.01	8.89	4.73	8.50	4.40
Checks	Checklist	21.11	31.39	23.89	20.11	22.50	26.40
Power Down	TM	27.89	26.59	27.44	13.20	27.66	20.99
Driver's	Proc. Guide	12.33	4.39	10.33	8.79	11.33	7.02
Stat ion	Checklist	8.78	9.26	11.67	11.87	10.22	10.74
Install	TM	83.89	82.27	127.88	58,14 ^f	105.88	74.55
Loader's	Proc. Guide	30.00	22.47 45.67 ^b	15.33	5.59	22.66	17.94
Machinegun	Checklist	97.82	45.67	60.18	22.29 ⁸	79.00	40.56
Power Up	TM	56.11	28.91	75.68	46.25 ^h	65.90	39.79
Loader's	Proc. Guide	10.89	5.60	10.11	2.57	10.50	4.37
Station	Checklist	10.89	5.75	13.11	6.58	12.00	6.28
Power Down	TH	36.00	25.42	57.89	40.21	46.94	35.37
Loader's	Proc. Guide	9.89	9.52	9.00	2.91	9.44	7.05
Station	Checklist	11.78	6.94	18.11	9.03	14.94	8.65
Power Up	TH	75.67	58.73	111.00	100.53	93.33	84.20
Gunner's	Proc. Guide	43.89	56.13	48.15	25.91	46.02	43.77
Station	Checklist	15.56	8.11	15.67	7.87	15.61	7.99
Perform	TM	72.22	50.55	201.46	193.13 [‡]	136.84	155.25
Computer	Proc. Guide	22.44	22.67_	22.22	13.03	22.33	18.49
Self-Test	Checklist	112.51	89.85°	57.22	32.53	84.86	73.01
Perform	TH	134.54	147.90 ^d	131.02	84.25 ^k	132.78	120.37
TIS	Proc. Guide	17.67	25.69	13.56	6.58	15.61	18.86
Checkout	Checklist	20.33	18.10	34.78	38.24	27.56	30.78
Install	TH			41.00	11.56		
Commander's	Proc. Guide	2		15.89	7.12,		
Weapon	Checklist			74.26	38.60 ¹		
Power Up	TH	(NA)		33.00	20.33	(NA	A)
Commander's	Proc. Guide	1		10.00	3.40		
Stat ion	Checklist			6.78	2.48		
Power Down	TH			48.00	37.96		
Commander's	Proc. Guide	•		10.78	1.87		
Station	Checklist			9.11	5.42		

Note 1.- Locate Times Test for Tank Commander Tasks not administered at Ft. Knox.

Mote 1.- Locate Times Test for Tank Commander Tasks not administered at Ft. Knox.

Note 2.- Missing times were replaced by a penalty score equal to the maximum score for the task, aid, and location plus one-half the standard deviation for the task, aid, and location. Scores were added in cells with superscripts as follows:

a. One score of 196.97

b. Three scores of 132.89

c. One score of 240.42

d. One score of 422.84

e. One score of 422.84

e. One score of 98.15

h. One score of 98.15

h. One score of 150.16

1. One score of 89.36

1. Two scores of 487.06

Two scores of 487.06 Two scores of 226.10 One score of 132.34

commander task analyses were one-way ANOVAs. As before, protection levels were set a priori at .005 and .001 for the nine driver, loader, and gunner tasks, and at .017 and .003 for commander tasks, for the effective rates of about .05 and .01, respectively. The ANOVA \underline{F} and \underline{p} values are in Table 10.

	TASK								
Source	<u>df</u>	Power Up Hull Systems	Start Engine/ Checks	Power Down Driver's Station		Install Loader's Mach'gun	Power Up Loader's Station	Power Down Loader's Station	
Job Aid	2	8.23**	11.40**	8.56**		16.30**	37.50**	13.84**	
Location	1	1.34	1.10	<1		<1	1.38	2.10	
Aid x Loc.	2	<1	<1	<1		4.00	1.14	1.14	
Error	48								
			TASK				TASK		
								Power	
		Power Up		Perform		Install	Power Up	Down	
		Gunner's	Computer	TIS		Cmdr's	Cmdr's	Cmdr's	
Source	df	Station	Self Test	Checkout	df	Weapon	Station	Station	
Job Aid	2	9.45**	6.79**	13.36**	2	11.82**	13.46**	8.86**	
Location	1	<1	<1	<1	`-	-	-	_	
Aid x Loc.	2	<1	4.63	<1	-	-	-	_	
Error	48				16				

^{*}p <.05 (effective)
**p <.01 (effective)

For every analysis, the job aid's main effect was significant; location and the interaction were not. Pairwise tests of the differences between job aids revealed relatively consistent relationships among the three formats (Table 11). On nine of the 12 tasks, locating a procedure in the TM took significantly longer than locating it in the procedure guides; likewise on nine tasks the TM required more time than the checklist. The guides and checklist produced different times on only two of the tasks; in both cases the procedure guide was associated with shorter locating times.

Table 11 Pairwise Differences in Locate Times Among Job Aids by Task

			Power			Power
	Power Up	Start	Down	Install	Power Up	Down Loader's Station
	Hull	Engine/	Driver's	Loader's	Loader's	
Comparison	Systems	Checks	Station	Mach'gun	Station	
TM-Proc.Guide	39.01	36.22	16.33	83.22	55.40	37.50
<u>t</u>	2.64	4.74**	3.46*	5.60**	7.60**	4.87**
TM-Checklist	58.83	22.22	17.44	26.88	53.90	32.00
<u>t</u>	3.99**	2.90*	3.70**	1.81	7.40**	4.16**
P'Guide-C'List	19.82	-14.00	1.11	-56.34	-1.50	5.50
<u>t</u>	1.34	-1.83	.23	3.79**	21	71
			TASK			
						Power
	Power Up		Perform	Install	Power Up	Down
	Gunner's	Computer	TIS	Cmdr's	Cmdr's	Cmdr's
Comparison	Station	Self-Test	Checkout	Weapon	Station	Station
TM-Proc.Guide	47.32	114.51	117.17	25.11	23.00	37.22
<u>t</u>	2.63	3.68**	4.74**	2.08	4.17**	3.56**
TM-Checklist	77.72	51.98	105.22	-33.26	26.22	38.89
<u>t</u>	4.31**	1.67	4.26**	-2.76	4.76**	3.72**
P'Guide-C'List	30.40	-62.54	-11.95	-58.37	3.22	1.67
<u>t</u>	1.69	-2.01	48	-4.85**	.58	.16

^{*}p< .05 (effective) **p< .01 (effective)

REFERENCES

- Black, B. A., & Kraemer, R. (1981). XMl Gunnery Training and Aptitude Requirements Analysis (ARI Research Product 81-5). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.
- Dalzell, CPT, & Harrison, CSM. (1980). <u>Tanker's Checklist Scroll and Display Device</u> (TCATA Test 00238). Fort Hood, TX: HQ TCATA.
- Goldberg, S. L., Drillings, M., & Dressel, J. D. (1981). Mastery Training:

 Effect on Skill Retention (ARI Technical Report 513). Alexandria, VA:

 U.S. Army Research Institute for the Behavioral and Social Sciences.

 (AD Al20 762)
- Maier, M. H., & Kessler, J. (1975). Implementation of job aids in the US Army. In R. C. Rowan (Ed.), <u>Invitational Conference on Improved Information Aids for Technicians</u>. Washington, DC: Society for Applied Learning Technology and Logistics Management Institute.
- Maitland, A. J., Robinson, N. J., Butler, W. G., & Reynolds, M. J. (1981).

 Effectiveness of Training-OT III for Ml (Abrams) Main Battle Tank,

 Volume II. Tank Operator Training (MOS 19K/L) (TRASANA TEA 37-81).

 NM: White Sands Missile Range.
- Scott, P. G., McDaniel, W. C., & Braby, R. (1982). Improved Procedures
 Training Through Use of Aids Developed from Learning Guidelines (TAEG
 Technical Report 113). Orlando, FL: Training Analysis and Evaluation
 Group.
- Winer, B. J. (1971). <u>Statistical Principles in Experimental Design</u> (2nd ed.). New York: <u>McGraw-Hill</u>.

PRECEDING PAGE BLANK-NOT FILLED

APPENDIX A

Sample Page from Procedure Guide: Power Up Gunner's Station

POWER UP STATION

IF LOUD, HICH-PITCHED SQUEALING MOISE IS HEARD, OR IF HYDRAULIC PRESSURE DROPS SUDDENLY TO BELOW 500 751, SHUT OFF TUR-RET POWER AND SHUT DOWN ENGINE

- 1. Turret power . . . Assure ON
- 2. Electrical Assure minimum system gage. . . . 18 volts
- Engine or AUX HYD PWR. . . . Running or ON (TC)
- All lights on 4. PANEL LIGHTS All lights on GPS upper and lower panels and TIS panel on TEST button. . . Press -
- 5. PANEL LIGHTS . . . Adjust
- 6. Hydraulic pressure gage. . . 1500-1700 PSI
- 7. CCP pover. . . . ON-
- 8. CCP TEST button. . Press/check lights
- 9. CCP cover. . . . Close/latch

- 11. Elevation travel
 - lock Unlock (loader)
- 12. Turret traverse lock Unleck (loader)
- 13. FIRE CONTROL MODE - HANUAL -
- 14. GUN/TURRET DRIVE . POWERED (loader)

APPENDIX B

Experimental Design Diagrams

Table B.1 Job Aid Used for Locate Time Tests

Soldier	Assigned Crew Position	Tasks Order_	Job DVR	Aid Used LDR	For GNR
1,10,19 2,11,20 3,12,21	Driver Loader Gunner	DVR-LDR-GNR LDR-GNR-DVR GNR-DVR-LDR	TM	PG	CL
4,13,22 5,14,23 6,15,24	Driver Loader Gunner	DVR-LDR-GNR LDR-GNR-DVR GNR-DVR-LDR	PG	CL	TM
7,16,25 8,17,26 9,18,27	Driver Loader Gunner	DVR-LDR-GNR LDR-GNR-DVR GNR-DVR-LDR	CL	TM	PO
28-35 ^b	Commander		TM	PG	CL

 $^{^{\}mathbf{a}}$ Ft. Hood only; Ft. Knox soldiers did not have assigned crew positions. $^{\mathbf{b}}$ Ft. Hood only; commander tasks were not tested at Ft. Knox.

Table B.2
Experimental Design for
Driver, Loader, and Gunner Performance Tests

						Job Aid	Used For				
	Assigned		Power Up	Start	Power Down	Inetall	Pouse IIs	Power	Power IIs	Perform	Perform
Soldier	Crew Position	Station Order	Hull Systems	Engine/	Driver's	Loader's	Loader's	Loader's	Cunner's	Computer Self-Test	TIS
1,10,19	Driver	DVR-LDR-GNR									
2,11,20	Loader	LDR-CNR-DVR	TM	P'Cuide	C'List	P'Guide	C'List	TM	C'List	TM	P'Gu1de
3,12,21	Gunner	GNR-DVR-LDR		·							
4,13,22	Driver	DVR-LDR-GNR									
5,14,23	Loader	LDR-CNR-DVR	P'Guide	C'List	TM	C'List	TH	P'Guide	TM	P'Guide	C'List
6,15,24	Gunner	CNR-DVR-LDR									
7,16,25	Driver	DVR-LDR-CNR									
8,17,26	Loader	LDR-GNR-DVR	C'List	TM	P'Gu1de	TH	P'Gu1de	C'List	P'Guide	C'List	TM
9.18.27	Gunner	CNR-DVR-LDR									

Note.-The three major groupings in the design shown are represented in the analysis by the Groups factor.

Table B.3
Experimental Design for
Tank Commander Performance Tests
(Ft. Hood)

		Job Aid 1	Used For	Power
Soldier	Assigned Crew Position	Install Cmdr's Weapon	Power Up Cmdr's Station	Down Cmdr's Station
3,18,24 28,31,34	Gunner Commander	C'List	TM	P'Guide
6,12,27 29,32,35	Gunner Commander	TM	P'Guide	C'List
9,15,21 30,33,36	Gunner Commander	P'Guide	C'List	TM

Note.-The three groupings shown in the design are represented in the analyses by the Groups factor.

APPENDIX C

Data Collection Materials

Study Guides: Driver, Loader, Gunner, Tank Commander	C-5 C-6 C-10 C-11
Locate Time Test (One of Nine)	C-10
	C-11
Driver's Station:	
Requirements for Job Aid Testing	
	C - 12
	C-13
Loader's Station:	
Requirements for Job Aid Testing	C-18
	C-19
	C-20
Gunner's Station:	
Requirements for Job Aid Testing	C-23
·	C-24
	C-25
Tank Commander's Station:	
Requirements for Job Aid Testing	C-29
	C-30
	C-31

GENERAL INSTRUCTIONS FOR ADMINISTERING AND SCORING JOB AID TESTS

- The purpose of this study is to measure speed and accuracy of soldiers as they perform various Ml tank tasks using one of three job aids:
 - TM 9-2350-255-10, Operator's Manual for Ml Tank
 - TM 8-2350-255-CL, Ml Tank Crew Checklist
 - Procedure Guides (Driver, Loader, Gunner, Commander) for Ml Tank
- The equipment and site requirements for testing are listed in the Consolidated Equipment and Site Requirements List (para 6 below).
 Personnel required include three trained scorers, one tank commander, and one test site supervisor (TSS).
- 3. Test materials include:
 - a. General Instructions for Administering and Scoring Job Aid Tests. Includes handling of soldiers and rules for scoring tests.
 - b. Job Aids Tests Briefing. To be read to soldiers before tests are administered, and to provide familiarization with job aids.
 - c. Driver, Loader and Gunner Study Guides. To familiarize soldiers with the Procedure Guide and TM Checklist formats.
 - d. Job Aids Locate Time Tests. To measure times to find procedures in each job aid.
 - e. Requirements for Job Aids Testing Driver's Station, Loader's Station, Gunner's Station, Tank Commander's Station. Includes station equipment, personnel, and site requirements.
 - f. Station Setup Driver's Station, Loader's Station, Gunner's Station, Tank Commander's Station. Includes test site preparation before each test session, station restoration before each soldier, and additional station maintenance instructions as needed.
 - g. Scoresheets Driver's Station, Loader's Station, Gunner's Station, Tank Commander's Station (3 each). Contains soldier identification, instructions to soldiers, performance measures for each task, and special scoring instructions for performance measures as needed.
- 4. Handling of Soldiers (TSS Instruction)

NOTE: Tests may be conducted either with a full crew of four soldiers, or with only three soldiers. In the latter case, tank commander tasks will not be tested. Unless otherwise noted, instructions below apply in both situations.

- a. Read Job Aids Tests Briefing to soldiers.
- b. Give each soldier a Study Guide, the corresponding Procedure Guide, and a TM Checklist. As the soldier completes the Study Guide, a scorer should check his answers, and correct them, showing him the correct answers in the job aid as necessary.
- c. Administer Locate Times Tests, with one scorer testing each soldier.
- d. With three soldiers, send one soldier to each tank. With four soldiers, keep the tank commander in the waiting area, and test the other three soldiers on the driver, loader, and gunner's stations. When the three have completed testing on all three stations, have them wait in the waiting area, and test the tank commander (and gunner, if planned) on the tank commander tasks.

- e. When three soldiers are being tested, they should rotate from driver's to loader's station, from loader's to gunner's station, from gunner's to driver's station. If the soldiers have assigned crew positions, they should begin at the station for their position. If the gunner and TC are to be tested on TC tasks, the gunner should be tested on these tasks at the loader's station (his last station) and the TC should be tested at the gunner's station.
- 5. Rules for Conducting and Scoring Job Aids Tests (Scorer Instructions)
 - a. Prepare the station for testing before the soldier arrives.
 - b. Position yourself and the soldier as directed on the scoresheet.
 - c. Read the instructions to the soldier. Hand the appropriate job aid to him, opened to the correct page, just before you tell him to begin. (The job aid to be used will be circled on the scoresheet.)
 - d. If the soldier has a question, read the instructions to him again. If he still does not understand, say "Do the best you can."
 - e. Start timing the task as you say "Begin." Stop timing when the last PM is completed. (NOTE: If PM are done out of scoresheet sequence, the last PM performed may not be the last PM listed.)
 - f. Mark a PM "Yes" if the soldier does the action. Mark "No" if he omits a PM (but see para 5.k below) or does it incorrectly. Mark "V" or "VP" as described in para 5.k(4) below.
 - g. Where an asterisk (*) appears on the scoresheet, the PM must be done before the next test starts. If the soldier completes a test and has not done a PM so marked, stop timing and either do it for him (preferred) or tell him to do it (if necessary).
 - h. Notes are given on the scoresheets where PM must be performed before the test continues. These are important safety measures and must be followed!
 - i. On PM where the soldier is to check a switch or control in another crewmember's station, score "Yes" if the soldier tells you he would check, or would ask the other crewmember, or if he asks you or if he does it himself.
 - j. If you don't see the soldier perform a PM, and you can't tell whether he did it, don't guess. Mark the scoresheet NS (not scored).
 - k. The scorer will prompt if the soldier is unable to proceed with the task, as follows:
 - (1) A prompt should be given only when the soldier is unable to proceed, or if his error can cause damage or injury.
 - (2) The first prompt for any PM will be verbal "You must [read PM to the soldier]."
 - (3) If the soldier is unable to perform the PM after a verbal prompt, perform the step for him and tell him to continue.
 - (4) Mark the scoresheet with a V (verbal) or VP (verbal and perform) for all PM which were prompted.
 - (5) Continue timing.
 - 1. If a malfunction occurs during a test:
 - (1) Stop the test, record the elasped time and the PM where the test was stopped.
 - (2) Have the soldier leave the tank.
 - (3) Have the TC check the tank and correct if possible.
 - (4) Note the malfunction on the scoresheet; note whether or not it was the soldier's fault.
 - (5) If malfunction is corrected, restore station for the test, and have soldier repeat entire task; begin scoring and timing where test was stopped on first attempt.

- (6) If the malfunction can't be corrected, but part of the task (beyond the involved PM) can be tested, do so. Be sure to indicate which PM could not be scored.
- m. Anything that happens that is not provided for in the preceeding guidance, describe on the scoresheet. Be specific.
- 6. Consolidated Equipment and Site Requirements List:
 - a. Equipment
 - (1) 3 fully operational Ml tanks.
 - (2) 1 extractor tool.
 - (3) 1 dummy round.
 - (4) 1 wooden block for tripping extractors.
 - (5) 1 complete antenna (AS 1729).
 - (6) 1 set of chock blocks.
 - (7) 1 loader's machinegun.
 - (8) 2 CVC with complete cables (1 for commander testing).
 - (9) 1 commander's machinegun (for commander testing only).
 - (10) I adjustable wrench in tool bag (for commander testing only).
 - (11) 4 sets job aids
 - (12) 1 set scoresheets per station per soldier.
 - b. Site
 - (1) The Loader's Station (and Tank Commander's Station) tank may be located indoors or outdoors.
 - (2) The Driver's Station tank must be outdoors, with clearance in back and front to prevent injury or damage when tank is started.
 - (3) The Gunner's Station tank must be outdoors with room for full safe turret movement.
 - (4) An object such as a boresight panel must be located at least 1000 meters from the Gunner's Station tank with line of sight.

JOB AIDS TESTS BRIEFING

Read the following to the Soldiers:

"This research falls under the provisions of the Privacy Act. I have copies of the Privacy Statement if anyone wants to read it.

"Today you will be helping us with a test of three Ml job aids: the TM, the TM Checklist, and Procedure Guides for each Ml crew position. We are trying to determine which job aid works best with which tasks. To do this, we will ask each of you to do three tasks at the driver's station, the loader's station, and the gunner's station. [We will have the TC do three tank commander tasks also.] We will be scoring and timing gunner and each task, but remember: we're testing the job aids, not you.

"We know that all of you are familiar with the TM, and some of you may have worked with the TM Checklist. In order to give all of you a chance to examine the TM Checklist and the Procedure Guides, we have prepared some brief study guides. Please note: these are not tests! Please use the TM Checklist and the Procedure Guides to fill out these study guides now."

DRIVER

STUDY GUIDE

Use the TM CHECKLIST for	these questions		
What is the Page Letter	Code for Driver Check	ks Di	uring Normal Operations?
On what page are the ste	ps for Place Tank in	Mot:	ion?
On what page are the ste	ps for emergency serv	vice	of the air cleaner?
Turn to page D-8. After you do next?			driver's hatch, what should
Use the DRIVER PROCEDURE	GUIDE for these que	stio	<u>ns</u>
Write the letter of the	right meaning by each	h sy	mbol.
\wedge	Meaning		
$\langle \rangle$		Α.	More information or a caution or warning.
		В.	Knob or switch position and light.
__		c.	Question.
On what page are the ste	ps for Before Operat:	ions	PMCS?
On what page is the pict			
Turn to page 20. If the should you do after remo	-		arctic conditions, what socket?
Turn to page 27. What s	hould happen when the	e he	ater is turned on?

LOADER

STUDY GUIDE

Use the TM Checklist for these questions:					
What is the Page Letter Code for Loader Checks During Normal Operations?					
On what page are the steps for Loader's Firing Operations?					
On what page are the steps for emergency service of the air cleaner?					
Turn to page L-3. After you remove the spent case ammunition casings, what should you do next?					
Use the LOADER PROCEDURE GUIDE for these questions					
Write the letter of the right meaning by each symbol.					
	Meaning				
		A.	More information or a caution or warning.		
		В.	Knob or switch position and light.		
-\ -		c.	Question.		
On what page are the sto	eps for Before Operat	ions	PMCS?		
On what page is the pic	ture of the Loader's	Pane	1?		
Turn to page 15. If the tank is operating under arctic conditions, what should you do after removing the hose breakaway socket?					
Turn to page 19. What should happen when the heater is turned on?					

GUNNER

STUDY GUIDE

Use the TM CHECKLIST for th	ese questions	
What is the Page Letter Cod	le for Gunner Checks D	uring Normal Operations?
On what page are the steps	for Gunner's Pre-Fire	Operations?
On what page are the steps	for emergency service	of the air cleaner?
Turn to page G-10. After y	ou clear the coax, wh	at should you do next?
Use the GUNNER PROCEDURE GU	JIDE for these questio	<u>ns</u>
Write the letter of the rig	tht meaning by each sy	mbol.
Me	eaning	
_	A.	More information or a caution or warning.
	В.	Knob or switch position and light.
-\\\-	c.	Question.
On what page are the steps	for Before Operations	PMCS?
On what page is the picture	e for the Gunner's Aux	iliary Sight Panel?
Turn to page 63. If the ta should you do after removing		

Turn to page 68. What should happen when the heater is turned on?

TANK COMMANDER

STUDY GUIDE

Use the TM CHECKLIST for these questions					
What is the Page Letter Code for Commander Checks During Normal Operations?					
On what page are the steps for Commander's Pre-Fire Operations: Cal .50?					
On what page are the steps for emergency service of the air cleaner?					
Turn to page C-3. In post fire operations, after you clear the machinegun, what should you do next?					
Use the DRIVER PROCEDURE GUIDE for these questions					
Write the letter of the right meaning by each symbol.					
Meaning					
A. More information or a caution or warning.					
B. Knob or switch position and light.					
C. Question.					
On what page are the steps for Before Operations PMCS?					
On what page is the picture of the Commander's Panel?					
Turn to page 29. If the tank is operating under arctic conditions, what should you do?					
Turn to page 31. What should happen when the heater is turned on?					

JOB AIDS LOCATE TIME TEST

Scorer: Read the instructions to the soldier. Start timing when you hand him the closed job aid, after you read the instructions. Stop timing when he points to the right task. If he's wrong, keep timing and say, "Wrong." The task is [task title]. "Keep looking." If he doesn't find it within three (3) minutes, stop him and go on to the next task. Have him close the job aid between tasks.

Instructions: "Now we will conduct a test of the three job aids, to see how long it takes to find different tasks in each. I will tell you the name of a task. You are to fine the task in the __[job aid] . When you find it, point to it on the page so I know that you have it. Do you

soldier.)

"Find the [position] task [task title]. Begin."

have any questions?".... (Give the job aid to the

NAME: _			
CL	GUNNER	PREPARE GUNNER'S STATION FOR OPERATION (G-1)	
		PERFORM COMPUTER SELF-TEST (G-2)	
		PERFORM TIS CHECKOUT (G-4)	
TM	DRIVER	POWER UP HULL SYSTEMS (2-76)	
		START ENGINE (2-98)	
		SHUT DOWN ENGINE (2-124)	
PG	LOADER	INSTALL LOADER'S MACHINEGUN (2)	
		POWER UP LOADER'S STATION (4)	
		POWER DOWN LOADER'S STATION (6)	
Months	as CUNNER:	•	
Months	assigned a	as Driver: Ever done Driver tasks:	
Months	assigned a	as Loader: Ever done Loader tasks:	
Months	assigned a	as TC: Ever done TC tasks:	

REQUIREMENTS FOR JOB AID TESTING

DRIVER'S STATION

Objective: To measure speed and accuracy of soldiers using three job aids (M1 Tank TM, M1 Tank Driver's Procedure Guide, or M1 Tank Crew Checklist) while performing three Driver tasks: Power Up Hull Systems, Start Engine and Make After Start Checks, and Shut Down Engine and Power Down and Secure Driver's Station.

Equipment Requirements:

- a. 1 Ml tank.
- b. 1 stopwatch.
- c. 1 clipboard.d. 2 pencils.
- e. 1 set job aids.
- f. 1 set of scoresheets per soldier.

Personnel Requirements:

a. Trained scorer.

Site Requirements:

- a. These tasks will be performed on M1 tanks outdoors.
- b. There must be clear area on all sides of tank to prevent injury or damage when the tank is started.
- c. Turret must be turned 90°.

STATION SETUP

DRIVER'S STATION

Before Each Test Session:

- a. See that tank chock blocks are in place.
- b. Have turned to side.
- c. Lock turret traverse lock.
- d. Ensure CREW FIRE and ENGINE FIRE extinguisher handles are seated in mount.
- e. Test PANEL LIGHTS with VEHICLE MASTER POWER ON.

Before Each Soldier:

- a. Open driver's hatch.
- b. Set parking brake.
- c. Ensure transmission control is set to N.
- d. Ensure steer throttle control is centered.
- e. Set TACTICAL IDLE switch in the ON position.
- f. Set TANK SELECTOR switch to LEFT FRONT.
- g. Open FIRE EXTINGUISHER 2ND SHOT cover (don't trip switch!).
- h. Turn domelight knob fully clockwise.
- i. Turn PANEL LIGHTS knob fully counterclockwise.
- j. Place job aids on front slope of hull.

NOTE: Have soldier do k, 1, and m before leaving tank.

- k. Close drain valves (down).
- 1. Set circuit breaker 6 in the hull networks box to OFF.
- m. Set circuit breaker 4 in the power distribution box to OFF.

Other:

a. Turn on AUX HYDR PWR every two hours for 15 minutes.

Station Restoration for Fower Up Hull Systems: (as above)

Station Restoration for Start Engine and Make After Start Checks:

- a. Set TACTICAL IDLE switch to OFF.
- b. Set parking brake.
- c. Ensure transmission control is set to N.
- d. Ensure steer throttle control is centered.

Station Restoration for Shutdown Engine and Power Down and Secure Driver's Station:

- a. Set parking brake.
- b. Start engine.
- c. Close drain valves.
- d. Open driver's hatch.

DRIVER'S STATION

POWER UP HULL SYTEMS

Name	::	SSN:		TM	PG	CL
is :	lier's Position: In driver's locked. Enter through driver back."					
Sco	er's Position: On front s	lope of hull.				
is have	tructions: "Let me have you to power up the hull systems any questions? (For pare the Driver's Station foin." Start time.	s. You must use th CL only: "Power u	e p begin	s at ste	Do plo	you f
					Pro	mpt
Per	formance Measures:		Yes	<u>No</u>	<u>v</u>	<u>VP</u>
1.	Set the TACTICAL IDLE switch	ch to OFF.				
2.	Set the TANK SELECTOR switch	ch to REAR.				
3.	Close the FIRE EXTINGUISHED	R 2ND SHOT cover.				
4.	Turn domelight control known clockwise all the way. (Domelight will not light a			· · · · · · · · · · · · · · · · · · ·		
5.	Open cover of hull network	s box.				
* 6.	Set circuit breaker to ON.					
7.	Open cover of hull power d	istribution box.				
*8 .	Set circuit breaker to ON.					
NOT	E: For CL only Say "Tur	n on VEHICLE MASTER	POWER.	**		
9.	Set VEHICLE MASTER POWER strelease.	witch to ON and				
10.	Press and hold PANEL LIGHT	S TEST button.				
11.	Release PANEL LIGHTS TEST	button.				
(No	t scored: Soldier may pres	s PNL DIM button.)				
12.	Turn PANEL LIGHTS knob clo (Panel lights get brighter					
13.	Push in and set TANK SELEC RIGHT FRONT.	TOR switch to				

				Pro	mpt
		Yes	No	<u>_v</u> _	<u>vp</u> _
14.	Push in and set TANK SELECTOR switch to LEFT FRONT.				
*15.	Push in and set TANK SELECTOR switch to REAR.				
NOT	E: For CL only stop time and say "Stop. task."	Do not	do the	rest of	the
		Time:			
Com	ments:				

DRIVER'S STATION

START ENGINE AND MAKE AFTER START CHECKS

MAID	e:			1 PG	CL
So1	dier's Position: Driver's seat.				
Sco	rer's Position: Front slope of hull.				
	tructions: Your next task is to start the encks. You must use the Do you rt when I say begin Begin." Start time				
				Pro	
Per	formance Measures:	Yes	<u>No</u>	<u>v</u>	<u>VP</u>
1.	Ensure no one is behind tank (ask scorer, say he'd ask TC, say he'd look).				
NOT	E: Make sure no one is behind tank. Tell so	oldier "	Clear."		
2.	Ensure TURRET POWER is set to OFF (ask scorer, say he'd ask TC).				
3.	Press in and hold PUSH TO START button for about 1 second, then let go.				
NOT	E: If engine start aborts, stop time, wait we then have soldier try to start engine agas score PM4 Yes. If not, follow malfunction	in. If	engine		
NOT	E: TRANSMISSION OIL PRESS LOW light may stay minute after engine is started. If solding say "There is no malfunction. Continue to the started of the started	ier trie	s to tr		
4,	Wait until green STARTED light is OFF.				
5.	Set TACTICAL IDLE switch to ON.				
۴6.	Set TACTICAL IDLE switch to OFF.				
7.	Inform all personnel inside and outside of tank that brake check is going to be done. (Tell scorer.)				
NOT	E: Make sure area in front is clear. Tell s	soldier	"Clear.		
8.	Press and hold service brake pedal.				
9.	Pull PARKING BRAKE RELEASE handle, then push it back.		_		
10.	Hold service brake pedal and set transmission control to D (tank doesn't creep).	ов ——			

				Pro	mpt
		<u>Yes</u>	<u>No</u>	<u>v</u>	<u>vp</u>
11.	Twist throttle controls slowly rearward and hold when RPM gage shows 1450-1550 rpm.	_			
12.	Let go of throttle controls (forward).				
13.	Set transmission control to N.				
14.	Press parking brake pedal (ratchet noise) then let go.				
15.	Release service brake pedal.				
16.	Inform personnel inside and outside tank that brake check is finished. (Tell scorer.)				
17.	Press and hold service brake pedal.				
18.	Set transmission control to D.				
19.	Turn steer control all the way to the right.				
20.	Turn steer control all the way to the left.				
21.	Turn steer control back to center position.				
22.	Set transmission control to N.				
23.	Release service brake pedal.				
		Time:			
Com	ments:		···		
					_

DRIVER'S STATION

SHUT DOWN ENGINE AND POWER DOWN AND SECURE DRIVER'S STATION

Nam	e: SSN:		TM	PG	CL
So1	dier's Position: In driver's seat.				
Sco	rer's Position: On front slope.				
sec	tructions: Your next task is to shut down ure the station. You must use thestions? Start when I say begin	Do yo	ou have	any	vn and
				Pro	npt
Per	formance Measures:	Yes !	ło_	<u>v</u>	<u>VP</u>
1.	Pull out and set ENGINE SHUTOFF switch do to SHUTOFF.	wn			
2.	Move both drain valve handles up to open.				
NOT	E: Wait 5 seconds then say "Turn VEHICLE should be scored NO if he does PM3 bef				ier
3.	Set VEHICLE MASTER POWER switch to OFF.				
4.	Turn and hold latch to release from stop.				
5.	Squeeze and turn hatch handcrank about one turn to move latch past stop.	-	agaa dhaan		
6.	Let go of latch.				
7.	Turn handcrank until hatch is over openin	18•			
8.	Reach over right shoulder with right hand and grasp hatch lifting handle.	·			
9.	Press and hold button in handle.				
10.	Pull down handle until it snaps into clip then let go (hatch drops into place).	·, 			
NOT	E: For CL only Stop time and have sold	lier open hat	ch and	exit	tank.
		Time:			
Con	ments:				
				·	

REQUIREMENTS FOR JOB AID TESTING

LOADER'S STATION

Objective: To measure speed and accuracy of soldiers using three job aids (Ml Tank TM, Ml Tank Loader's Procedure Guide, or Ml Tank Crew Checklist) while performing three Loader tasks: Install Loader's Machinegun, Power Up Loader's Station, and Power Down Loader's Station.

Equipment Requirements:

- a. 1 Ml tank.
- b. 1 loader's machinegun.
- c. 1 dummy main gun round.
- d. 1 extractor tool.
- e. 1 wooden block (2 ft. long, 4 x 4 inches).
- f. 1 two piece antenna (AS1729).
- g. 1 stopwatch.
- h. 1 clipboard.
- i. 2 pencils.
- j. 1 set of job aids.
- k. l set of scoresheets per soldier.

Personnel Requirements:

a. Trained scorer.

Site Requirements:

- a. These tasks will be performed on an Ml tank.
- b. Turret must be positioned so hull ammo door is visible.

STATION SETUP

LOADER'S STATION

Before Each Test Session:

- a. Erect crosswind sensor.
- b. Set GUN SELECT switch on gunner's panel to TRIGGER/SAFE.
- c. Unlock turret traverse lock.
- d. Ensure hull ammo door is visible.
- e. Ensure spent case ejection guard is forward.

Brfore Each Soldier:

- a. Loosen skate lock on loader's machinegun mount.
- b. Loosen azimuth lock on loader's machinegun mount.
- c. Unlock elevation lock pin on loader's machinegun mount.
- d. Ensure loader's machinegun mounting pins are locked into the mount.
- e. Place loader's machinegun on turret next to mount.
- f. Set TURRET POWER switch on TC panel to ON (TURRET POWER light on).
- g. Set AUX HYDR PWR on TC panel to ON.
- h. Set GUN/TURRET DRIVE switch to POWERED.
- i. Level gun tube.
- j. Load dummy round.
- k. Place knee guard in stowed position.
- 1. Place antenna in loader's oddment box.
- m. Place wooden block in TC's canteen box.
- n. Place extractor tool under gunner's seat.
- o. Set MAIN PWR switch on amplifier to OFF.
- p. Set POWER CKT BKR switch to OFF.
- q. Set INT ACCENT switch to OFF.
- r. Set RADIO TRANS switch to LISTENING SILENCE.
- s. Connect loader's CVC cables to intercom box.
- t. Turn domelight on if needed.
- u. Put job aids in TC station.

Other:

a. Set TURRET POWER to OFF between soldiers.

Station Restoration for Install Loader's Machinegum: (as above)

Station Restoration for Power Up Loader's Station:

- a. Set GUN/TURRET DRIVE to POWERED.
- b. Place antenna in loader's oddment box.
- c. Set MAIN PWR switch on amplifier to OFF.
- d. Set POWER CKT BKR switch to OFF.
- e. Set INT ACCENT switch to OFF.
- f. Set RADIO TRANS switch to LISTENING SILENCE.

Station Restoration for Power Down Loader's Station:

- a. Unlock turret traverse lock.
- b. Load dummy round.
- c. Set MAIN PWR switch on amplifier to ON.
- d. Connect loader's CVC cables to intercom box.

LOADER'S STATION

INSTALL LOADER'S MACHINEGUN

Mam	e:SSN:		1	M PG	CL					
So1	dier's Position: Standing in loader's hatch	•								
Sco	rer's Position: Standing in TC hatch.									
sta Do gun	Instructions: "Let me have your attention. Your first task at this station is to install the loader's machinegun. You must use the Do you have any questions? [For CL only: "Install Loader's Machinegun is at step 3 of Prepare Loader's Station for Operation."] Start when I say begin Begin." Start time.									
				_ <u>r</u>	rompt					
Per	formance Measures:	<u>Yes</u>	<u>No</u>	<u>v</u>	VP					
1.	Turn skate lock clockwise.									
2.	Turn azimuth lock clockwise.									
3.	Pull out on ring on elevation lock pin and rotate one quarter turn and release.									
4.	Remove 2 mounting pins.									
5.	Put machinegun into mount.									
6.	Insert mounting pins (rings flush with mount).	_								
		Time:								
Сош	ments:	····		- <u>-</u>						
	··									
										

LOADER'S STATION

POWER UP LOADER'S STATION

Nam	e:		T	M PG	CL
So1	dier's Position: Seated in loader's seat.				
Sco	rer's Position: Seated in TC seat.				
Sta [Fo	tructions: "Your next task at this station i tion. You must use the Do you r CL only: "Power Up the Loader's Station be der's Station for Operation."] Start when I start time.	have a gins at	ny ques step 1	tions? O of P	 repare
				Pr	ompt
Per	formance Measures:	Yes	<u>No</u>	<u>v</u>	<u>VP</u>
*1.	Set GUN/TURRET DRIVE switch to MANUAL.				
2.	Screw 2 antenna pieces together.				
3.	Screw antenna to mount base.				<u></u>
*4.	Set MAIN PWR switch on amplifier to NORM.				
5.	Set POWER CKT BKR switch to ON.				
6.	Set INT ACCENT switch to ON.				
7.	Set RADIO TRANS switch to CDR + CREW.				
NOT	E: For CL only Say "Stop. Do not do the	rest of	the ta	sk."	
		Time:			··
Соп	ments:				
			···		

LOADER'S STATION

POWER DOWN LOADER'S STATION

Name:SSN:		T	M PG	CL
Soldier's Position: Seated in Loader's seat.				
Scorer's Position: Seated in TC seat.				
Instructions: "Your third task at this station Loader's Station. You must use the questions? Start when I say begin Bo				
			Pro	mpt
Performance Measures:	Yes	No	<u>v</u> _	<u>VP</u>
1. Lock turret travere lock.				
2. Set GUN/TURRET DRIVE switch to EL UNCPL.				
3. Pull breech handle to rear until it locks.				
4. Return handle to upright locked position.	· ·			
NOTE: PM 4 must be done before test continues!				
5. Remove round from chamber.				
SAY: "Stow round in ready ammo rack."				
6. Place round in ready ammo rack.				
7. Check main gun tube (look into tube).				
Trip right extractor (use block or extractor).				,
Trip left extractor (use block or extractor).				
10. Set GUN/TURRET DRIVE switch to MANUAL.				
ll. Set amplifier MAIN PWR switch to OFF.				
12. Disconnect CVC from intercom box.				
NOTE: For CL only Say "Stop. Do not do the	rest of	the ta	sk•"	
	Time:			
Comments:				

REQUIREMENTS FOR JOB AID TESTING

GUNNER'S STATION

Objective: To measure the speed and accuracy of soldiers using three aids (M1 Tank TM, M1 Tank Gunner's Procedure Guide, or M1 Tank Crew Checklist) while performing three Gunner tasks: Power Up Gunner's Station, Perform Computer Self-Test, and Perform TIS Checkout.

Equipment Requirements:

- a. 1 Ml tank.b. 1 stopwatch.
- c. 1 clipboard.
- d. 2 pencils.
- e. 1 set of job aids.
- f. 1 set of scoresheets per soldier.
- g. Identifiable object at least 1000 meters from tank.

Personnel Requirements:

a. Trained scorer.

Site Requirements:

- a. These tasks will be performed on MI tank outdoors.
- b. Sufficient space is required for free and safe turret movement.

STATION SETUP

GUNNER'S STATION

Before Each Test Session:

- a. Perform panel lights test.
- b. Null out turret drift.
- c. Perform computer lights test and self-test.
- d. Open DAY ballistic door.
- e. Perform TIS checkout.
- f. If gun is over rear deck, elevate at least 5°.

Before Each Soldier:

- a. Lock elevation travel lock.
- b. Lock turret traversing lock.
- c. Set FIRE CONTROL MODE switch to NORMAL.
- d. Set GUN/TURRET DRIVE switch on loader's panel to MANUAL.
- e. Set FLTR/CLEAR/SHTR switch to CLEAR.
- f. Set POLARITY switch to BLACK HOT.
- g. Set THERMAL MAGNIFICATION lever to 10X.
- h. Set UNIT TEST PATTERN switch to OFF.
- Close THERMAL ballistic door.
- j. Set TURRET POWER to ON.
- k. Set AUX HYDR PWR to ON.
- Cancel range input and latch CCP door.
- m. Press TC's MANUAL RANGE BATTLE SGT button.
- n. Turn adjustment knob for GPS and TIS panel lights counterclockwise until it stops.
- o. Set circuit breaker 25 (LRF) to OFF in turret networks box.
- p. Place job aids in commander's .50 caliber ammunition stowage compartment.
- q. Point out target to soldier before he enters the tank.

Other:

- a. Have TC run tank every 2 hours to maintain battery charge (monitor TC's LOW BAT CHG Light).
- b. Set TURRET POWER to OFF between soldiers and at the end of each test session, after TIS READY goes OFF.

Station Restoration for Power Up Gunner's Station: (as above)

Station Restoration for Perform Computer Self-Test:

- a. Set FIRE CONTROL MODE switch to MANUAL.
- b. Latch cover on CCP.

Station Restoration for Perform TIS checkout.

- a. Set FLTR/CLEAR/SHTR switch to CLEAR.
- b. Set POLARITY switch to BLACK HOT.
- c. Set THERMAL MAGNIFICATION lever to 10X.
- d. Set UNIT TEST PATTERN switch to OFF.
- e. Close THERMAL ballistic door.
- f. Cancel range input and latch CCP cover.
- g. Press MANUAL RANGE BATTLE SGT button.

GUNNER'S STATION

POWER UP GUNNER'S STATION

Nam	e:SSN:		TM	l PG	CL
So1	dier's Position: Gunner's seat.				
Sco	rer's Position: Commander's seat.				
at [Fo	tructions to Soldiers: "Let me have your attended this station is to Power Up the Gunner's Statender of the TIS will be used. Do you have CL only: "Power Up begins at step 7 of Proceedings of the Clark of the Coax."] Statender of Start time.	tion. Y ve any q epare th	Ou must puestion ne Gunne	use thes? er's Sta	e tion
				Pro	mpt
Per	formance Measures:	Yes	No	<u>v</u>	<u>VP</u>
1.	Push PANEL LIGHTS TEST pushbutton.		_		
2.	Turn PANEL LIGHTS knob.				
3.	Open CCP cover.				- '
4.	Set CCP power to ON.				
5. 6.	Push TEST pushbutton on CCP. Latch cover on CCP.				
*7.	Set THERMAL MODE switch to STBY (noise).				
* 8.	Unlock elevation travel lock.				
*9 .	Ensure turret traverse lock is unlocked. (Look, ask Scorer, say he would ask loader, or unlock.)				
10.	Set FIRE CONTROL MODE switch to MANUAL.				
11.	Ensure GUN/TURRET DRIVE switch is set to POWERED. (Look, ask Scorer, say he would ask loader, or set switch.)				
NOT	E: For CL only Stop time and say "Stop. task."			rest of	
Com	ments:	·		<u> </u>	
		 			

GUNNER'S STATION

PERFORM COMPUTER SELF-TEST

Nam	e:	_ 	TM	PG	CL
Sol	dier's Position: Gunner's seat.				
Sco	rer's Position: Commander's seat.				
a C que 23	omputer Self-Test. Your next stions? [For CL only: "Perfof Prepare Gunner's Station for Op Begin." Start time.	he D orm Computer Self-T	o you ha est beg:	ive an	y step
				Pro	mpt
Per	formance Measures:	<u>Yes</u>	<u>No</u>	<u>v</u>	<u>VP</u>
1.	Set FIRE CONTROL MODE switch to N	ORMAL.			
2.	Look into GPS with palm switches	squeezed.			
3.	Open CCP cover.				
4.	Set CCP POWER switch ON.	_ 	_		
5.	Wait 90 seconds.				
6.	Squeeze and hold palm switch on p control handle.	ower		_	
7.	Push and release TEST button.				
8.	When NO GO lights up and 8 appear window, push and release flashing RANGE button.				
9.	Push and release ENTER key.				
7.	rush and release Enter Rey.				
TON	TE: When FAIL appears in window, s	ay "Do not troubles	hoot."		
10.	Release palm switches.	<u></u>			
11.	Latch CCP door.				
		Time:_			
Con	ments:		·		
			·		

GUNNER'S STATION

PERFORM TIS CHECKOUT

Name:SSN:		T	M PG	CL
Soldier's Position: Gunner's seat.				
Scorer's Position: Commander's seat.				
NOTE: Do not begin until THERMAL MODE READY lig	ht is 1	it.		
Instructions to Soldier: "Your third task at the a TIS Checkout. You must use the shown to you before entering the Gunner's statio questions? [For CL only: "TIS Checkout be Gunner's Station for Operation."] Start when I Start time.	Use th n. Do gins at	e targe you hav step 2	t that e any 5 of Pi	was epare
			Pro	mpt
Performance Measures:	Yes	No	<u>v</u>	VP
1. Set FLTR/CLEAR/SHTR switch to SHTR.	 .			
2. Set POLARITY switch to WHITE HOT.				
3. Set THERMAL MAGNIFICATION lever to 3X.				•
4. Set UNIT TEST PATTERN switch to PCU.				
NOTE: FAULT LIGHT may come on for 5 seconds wit SETTING. Tell soldier to continue.	h each	UNIT TE	ST PAT	TERN
5. Look into GPS.				
6. Set UNIT TEST PATTERN switch to ICU.				
7. Look into GPS.				****
8. Set UNIT TEST PATTERN switch to EU.				
9. Set THERMAL MODE switch to ON.				
.O. Look into GPS.				
1. Set THERMAL MAGNIFICATION lever to 10X.	_			
12. Look into GPS.				
13. Set UNIT TEST PATTERN switch to TRU.				
14. Look into GPS.				
15. Turn CONTRAST knob while looking in GPS.				
16. Turn SENSITIVITY knob while looking in GPS.				

				Prom	pt
		Yes	<u>No</u>	<u>v</u>	<u>vp</u>
17.	Turn RETICLE knobs while looking in GPS.				
18.	Set POLARITY switch to BLACK HOT.				
19.	Look into GPS.				
20.	Set POLARITY switch to WHITE HOT.				
21.	Look into GPS.				
22.	Set UNIT TEST PATTERN switch to OFF.				
23.	Open THERMAL ballistic door.				
24.	Look into GPS.				
(No	t scored: soldier may adjust TIS image.)				
NOT	E: Make sure no one is in the way of the gun.				
25.	Lay gun on target. (Scorer: check the lay of the gun by observing it through the Commander's GPS extension.)				
26.	Open CCP cover.				
27.	Set CCP POWER switch to ON.				
28.	Press RANGE key.				
29.	Press keys 2, 6, 8, and 0.				
30.	Press ENTER key.				
31.	Turn SYMBOL knob clockwise while looking in GPS.				
32.	Turn SYMBOLS knob counterclockwise while looking in GPS.				
33.	Set THERMAL MAGNIFICATION LOCK lever to 3X.				
NOT	E: Be sure UNIT TEST PATTERN is OFF before PM	34.			
NOT	E: Say "The TIS will not be used any more."				
34.	Set THERMAL MODE switch to OFF.				
35.	Close THERMAL ballistic door.				
36.	Set FLTR/CLEAR/SHTR switch to CLEAR.				
(No	t socred: Soldier may cancel range input.)	Time:_			·
Com	ments:				

REQUIREMENTS FOR JOB AID TESTING

TANK COMMANDER'S STATION

Objective: To measure speed and accuracy of soldiers using three job aids (M1 Tank TM, M1 Tank Tank Commander's Procedure Guide, or M1 Tank Crew Checklist) while performing three tank commander tasks: Install Commander's Weapon, Power Up Commander's Station and Turret, and Power Down and Secure Station.

Equipment Requirements:

- a. 1 Ml tank.
- b. 1 Caliber .50 M2 machinegun.
- c. l adjustable wrench.
- d. 1 stopwatch.
- e. 1 clipboard.
- f. 2 pencils.
- g. 1 set job aids.
- g. 1 set scoresheets per soldier.

Personnel Requirements:

a. Trained scorer.

Site Requirements:

a. These tasks will be performed on an Ml tank.

NOTE: The Tank Commander's tests may be set up and conducted at the Loader's Station or Gunner's Station.

STATION SETUP

TANK COMMANDER'S STATION

Before Each Test Session:

- a. Place the GUN/TURRET DRIVE switch on loader's panel in MANUAL position.
- b. Place the spent case ejection guard forward in safe position.
- c. Set timing on commander's weapon.

Before Each Soldier:

- a. Place TC hatch in full open position.
- b. Place safety on commander's weapon station elevation crank to FIRE.
- c. Turn CWS MANUAL/POWER lever to POWER.
- d. Adjust equilibrator too tight.
- e. Un-level commander's weapon mount.
- f. Place mounting pins in mount.
- g. Place machinegun on turret, barrel removed.
- h. Place wrench in tool bag.
- i. Connect CVC cord to intercom box.
- j. Turn PANEL LIGHTS knob fully counterclockwise.
- k. Turn domelight seitch fully clockwise.
- 1. Turn VEHICLE MASTER POWER switch OFF.
- m. Unlock elevation travel lock and turret traverse lock.
- n. Place job aids on top of turret.

Station Restoration for Install Commander's Weapon: (as above)

Station Restoration for Power Up Commander's Station and Turret:

- a. Turn VEHICLE MASTER POWER switch OFF.
- b. Turn PANEL LIGHTS knob fully counterclockwise.

Station Restoration for Power Down and Secure Station:

- a. Mount machinegun.
- b. Connect CVC cord to intercom box.
- c. Turn domelight switch all the way clockwise.
- d. Unlock elevation travel lock and turret traverse lock.
- e. Turn TURRET POWER switch ON.
- f. Turn AUX HYDR PWR switch ON.

TANK COMMANDER'S STATION

INSTALL COMMANDER'S WEAPON

Name	e: SSN:		ŦM	PG	CL
Solo	dier's Position: On turret.				
Sco	rer's Position: On turret.				
is set	tructions: "Let me have your attention. Yo to install the commander's weapon. You must headspace and timing. Do you have any quesstall Commander's Weapon is at step 1 of Preration."] Start when I say begin Begin	use the tions?" pare Commande	[For CL o	Do	not
			1	Promp	t
<u>Per</u>	formance Measures:	Yes .	<u> </u>		<u>VP</u>
1.	Check that weapon is clear.				
2.	Set safety above CWS elevation crank to SAF	e			
3.	Level commander's machinegun mount using elevation crank.				
4.	Remove 2 round mounting pins from the mount				
5.	Remove rear flat mounting pin from mount and insert pin in stowage slot.				
6.	Put machinegun receiver in mount.		 -		
7.	Ensure trigger is behind butterfly.				
8.	Insert 2 mounting pins.				
9.	Pull and hold charging handle to the rear (barrel locking spring lug visible in 3/8 inch hole).				
10.	Screw barrel all the way into barrel extension.			<u> </u>	
11.	Unscrew barrel two notches (clicks).				

				Promp		
		Yes	No	<u>v</u>	VP	
12.	Release charging handle, allowing bolt to go forward.			_		
13.	Elevate and depress weapon (will bind).					
14.	Depress weapon to maximum depression.					
15.	Loosen equilibrator locknut on equilibrator adjusting bolt.		_			
16.	Turn equilibrator adjusting bolt.					
17.	Elevate and depress weapon.					
18.	Turn locknut clockwise until locknut is fully seated against mount.					
NOTE	: Say "Do not set headspace and timing."					
19.	Set machinegun safety to F.					
20.	Pull charging handle down and to the rear, then let go.					
21.	Set safety switch on CWS elevation crank to FIRE.					
22.	Pull down on CWS elevation crank knob to test machinegun firing mechanism.					
23.	Set CWS safety switch to SAFE.					
24.	Set machinegun safety to S.					
		Time:	<u></u> ,			
Сопи	ents:					

TANK COMMANDER'S STATION

POWER UP COMMANDER'S STATION AND TURRET

Name):	SSN:		T	M	PG	CL
Solo	lier's Position: In TC seat.						
Sco	rer's Position: In Loader's sta	ation.					
turi the "Pos The	tructions: Your next task is to ret. You must use the engine will not be started. Do wer up begins at step 3 of Prepa crew has reported 'Ready.'"] S ct time.	Turret equipolyou have any que the Commander	ipment v stions: 's Stati	vill be ?" lon for	use (Fo	ed, or C erat	and L only:
					1	Prom	<u>pt</u>
Per	formance Measures:		Yes	<u>No</u>	_ <u>v</u>	_	VP
*1.	Set TURRET POWER switch to ON MASTER POWER light and TURRET loome on).	•		_		_	
*2.	Set AUX HYDR PWR switch to ON PWR light comes on).	(AUX HYDR				_	
3.	Press PANEL LIGHTS test button	•				_	
4.	Check lights on loader's panel: LIGHTS test button pressed. (Mask loader, ask scorer.)				_	-	
5.	Turn PANEL LIGHTS knob clockwis MASTER POWER LIGHT gets bright	•				- -	
NOT	E: For CL only say: "Stop. De	not do the rest	of the	task."			
			Time:_				
Com	ments:						

TANK COMMANDER'S STATION

POWER DOWN AND SECURE STATION

Nam	e:	SSN:			TM	PG	CL
Sol	dier's Position: In TC seat.						
Sco	rer's Position: In Loader's s	tation.					
Ins	tructions: "Your next task is	to power do	wn and secure	the c	omnan	der's	3
sta	tion. You must use the	If	you need assi	stance	, you	may	
Beg	in." Start time.	s? Star	t when I say	begin	• • •		
					Prompt		
Per	formance Measures:		Yes	<u>No</u>	<u>v</u>	7	<u>VP</u>
1.	Unlatch and open receiver cover	er.				_	
2.	Hold charging handle back and chamber.	look in					
						-	
3.	Let charging handle go (pull ease bolt forward).	trigger and				_	
4.	Set butterfly trigger safety	to F.				-	
5.	Close and latch receiver cover	r.				-	
6.	Press butterfly trigger to refiring pin.	lease					
						-	_
7.	Set butterfly trigger safety	to S.				-	
8.	Pull charging handle back and (barrel locking spring lug vi. 3/8 inch hole).						
	.,					-	
9.	Unscrew and remove barrel from extension.	m barrel				_	
l O .	Release charging handle and a	llow					

				Pro	mpt
		Yes	No	<u>v</u>	VP
12.	Remove 2 mounting pins.				
13.	Lift receiver from machinegun mount. (Set on turret.)			_	_
14.	Insert mounting pins back into holes in mount.				
15.	Lock elevation travel lock (ask, say he'd ask gunner).				
16.	Lock turret traverse lock (ask, say he'd ask loader).				
17.	Disconnect CVC cord from intercom box.				
18.	Close commander's hatch.				
19.	Set and hold VEHICLE MASTER POWER switch to OFF (light goes out).				
		Time:			
Comm	ents:	·			

APPENDIX D

Analysis of Variance Summary Tables for Performance Accuracy (Percent Performance Measures Passed)

Table D.1 ANOVA Summary Table for Performance Accuracy (Percent Performance Measures Passed) on Driver, Loader, and Gunner Tasks with Location, Group, Job Aid, Crew Position, and Task Within Crew Position as Factors

Source	df	MS	F
Between Subjects	53		
Location	1	6568.00	9.52*
Group	2	1100.27	1.91
Location x Group	2	279.68	<1
Subjects/Location x Group	48	576.80	<1
Within Subjects	432		
Job Aid	2	4484.35	21.08**
Crew Position	2	22172.45	104.24**
Task/Position	6	10135.82	47.65**
Aid x Position ,	4	514.50	2.42*
(Aid x Task/Position)	10	665.88	3.13**
Aid x Location	2	1281.65	6.02**
Position x Location	2	651.35	3.06*
Task/Position x Location	6	1296.68	6.10**
Aid x Position x Location	4	531.88	2.50*
(Aid x Task/Position x Location)	10	237.34	1.12
Error	384	212.71	

Partially confounded with Group
Partially confounded with Location x Group

^{*} p <.05 ** p <.01

Table D.2 ANOVA Summary Table for Performance Accuracy (Percent Performance Measures Passed) on Tank Commander Tasks With Crewmember, Group, Job Aid, and Task as Factors

Source	df	MS	F
Between Subjects	17		
Crewnember	1	2268.52	7.91**
	2	291.73	1.02
Group Crewmember x Group	2	723.59	2.52
Subjects/Crewmember x Group	12	286.70	
Within Subjects	36		
Job Aid	2	2026.87	2.94
	2	2971.92	4.31*
Task	2	47.34	< 1
(Aid x Task) * Aid x Crewmember	2	146.58	< 1
Task x Crewmember	2	46.20	< 1
(Aid x Task x Crewmember)	2	41.65	< 1
Error	24		

Partially confounded with Group
Partially confounded with Crewmember x Group

^{*} p < .05 ** p < .01

APPENDIX E

Analysis of Variance Summary Tables for Performance Accuracy (GO/NO GO)

Table E.1 ANOVA Summary Table for Performance Accuracy (GO/NO GO) on Driver, Loader, and Gunner Tasks With Location, Group, Job Aid, Crew Position, and Task Within Crew Position as Factors

Source	df	MS	F	
Between Subjects	53			
Location	1	.00	0.00	
Group	2	.31	1.94	
Location x Group	2	.04	< 1	
Subjects/Location x Group	48	.16		
Within Subjects	432			
Job Aid	2	2.31	17.04**	
Crew Position	2	6.28	46.31**	
Task/Position	6	3.33	24.54**	
Aid x Position ,	4	.10	< 1	
(Aid x Task/Position) 1	10	.34	2.49**	
Aid x Location	2	.24	1.77	
Position x Location	2	.10	< 1	
Task/Position x Location	6	.17	1.26	
Aid x Position x Location	4	.02	< 1	
(Aid x Task/Position x Location) ²	10	.34	2.54	
Error	384			

Partially confounded with Group
Partially confounded with Location x Group

** p < .01

Table E.2 ANOVA Summary Table for Performance Accuracy (GO/NO GO) on Tank Commander Tasks With Crewmember, Group, Job Aid, and Task as Factors

Source	df	MS	F
Between Subjects	17		
Crewmember	1	1.18	16.00**
Group	2	.21	2.88
Crewmember x Group	2	.16	2.12
Subjects/Crewmember x Group	12	.07	
Within Subjects	36		
Job Aid	2	.30	6.40**
Task ,	2	.69	15.80**
(Aid x Task) I	2	.05	1.00
Aid x Crewmember	2	.07	1.60
Task x Crewmember	2	.35	7.60**
(Aid x Task x Crewmember) ²	2	.32	7.00**
Error	24	.05	

Partially confounded with Group
Partially confounded with Crewmember x Group

** p < .01