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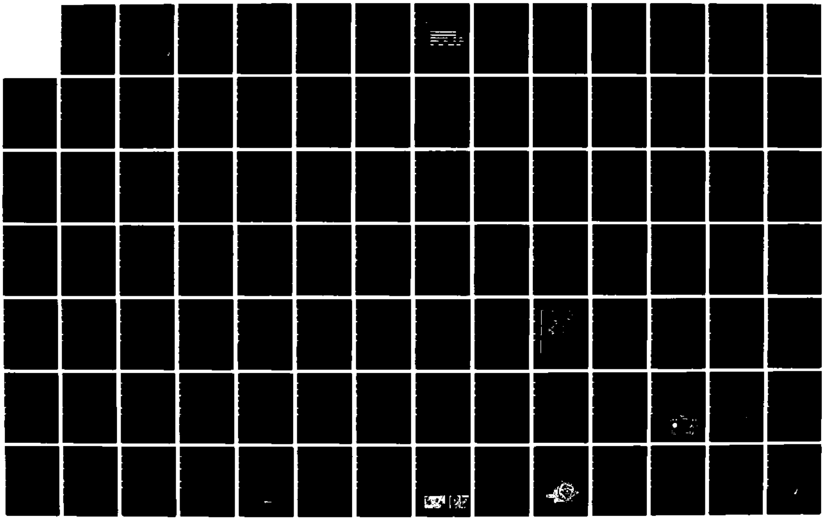

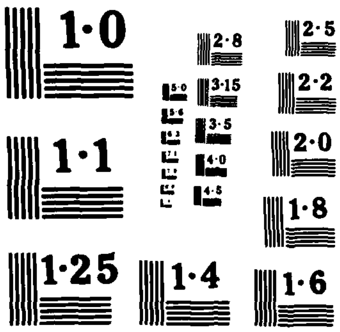
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FINAL REPORT

Title:
"A PLATO-based Test Item Bank for Army *Vehicle Mechanics (MOS63B-Series)*"

Contract Number: MDA903-83-C-0221

Date: March 30, 1984

Project Manager: Stanley R. Patton, Director

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Final Report

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The report introduces the overall objectives of Phases 1 and 2, presents a series of Test Domain Specifications for identifying test items from MOS tasks, presents the prototype structures of the Test Item Bank and provides recommendations for further work. Appendices also include PLATO coding sequences for the model Test Item Bank.

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TABLE of CONTENTS

Final Report, Contract: MDA903-83-C-0221.
TITLE: "A PLATO-based Test Item Bank for Army Vehicle Mechanics"

Section 1: INTRODUCTION

The activities of this two-phased project were directed towards (1) creating a new set of criterion-referenced test items for Army Vehicle Mechanics (MOS63B series, Skill Levels 1-4), (2) development of a prototype Test Item Bank (referred to as the TIB), and (3) preliminary evaluation of the PLATO AUTHOR Language (PAL) and PLATO Learning Management (PLM) systems for use in building future TIBs.

PLATO (Programmed Logic for Automatic Teaching Operations) is a computer-based education system consisting of a Control Data PLATO terminal (display screen and keyboard) connected to a large central computer system such as the Control Data CYBER 170 or 6000 series computers. The user programs and/or replies to the screen displays by using either the keyboard or the touch panel on the screen. For most purposes, the PLATO computer system interprets only one programming language: the PLATO Author Language (PAL). The PLATO Learning Management (PLM) system is a specialized subset of the PLATO computer system and is used by authors to organize instructional materials and to manage the delivery process.

During Phase 1 of this project, a prototype TIB was configured on the PLATO, on-line system, and 40 new test items at various taxonomic levels were developed and loaded into the TIB. Contractor-revised parent MOS tasks were also loaded and attached to the test item files for reviewer reference. The PLM, on-line system was evaluated as a potential test item authoring and delivery tool.

During Phase 2 of this project, selected MOS63B tasks (at Skill Levels 1-4) were subjected to 3 levels of task analysis and revised into a form which specified the sequence of task elements, task key elements (i.e., interim standards for the task action) and task product standards. Each of the revised MOS tasks were then translated into one master test item which was, in turn, used to develop a cluster of smaller test items for the parent MOS task. A total of 530 new test items at different taxonomic levels were developed. Criterion graphics from Army technical manuals were selected and attached to the test items for Skill Levels 1 and 2.

Following content validation and revision, the test items for Skill Level 3 were loaded into a series of PLATO, on-line files, and subsequently configured for sequential and/or random call-up. Instructions to the Test Administrator were also included in these files. The prototype files were then transferred to a PLATO mainframe located at Florida State University for subsequent field try-out by the Vehicle Mechanics School (Aberdeen Proving Grounds) at a later date.

Section 2: Test Domain Specifications

In order to design valid test items it is important to use two tools. First, a task analysis model which specifies the content of a job through successive approximations. And, second, use of a Table of Test Item Specifications which helps in identifying specific test items which need to be developed for specific task content. In this report, several Tables of Specifications in combination with task analytic data are provided as means of explaining how specific test items for specific task content were identified and developed.

A Table of General Specifications for Army Vehicle Mechanics, in the form of a two-dimensional matrix, is shown on page 5. It can be seen, in this introductory table, that job content for the MOS is listed down the left column, and is broken down into tasks per skill level. Also, along the horizontal row, the kinds of mechanic performances desired during testing and/or training are listed. The intersection of each performance (P) with each content area (C) results in a chart composed of P X C, or "n" performance-content cells. If a cell is filled then test items for that cell are considered for development. If a cell is empty then the specific performance for that particular task content is either not appropriate or is not an objective of testing.

It can be seen that the majority of MOS63B tasks fall into three domains: the cognitive, perceptual and the psychomotor domains. However, a small number of tasks from skill levels 3-4 (supervisory) may fall into the Affective Domain. (NOTE: a Summary of these domains is provided in **APPENDIX I, on pages 66-69**).

According to the original concept of Benjamin Bloom(1) and others who developed the taxonomy for the Cognitive Comain, three domains (Cognitive, Psychomotor and Affective) should be sufficient for explaining all the objectives of testing. However, Moore(2), at Educational Testing Service, felt that an additional domain was needed to supplement the other three, and in 1967 she published a taxonomy for the Perceptual Domain. It is our belief that this Domain is important in job-based testing and training, thus it has also been included.

One possible way to conceptualize MOS tasks for Army vehicle mechanics at a general level is seen in Table 1 (page 5). It can be seen that this Table incorporates tasks at four Skill Levels in each of the four domains. After

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1. Bloom, B.S. (Ed.) **Taxonomy of educational objectives: The classification of educational goals.** Handbook 1. **Cognitive domain.** New York: McKay. 1956.
2. Moore, M.R. **A proposed taxonomy of the perceptual domain and some suggested applications.** (Tech. Rep. No. TDR-67-3.) Princeton, N.J.: Educational Testing Service, August 1967.

TABLE 1. Table of General Testing Specifications for Army Vehicle Mechanics.

Explicit (solid bar) · Implicit (hatched bar)

	LEVELS of PERFORMANCE																		
	COGNITIVE				PERCEPTUAL					PSYCHOMOTOR					AFFECTIVE				
TASK CONTENT	A Knowledge	B Understanding	C Application of Knowledge	D Application of Understanding	E Sensation	F Figure Perception	G Symbol Perception	H Perception of Meaning	I Perception of Performance	J Perception	K Set	L Guided Response	M Mechanism	N Complex Response	O Receiving	P Responding	Q Valuing	R Organization	S Value Complex
Skill Level 1 Tasks	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit				Implicit	Implicit
Skill Level 2 Tasks	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit				Implicit	Implicit
Skill Level 3 Tasks	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit	Explicit				Explicit	Explicit			Explicit	Explicit	Implicit
Skill Level 4 Tasks	Explicit	Explicit	Explicit	Explicit				Explicit	Explicit				Explicit	Explicit			Explicit	Explicit	Explicit
General Training in Vehicle Mechanics	Explicit	Explicit			Explicit	Explicit	Explicit			Explicit	Explicit	Explicit	Explicit		Explicit	Explicit	Explicit	Implicit	Implicit

Skill Level 1 = E-1 to E-4
Skill Level 2 = E-5
Skill Level 3 = E-6
Skill Level 4 = E-7

NOTE: See APPENDIX I on pages 66-69 for an Explanation of the Four Domains.

viewing the task/performance cells for a particular skill level it becomes possible to identify performances in each of the domains and then design test items to measure these performances. At the least, the taxonomies should serve the purpose of giving a conceptual framework within which the kind and content of test items can be determined.

One of the primary reasons for presenting a method of conceptualizing MOS tasks in the four domains can be shown in the concept of "criterion deficiency". This concept was originally developed in the context of measuring job performance in industrial settings and refers to the failure to include important elements of the job when evaluating a person's performance. For instance, if we were to evaluate only the cognitive abilities of a vehicle mechanic at the lowest level of knowledge (see Column A), we would then have a deficient test criterion.

This concept can also be applied to evaluating the performance of Army vehicle mechanics. As one moves up the domain hierarchy, criterion deficiency becomes increasingly apparent because it is much more difficult to create test items which psychometrically assess the higher-order domain levels.

When we reviewed the most recent Skill Qualification Tests (referred to as **SQTs**) for Skill Levels 1 and 2, most of the test items emphasized the lowest levels of performance (e.g., the recall of memorized facts). Thus, we concluded that for these tests there was a significant criterion deficiency because the test items did not emphasize the Application of Knowledge and Understanding (Levels C and D) in the Cognitive Domain. Since we did not have the new SQTs for Skill Levels 3 and 4 available, no evaluation as to criterion deficiency and domain levels can be made at this time.

Thus, by displaying MOS tasks by Performance Domains, test developers should be able to specify clusters of test items more easily rather than ignoring these items entirely or hoping they will be embedded in some future OJT experience. Should the extent that this is achieved with Army vehicle mechanics, the testing program (for both training and skill qualification) should avoid problems of criterion deficiency.

Several Conclusions can be reached by studying the general specifications for test items in Table 1. One of the obvious conclusions concerns the differences in tasks per skill level. While SLs 1-2 call upon strong performances in the Cognitive, Perceptual and Psychomotor domains, SL-3 becomes stronger in the Affective domain because of greater supervisory responsibilities. And, SL-4 shows a decrease in performances at the Perceptual and Psychomotor domains, and a stronger representation in the Affective domain. These differences become apparent as the kinds of task responsibilities change from SL-1 up through to SL-4.

It can also be seen that the general training component of Army vehicle mechanics should contain test items which encompass all four domains. While specific tasks in general training vary with the level at which this training is given, some degree of proficiency in each domain is unquestionably important at each level. It is interesting to note that when one reviews the kinds of test items given in the Army Institute for Professional Development (IPD) Courses for vehicle mechanics (e.g., Subcourses HB6404-6308), the test items are concentrated at the lowest level of the Cognitive domain (see Table 3, page 18). One would think, however, with the increased body of knowledge required by mechanics that there would be a stronger emphasis of the test items in the higher levels of both the cognitive and perceptual domains.

It should be noted that a distinction is made between implicit and explicit tasks in Table 1. Most instructors in an educational environment have an explicit objective which requires a student, for example, "to develop co-operative attitudes and self reliance through problem-solving situations." However, such explicit statements from the Affective domain are not found in military training environments because of the obvious difficulty in assessing these kinds of statements.

Most military instructors, on the other hand, do have implicit objectives, especially for achievement of, at least, the **Valuing (Q)** level in the Affective domain; that is, they attempt to create in their trainees a more organized value complex toward the occupation of vehicle mechanics. At the present time, we have not found test items in the vehicle mechanic training materials which assess the affective domain, however, the future explicit consideration of such training or testing objectives might be helpful in bringing about these kinds of changes in the mechanics' job performance.

Preparing MOS Tasks for Test Item Development:

FIRST LEVEL TASK ANALYSIS

When developing test items it is important to start with valid and appropriate task content since this is the information which specifies the job, and since tasks represent the testing objectives. To accomplish the difficult job of translating tasks into test items, the contractor formed a special test item development team.

(**NOTE**: the Development Team consisted of (1) one senior instructional technologist, (2) one registered electrical engineer, (3) one mechanical engineer, (4) one senior mechanic, and (5) one word processing specialist.)

Before test items were developed, the team undertook an analysis of the existing MOS tasks. Table 2 (pages 8-9) shows how tasks for skill levels 1-4 are distributed over the responsibilities of mechanic and supervisory personnel in MOS63B. These are the tasks which are presented in the Soldier's Field Manual and represent the job content which is likely to be assessed during yearly skill qualification testing.

For skill levels 1-2, eighteen vehicle systems are listed down the left column while four vehicle weight classes are listed along the top row. A number in any one cell of the Table shows how many tasks from the Soldier's Field Manual cover that particular area. For example, under skill level 1, the cell for "Brake::1/4-ton" contains one task. In this manner, it is possible to see how the tasks are distributed over skill level per vehicle system per vehicle weight class. Since these were the tasks selected by the School for qualification testing, the team was able to see in which areas test items should be considered for development.

TABLE 2. First Level Task Analysis Showing Numbers of MOS63B Tasks by Vehicle System per Skill Level.

	Vehicle System	¼-Ton Vehicle	1¼-Ton Vehicle	2½-Ton Vehicle	5-Ton Vehicle
MOS63B Skill Level 1.	a. Axle				
	b. Body/Cab				
	c. Brake	1	1	2	3
	d. Clutch	1			
	e. Cooling	1		1	
	f. Electrical	1	1	1	3
	g. Engine				1
	h. Exhaust				
	i. Fuel	1			1
	j. General Maintenance	1			
	k. Drive Train	1			
	l. Springs/Shocks	1	1	1	1
	m. Steering				
	n. Transfer				
	o. Transmission				1
	p. Towing				3
	q. Wheel	2			1
	r. Winch/Hoist				
MOS63B Skill Level 2.	a. Axle				1
	b. Body/Cab				
	c. Brake		2		2
	d. Clutch				1
	e. Cooling				
	f. Electrical	1			
	g. Engine				1
	h. Exhaust		1		
	i. Fuel				
	j. General Maintenance		2		
	k. Drive Train		1		
	l. Springs/Shocks				2
	m. Steering				2
	n. Transfer				
	o. Transmission				
	p. Towing				
	q. Wheel				
	r. Winch/Hoist				1

TABLE 2. (Continued from page 8)

	Vehicle System	Supervise Only ---------► ¼-Ton	1¼-Ton	2½-Ton	5-Ton	Do and Supervise
MOS63B Skill Level 3.	c. Brake					1*
	d. Clutch	1				
	e. Cooling					1*
	f. Electrical					1*
	j. General Maintenance					3*
	l. Springs/Shocks					1*
	m. Steering				5	
	o. Transmission		1			
	s. Operator Maintenance					3
	t. Welding					1
	Administrative Tasks					
	u. Review Records					2
	v. Prepare Reports					2
MOS63B Skill Level 4.	u. Review Records					8
	v. Prepare Reports					2
	w. Plan/Manage Programs					2
	x. Review Requests					2
	y. Prepare/Conduct Training					2

NOTE: Tasks marked with an (*) deal with Tracked Vehicles.

Table 2 also shows how Army management views the importance of certain task areas. For example, under the cells (skill level 1) for engine, exhaust and towing there are no tasks for the 1/4-ton, the 1-1/4 ton and 2-1/2 ton vehicles. However, there are four tasks for these cells under the 5-ton vehicle. This also applies to the cells for steering, transmission and the transfer case for the 1/4-ton, the 1-1/2 ton, and the 2-1/2 ton vehicles.

Also, since test items (under the present contract) were not specified for development for those cells which are empty then it can be assumed that, at some later date, test items for these blank cells would be considered for development. In this manner, future development efforts might concentrate on only those task areas which are not now represented on the Table, thus creating a more complete test item bank.

It should be mentioned that Table 2 does not show the kind of specific content required in the test items. For example, under skill level 1, the cell for "springs/shocks" indicates there is a task at each of the four vehicle weight classes which may require test item development. One might think from the Table that a cluster of test items for the 1/4-ton vehicle would also suffice for the other three weight classes. This, however, is not the case. While the principles and theory regarding springs and shocks are constant over the four classes of vehicles, the installation and repair kinds of test items would differ greatly for each class of vehicle.

Also within each weight class (e.g., the 2-1/2 ton vehicle) there m be several different kinds of vehicles which require different kinds of ir stallation and repair actions. For example, under the 2-1/2 ton class, 6X vehicle, there are the M44A1-Series and M44A2-Series Trucks. There ar so other series of trucks in this weight class which may require different k c of job actions. Thus, great care had to be taken to make sure test items "within" a weight class were also appropriate because each series of vehicles (within a weight class) may have its own peculiar maintenance requirements.

As the development team discovered careful analysis was required when using a *Technical Manual (TM) for a particular weight* class and for a particular series (in that class) because test items for one series may not apply to another series of vehicles even though they are both in the same weight class. For this reason, it was critical to use the TM for the specific vehicle weight class and the specific series for which test items were to be developed and not a TM for a different series even though the series might be in the same weight class. This is also the reason why holding many review-revision cycles and systematic content validation sessions were needed for test item development.

SECOND LEVEL TASK ANALYSIS

During the FIRST LEVEL Task Analysis, the density of MOS tasks was analyzed according to skill level/vehicle system per weight class of vehicles. As a result of this activity, the development team was able to pinpoint specific TMs which were either already available or which needed to be obtained by the Army's project manager.

As the TMs and the vehicle course material began to arrive, these materials were organized according to Table 2. Also specific, non-wheeled vehicle tasks, e.g., electrical generators and track vehicles, were deleted from the master task list provided by the Army since item development for this kind of equipment had been deleted from MOS63B. At this point, the development team was ready to begin the SECOND LEVEL Task Analysis which is shown in Figure 1 below.

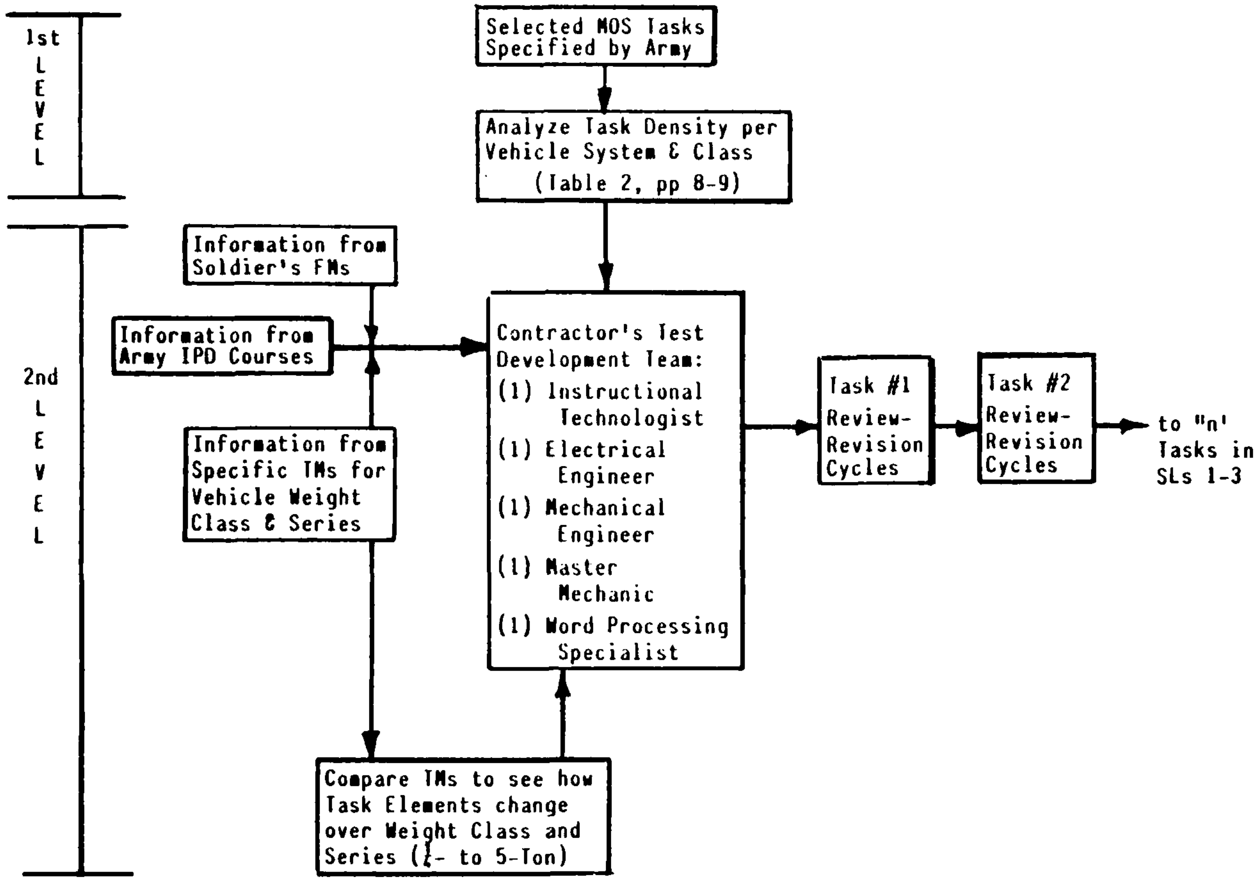


Figure 1. Schematic showing 1st and 2nd Levels of Task Analysis required to improve task content and format before test item development could be undertaken.

There are several reasons why the development team systematically studied each task before attempting to write test items, and why it was determined that many tasks (at SLs 1-3) would have to be reformatted and/or revised in order for test items to be developed.

1st. Since each MOS task is a specific testing objective, the task content will directly determine the content and validity levels of the test items. If the task content is not clear, is inadequate, or is incorrect then through the translation process, unclear, inadequate, or incorrect test items will result.

2nd. If each task is not accompanied by a list of elements, key elements, contingency actions, and a specific set of measurable standards then it can be expected that the quality of test items will suffer since these parts are used to build test items.

3rd. And, it is important to compare each task's content (as given in the Soldier's FM) to the procedural steps presented in the various TMs so that the incorrect options which are included under each multiple-choice test item will be both reasonable and realistic in terms of errors that commonly occur on the job.

It is important at this point to look at how tasks are formatted in the Soldier's FMs so the reader will see why a second level task analysis was necessary before test item development could be undertaken. A typical example of an MOS task for skill level 1 is shown below:

091-499-1017

REPLACE FRONT WHEEL BEARING

CONDITIONS: Task will be performed in a maintenance shop or field environment with supervision.
Equipment required: Toolkit, general mechanic's; bearing puller; replacement bearings; cups; M151 series vehicle; and TM 9-2320-218-20.
NOTE: The vehicle must be placed on a jack stand and one front tire and wheel removed prior to performing this task.

STANDARD: You must, within 1-hour and 15-minutes, replace the front wheel bearings in accordance with the technical manual.

PERFORMANCE MEASURES:
1. Remove front wheel bearings.
   a. Remove spindle and wheel drive flange.
   b. Remove outer seal and bearing cup.
   c. Remove outer bearing cone.
   d. Remove inner seal, bearing, and cone.
2. Replace seals, bearings and cups.
3. Reassemble in reverse order of removal.

REFERENCES: TM 9-2320-218-20, Truck, Utility, 1/4-ton, 4X4, Chap 2, sec XIX, para 2-138 to 2-142,

STUDY AIDS: Army Correspondence Course(s): HB6306-Wheeled Vehicle Drive Lines, Axles and Suspension Systems.

SOURCE: FM 9-63B1/2, January 1981, page 2-14

When the development team began to analyze the tasks selected for test development several suggestions were offered for improvement of the task content. These suggestions are listed below for the sample task on page 12:

1st. Task action: "Replace Front Wheel Bearing" is a single overt action which is observable and measurable. The action is acceptable for test item development as it stands.

2nd. Task conditions: Appear to be complete and acceptable.

3rd. Task standards: Although "time" is one possible product standard for the task action, there are other, more critical standards, such as, accuracy (tightness of bearings, correct placement of the bearing tapers, etc.) and quality of performance. These standards are perhaps more important than a standard of time. The standard: "...replace front wheel bearings in accordance with the TM" may be appropriate if the TM content is accurate and complete. As it stands, these standards need to be revised for use at the taxonomic Level-3 (Application).

4th. Performance measures: To be a statement of performance there must be at least one action, a set of conditions and one set of standards (for accuracy, quality, quantity or some combination of these). Thus, the statements listed as performance measures need to be entirely rewritten.

Also, as the master mechanic pointed out, three statements under item 1, as well as, item 2 are incorrect. They should read:

PERFORMANCE MEASURES (as stated under original Task, page 12)	PERFORMANCE MEASURES (corrected content shown in BOLD TYPE)
1. Remove front wheel bearings.	1. (content is correct)
a. Remove spindle and wheel drive flange.	a. (content is correct)
b. Remove outer seal and bearing cup. ---►	**b. Remove outer seal and bearing cone.**
c. Remove outer bearing cone.------------►	**c. Remove outer bearing cup.**
d. Remove outer bearing cone.------------►	**d. Remove inner seal, bearing cone and cup.**
2. Replace seals, bearings and cups.-------►	**2. Replace cups, cones and seals.**
3. Reassemble in reverse order	3. (content is correct)
	4. (Should Add: Adjust Tightness of Bearings.)

It was also pointed out that SL-1 mechanics do not just remove and replace bearings, they must also adjust the new bearings using a torque wrench to 30-lbs/ft after the new bearings have been installed. If the standard under the task action had been more complete, the bearing adjustment action would have been identified and included as an important performance measure. As they stand in the Soldier's FM, the performance measures are incomplete and inaccurate (see PM #1b, c and d, and PM #2). A suggested format for improved Performance Measures is shown below. (NOTE: each improved PM below contains (a) an interim action, (b) a smaller set of conditions, and (c) one or two interim standards for the action.)

Original Performance Measures as stated in FM 9-63B1/2, page 2-14.

(for TASK: Replace Front Wheel Bearings/901-499-1017)

1. Remove front wheel bearings. (see page 12)
   a. Remove spindle and wheel drive flange.

Improved PM:

(1a.1) The wheel nut and lifting eye will be removed BEFORE the front of vehicle is placed on jack stands, then the wheel will be removed.

(1a.2) If the wheel can not be removed, retract brake shoes by backing off on the adjusting screws, then remove the wheel and spindle.

(1a.3) The wheel drive flange will be removed by FIRST disconnecting the U-joint then moving the drive shaft out of the way.

1. Remove front wheel bearings. (see page 12)
   b. Remove outer seal and bearing cup.

Improved PM:

(1b.) The outer seal will be removed by prying off both the seal and retainer, then a puller will be used to remove the bearing cone.

1. Remove front wheel bearings. (see page 12)
   c. Remove outer bearing cone.

Improved PM:

(1c.1) A brass drift and hammer will be used to knock out the outer bearing cup so that no dents or creases will be placed in the cup.

(1c.2) The spindle and bore shafts will be cleaned of all dirt and debris using solvent 1.X5.

5th. Since the task key elements (e.g., the interim standards for the task action) are not given in the Soldier's FM, one must go to the relevant TM (9-2320-218-20, pages 2-183 to 2-187) to locate the key elements since these are important statements which can be translated into Levels C and D test items. *If one studies the relevant TM content, it will be noted that many* of the key elements may be missing or are not stated as interim standards for the task action. Thus, an engineer or master mechanic is needed to identify these interim standards. (NOTE: the improved PMs shown above are written in the form of task key elements.)

6th. It was also pointed out that none of the tasks in the Soldier's FMs and rarely in the associated TMs contained contingency actions which, if not performed, could prevent the task from being completed. For example, what does the mechanic do if the spindle can not be removed during the task: "Replace front wheel bearing?"

In this case, the mechanic must **retract the brake shoes by backing off the adjusting screws.** This then will allow the mechanic to continue on with the task steps as outlined in the TM. And, after the new bearings and brake drum have been installed on the spindle, the **brake shoes must be readjusted.** This may not seem to be key information to the casual observer (since it is not provided in the TM), however, to the mechanic struggling with a spindle that can not be removed because the brake shoes are jammed tight against the drum, the information is important. Since contingency actions can prevent a task from being completed, the team felt it was important to add these actions to the parent tasks, especially since they may give rise to new test items.

Using the foregoing 6 points, the development team revised 18 of the selected 27 tasks for skill level 1, and 10 of the 21 selected tasks for skill level 2 before undertaking test item development. During this "task revision" activity, it was noted that (in some cases) the TM content was unclear or incomplete. Thus, for these tasks, the development team convened a conference at a large, nearby county fire department which had most of the identical vehicles (from 1/4-ton through 5-ton) and a different set of TMs than those provided by the Army.

For each task in question, the team (along with the fire department's chief mechanic) went through both sets of TMs, and the actual truck component for which the task (in question) applied. In this manner, the team was able to identify which task and TM content had to be revised, corrected and/or deleted. It was especially helpful for the team to have vehicles available which could be compared to the graphics in the TMs, especially since many of the graphics are either unclear or do not show the task element under consideration.

Using these field experiences and by closely scrutinizing each of the selected MOS tasks, the development team was able to revise and/or rewrite all those tasks which were inadequate or incomplete in the Soldier's FMs.

(NOTE: see **APPENDIX II**, pages 70-72, for an example of the revised task: Replace Front Wheel Bearing.)

THIRD LEVEL TASK ANALYSIS

After all the selected tasks had been analyzed for completeness and accuracy and after specific tasks were revised per the completeness/accuracy criteria, the development team undertook a THIRD LEVEL of Task Analysis shown in Figure 2, page 17. There were two objectives to be achieved during this level of task analysis:

1st OBJECTIVE: to review the kinds and levels of performance of the existing test items in the Army IPD Courses and the Skill Qualification Tests (SQTs). This also included seeing how much of each task was represented in the test items (see Figure 2, page 17, left-hand box under 3rd Level). Examples of data from this objective are shown in Table 3 (page 18), and Table 4 (page 19).

2nd OBJECTIVE: to specify the content and number of new test items which need to be developed for the selected tasks at skill levels 1-4 (see Figure 2, page 17, right-hand box under 3rd Level). Examples of data from this objective are shown in Tables 5 (page 21), 6 (page 25), 7 (page 27) and 8 (page 28).

During the 1st Objective, the development team wanted to determine the kinds of test items which had been developed for the Army IPD courses. Referring to Table 2 (page 8), it can be seen (for skill level 1) that there are 7 MOS tasks centered around the Brake System ("c") and 4 tasks for the Springs/Shocks System ("I"). Since these two vehicle systems show the greatest task density, the team wanted to examine the Army IPD courses for these systems so the level of test items per task could be determined. Table 3 (page 18) shows the distribution and testing level emphasis by subject matter for these two courses (suspension and braking).

It is apparent from Table 3 that while there is a complete coverage of the subject matter by "test items for knowledge" (58 items), there is very little coverage at the understanding level (7 items), and no coverage at any of the other levels. This table shows what typically happens in many courses; that there is the tendency to write all the items at the knowledge level because these are the simplest to develop and to neglect test items at the other performance levels (e.g., the Application of Knowledge and Understanding) which are much more difficult to develop. Thus, a Table of Specifications is useful in showing where there is adequate test item coverage of content per Domain levels.

Turning our attention to Table 4 (page 19), we can see the emphasis of testing per task by Domain level for two recent SQTs (1982) developed by the Army School at APG. In these cases, both SQTs show a greater testing emphasis at the Level B (52 items) and Level C (7 items) than what was observed in the Army IPD Courses. Even though the objective of the written component of SQTs is to assess the application of both knowledge and under-

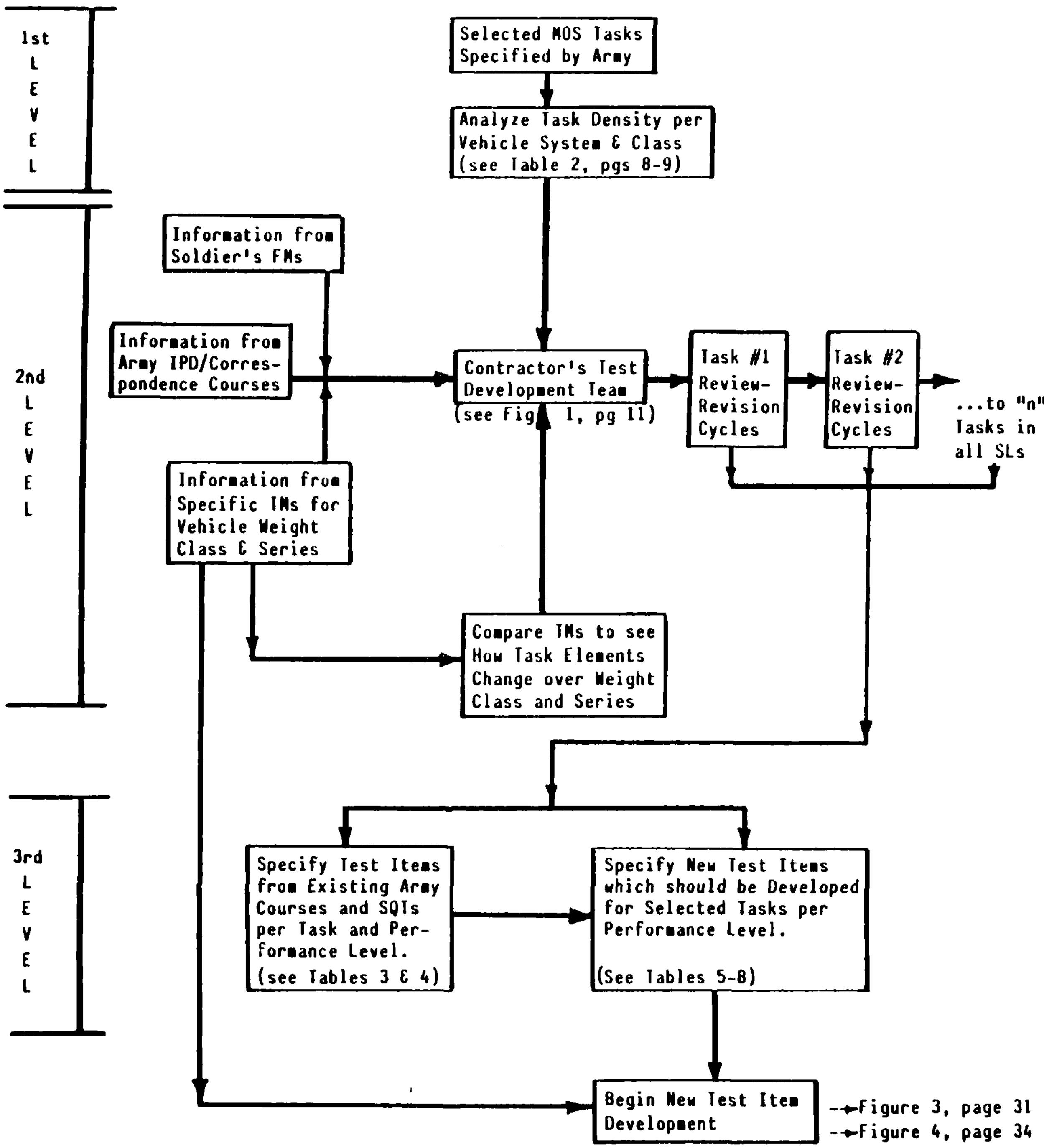


Figure 2. Schematic showing three levels of task analysis prior to new test item development.

TABLE 3. Table of Specifications for Army Correspondence/IPD Courses in Suspension & Braking Systems Showing Number of Test Items by Course Content and Performance Level.

Course Content	LEVEL of PERFORMANCES														Source
	COGNITIVE				PERCEPTUAL					PSYCHOMOTOR					
	Knowledge A	Understanding B	Application of Knowledge C	Application of Understanding D	Sensation E	Figure Perception F	Symbol Perception G	Perception of Meaning H	Perception of Performance I	Perception J	Set K	Guided Response L	Mechanism M	Complex Response N	
I. Chassis & Suspension															SOURCE: IPD Subcourse, HB6306, Edition 5: Wheeled Vehicle Drive Lines, Axles and Suspension Systems.
A. Fundamentals:															
1. Frames, Springs and Shocks	9	2													
2. Drivelines and Axles	12	2													
B. Operating Principles:															
1. Steering Mechanisms	3														
2. Stabilizer Principles	7														
C. Service & Repair:															
1. Diagnosis	1														
2. Tool Usage	1														
3. Steering	1														
II. Braking Systems															SOURCE: IPD Subcourse, HB6308, Ed. 5: Principles of Wheeled Vehicle Braking Systems.
A. Fundamentals:															
1. Drums & Shoes	3														
2. Disc	2														
3. Hydraulic	5														
B. Operating Principles:															
1. Pressures, Mechanical & Hydraulic	6														
2. Friction Coefficients	2														
C. Service & Repair:															
1. Diagnosis of Trouble and Adjustments		3													
2. Drum, Line and Cylinder Repair	4														
3. Tool & Equipment Usage	2														
TOTAL TEST ITEMS	58	7	0	0	0	0	0	0	0	0	0	0	0	0	

TABLE 4. Table of Specifications for SQTest (Written Component) Showing Number of Test Items by Task and Performance Level.

	Levels of Performance			
	COGNITIVE			
	Knowledge A	Understanding B	Application of Knowledge C	Application of Understanding D
TASK CONTENT for Skill Level 1. (SQT for Mar-82 to Nov-82)				
Task #1. Replace Front Wheel Bearings	1	3		
Task #2. Replace Master Cylinder	2	4		
Task #3. Replace Ball Joints	1	3	1	
Task #4. Replace Front Springs	2	3	1	
Task #5. Replace Wheel Cylinder		3		
Task #6. Replace Hydraulic Master Cylinder		2	1	
Task #7. Tow Disabled Vehicle with 5-Ton Wrecker	1	4		
Task #8. Troubleshoot Electrical Systems Malfunctions	4	1		
Task #9. Troubleshoot Fuel System Malfunctions		4		
TOTAL TEST ITEMS for Skill Level 1.	11	27	3	0
TASK CONTENT for Skill Level 2. (SQT for Mar-82 to Nov-82)				
Task #1. Troubleshoot Fuel System Malfunctions	1	2	1	
Task #2. Troubleshoot Clutch Malfunctions		6		
Task #3. Troublshoot Steering System Malfunctions		7	1	
Task #4. Troubleshoot Suspension System Malfunctions	1	1	1	
Task #5. Adjust Governor Control Assembly	1	2		
Task #6. Replace Master Cylinder		8	1	
TOTAL TEST ITEMS for Skill Level 2.	3	26	4	0
TOTAL TEST ITEMS FOR BOTH SQTs (SLs 1+2)	14	52	7	0

NOTE: Since none of the SQTs items were written at the other three Performance Domains these Domains have not been included in the above Table.

standing, Table 4 shows there are relatively few test items (10%) at the Application of Knowledge Level (C) and no items at the Application of Understanding Level (D). Thus, we can see that the greatest emphasis of testing for these recent versions of SQTs is at the Knowledge (19%) and Understanding Levels (71%), that is, 90% of the total test items assess the lowest levels of the Cognitive Domain.

It should be suggested that if the SQTs for SLs 1-2 are revised in the future they might contain test items which evaluate Levels C, D, H and I, and not emphasize Levels A and B as they now do. In this manner, the application of higher-order job skills could be assessed. And this, in turn, could impact the content of training in a positive way.
(NOTE: During the period of this contract, the SQTs for Skill Levels 3 and 4 were not available to the contractor. Thus, no specification data for these skill levels are provided in this report.)

The second objective under this level of task analysis was directed towards specifying the content and emphasis of new test items which needed to be developed for selected tasks at the four skill levels. While the information from Tables 3 and 4 give an indication as to the level of testing emphasized by the Army in this MOS, the information from this second objective provided more specific information for actual test item development.

An example of this level of task analysis can be seen in Table 5 (see page 21). This is a Table of Specifications for the Army IPD course in vehicle steering systems (IPD Subcourse HB6307) and is given as an example because it covers 8 MOS tasks from SL 1-3 which were specified by the Army for new test item development. The subject matter of the course is shown down the left margin while the performance domain and levels are shown across the top of the Table. An "X" in a cell indicates that test items for a specific content by performance level already exist. For example, the "X" in cell A-1.21 designates that test items exist in the course for assessing knowledge of caster and camber. An "O" in a cell indicates that the team felt that new test items might emphasize that content and Domain level.

Looking at Table 5, one can see that the existing course test items for steering systems emphasize the knowledge level (A), however, there were a few items at the understanding level (B). Given this particular content, the development team felt that test items should be developed for the other indicated cells (see cells with a "O"). In this manner, the content and associated MOS tasks would be more thoroughly assessed, especially at the application levels (C and D), and the perceptual levels (H and I).

At this point, several sample test items are provided, to show how an item changes in content as one moves from the Knowledge Level (A) up to the Applications Levels (C-D). For example, in item 1 (page 22) for cell A-1.21 in Table 5, it can be seen that the mechanic is required to only "re-

TABLE 5. Table of Specifications for Army IPD Course (HB6307/Steering Systems) Showing Existence of Test Items by Course Content and Performance Level And Showing Where New Test Item Development Should Be Emphasized.

("X" = Test Items Exist)
("0" = Test Items Should be Developed)

	LEVEL of PERFORMANCES								
	COGNITIVE				PERCEPTUAL				
COURSE CONTENT IPD Course HB6307 (Steering Systems)	Knowledge A	Understanding B	Application of Knowledge C	Application of Understanding D	Sensation E	Figure Perception F	Symbol Perception G	Perception of Meaning H	Perception of Performance I
1.0 Steering Systems									
1.1 Functions of Steering Systems	X	0	0	0					
1.2 Geometric Principles in Steering Systems	0		0						
1.21 Camber and Caster	X	0	0	0					
1.22 Kingpin and Inclination	X	X	0	0					
1.23 Included Angle	X		0						
1.24 Toe-in and Toe-out	X		0						
1.3 Steering Linkages & Gears	X	0	0	0					
1.4 Power Steering	X	0	0	0					
2.0 Troubleshooting Steering Systems									
2.1 Troubleshooting Equipment	X		0					0	
2.2 Preliminary Checks	X	0	0	0				0	0
2.21 Air Pressure in tires		X							
2.22 Wheel bearings wear/Adjustment	X	0	0	0				0	0
2.23 Wheels for run-out	X		0					0	
2.24 Steering Knuckles and/or Ball Joints	X	0	0	0				0	0
2.25 Steering Linkage	X	0	0	0				0	0
2.26 Wheel Balance		X		0					0
2.27 Shock Absorbers & Springs	X	0		0					0
2.28 Tracking	X		0					0	
2.3 Adjustment Procedures									
2.31 Check & Adjust Caster	X	0		0				0	0
2.32 Check & Adjust Camber	X	0		0				0	0
2.33 Check Kingpin Inclination	X	0		0				0	0
2.34 Check & Adjust Toe-in	X	0		0				0	0
2.35 Check Toe-out	X	0		0				0	0

call" the specific definition of negative camber as being the inward tilt of the kingpin at the top. In **item 2**, the mechanic is required to recall the definition of steering-axis inclination as being the inward tilt of the center line of the kingpin or ball joint. In both instances, no response other than the "recall of specific information" is required.

Item 1: (see Cell A-1.21 on TABLE 5, page 21)
(Knowledge Level A)

Negative camber is the...
*a. inward tilt of the kingpin at the top
b. outward tilt of the kingpin at the top
c. forward tilf of the kingpin
d. backward tilt of the kingpin

Item 2: (see Cell A-1.22 on TABLE 5, page 21)
(Knowledge Level A)

The inward tilt of the center line of the kingpin or ball joints is called:
*a. steering axis inclination
b. included angle
c. camber
d. caster

At the Understanding Level (B) of cognition, the mechanic is expected to respond by making interpretations and translations which are in addition to the recall of specific information. In item 3 (below), the mechanic must see the similarity between the design of the front end and the geometric principles upon which this design is based. A similar understanding is required with regard to the shock absorber in item 4 (page 23).

Item 3: (see Cell B-1.21 on TABLE 5, page 21)
(Understanding Level B)

In terms of steering geometry the inward tilt of the top of the front wheel from the vertical plane is referred to as....
*a. toe-out on turns
b. positive caster
c. excess toe-in
d. negative camber

Item 4: (see Cell B-2.27 on TABLE 5, page 21)
(Understanding Level B)

When the direct-acting shock absorber is compressed or telescoped, fluid passes through the piston orifices into the upper part of the cylinder and also...

*a. out of the reservoir
b. out of the dust shield
c. into the reservoir
d. into the dust shield

At the Application of Knowledge Level (C), the mechanic is required to apply previously learned facts to eliminate the cause of tire squeal. In item 6, it is necessary to apply knowledge regarding the steering system to arrive at the correct response of disconnecting the linkage from the pitman arm. In both cases, the problems are comparatively routine.

Item 5: (see Cell C-1.3 on TABLE 5, page 21)
(Application of Knowledge Level C)

A service order states that tires squeal on turns. The condition that causes this is...

*a. incorrect toe-in
b. steering-gear center point not aligned straight ahead
c. bent steering arm
d. excessive speed

Item 6: (see Cell C-2.25 on TABLE 5, page 21)
(Application of Knowledge Level C)

With a manual steering gear, hard steering caused by trouble in the steering linkage or in the steering gear could be located by...

*a. disconnecting the steering linkage from the pitman arm
b. disconnecting the linkage at the steering knuckle
c. jacking up the front end and turning the steering wheel
d. jacking up one side of the vehicle and checking the gear

In items 7 and 8, at the Application of Understanding Level (D), the correct response requires that the mechanic understand the principles of operation of both the suspension and steering systems. In neither item would the mechanic be expected to have much experience with this type of problem before and in neither case would knowledge alone provide the correct answer. Nevertheless, with an understanding of the particular system, the mechanic should be able to arrive at the correct solution to these previously unexperienced problems (see page 24).

Item 7. (Cell D-2.31/TABLE 5)

On the type of suspension systems with a single inner support for the lower control arm, changing the length of the strut rod between the lower arm and frame changes....

*a. caster angle
b. camber angle
c. axis inclination
d. toe-out on turns

Item 8. (Cell D-2.25/TABLE 5)

In a vehicle with a manual steering gearbox, a design modification is to be made to the gear reduction ratio. The steering characteristic is desired to be slowed, thus the ratio is set at 15/1. As a check on the accuracy of this modification the steering wheel should turn, on an average, from...

a. 3 to 5 turns
*b. 4 to 6 turns
c. 5 to 7 turns
d. 5.5 to 7.5 turns

Table 5 is given as an example because it represents an IPD course which covers 6 MOS tasks specified for new test item development, and it shows the areas in which test items had already been developed (for the course). If the course content shown in the left-hand column is substituted with one of the tasks associated with this content it is now possible to determine specific new test items which need to be developed by task element per performance Domain. In this manner, we would have specifications for test development for both the course and the task.

Table 6 (page 25), shows the cells in which SQT test items already exist and the specifications for new test item development for the TASK: Troubleshoot Steering System Malfunctions (091-474-2184), Skill Level 2. In this table the number of the existing SQT items are shown in brackets. Cells with an "X" show where new test items might be developed.

One can see that in the row for "Total Existing Test Items (SQTs)", the Understanding Level (B) is represented by 8 items while the other levels show no items. Of the two Army revised SQTs this particular task showed some of the best test item content. For the "Total New Test Items" row, one can see that the team suggested 11 new test items at Level (C), 7 new items at Level (D) and possibly 5 new items at Level (I).

While Table 6 shows the item specifications for the skill level-2 task,

TABLE 6. Table of Specifications for the MOS TASK - Troubleshoot Steering System Malfunctions (091-474-2184).

[1] = Test Items Exist in SQTs
X = Test Items for Development

*TASK 091-474-2184 (Skill Level 2) (Troubleshooting Steering Systems)	LEVEL of PERFORMANCE: COGNITIVE — Knowledge A	Understanding B	Application of Knowledge C	Application of Understanding D	PERCEPTION — Sensation E	Figure Perception F	Symbol Perception G	Perception of Meaning H	Perception of Perception I
1.0 Steering Systems									
1.1 Functions of Steering Systems									
1.2 Geometric Principles									
1.21 Camber and Caster			X	X					
1.22 Kingpin and Inclination			X	X					
1.23 Included Angle									
1.24 Toe-in and Toe-out		[2]	X	X					
1.3 Steering Linkages & Gears			X						
1.4 Power Steering			X						
2.0 Troubleshooting Steering Systems									
2.1 Equipment			X						
2.2 Preliminary Checks									
2.21 Power Steering System Oil Low		[1]							
2.22 Defective Gasket & Seals (Power Steering)		[1]		X					X
2.23 Steering Gear: Loose Tie Rod		[1]	X	X					X
2.24 Steering Gear: Loose Drag Link		[1]	X	X					X
2.25 Steering Gear: Toe-in		[2]	X	X					X
2.26 Low Tire Pressure			X						
2.27 Lines & Fittings for Defects			X						X
TOTAL NEW TEST ITEMS			11	7					5
TOTAL EXISTING TEST ITEMS (SQTs)		[8]							

*SOURCE: Soldier's Field Manual, FM 9-63B1/2, January 1981, pages 2-100 to 2-101.

Table 7 (page 27) shows essentially the same task for skill level 3. However, in this Table one can see the additional responsibilities placed on the mechanic supervisor and how the test items might assess the Affective Domain (Levels R and S). As is evident, the supervisor not only deals with actual maintenance skills involved in the steering system, but also administrative and people-related skills (see Cell R-1.3, Cell S-1.4, Cell R-1.5 and Cell S-1.6/ Table 7, page 27). Thus, it can be seen from this Table that for SL-3, test items at the Affective Domain might be developed to assess these people skills. (NOTE: the development team understands the Army has recently revised the SL-3 SQTs, however, these new SQTs were not available. Thus no comparison between existing test items and areas for new test item development is presented.)

The question is: How does the information from Table 5 (page 21) relate to Tables 6 (page 25) and 7 (page 27)? It can be assumed that during training the novice mechanics must learn the applied geometric concepts underlying the operation of the front end of a vehicle, how these concepts are related to the vehicle's construction, the consequences of out-of-tolerance conditions in the front end, and how to correct such conditions. These concepts are listed down the left column under **Item 1.0** in Table 5. It can then be assumed that if novices mastered the geometric principles in steering systems (see **Item 1.2**, Table 5) they would then be able to perform certain task elements which deal with troubleshooting *steering systems, e.g., a loose tie rod, drag link,* or incorrect toe-in (see **Items 2.23** to **2.25**, Table 6, page 25). Several of these skills are also important in this task at SL-3 (see **Item 2.3**, Table 7, page 27).

Table 8 (page 28) is presented as a means of visualizing how conceptual information flows from the course content and into certain applied skills which are part of the associated tasks. For example, down the left column in Table 8, one can see the list of geometric concepts presented in the Army course on steering systems. (NOTE: these terms are keyed to the outline presented in Table 5, page 21). It is assumed that these concepts are expected to be learned by novice mechanics either during formal training or during OJT experiences in the field.

On Table 8, one can see that knowledge of positive caster (see **Item 1.21**) is critical since it becomes a basis for higher levels of task performance in the Cognitive Domain. A test item measuring this knowledge might be:

Item 9. (See Cell A-1.21, Knowledge Level A, Table 8, page 28)

Positive caster is the..

*a. backward tilt of the kingpin at the top
 b. inward tilt of the kingpin at the top
 c. outward tilt of the kingpin at the top
 d. forward tilt of the kingpin at the top

TABLE 7. Table of Specifications for the MOS TASK - Supervise Steering Assembly Maintenance: Replace Drag Link Seals and Ball Seats (091-474-3120).

X = Test Items for Development

*TASK 091-474-3120 (Skill Level 3) (Supervise Steering Assembly Maintenance/Replace Drag Link Seals and Ball Seats)

	LEVELS of PERFORMANCE									
	COGNITIVE				AFFECTIVE					
	Knowledge A	Understanding B	Application of Knowledge C	Application of Understanding D	Receiving O	Responding P	Valuing Q	Organization R	Value Complex S
1.0 Steering Systems/Supervision									
1.1 Review DA Form 2404 for noted faults			X						
1.2 Determine Necessary Tools and Equipment to Perform Task			X						
1.3 Assign Personnel to Task								X	
1.4 Insure all Safety Precautions are Met									X
1.5 Provide/Offer Assistance if Necessary								X	
1.6 Spot Check Performance in Progress									X
2.0 Supervise Steering Maintenance									
2.1 Removal of Drag Link Assembly			X						
2.11 Removal of Cotter pins/both ends			X						
2.12 Disconnecting Dust Shields			X						
2.13 Loosening Adjusting Plug/both ends			X						
2.14 Removal of drag link/both ends			X						
2.15 Removal/Discarding of Dust Shields			X						
2.16 Removal Adjusting Plug, Retainers, and Springs			X						
2.2 Installing Replacement Seats/Seats				X					
2.3 Adjusting Drag Link				X					
2.4 Reassembling Drag Link				X					
2.5 Lubricating Drag Link			X						
2.6 Inspecting Repaired Equipment				X					
2.7 Critiquing Personnel on Performance									X
2.8 Insuring DA Form 2404 is Completed			X						
2.9 Insuring all tools properly cleaned and stored			X						
2.10 Return DA Form to MP Office									
TOTAL NEW TEST ITEMS			12	4				2	3

*SOURCE: Soldier's Field Manual, FM 9-63B3, June 1981, pages 2-19 to 2-20.

TABLE 8. Table of Specifications for an Army IPD Course (HB6307)/Steering Systems as Related to Specific MOS Task Elements Showing Flow of Course Content Through Higher-Order Domain Levels.

LEVELS of PERFORMANCE			
COGNITIVE DOMAIN			
A. Knowledge	B. Understanding	C. Application of Knowlege	D. Application of Understanding
1.21 Caster	Steering Ability		
1.21 Caster Angles		Diagnosis of Steering Difficulties	Consequences of Structural Modification
1.21 Positive Caster	Roll-out on Turns	Altering Spindle Supports	
1.21 Negative Caster			
1.21 Camber	Uneven Tire Tread Wear		
1.21 Camber Angle			
1.21 Positive Camber			
1.21 Negative Camber	Inward Tilt of Front Wheels		
1.2 Steering Geometry	Centerline of Wheel and Kingping or Ball Joint		
1.22 Steering Axis Inclination	Structural Faults		Adjustments for Absorbing Suspension Shocks
1.22 Kingpins			
1.22 Ball joints		Adding or Removing Shims	
1.22 Steering Knuckle	Effect of Altering Angles		
1.23 Toe-in/Toe-out	Point of Intersection	Adjustment of Tie Rods	
2.1 Equipment			

NOTE: Refer to Table 5, page 21; Table 6, page 25; and Table 7, page 27.

Table 8 also shows that mastery of the positive caster concept (and negative caster) during training is now the basis for mastering the next higher level which deals with an understanding of roll-out on turns, as measured by the following test item:

Item 10. (See Cell B-1.21, Understanding Level B, Table 8, page 28)

Positive caster will tend to cause the vehicle to...
*a. roll-out on turns
b. lean-in on turns
c. toe-out on turns
d. bank on turns

Now for the mechanic to be able to diagnose steering difficulties at the task level (see **Item 2.2**, Table 6) and to realize why it is necessary to alter spindle supports, the mechanic must have previously mastered the concepts of positive and negative caster. An example of how this task element might be assessed is shown in the item below:

Item 11. (see C-1.21, Application of Knowledge Level C, Table 8, page 28)
The top of the front spindle support is tilted toward the rear of the vehicle to obtain...
*a. positive caster
b. negative caster
c. positive camber
d. negative camber

At the Application of Understanding the problem confronting the Skill Level-2 mechanic is one which is based upon mastery of the concepts of caster and camber, a thorough understanding of the causes of roll-out on turns and what altering the spindle supports affect. A sample item is shown below:

Item 12. (see Cell D-1.21, Application of Understanding Level C, Table 8, page 28)

On the type of suspension systems with a single inner support for the lower control arm, changing the length of the strut rod between the lower arm and frame changes....
*a. caster angle
b. camber angle
c. axis inclination
d. toe-out on turns

In this manner, Table 8 combines the basic course content (from Table 5) which must be learned in order to perform specific job elements (shown in Tables 6 and 7) which are required in MOS Tasks associated with that content. Using this kind of analysis, as shown in Table 8, allowed the test item development team the opportunity to see how concepts and principles flowed from course-to-task elements, provided a means for identifying specific areas in which test items should be developed, identified the level at which items should be written, and provided a means for checking both item content and criterion validities. Thus, using these kinds of Tables of Specifications can significantly aid test development in a positive and practical way.

The end result of the three levels of task analysis was a set of MOS Tasks which had undergone a series of intensive **review** and **revision cycles**. Figure 3 (page 31) is an overall flow diagram which shows the relationship of the starting input information (tasks selected by Army, Soldier FMs, IPD Courses and TMs) used by the development team to undertake the task analytic activities required before test item development could begin. At the point that all the motor skill tasks for Skill Levels 1-3 had undergone these cycles, the tasks were ready for translation into new test items.

(**NOTE**: the reader's attention is called to APPENDIX III, pages **73-76**, which presents the 57 MOS Tasks (Skill Levels 1- 3) selected for analytic review and revision. The cells in this Table depict the kind of activity performed by task and skill level. MOS Tasks for administrative and training functions in Skill Levels 3-4 did not undergo the revision-part of the cycles.)

It should be pointed out that the type of front-end analysis discussed in the above can consume a significant amount of project time. When reviewing the team members' time expenditures, it was seen that it required, on the average, 10.5-hours per task (3-hours per person Xs 3 specialists + 1.5-hours of word processing). This average time included, (1) initial review of task content, (2) comparing task content to TMs and IPD Course materials, (3) tracking task elements and identifying errors at the contractor's site and at the local county fire department, (4) coming to a team consensus as to how certain task key elements and contingency actions would be stated, and (5) word processing the task at least through 3, but usually 5 or 6 revisions.

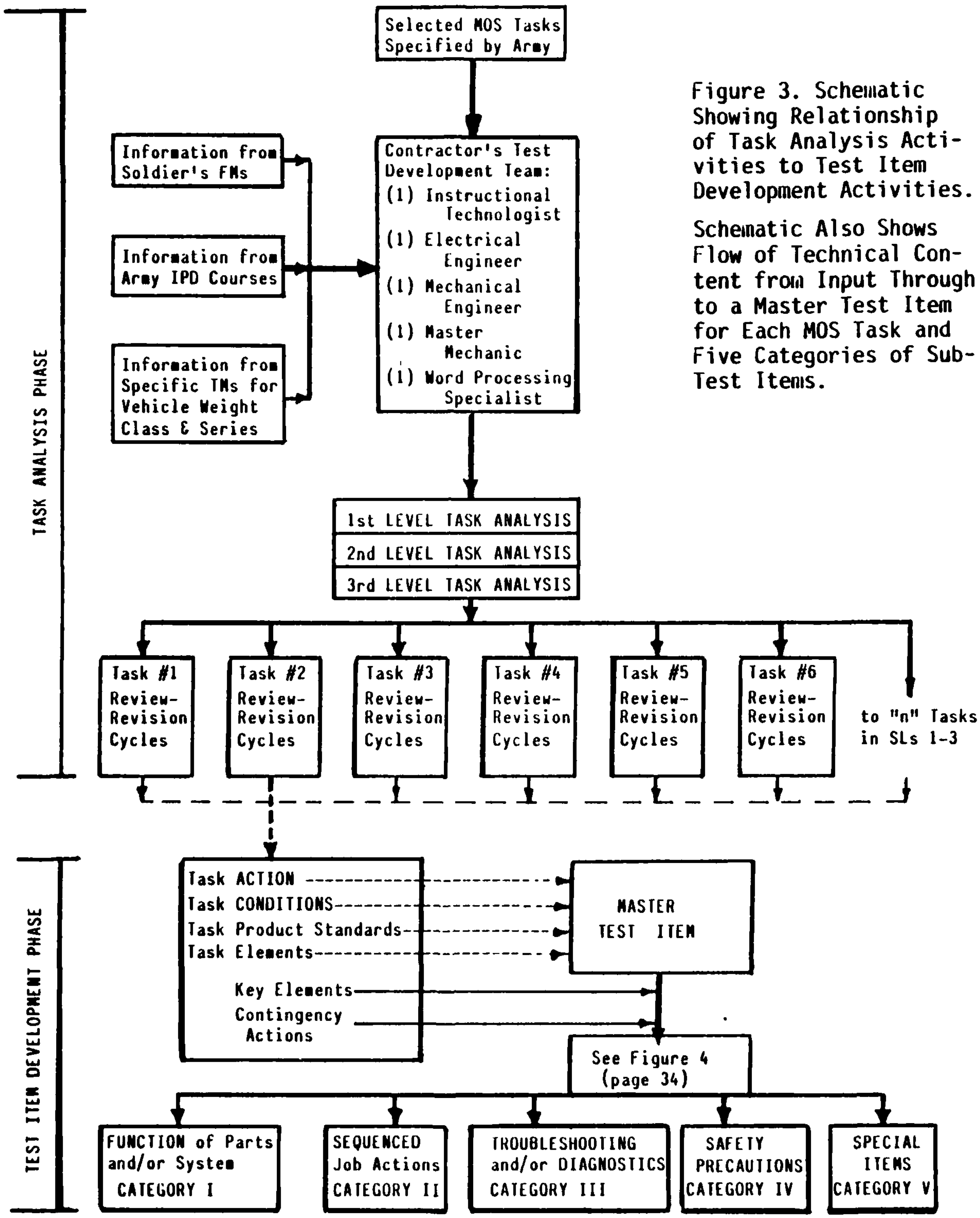


Figure 3. Schematic Showing Relationship of Task Analysis Activities to Test Item Development Activities.

Schematic Also Shows Flow of Technical Content from Input Through to a Master Test Item for Each MOS Task and Five Categories of Sub-Test Items.

Using MOS Tasks to Develop New Test Items

As each task emerged from the analysis phase, the test item development process was able to begin. Figure 3, page 31, shows how the contents of a task were used to (1st) build at least one primary master test item, then (2nd), how this content was broken down into five categories of smaller, secondary test items.

The question is: How does the process of translating task content into test item content come about? The bottom half of Figure 3 gives a general idea as to how this translation process takes place.

1st. In order to develop a Master Test item the task action, the conditions and the task product standards are used to develop the item's situation. In many cases, this is a direct translation and is probably the easiest part of item construction if the product standards are complete and accurate. If the standards only state a time limit then they should be revised to specify the quality and quantity (or some combination) of the product. Thus the standards not only can determine the scoring standards they also become the important job environment around which the item's situation is developed. This point is shown in the example below:

TASK Action: Replace front wheel bearing.

Conditions: Toolkit, bearing puller, replacement bearings, cups, M151 series (¼-Ton) vehicle and TM 9-2320-218-20.

Standards: The remounted wheel with new bearings will turn in a smooth, straight track without shimmy, wobble or scrapping sounds. The wheel will not move away from the 90-degree axis when pushed in and out at the top and bottom points of the wheel while the vehicle front is on jack stands. (Revised Task Standards)

(NOTE: The original Task Standards before revision read:
"You must, within 1-hour and 15-minutes, replace the front wheel bearings in accordance with the technical manual."
SOURCE: FM 9-63B1/2, January 1981, page 2-14)

Test Item (Troubleshooting, Level C)

Situation: It has been reported the front wheels on a 1/4-Ton vehicle wobble and shimmy. You have been directed to troubleshoot this problem.

Question: What would you do?

2nd. The task elements are then used to write the one correct answer. At this point, the Master Item essentially follows the correct sequence of actions performed on the job. This is also not overly difficult, especially if a criterion graphic accompanies the sequence of elements which has clear features to which the elements can be keyed to and matched.

3rd. Now comes the difficult part: that of configuring two or three alternative options which are incorrect but are still highly feasible and job relevant. Even though the situation, the correct answer and a criterion graphic are available, developing high quality incorrect alternatives is the most difficult and time consuming part of the operation.

We frequently observed that some vehicle equipment and/or task elements often contained specific limiting features which made any sequence of elements other than the correct sequence obvious and ludicrous to the examinee. For very simple tasks (e.g., Maintain Assigned Toolkit) it is just not possible to develop good incorrect alternatives. How does one write, for example, 3 incorrect alternatives for the action of sounding the horn? And, at other times, certain tasks were so difficult and contained so many key elements that developing three incorrect alternatives made the Master Item even more ponderous and difficult to understand even though it may have been an accurate representation of the parent task.

Keeping these points in mind, we turn our attention to Figure 4, page 34, which shows the developmental relationship between the Task-to-Master Item, and the Master-to-Secondary Test Items. In principal, this 2-level, translation model is a process of successive approximations; that is, breaking the general content level down into successively *smaller approximations* of the larger content.

There are several reasons why the development team decided to follow this 2-level breakdown process shown in Figure 4:

***1st.** The team felt that by writing a master item which encompassed all the task elements in the correct sequence and by keying this correct sequence to a criterion graphic it would then be easier to identify and write the two or three incorrect alternative sequences required in a multiple-choice item.

***2nd.** The team felt that by translating the task/TM content into a large master item and then breaking this down into a series of smaller items would, in effect, force several more chances at content validation; that is, forcing additional review and even revision of materials which were previously thought to be ready for item development. Even though this level of validation redundancy may seem excessive, the team did discover that when one tracks job content from a task and TM through to a master test item and then on through to a series of secondary items, the need for additional content revisions will surface. In fact, this happened more than once on several tasks the team felt were "perfect" and ready for the translation process. The point being that continual review and revision of the input materials is a necessary part of the test item development process!

***3rd.** The team felt that by writing a master item first would, in effect, provide a certain "mental set" and an orientation to the parent task and

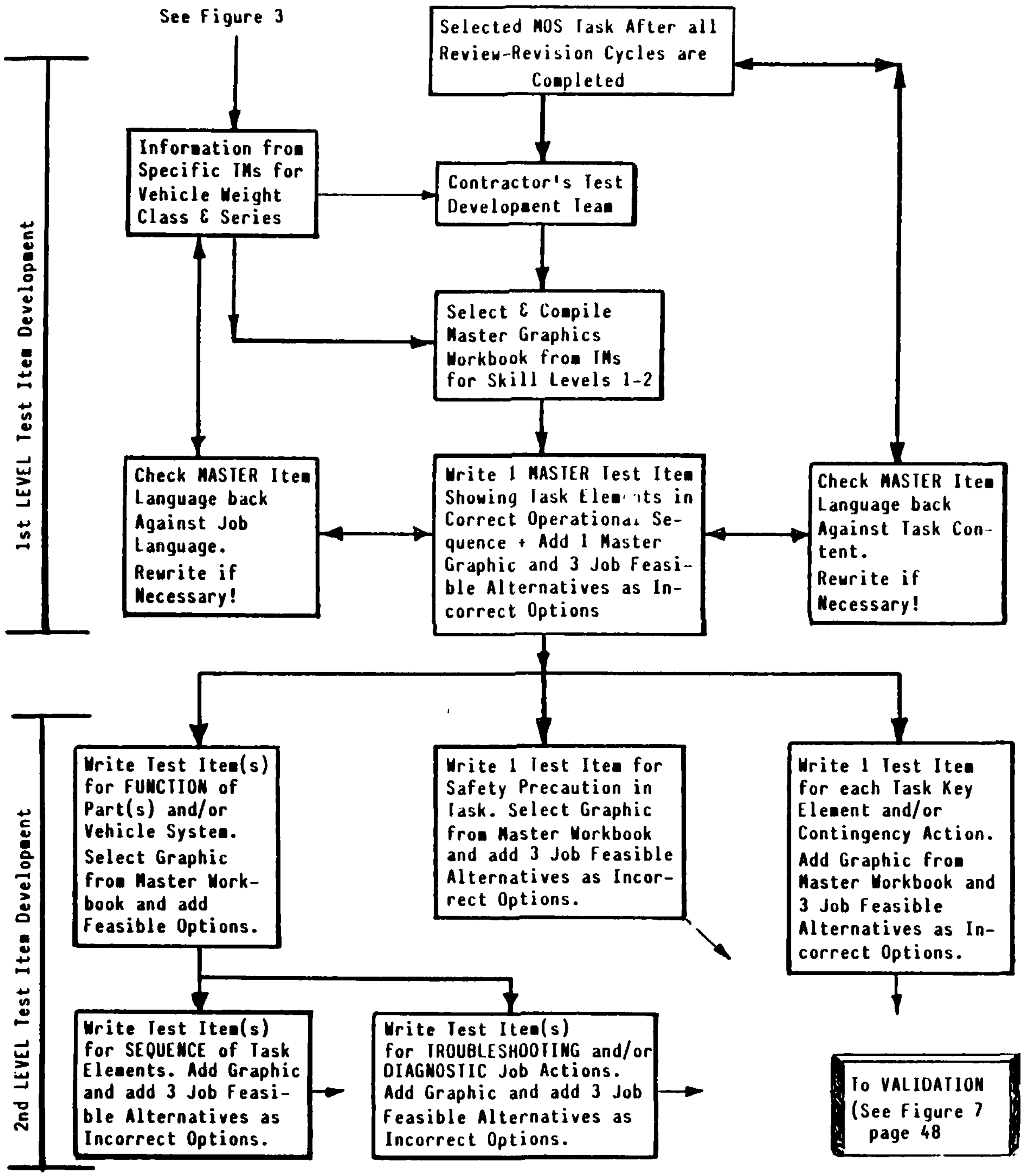


Figure 4. Schematic Showing Flow of Content from TMs and Parent Tasks into Master Test Item and into smaller, secondary test items.

this, in turn, would make the job of developing relevant incorrect alternatives for the smaller, secondary test items easier. This idea also proved to be correct.

***4th.** Since the new test items were to be based on job performance (at Levels C and D) because these are the kind of items that SQTs are supposedly based upon, and since the team wanted to focus on the reasons why vehicle mechanics cannot perform certain tasks, it was felt that starting with a master item which was then broken down into subcategories of items would make the process of identifying potentially non-mastered skills easier.

Figure 4 thus shows how each master item was broken down into test items for FUNCTION which, in turn, gave rise to items for SEQUENCE and items for TROUBLESHOOTING and/or DIAGNOSTIC actions. The Figure also shows how a specific item was developed for every SAFETY PRECAUTION, and for every Task Key Element and/or for every Task Contingency Action.

In essence then, the team hoped that by first writing a master test item, it would be easier to identify potential key elements which mechanics might fail in the job environment. These potential failure points might then be incorporated into the correct and incorrect alternatives provided in each item. Several reasons why a key job element might be failed and how these potential failure points were used by the team to develop secondary test items are listed below:

1. A mechanic might fail to perform some key element due to the inability to locate some part in the system. For example, a mechanic might fail to zero the multimeter while attempting to adjust the timing on a newly installed distributor because he does not know WHERE the correct adjustment screw is located. A test item aimed at assessing this performance would contain an actual view of the multimeter and ask the examinee to identify the adjustment screw among a variety of screws. In this case, writing three incorrect alternatives would not be overly difficult since there are several screws on the multimeter which could be reasonably selected.

2. A mechanic might fail to perform because he does not know WHEN to perform a key step in a sequence of steps. In order to assess this kind of problem, the team developed the master item around the phrase: "Which of the following steps must be performed before....?" Or, "What would you do first?" The secondary sequence items were then built around this step given as either the wrong point in a sequence of actions, or leaving the step out from an otherwise correct sequence of actions, thus making the sequence incorrect.

3. A mechanic might fail to perform because he does not know WHAT the end result of a sequence of steps should look like. For example, a mechanic who is connecting fuel lines to the fuel pump may not start the male fittings by hand (to prevent cross-threading) because he does not know what the male fittings look like. In these cases, the team attempted to locate a

graphic which contained the criterion for the correct product of the action then wrote out a description of the product which contained the discriminating cues the mechanic would normally use on the job, e.g., "...the handle is rotated until the gear is engaged".

4. A mechanic may know where and when to perform a step, and what the correct result looks like, but may fail because he does not know HOW to produce the result; that is, how to execute the correct action. For instance, the mechanic might be installing a new distributor but finds that the engine was mistakenly cranked before the distributor was installed. If the mechanic does not know HOW to crank the engine (until the notch on top of the oil pump shaft faces towards the front of the engine) then he will fail the action even though he may know where and when to perform the action.

These WHERE, WHEN, WHAT, and HOW causes of possible job failures which were used to write the Master Test Items also flowed into and became a part of the smaller, secondary items as shown in Figure 5, page 37. What is important to realize is that, in every case, the master item was used to set both the correct and incorrect sequences of task actions based upon one or a combination of the WHERE, WHEN, WHAT, and HOW factors. And, these four factors were, in turn, used to develop the smaller, secondary items for (1) FUNCTION, (2) SEQUENCE, (3) TROUBLESHOOTING and/or DIAGNOSTICS, (4) SAFETY, and (5) KEY ELEMENTS and/or CONTINGENCY ACTIONS. At the secondary level, each test item usually contained only one of the four factors and not a combination of these factors as was the case in master items.

On pages 38 to 46, the reader can see examples which show the results of the 2-level item development process. Initiating the examples is Table 9, page 38, which presents the specifications for new test item development for the TASK: Replace Mechanical Fuel Pump. The task content listed down the left column was derived from the Army IPD Course (HB6304) and TM 9-2320-218-20. It can be seen that the team recommended 7 new items at Level B and 7 items at Level C. Many of these items are provided on pages 40-46 as examples.

Figure 6, page 39, shows the translation of the item specifications from Table 9 into a schematic which shows the relationship between two Master Items and their smaller, secondary items. Here the reader can follow the breakdown process and see how the WHERE, WHEN, WHAT and HOW factors have been identified in the secondary items. The page numbers for each example set of items are given in each box for easy reference.

On pages 40 through to 46 will be found sample test items which were first specified on Table 9 and then translated into the schematic in Figure 6. Even though it is somewhat tedious to read through a set of test items, especially if one is not familiar with the task area, the sample items have been chosen to show each of the principles and concepts presented earlier in the report. (NOTE: discussion continues on page 47.)

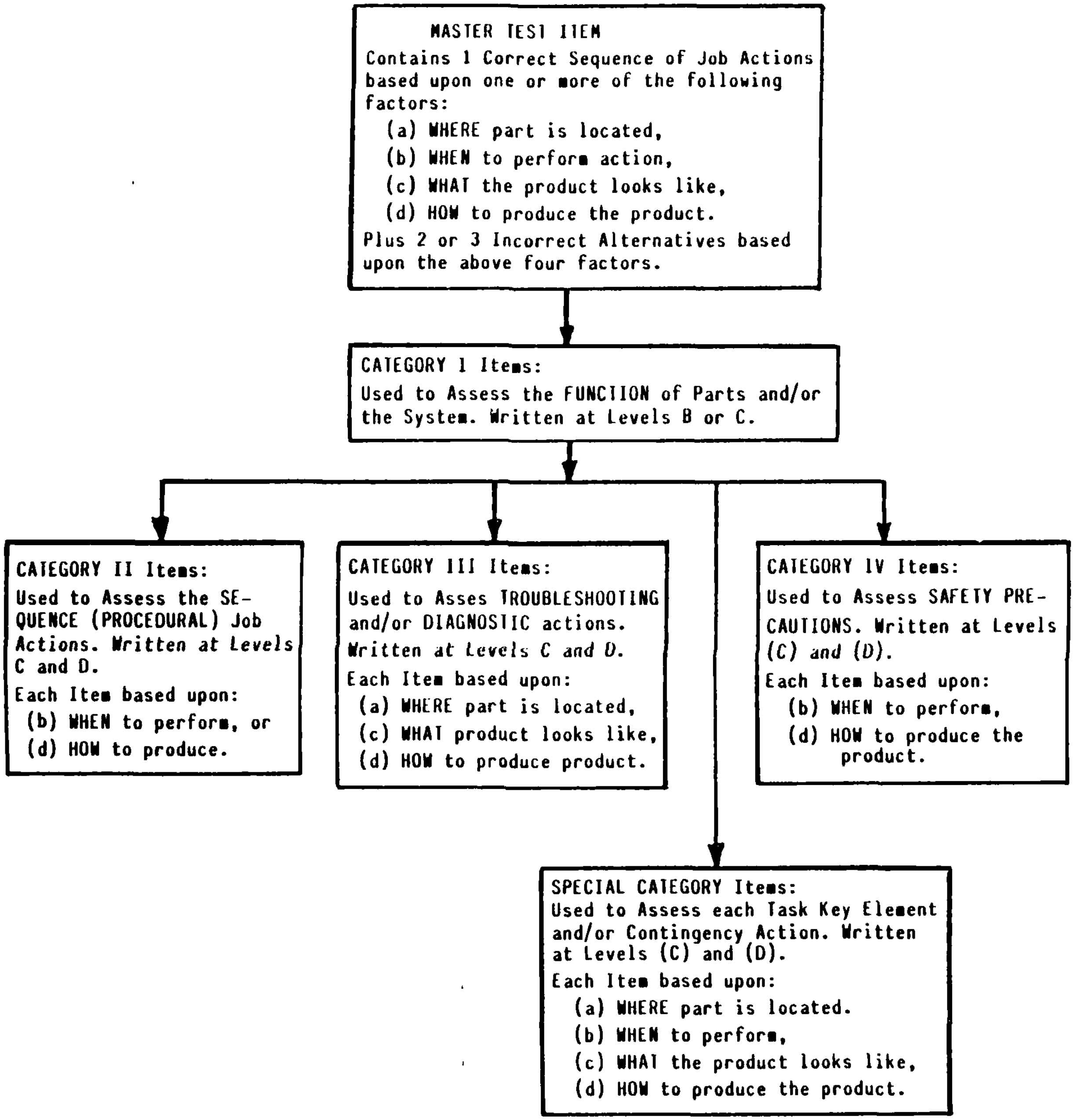


Figure 5. Schematic Showing Relationship of the Master Test Item to the smaller, Secondary Test Items.

TABLE 9. Table of Specifications for the MOS Task: Replace Mechanical Fuel Pump (¼-Ton), 091-499-1003. (FM 63B1/2, page 2-8 to 2-9).

X = Cells for New Test Item Development

TASK 091-499-1003, Skill Level 1 (Replace Mechanical Fuel Pump)	LEVEL of PERFORMANCE — COGNITIVE			
	Knowledge A	Understanding B	Application of Knowledge C	Application of Understanding D
1.0 Fuel System 1.1 Fundamental Principles				
1.11 Components		X		
1.12 Operation of Parts		X		
1.2 Differences Between Mechanical and Electrial Fuel Pumps				
2.0 Procedures to Remove 2.1 SAFETY PRECAUTIONS				
2.11 Hood Raised and Secured				
2.12 Battery Terminal (NEG) Disconnected & Taped		X		
2.13 Wheels Blocked & Parking Brake Set to FULL.				
2,2 Disconnect all Lines		X	X	
2.3 Unbolt Holding Screws				
3.0 Procedures to Replace 3.1 Clean Surfaces, Add New Gasket		X	X	
3.2 Attach All Lines, Tighten Clamps			X	
4.0 Test Pressure on New Pump 4.1 Disconnect Fuel Line, Insert Tapered End of Fuel Gage		X	X	
4.2 Start Engine, Read Pressure to 5-6 PSI			X	
4.3 Reconnect Fuel Line		X		
5.0 Troubleshooting Problems 5.1 No Fuel to Carburetor			X	
5.2 Engine Floods During Operation			X	

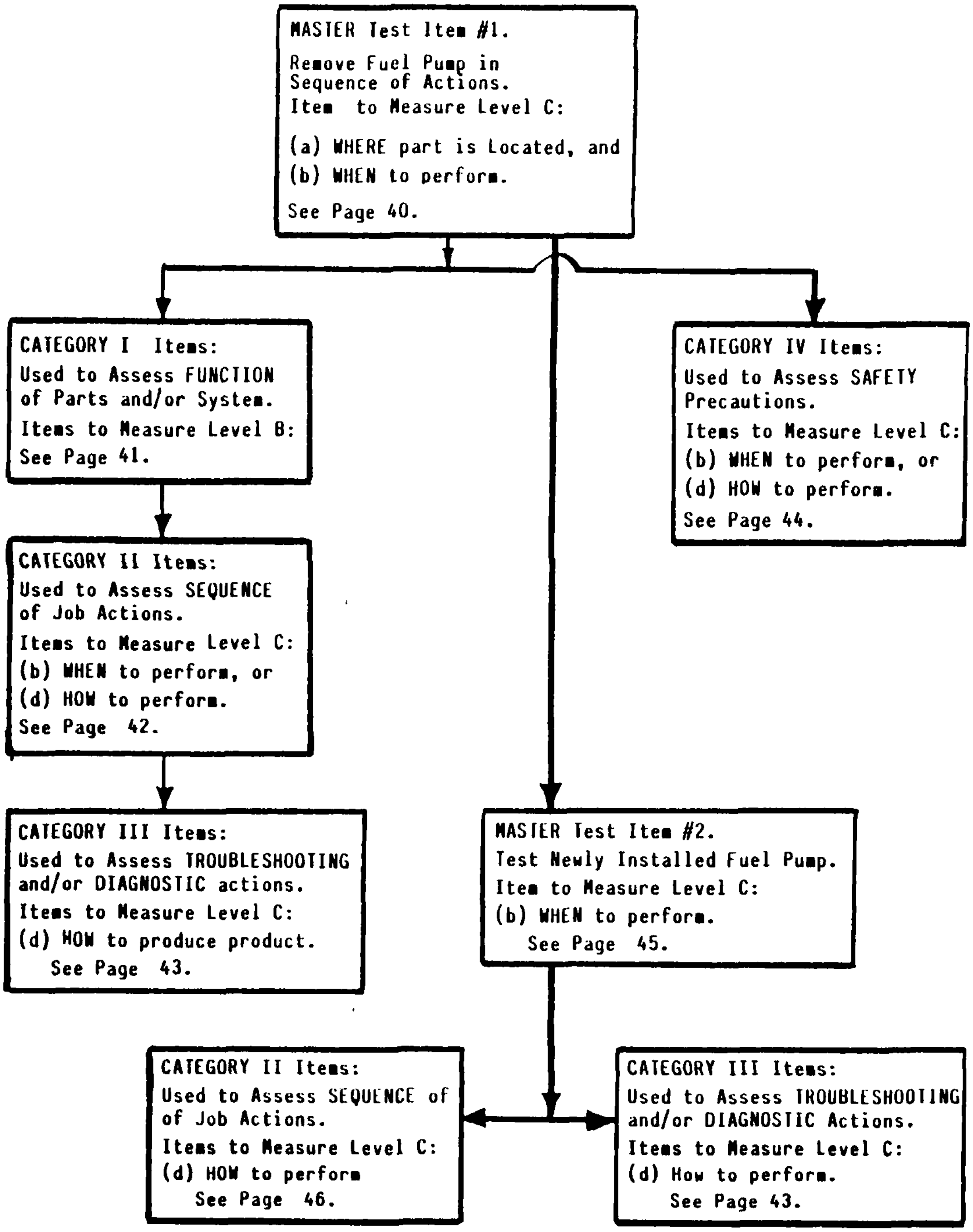


Figure 6. Schematic Showing Translation of the Table of Specifications (page 38) into Master and Secondary Test Items.

Master Test Item #1 (for Task: Replace Mechanical Fuel Pump, 091-499-1003)

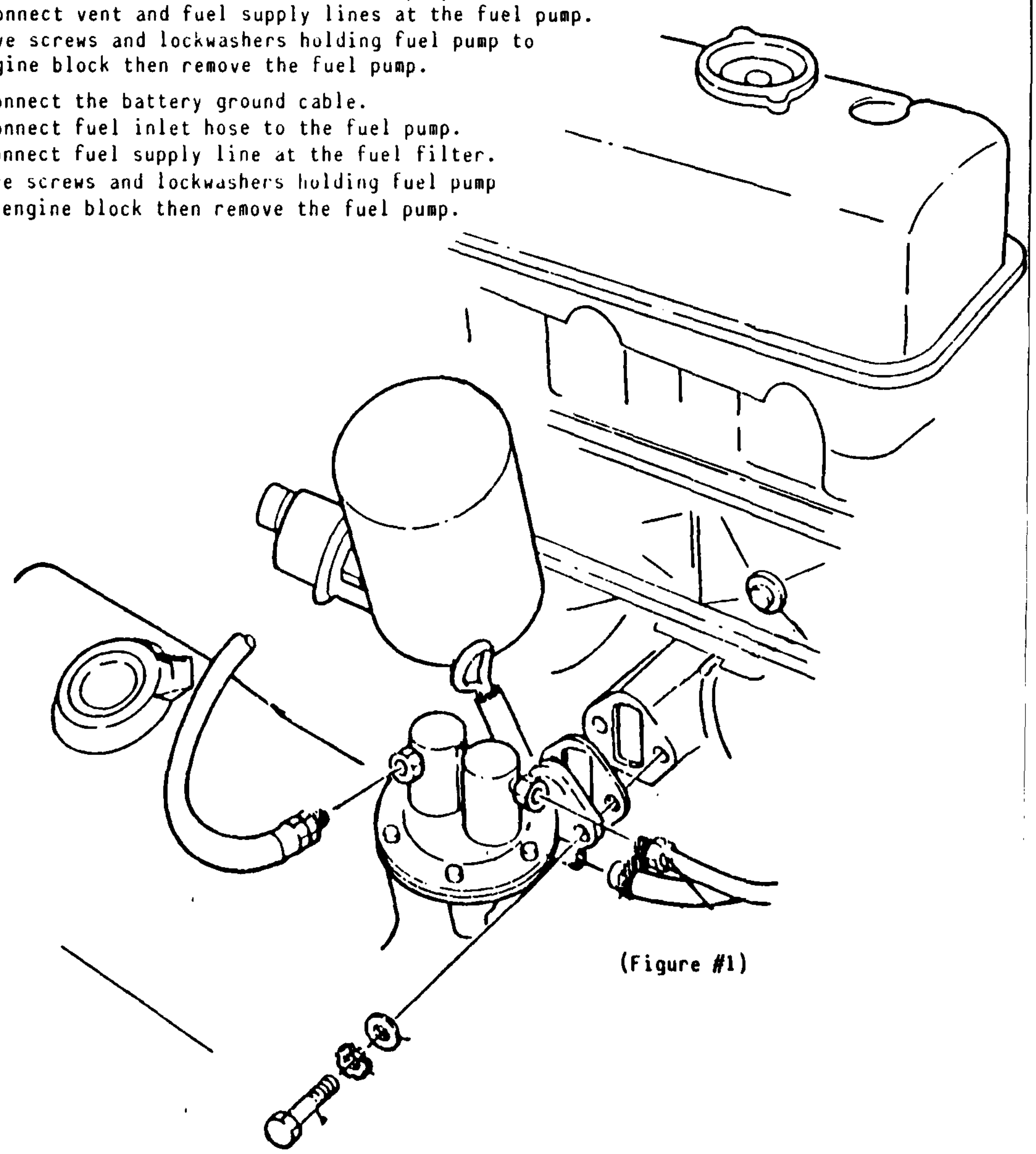
SITUATION: You are directed to replace the mechanical fuel pump on a ¼-Ton truck. The truck is parked, the engine is OFF, and the handbrake is set.

QUESTION: Which group of actions below would you follow in order to remove the fuel pump? (see figure #1)

**1. (1st) Disconnect the battery ground cable.
(2nd) Disconnect fuel inlet hose to the fuel pump.
(3rd) Disconnect vent and fuel supply lines at the fuel pump.
(4th) Remove screws and lockwashers holding fuel pump to engine block then remove the fuel pump.

2. (1st) Disconnect fuel inlet hose to the fuel pump.
(2nd) Disconnect vent and fuel supply lines at the fuel pump.
(3rd) Remove screws and lockwashers holding fuel pump to engine block then remove the fuel pump.

3. (1st) Disconnect the battery ground cable.
(2nd) Disconnect fuel inlet hose to the fuel pump.
(3rd) Disconnect fuel supply line at the fuel filter.
(4th) Remove screws and lockwashers holding fuel pump to engine block then remove the fuel pump.



(Figure #1)

CATEGORY I ITEMs to Assess FUNCTION of Parts (for Master Item #1)

#1-1. As the engine demands more fuel, the level of fuel in the carburetor reservoir drops. This lets the float valve in the carburetor open which, in turn, lets more fuel flow from the fuel pump to the carburetor.

QUESTION: How is the mechanical fuel pump driven? (NO FIGURE)

***1. By a lever riding on the engine's cam shaft lobe which moves the diaphragm in the fuel pump back and forth.**

2. By a centrifugal pump mounted on front of the engine and which is driven by the fan drive belts.

3. By a vacuum motor operated by the intake manifold's pressure.

#1-2. When the engine is idling, minimal fuel is required. The level of fuel in the carburetor will cause the needle valve to close which shuts off the fuel flow from the fuel pump.

QUESTION: Since the fuel pump is a positive displacement-type pump, what happens to the fuel as the pump continues to operate? (NO FIGURE)

***1. The fuel is re-circulated within the pump by a pressure release valve.**

2. The fuel is pumped back into the fuel tank through a pressure release valve.

3. The fuel pump's high-pressure detector causes the diaphragm to be disconnected from the actuating lever.

CATEGORY II ITEMS to Assess SEQUENCE of Actions (for Master Item #1)

#1-3. SITUATION: You have just mounted a new fuel pump on a $\frac{1}{4}$-Ton truck and are ready to connect the fuel lines to the fuel pump.

QUESTION: Which action below would you follow? (NO FIGURE)

*1. Start all male fittings by hand to prevent cross-threading.

2. Install new hoses when replacing the fuel pump.

3. Install new hose fittings when replacing the fuel pump.

4. Lubrucate male threads of hose fittings before making the connection.

#1-4. SITUATION: You have installed a new mechanical fuel pump in a $\frac{1}{4}$-Ton truck and have set-up to test the new fuel pump, however, the truck's engine will not start because there is not enough fuel in the carburetor.

QUESTION: What do you do now? (NO FIGURE)

*1. Continue cranking the engine with the starter until the pressure reading on the gage is stabilized.

2. Reconnect the fuel line to the carburetor, start the engine in order to fill the carburetor bowl with fuel, then stop the engine and continue testing.

3. Pour some fuel into the carburetor throat to run the engine long enough to test the fuel pump.

CATEGORY III ITEMS to Assess TROUBLESHOOTING Actions (for Master Items #1/#2)

#1-5. SITUATION: You have been directed to determine why the carburetor on a ¼-Ton truck does not receive fuel.

QUESTION: What would you check to isolate the cause of this problem? (NO FIGURE)

*1. Check to see if the fuel pump pressure is too low at the fuel filter.
2. Check to see if the carburetor choke valve closes fully.
3. Check to see if the carburetor float valve is stuck in the open position.
4. Check to see if the air filter on the carburetor is clogged.

#1-6. SITUATION: You have been directed to determine why the engine floods on a ¼-Ton truck.

QUESTION: What would you check to isolate the cause of this problem? (NO FIGURE)

*1. Check to see if the fuel pump pressure is too high at the fuel filter.
2. Check to see if the carburetor choke valve is stuck in the open position.
3. Check to see if the carburetor float valve is stuck in the closed position.
4. Check to see if fuel filter is clogged.

CATEGORY IV ITEMS to Assess SAFETY PRECAUTIONS (for Master Items #1/#2)

#1-7. SITUATION: You are directed to replace the mechanical fuel pump on a ¼-Ton truck. The truck is parked, the engine is off and the handbrake is set.

QUESTION: What must be disconnected before the fuel pump is removed?
(NO FIGURE)

*1. Disconnect ground cable at the battery and disconnect the fuel/vent lines at the fuel pump.

2. Disconnect ground cable at the battery and disconnect the fuel/vent lines at the fuel pump then remove fuel filter.

3. Disconnect the positive cable at the battery and disconnect the fuel/vent lines at the fuel pump.

4. Disconnect the ground cable at the frame and disconnect the fuel/vent lines at the fuel pump.

#1-8. SITUATION: You are directed to replace the mechanical fuel pump on a ¼-Ton truck.

QUESTION: Why must the ground cable at the battery be disconnected before removing the fuel pump?
(NO FIGURE)

*1. To prevent an accidental fire or explosion while the fuel system is being worked on.

2. To prevent some one from accidentally turning over the engine while the fuel system is being worked on.

3. To prevent fuel spillage from the fuel pump if the engine is accidentally turned over when the fuel line is disconnected.

MASTER Test Item #2 (for TASK: Replace Mechanical Fuel Pump, 091-499-1003)

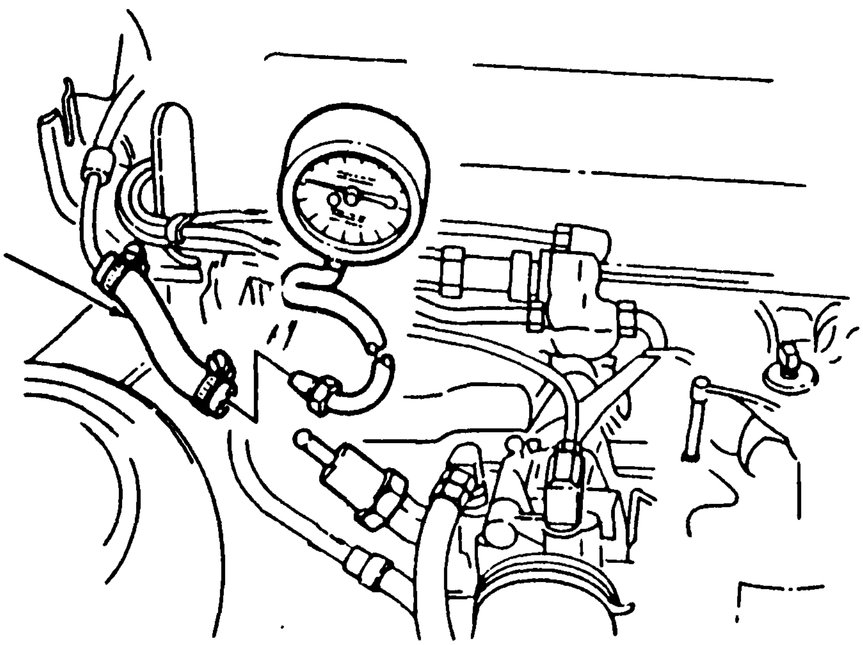
SITUATION: You have replaced the mechanical fuel pump on a ¼-Ton truck and are now ready to test the new fuel pump for pressure.

QUESTION: Which group of actions below would you follow? (see Figure #2)

*1. (1st) Disconnect the fuel line at the fuel filter.
(2nd) Insert the tapered adaptor of the fuel gage into the disconnected fuel line.
(3rd) Start the truck's engine.
(4th) The pressure gage should read 5 to 6 psi.
(5th) If pressure is correct, reconnect fuel line to fuel filter.

2. (1st) Disconnect the inlet fuel line to fuel pump.
(2nd) Insert the tapered adaptor of the fuel gage into the disconnected fuel line.
(3rd) Start the truck's engine.
(4th) The pressure gage should read 5 to 6 psi.
(5th) If pressure is correct, reconnect fuel line to fuel pump.

3. (1st) Disconnect the fuel line at the fuel filter.
(2nd) Insert the tapered adaptor of the fuel gage into the disconnected fuel line.
(3rd) Start the truck's engine.
(4th) The pressure gage should read ½ to 1 psi.
(5th) If pressure is correct, reconnect fuel line to the fuel filter.


(Figure #2)

CATEGORY II Item to Assess SEQUENCE of Job Actions (for Master Item #2)

#2-1. SITUATION: You have just mounted a new fuel pump on a ¼-Ton truck and must now connect the fuel hoses.

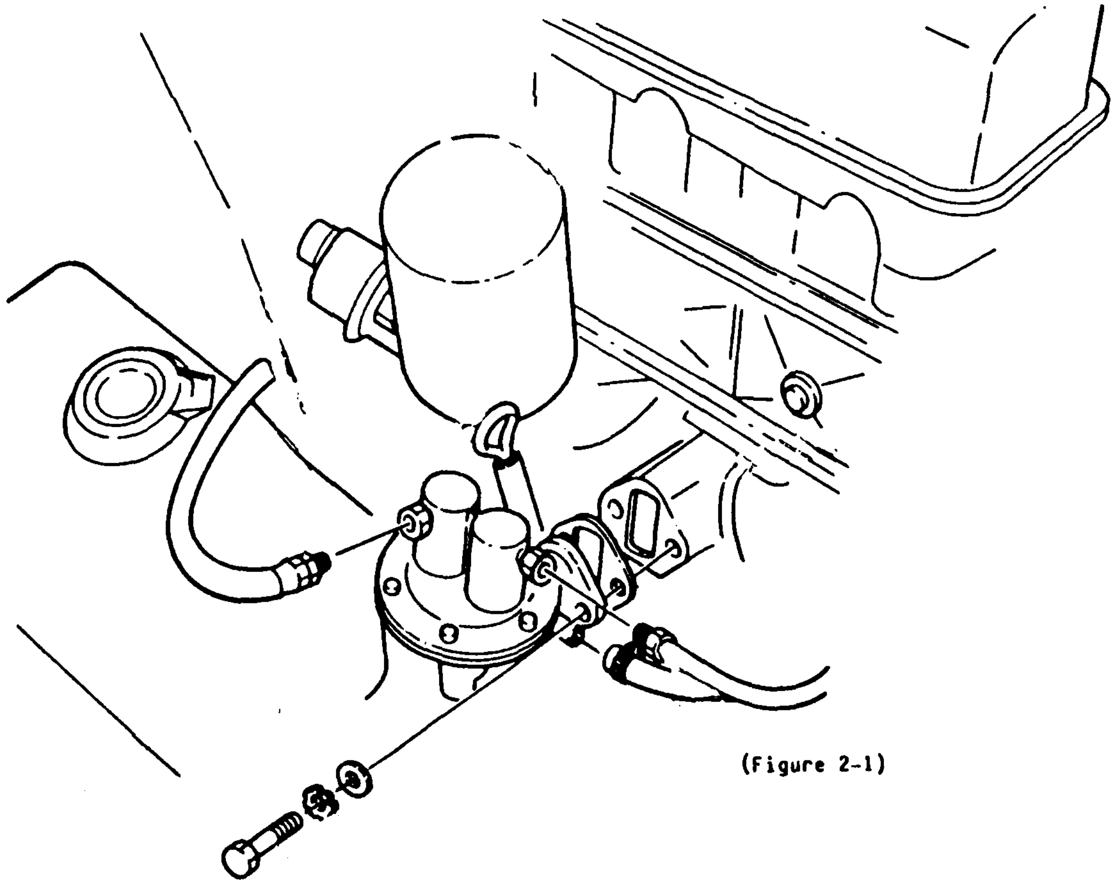
QUESTION: Which action action would you follow when connecting the fuel pump inlet hose to the fuel pump? (see Figure 2-1)

*1. Position fuel pump inlet hose to allow easy removal of oil dipstick without causing hose kink.

2. Position fuel pump inlet hose so it can be easily attached to the oil dipstick tube away from the engine.

3. Bend the oil dipstick tube enough so it will not contact the fuel pump inlet hose.

4. Install appropriate fitting on the fuel pump so inlet fuel line can be routed away from the oil dipstick tube.



(Figure 2-1)

(NOTE: The reader's attention is also called to APPENDIX IV, pages 77-102, which provides an example of a complex MOS Task translated into six Master Items and clusters of smaller secondary items.)

Content Validation of New Test Items:

The most important part of the test item development process centers around the content validation process (establishing face validity). Yet this is the phase which is usually short-changed since it is perceived as being too costly and time-consuming. Because of the team's belief that all new items should undergo a rigorous series of content validation/review-revision cycles, the team applied the following validation schedule.

Figure 7, page 48, shows the general scheme of validation used. The top of the Figure shows the starting input information (Revised MOS Tasks, Army IPD Courses, a set of Army TMs, and a local county fire department).

(NOTE: for every 6-hours spent in reviewing the MOS Task data, e.g., comparing to TMs, course content and on-site vehicle equipment checks, 3-hours were spent in revising the task content. Each MOS Task went through three major review-revision cycles. This is shown as the **1st Level** of Content Validation in Figure 7.)

Using the revised task material, the team developed one or more Master Items per task. While most tasks only required one or two Master Items, about 25% of the larger, more complicated tasks required upwards of five to six Master Items. (NOTE: the task shown in APPENDIX IV required six Master Items.)

Each Master Item underwent at least 3, in-house, review-revision cycles which involved tracking the job content from the available TMs, the course material, and the revised task content through to the Master Item content. At this point, the team forwarded the new Master Items to the Army for review of the content. The Army Subject Matter Experts (SMEs) were asked to complete a simple Reviewer's Form consisting of five questions:

1. **Should the test item's SITUATION and/or QUESTION be revised?**
   (Y) or (N) Explain if YES.

2. **Does the item's SITUATION and/or QUESTION contain definite clues to the correct answer?** (Y) or (N) Explain if YES.

3. **Is each answer realistic, pertinent and plausible?** (Y) or (N)
   Explain if NO.

4. **Does the test item clearly measure the TM content and Task Actions?**
   (Y) or (N) Explain if NO.

5. **If a graphic is used, does it match the test item?** (Y) or (N)
   Explain if NO. Attach a better graphic if you have one.

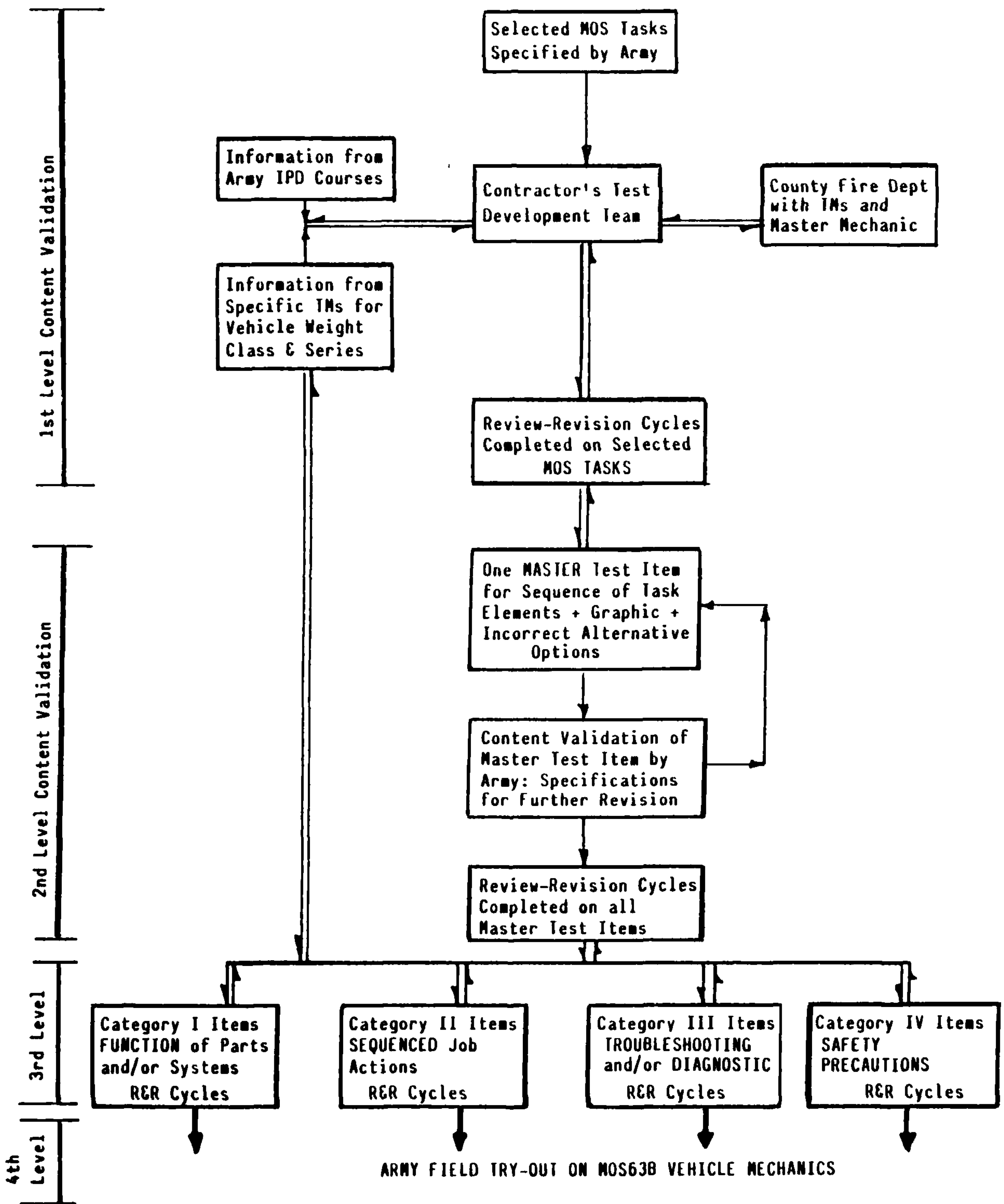


Figure 7. Schematic Showing Levels of Content Validation.

After the Master Items had been reviewed by the Army SMEs and returned to the team, it was noted that about 15% of these items required further review and revision. In these cases, the Army SMEs had identified that TM content for an incorrect series or class of vehicle was used to develop these Master Items. Since not all the TMs were available at the time of Master Item development, the Army was usually able to locate the appropriate TM content and forward it to the team. In several cases, the team adjorned to the local fire department and used either the actual equipment or a different set of TMs to correct the Master content. This part of the process constituted the **2nd Level** of Content Validation.

After each Master Item was deemed to be usable, the team began translating these items into the smaller, secondary items. Again, the content of each secondary item underwent at least two or more review and revision cycles. This is identified in Figure 7 as the **3rd Level** of Content Validation. During these tertiary cycles, the team tracked the content from the Master Item through to the individual secondary item using a "novice" (a person who had not participated in the previous task or Master Item development). The novice was able to identify secondary item content which did not match the Master or task content in less than 5% of the cases. In these cases, it was usually the task content which was not clear.

At the end of the **3rd Level**, the task content had undergone at least 3 review and/or revision cycles, the Master Items had undergone at least 3 review and/or revision cycles, and the secondary items had undergone at least 2 review and/or revision cycles. Thus, the job content and test item content sustained at least 8 different review and revision cycles through the life of the development process.

This is not to say that master engineers (two on the team) and master mechanics (one on the contractor's team and one with the fire department) and one senior instructional technologist are not able to spot content problems during the development process. It does, however, say something about the difficulty in identifying problem areas, the difficulty in coming to a consensus of agreement as to how an item should be worded, described, and portrayed by a graphic. Achieving consensus usually becomes more difficult when items are written at the higher domain levels (the Application of Knowledge and Understanding, Analysis, Synthesis and Evaluation), especially since different procedures can be used to isolate faults, to repair and to maintain vehicle equipment. Added to these kinds of problems is the fact that, on many occasions, the TM content was unclear, incomplete or somewhat incorrect.

It is believed, however, that once appropriate task product standards, key elements (interim standards for the task action) and contingency actions have been developed and agreed upon, that the problems attendant to item content validation seem to diminish. Even though the TM and course content might be deficient, the use of highly relevant job standards can ameliorate most of these problems. Thus, the lesson learned from this experience is:

content validation must be an on-going, **dynamic process** which will consume perhaps more time than the time involved in developing the original task and test item content. And, if management is not willing to expend this seemingly inordinate amount of time, then the quality of the test item products will suffer!

(**Author's NOTE**: since an American automobile undergoes at least 90 different quality control checks during production because customers will no longer tolerate equipment that does not function, it should not be too much to require task and test item content to undergo 8 quality control checks, especially since these products may be used to assess training, to assess individual job performance, and to assess overall group performance.)

Section 3: Structure of the Test Item Bank

During Phases I and II of this project there were two computer evaluation objectives:

(1) to test the feasibility of and to evaluate Control Data Corporation's (CDC) newly developed PLM (PLATO Learning Management) system for on-line development and delivery of Computer-based Testing (CBT), and....

(2) to configure an initial prototype test item bank using CDC's PLATO AUTHOR Language for on-line development and delivery of tasks and test items. In this way, test item loading, file management, test administration and delivery, test construction, and scoring routines could be evaluated by Army management at a later date. These two objectives are presented below.

Evaluation of the PLATO Learning Management (PLM) System:

In 1981, CDC announced the availability of its PLATO Learning Management (PLM) system. According to CDC, PLM was designed to solve many of *the usual CBT delivery problems associated with large scale curricula* by sequencing activities for individual students, administering placement and diagnostic tests, selecting learning resources, and keeping records of student and courseware performance (3). According to CDC, authors did not need to have programming skills in order to use the PLM system to administer tests, prescribe individualized study assignments, and to keep records.

In order to evaluate the PLM system, the contractor obtained access to PLM on its IST-II, on-line terminal, and loaded two SQTs (for SLs 1/2) which had recently (1982) been revised by the Army. What follows is a general evaluation of the (1) curriculum editor, (2) course options, and (3) module editor functions which were reviewed during Phase I of this project.

PLM contains four primary components: (1) **Curriculum** (the largest component which can hold up to 15 courses), (2) **Course** (can consist of up to 28 modules), (3) **Module** (can hold up to 30 Instructional Units, or IUs), and (4) the **Instructional Unit** (can hold 60 test items that assess a single objective).

In the PLM system there are three modes of use: (1) the **Author Mode** which allows a person to construct and revise curricula, courses, modules, IUs and test items, (2) the **Instructor Mode** which allows a person to register

3. **PLATO Learning Management: Author's Guide.** Control Data, Minneapolis, Minnesota, 1982.

students into appropriate groups, allows a person to change individual records in the PLM gradebook and to review group summary data in the form of tables and graphs, and (3) the **Student Mode** which allows a person to "sign-on" or register into a course or module. The PLM author can determine several other options which can be presented in the student mode, such as gradebook access, display of objectives and student notes.

Even though PLM is easier to use compared to programming in the PLATO AUTHOR Language (PAL), the Author's Guide is difficult to follow because of the amount of verbage and lengthy explanations that have been included. For example, an education specialist at Ft. Ord was attempting to load test items but was not able to understand the set-up instructions in the Guide. It took the contractor's team about 60-hours to figure out how to use PLM's editors and authoring options. At this point, the team was able to load Ft. Ord's items and provide instructions in how to use the authoring routines and editor functions.

The basic authoring operation on PLM is somewhat typical of other CBE authoring routines (e.g., IBM's Coursewriter and the Phoenix System). The account director (assigned by CDC) sets various authoring options and signs on the authors' names. (NOTE: see **APPENDIX V**, page **103**, for authoring operation displays.) There are ten author options which the account director can assign to an author. By entering a "yes" or "no" at each option, the author is then allowed to perform operations, such as, edit, see performance data, collect data, change scheduling options, access student gradebooks, change test locks/interruption controls, and change the off-line testing options.

Before a person can begin authoring on PLM they should be familiar with the PLM key conventions, such as, TERM, SUPER, SUB, ACCESS, FONT, TAB, CR and MICRO keys provided on all PLATO terminals. Also the novice author must learn the editing procedures available on PLM, such as, a NEXT keypress is required after entering text at an arrow prompt, the COPY key is active to copy previous text, and clearing or deleting requires pressing the SHIFT-HELP key to avoid accidental deletion of text. All together, there are **16** editing functions which are used continually during the authoring process. These functions are listed on page **104**.

After the author signs on to PLM, he/she must create four files (for curriculum, course, module and IUs, see pages **105-106**). The contractor noted that the new author must create these four files in the prescribed order, otherwise the system will not function. Even though the Author's Guide neglects to mention this requirement, one discovers quickly that if these files have not been set-up in sequential order (1st the curriculum file, 2nd the course file, and so on) the system becomes non-functional.

Also during this period when the author is setting-up the four basic files, the associated files, including the character set to be loaded, introductory lesson file and curriculum comments file must be configured.

When these associated files were being established, the team found that using the PLATO AUTHOR Language (PAL) Reference Manual was more helpful than the PLM Author's Guide.

One of the more interesting aspects of the PLM system is the ability of an author to simulate the student mode. For instance, while simulating testing, an author or instructor can select certain rules that specify what messages the student sees, as well as, what options are available to the student while taking the test. The major difficulty the team encountered was that a testing module must be verified "before" it can be simulated and the module change, inspect or use code must be "blank." This information is embedded in the Author's Guide, however, since it is easy to miss, an author must be aware of these requirements. If not, one cannot enter the simulation mode.

This concept of verifying file structures also applies to PLM's variable management strategies (VMSs). On pages 107-108, one can see the VMS selection displays. The author must enter either "verified", or "not verified" while setting up the PLM files. Again, if this is not done, the system will default. After all of the VMSs have been verified by the author in the curriculum-level files, a student will be presented with the screen information shown on page 109.

At this point, the author must set up the course hierarchy files since they are not created within a curriculum file and they are not automatically included in the VMS files. The Course Hierarchy Display the contractor's team created for the two sample Army SQTs is shown on page 109.

Another interesting feature of the PLM system is that the author can configure a Placement Testing function which an Agency's training organization might find useful. In this manner, a student's performance on a curriculum-level placement test will determine if the student will be exempted or restricted from any course in the VMS course sequence. In PLM's case, a placement test consists of either a module created specifically for this purpose, or one that already exists. The author then indicates which IUs in the module are exemption or readiness IUs. At this point, each IU is then associated with specific courses in the VMS editor. (See pages 110-111 for an example of the PLM screen format for the placement test file.)

The author can also estimate how long it will take a student to complete a course and its modules. In this manner, as various students are moving through a PLM program, the author can generate various scheduling reports which show the predicted and actual student progress. The contractor's team felt this might be a useful tool in Army testing since the on-site, test administrator could generate a screen display of examinees' progress through a test at any time. This then would give an indication to the administrator as to how the examinees are progressing and where problem areas are surfacing.

While the PLM module files are being set up, the author must remember to set the Module List Controls, such as, "Tests Taken", "Mastery Schedule", "Mastered Modules You May Review", "Modules You Can Work on Later", and "Prerequisites". The author must set these list controls at the curriculum-level, even though the Guide implies they are set at the module-level. The default values for these controls can be seen in the Guide and are not presented in this report.

One of the most important features of PLM is the system message options presented to the student. The author selects these options while setting up the curriculum and course-level files, and when selected will determine how much introductory and explanatory information students see upon entering the curriculum and during the module tests. The team felt these student feedback messages would be useful in both testing for training and for skill qualification assessment since they can provide immediate feedback as to level of mastery on testing objectives and test scoring achieved. Several examples of these options and the information presented to the student can be seen on pages 112-117.

The contractor's team discovered that one of the more difficult aspects of PLM is that system will not present a module to students if it has not been first attached to a specific course and included in a VMS. Since this requirement is not clearly spelled-out in the Guide the team was unable to present the loaded test items until the entire system was tracked back through and analyzed. Also we discovered that when each module's position is specified the letter assignment is permanent. After much searching we did discover, however, that the author can control module sequencing and hierarchy through a course-level VMS option. This process caused the team some grief since the routines are not adequately explained in the Guide.

Since the team had placed each SQT task in a module file and test items into IU files we were unable, at first, to call-up the test items on the screen. When it was learned (after some 8-hours) that PLM will not present a module (in our case, an MOS task and associated test items) to a user until the module has been first attached to a course and included in a VMS, we were then able to correct the problem.

One of the more helpful aspects of PLM is that an author can override both the test controls and text entries at the module-level without actually having to delete the entire module and having to start over again. But, one feature we did not care for centered around the fact that when overrides are in effect, the student is always presented with the override information rather than the module's actual information. It seemed to the team that this override information was really not important to the student while in the testing mode. An example of the override status display is given on page 118.

One of the most intriguing features of the system is the author's ability to enter six different types of test items (multiple-choice, true-false, matching, touch, numerical and short answer) into PLM. Also, PLM allows the author to specify off-line testing using scoring sheets and a mark-sense reader to send the student answers to the PLM system. This feature would allow the

Army to test a group of soldiers in situations where only one terminal was available. However, test items for off-line use cannot include graphics, touch areas, or numerical and short answer questions.

In the early part of Phase I, the development team set-up the four PLM files (curriculum, course, module and IUs) on the contractor's PLATO terminal. Each MOS task in the two SQTS (for SLs 1 and 2) were assigned to the module level, and each test item/task was assigned to a separate IU. Thus, the SQT for SL-1 consisted of 12 modules (1 module for each MOS task), and 66 IUs (1 IU for each test item), while the SQT for SL-2 consisted of 10 modules and 54 IUs.

Since the SQTs for SLs 1 and 2 contained graphics of vehicle parts, the team attempted to generate technical graphics on the system using the PLM graphics editor keys. There are 22 different editing commands for graphic generation, however, the team discovered that it was very difficult to develop a vehicle graphic on the system. The team tried using a Summa Graphics Bit pad and pen, but again found it was very difficult and time consuming to generate just one graphic. (NOTE: the contractor understands that CDC has recently improved graphics generation on PLM which has eliminated many of the problems we experienced during May-July, 1982.)

After all the test items from both Army SQTs were loaded, the contractor used the student simulation routines many times. Several education specialists at Ft. Ord also used the files. The following comments are provided from both the contractor's team and from Ft. Ord's education specialists:

*1. PLM should be thoroughly tested and evaluated by all the Services, since it has many beneficial features both in the delivery and administration of course and testing materials.

*2. A large Military MOS Test Item Bank (TIB) for primary storage would not be appropriate on PLM because of the highly structured file architecture which would severely limit access, editing and retrieval of test items. Test construction (de novo) would be impossible in this situation. Instead, it would be more practical to store tasks and test items in a central PLATO system and off-load specific sets of test items to the PLM system for on-site delivery and test administration. In this way, PLM could still randomize test item presentation or could provide pre-structured tests for on-site delivery.

*3. Even though the contractor's team did not observe the off-line group testing feature of PLM in action, we do believe that the Services should evaluate this format on groups of examinees, especially since this feature allows the administrator to print a test and to read in student answers by a scanner. In this manner, the off-line group testing feature would eliminate the need for students to sign on the PLM system and would eliminate the need of having one terminal per examinee. It should be possible then for the Services to administer somewhere around 150 tests/day/terminal (30 examines per 1 hour session), have the tests automatically scored, and results provided immediately to the examinees.

*4. As it presently stands, PLM is not amenable to easy generation of technical graphics. Since CDC does not provide the capability of input via a digitizing camera, all graphics must be generated by either a bit pad/pen or by the PLM graphics generator commands. Because of the time involved and because PLM does not handle complex technical graphics easily, the team felt that if graphics were required it would be more appropriate to deliver graphics via a videodisc, videotape or sound/slide which can be plugged into the RS232 jack on the terminal. In this case, an expensive software program must be purchased from CDC at a cost of $5,000.

*5. Regardless of how CDC portrays PLM as being a programmer-less system, the contractor's team felt that novice military authors would have a difficult time at becoming proficient on the PLM system in less than 1-month. Even though PLM is one of the better authoring systems, the word "authoring" is a misnomer. The specialist must still analyze, design and develop test items (and course materials) on paper first using the Military's mandated ISD-process.

What PLM does provide, however, is a somewhat easier method for entering the materials (after they have already been developed on paper) since the author does not need to use the approximately 250 codes required by the PLATO Author Language (PAL). Thus the job of entering pre-developed material into PLM is considerably easier.

In the contractor's opinion, the Services would be able to train their personnel more easily if the present PLM Guidebooks were rewritten, simplified, and reorganized for easier understanding. There are some 75 different editor and option routines which must be learned before full benefit of PLM can be achieved. To do this, Military personnel should be given specific, hands-on training in the system.

*6. One major drawback of PLM (and all CBE, course-delivery systems) is the fact that the author is obligated to use the system's structure of files, menus, presentation routines and formats. One cannot change the presentation formats in PLM thus achieving different formats for special applications. The Military may find this overly limiting in the present PLM system.

*7. Since the Military is presently acquiring PLATO mainframe systems for Service-wide use, PLM as a delivery and convenient administrative system for training and testing should be considered for future use. Since the on-line PLM "through-put time" is slow and tiresome, the off-line, stand alone, disc-based PLM should be considered. This is presently available on the micro-PLATO format (e.g., either the PCD-1 or PCD-2).

(NOTE: the contractor's team favors the Regency, R2C, standalone terminal over microPLATO in everyone of some 32 CBE criteria. The Regency should be considered in place of off-line microPLATO from CDC.)

Development of a Prototype, On-Line Test Item Bank (TIB):

((NOTE: an in-depth discussion of the PLATO AUTHOR Language (PAL) will not be presented in this report since it has been documented in many previous sources. For Example, see:

(a) Gunwaldsen, R.L. "Theory of Operation and Author Language Support." HumRRO, Technical Report 75-3, 132 pp., May 1975. AD-AO12 672.

(b) Schulz, R.E. "Moniforms as Authoring Aids for the PLATO IV CAI System." HumRRO, Technical Report 75-5, 31 pp., May 1975. AD-AO12 674.))

There are two primary advantages of PLM over PAL. First, PLM requires no programming in the traditional sense, e.g., no lines of code are entered by the user. Even though PLM does require careful attention to certain routines (verifying author editing and option routines) it does not require an understanding of traditional programming. Second, PLM provides a convenient means for delivery of CBE materials and for managing the delivery and administrative processes of these materials in a structured, menu driven fashion.

Even though PLM has ameliorated many of the earlier CBE problems, its design and architecutral structure may be a drawback for certain operationally-specific requirements, e.g., creating a dynamic Test Item Bank (or TIB). In these cases, PAL is the preferred method of development since the author has about 250 programming options available. However, the problem with this is that the author must master a very large number of code words and coding sequences in order to enter information into the PLATO data base. This means that a heavy user of on-line, central PLATO would require almost a full-time, skilled PLATO programmer who thoroughly understands the PAL system.

For example, it requires about 240 to 275 lines of PAL code to set up one file into which the author wishes to load an SQT. (NOTE: see **APPENDIX VI, pages 120-178**, for an example of the type of coding required for a TIB.) After a suitable file has been established, it requires an additional 27 to 40 lines of code to enter one typical multiple-choice test item. An example of the coding sequence required for one test item is shown on page 58.

Thus, to create a computer-based Test Item Bank on central PLATO for one, medium-sized MOS (containing 110 Duty Position Tasks) would require about 1,000 lines of code for the initial file structure, including randomized or pre-determined call-up of the stored data and specific file management routines. Since a typical multiplce-choice test item averages about 35 lines of code, it would require some 18,550 lines of PAL code to enter 530 multiple-choice test items for a total of 19,550 lines of code for both the file struc-

```
 *
 unit     bypass
 *jump     c5Ø
-unit     resp1
 write    Select only A, B, or C.
-unit     resp2
 write    Select only A, B, C, or D.
 unit     sit1
 *jump    c48
 at       31Ø
 write    SITUATION:  You are supervising a mechanic who is
          replacing the brake pad(s) on an M88Ø.
 box      2Ø9;46Ø;3
-unit     c1
 add1     v4
 join     sit1
 at       61Ø
 write    1.  Your mechanic reports that he has found only
              one excessively worn brake pad on a front wheel.
              You instruct the mechanic to replace the pad(s)

              A.  on one front wheel.

              B.  on both front wheels.

              C.  on all four wheels.
 at       1615
 join     resp1
 arrow    183Ø
 storea   n4Ø
 answer   B,b
 add1     v5
 jump     c2
 answer   A,a,C,c
 jump     c2
 unit     c2
```

Figure 8.
PLATO Print-out Display Showing lines of code required to program one multiple-choice test item.

ture and test items. Since a skilled PLATO programmer can produce about 350 lines of code per day, it then requires about 56- to 60-man days to load a usable Test Item Bank consisting of 19,550 lines of code. To analyze and design the TIB's file structure (which are accomplished on paper before coding begins) requires about an additional 40- to 50-man days. Thus, to analyze, design and develop a prototype PLATO-based Test Item Bank requires about 90- to 100-man days of effort.

(NOTE: if the reader extrapolates from these average figures to 450 Army MOSs, there would be about 8,797,500 lines of PLATO code required to establish a TIB for each MOS. This amounts to about 87,975-man days of design and programming time needed if every Army MOS decided to implement a TIB for its own MOS. This figure does not represent the man days required for on-going file management. And the amount of stored information would require a very large data base, e.g., into the thousands of gigabytes of data. If a non-CBE programming language was used (e.g., FORTRAN, UNIX, or BASIC) the number of man days, lines of code and data base size would be increased by a factor of 4 or 5.)

In order to decrease the number of code lines required to initially establish a PLATO-based TIB which could be easily attached to an on-going training development effort, the contractor's development team decided to design the prototype *TIB around the contractor's TDQT model* (Test Development for Qualification & Training) which had been blueprinted on paper under a previous, long-term Federal contract.

Thus, the development team felt that once the initial PLATO files for the TDQT structure had been completed (which required 950 lines of coding) then all that an author would have to do, using this pre-coded architecture, would be to enter the selected tasks and/or test items, attach the data to the appropriate files, and a TIB would be available. In this way, the PLATO author would be faced with a significantly reduced number of coding lines and man days of effort required since the TIB structure would not have to be re-developed everytime an MOS wanted to try-out the TIB concept. Also, if an MOS was developing CBE programs for training, then the TIB and CBE modules could be easily and quickly attached thereby greatly reducing the development and management time now required for such activities.

(NOTE: the complete prototype Test Item Bank coding requirements built around the contractor's TDQT model and developed under Phase I of this project are presented in **APPENDIX VI**, pages 120-147. These coding profiles are included for future military reference.)

The basic concept of the prototype TIB (after all files and routines had been established) centered around the idea that Army field users, with little or no experience with terminals, should be able to easily sign-on to PLATO, and thereafter, by touching different boxes presented in a series of menus on the screen or by making one or two keystrokes in each menu could enter the TIB files. At this point, the novice user could select tasks for review and/or revision, could select clusters of test items (for each task) for review, editing and/or call-up in the form of a test, could administer the test (either on-line or download for off-line use), complete scoring and item analysis, and generate summative reports and/or statistics for individual evaluation.

The development team configured the prototype TIB as follows:

***1st.** After the terminal is turned on and loaded, a series of typical introductory frames is presented, such as....

a. Press NEXT to begin,
b. Identify your PLATO group name,
c. Give your PLATO password,
d. Give the Lesson Name (on the Author Mode page).

At this point, a large "T" on the TDQT (Test Development for Qualification & Training) page is presented and the user presses the Job Inventory Box (on the "T") and enters the primary files.

***2nd.** Now the user is given four options regarding use of a job inventory activity. If "box #4" (Translate Job Inventory into Tests) is pressed, the user enters the base files for the TIB.

***3rd.** At this point, the user selects one of three options:

(a) MOS63S, or..
(b) MOS63B, or..
(c) MOS63Y.

***4th.** If the "MOS63B" option is touched, the user is shown a menu which lists either vehicles or stationary equipment for MOS63. (NOTE: power generation equipment has recently been deleted from MOS63B.)

***5th.** If "Vehicle" is touched on the screen, the user is shown a menu which lists 18 different vehicle systems (from "a" Axle System through to "r" Winch, Hoist and PTO.) (NOTE: see page 8 for the entire listing of vehicle systems.)

***6th.** If the letter "q" (for Wheel System) is touched, for example, the user is presented a menu which lists the four classes of trucks in MOS63B (1/4-ton, 1-1/4 ton, 2-1/2 ton, and 5-ton).

At this point, the user has entered the TIB, selected the MOS desired, selected either vehicle or stationary equipment, selected type of vehicle system, and selected the series of vehicle. Now the user can access either the MOS tasks for this vehicle system, or the test items associated with a particular task. At any point, the user can shift from the parent MOS task to the associated test items, or go from the test items to the parent task with only one keystroke.

Also, test items in the prototype TIB were arranged according to taxonomic level as shown in the following:

a. Level 1 = Test Items for Knowledge,
b. Level 2 = Test Items for Understanding,
c. Level 3 = Test Items for Application of Knowledge,
d. Level 4 = Test Items for Application of Understanding,
e. Level 5 = Test Items for Analysis, etc.

Thus, if the user wanted to see only those test items which were designed to assess Level 3 (for a particular task), the user could move directly into those files which contained only Level 3 items. And, at any point, the user (with only one keystroke) could bring-up the parent task on the screen to compare the task contents directly to the test item contents at a particular performance domain level. The development team believed this ability to compare and contrast parent task-to-test item content would make the review-revision cycles easier on the user.

During the period of June-1982 to November-1983, the following kinds of data were loaded into the PLATO, on-line system using both the PLM and PAL systems:

1. **(using PLM)**: SQT #2 for MOS63B2, and SQT #3 for MOS63B1, for a total 82 Test Items were loaded. (NOTE: These SQTs were revised in 1982 by the Army.)

2. **(using PLATO Author Language/PAL)**: The prototype TIB (using the contractor's TDQT model) file structure, 5 MOS Tasks for Skill Level 1, 40 new Test Items at Domain Levels 2 to 5 (Understanding, Application of Knowledge & Understanding, and Analysis) were loaded.

3. **(using PAL)**: 68 test items for MOS63B3/4 were added to the TIB.

4. **(using PAL)**: 75 new test items for MOS63B3 were loaded into separate files not attached to the prototype TIB files. Routines for random generation or pre-determined item sequences for automatic construction of SQTs (for Skill Level-3), and on-line instructions to the Test Adminstrator were completed.

(NOTE: All TIB and associated files have been transferred to the Florida State University PLATO facility for on-line central storage.)

Generating Technical Graphics for PLATO, on-line Storage:

Generating technical graphics which can then be merged with text, modified and communicated for PLATO presentation is difficult, cumbersome and time-consuming. Most test developers want criterion graphics to accompany test items, especially for the lower skill levels. Because of this psychometric need, several engineering members of the development team attempted to use both the PLATO graphics generator codes and the Summa Graphics Byte Pad/electronic pen for entering technical graphics to accompany each new test item. In this manner, both the test item+graphic could be delivered, on-line, during test adminstration. And this would eliminate the need for separate test booklets containing the graphics keyed to the various test items.

The team tried generating graphics by both the pixel and vector methods. The pixel method involves calculating all points in a graphic then programming these points into PLATO's 512 X 512 terminal screen. The team also tried using the byte pad/pen by drawing a cluster of vectors between points on the X and Y axes. Simple boxes, circles, bar graphics and diagonal lines were not difficult, however, for the kind of graphics which show vehicle equipment parts and repair procedures the difficulty level was increased to the point that many hours of valuable and expensive manpower time were required just to generate one graphic for a test item. For example, generating a graphic of front wheel bearings in position required over 120-hours.

Compounding the generation problems is the fact that one full-screen graphic plus accompanying text can use upwards of 262,114 bytes of information on a 512 X 512 screen. In MOS63B, there are at least 1,000 specific technical graphics and text which might be considered for entry and use with test items. This would involve the storage of a very large amount of data, notwithstanding the storage required for data base file management. If data storage was not a problem then manpower cost alone to input graphics via the byte pad/pen method or programming via AUTHOR language would be unacceptable if all equipment/maintenance MOSs were to be computer based.

Because of these problems, the contractor tried to develop a simple and inexpensive graphics entry system which could then be used with on-line or off-line PLATO. Control Data Corporation has been promising over the years to have this ability available, however, to date this has not come to pass.

The contractor's development team was able to obtain a California Computer Systems (CCS) microcomputer frame. The CPU was built around a 4Mhz, 8-bit, microprocessor and had 64K of RAM with 1.2 Mb, dual floppy disc subsystem. We were also able to borrow specific IC boards (including an S100, 300, 2067, 2422, MA520 and FG520 boards) and installed these boards into the CCS console. We were also able to acquire a raster scan monitor with a 15-inch CRT display, and a DAGE, 800-line resolution video camera with a 35mm lens. Resolution of the camera was at 525 lines, which is close to the 512 lines available on the PLATO IST II terminal.

After assembling this prototype system, the team tried digitizing various technical graphics from the Army vehicle TMs which could be used along with the new test items. We discovered that capturing 2-D line drawings from the TMs was a simple and quick matter, requiring about 1-minute to digitize the graphic and to load it into the CCS floppy disc. The 1-minute required to capture and digitize a graphic compared to an average of 40-hours to generate the graphic by the vector or pixel methods was significant for the team. An example of the results can be seen on page 63.

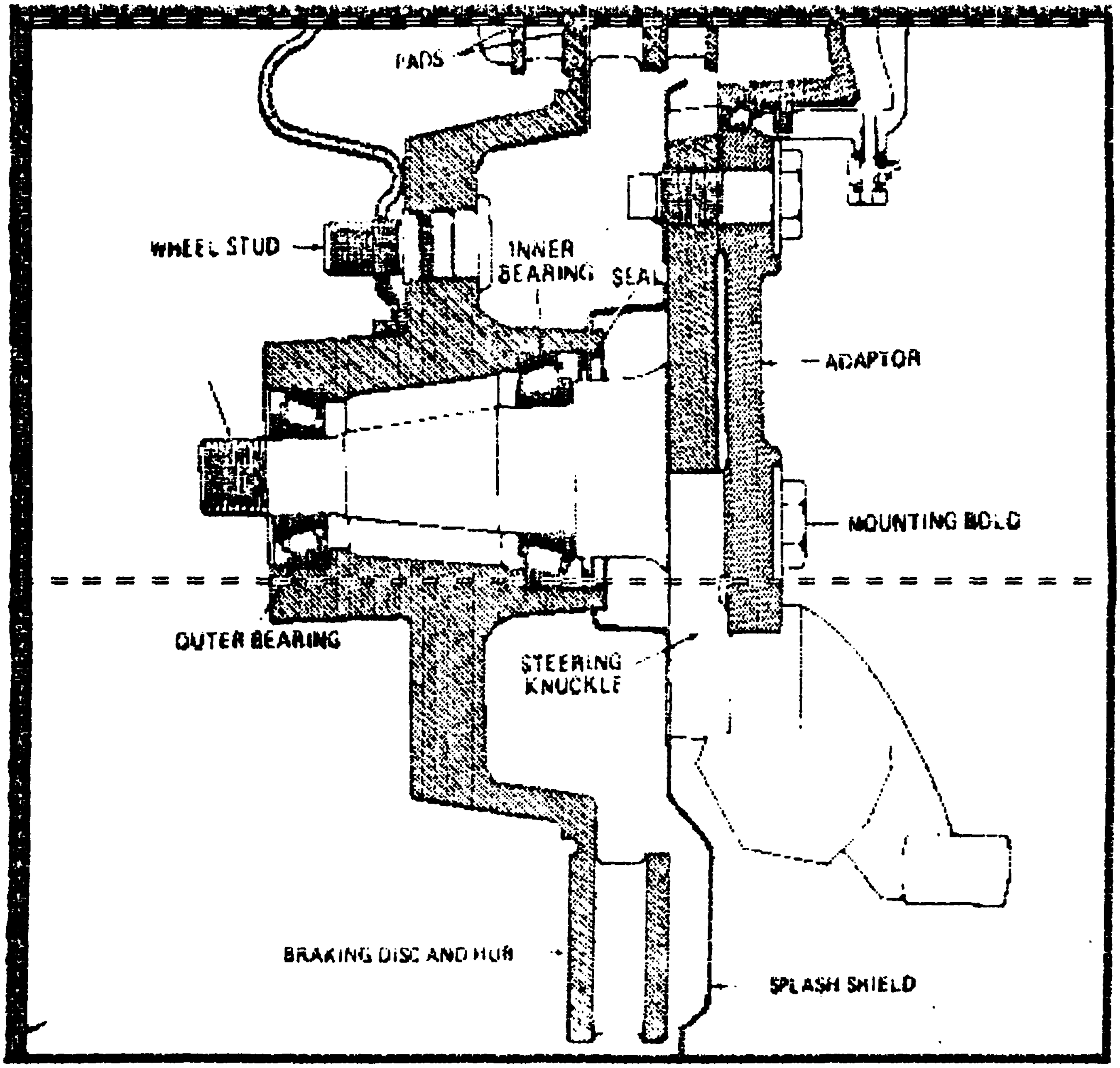


Figure 9. Printout from Graphic File Showing Stored Digitized Image from Army Technical Manual.

The prototype graphics input system is simple. Graphic data is first entered by digitizing the video input to a resolution of 8-bytes. The graphic data is then captured, one frame at a time in about 1/30th of a second. The results of this capture (245,760 bytes contained in memory) are then available for further processing by the CPU. Each monitor presentation contained 512H X 480V pixels of 2 bytes (two shades, or black and white) of information.

The contractor's team developed several small software programs to initiate the picture taking process for capture into CPU memory. Also, a data compression software routine was developed to decrease the amount of storage required.

After several digitized TM images had been stored in the CPU, the team felt that CDC would provide the software interface needed to transfer the images from the floppy discs to on-line PLATO. The team contacted CDC in hopes that they would provide such an interface program to accomplish this transfer to PLATO. At this point, CDC has quoted a cost to do this, however, the contractor has postponed the effort until a later date. The team has concluded that the completion of a simple graphics input method for PLATO is highly beneficial, especially in development of training and testing for CBE, CBI or CMI delivery.

(*NOTE: at this time, the contractor understands that the Regency R2C* terminal has the capability for digitized graphic input, but the interface software was not yet been completed. CDC has also announced that their PCD IV system for off-line PLATO will also have the ability to accept digitized images, but this system will not be ready until sometime within the next three years.)

Section 4.
Recommendations for Further Development of the Test Item Bank

The development team recommends the following considerations for completion, evaluation, and upgrading the prototype Test Item Bank (TIB):

1. To complete the entry of all new test items developed for MOS63B/ Skill Levels 1-4. The entry should be into either the prototype TIB as configured around the TDQT model or into special testing files per skill level. Additional test management routines for automatic test construction, test administration, test item analysis, the generation of statistical reports and/or generation of individual soldier reports should be completed.

2. Several Army sites having on-line PLATO terminals should systematically field evaluate the prototype system, including the test generation and management capabilities of the system. The existing routines should be carefully reviewed by the field level and revised where difficulty areas can be simplified.

3. The new test items should be clustered into tests and administered to both novice and master Army mechanics. An item analysis should be undertaken to determine content and criterion validities. During this activity, the Army may consider developing a simplified approach to computer-basing different levels of Task Analysis, the use of Tables for Specifying New Test Items, and simplified field review routines of new tasks and test items. In this way, the process of "field input" for the development of new tasks and/or test items can be enhanced.

4. The process for entering digitized graphics, data basing graphics, attaching graphics to stored text, and generating tasks and tests with both graphics and text should be completed. This should be considered for both on-line and off-line delivery of CBE programs in order to alleviate the problems now involved in adding graphics to text.

5. On-line task and test management, and administration thereof should be compared and evaluated against off-line delivery systems for both micro-PLATO (using the newer PCD-1 system) and the new Regency R2C floppy disc-based terminals. In this manner, actual cost centers can be determined for both on-line and off-line systems.

6. The Army should consider developing an overall master plan for implementing the computer-based Task/Test Item Bank concept for use at the School and field levels if the aforegoing evaluation activities provide positive data.

END of REPORT

APPENDIX I.

SUMMARY of TAXONOMIES (refer to Table 1, page 5)

1. The Cognitive Domain (A-D). (see footnote #4)

Knowledge (A): Performance which represent knowledge require the repetition of responses that have been practiced during previous training. After training, memory is the major requisite to correct performance.

Understanding (B): Performance which represent understanding require responses in addition to those previously practiced and learned. The additional responses are likely to be interpretations, translations, summarizations, analyses, detection of similarities, detection of differences. At this level test items do not require solutions other than explorations in meaning.

Application of Knowledge (C): Performance which represent application of knowledge require the use of previously learned responses in the solution of test items. At this level, the type of item is not new, having been experienced by the mechanic before to the extent that responses necessary to find solutions are more or less routine.

Application of Understanding (D): At this level the test items require reponses at the understanding level in which, at least, one element is new to the mechanic and is essential to the solution of the test item. The newness might appear either in the conditions of the test item's situation or in the answer required.

4. Adapted after: Bloom, B.S. (Ed.) **Taxonomy of educational objectives: The classification of educational goals.** Handbook 1. **Cognitive Domain.** New York: Mckay. 1956.

(APPENDIX I. Summary of Taxonomies....continued)

2. The Percpetual Doman (E-I). (see footnote #5)

Sensation (E): Performance that indicates awareness of the qualities of a stimulus or of material as perceived through the senses (e.g., hue, pitch, odor, etc.). This may be further divided into various sensory modalities (e.g., visual, auditory, tactile, etc.).

Figure Perception (F): Performance that indicates awareness of entity, or what is commonly called a percept (e.g., size, form, location, position, etc.). Also awareness of the relationships of parts to each other and to the whole, and awareness of relations between the parts and the background, or between the stimulus and its context. This is called "figure-ground" perceptual organization.

Symbol Perception (G): Performance that indicates awareness or percepts in the form of denotative signs, such as letters, digits, and other signs usually organized as in alphabet and number systems, or colors in a visual spectrum, when meanings and form are not considered. The ability to name the percept or assign it to an appropriate class, to indicate similarities and differences between percepts.

An example of this level might be to assess mechanics on their concept of "feel", that is, the ability to discriminate very close tolerances as would be found in adjusting front vehicle wheel bearings with a torque wrench. During training, the instructor might set up a series of plugs which fit into rings. If the plugs vary in size by 2/10,000 of an inch so that several plugs range from "snug" to "loose" the concept of tolerances could be assessed. The trainees task would be to rank the series in terms of looseness of fit. Since the task is one of determining similarities and differences between percepts, this kind of performance can be classified as Symbol Perception (LEVEL G).

Perception of Meaning (H): Performance that indicates awareness of the significance or value of a percept or symbol. The discovery of new relationships or insight into cause and effect relations between symbols or percepts. The abilities to generalize, to understand implications and to make decisions.

In many tasks, vehicle mechanics are expected to make precise absolute judgements while using equipment, such as feeler gauges and micrometers. A high degree of tactile-kinesthetic sensitivity is probably the most important

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5. Moore, M.R. **A proposed taxonomy of the perceptual domain and some suggested applications.** (Tech. Rep. No. TDR-67-3.) Princeton, H.J.: Educational Testing Service, August 1967, pp. 9-10.

(APPENDIX I. Summary of Taxonomies...continued)

factor. In this case, the mechanic might be assessed on the significance of varying degrees of friction exerted upon a particular measuring instrument.

Perception of Performance (I): Performance that indicates sensitive and accurate observation. Diagnostic ability with respect to mechanical or electrical systems, etc. Insight into personal, social, and political situations in which awareness of attitudes, needs, desires, moods, intentions, perceptions and thoughts of other people and one's self is indicated. Demonstrations of a successful analytical or global approach to problem-solving in all areas of endeavor and of artistry and creativity in any medium.

Vehicle mechanics extensively use electronic analyzers to diagnose ignition faults in engines. The ability to correctly identify the cause of a malfunction is considered an important part of a mechanic's performance. In doing this the mechanic must interpret a visual pattern presented on a CRT. Clearly, this involves both perceptual and cognitive abilities and shows how there is a practical overlap among domains. Because this performance involves both perception and cognition it is more difficult to specify the exact level of perceptual ability that is involved.

3. Psychomotor Domain (J-N). (see footnote #6)

Perception (J): This is the first step in performing a motor act. It is the process of becoming aware of objects, qualities, or relations by way of the sense organs. It is the central portion of the situation-interpretation-action chain leading to purposeful motor activity.

Set (K): Set is a preparatory adjustment or readiness for a particular kind of action or experience.

Guided Response (L): This is an early step in the development of a skill. Emphasis here is upon the abilities which are components of the more complex skill. guided response is the overt act of a person under the guidance of the instructor. Prerequisite to performance of the act are readiness to respond, in terms of set to produce the overt act and selection

6. Simpson, E.J. Taxonomy of Educational Objectives: The classification of educational goals. **Handbook III**: Psychomotor domain. New York: McKay, 1966.

(**APPENDIX I. Summary of Taxonomies**.....continued)

of the appropriate response. Selection of response may be defined as deciding what response must be made in order to satisfy the particular requirements of task performance.

Mechanism (M): Learned response has become habitual. At this level, the learner has achieved a certain confidence and degree of skill in the performance of the act. The act is a part of his repertoire of possible responses to stimuli and the demands of situations where the response is an appropriate one. The response may be more complex than at the preceding level; it may involve some patterning of response in carrying out the task, that is, abilities are combined in action of a skill nature.

Complex Overt Response (N): At this level, the person can perform a motor act that is considered complex because of the movement pattern required. At this level, a high degree of skill has been attained. the act can be carried out smoothly and efficiently, that is, with minimum expenditure of time and energy. There are two subcategories: resolution of uncertainty and automatic preformance.

4. Affective Domain (0-S). (see footnote #7)

Receiving (0): The individual is sensitized to the existence of certain phenomena and stimuli; that is, the person be willing to receive or attend to them.

Responding (P): The individual is sufficiently motivated to actively attend to certain stimuli.

Valuing (Q): This performance shows that a thing, phenomenon or behavior has worth to the individual.

Organization (R): The necessity arises for (a) the organization of the values into a system, (b) the determination of the interrelationships among them, and (c) the establishment of the dominant and pervasive values.

Characterization by a Value Complex (S): At this level of internalization the values are organized into some kind of internally consistent system, and have controlled the performance of the person for a sufficient time that he has adapated to behaving this way.

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7. Krathwohl, D.R., Bloom, D.B. & Masia, B.B. "Taxonomy of educational objectives: The classification of educational goals. Handbook 2. **Affective Domain.** New York: McKay, 1964.

APPENDIX II.

Example Revised MOS Task: Replace Front Wheel Bearing (091-499-1017)

(NOTE: Compare to original task on page 12)

Task Action: Replace front wheel bearing (1/4-ton vehicle).

Task Conditions: (same as in original task)

Task Standards: The remounted wheel with the new bearings will turn in a smooth, straight track, without shimmy or scrapping sounds, and will not move away from the 90-degree axis when pushed back and forth at both the top and bottom points of the wheel while the front end is on the jack stands.

Task Key Elements + Contingency Actions (CA):

1.100. The spindle will be removed **before** vehicle is placed on jack stands.
- 1.110 Remove nut and lifting eye (see fig 2-309).
- 1.120 Place front of vehicle on jack stands (see safety procedures).
- 1.130 Remove 5 nuts and wheel.
- 1.140 Remove brake drum (see fig 2-310).

*CA: Retract brake shoes by backing off adjusting screws if wheel can not be removed (see fig 2-367).

1.200. The wheel drive flange will be removed next by disconnecting the U-joint from the flange, then drive shaft will be swung out of the way so flange can be pulled off the spindle (see fig 2-313).
- 1.210 Remove 4-nuts/lock washers on U-joint then disconnet U-joint from flange.
- 1.220 Move drive shaft out of the way.
- 1.230 Pull flange off of support.

1.300. The outer seal and retainer will be pried off the shaft and the bearing cup will be knocked out using a brass drift so the cup's edges will not be damaged.
- 1.310 Pry off outer seal and retainer.
- 1.320 *Use BRASS DRIFT to knock out bearing cup from support bracket.
- 1.330 Clean spindle shaft and bore shaft.
- 1.340 Remove bearing cone using a puller (see fig 2-319).

(APPENDIX II - continued)

1.400. The inner seal, bearing cone and cup will be removed from the support bracket by first loosening and removing the bearing and seal with a block of wood or brass drift (to prevent damage to the bearing/seal), then bearing cone will be removed with your fingers.
- 1.410 Loosen and remove bearing and seal with block of wood or brass drift (see fig 2-323).
- 1.420 With your fingers, remove the bearing cone from support bracket (see fig 2-325).
- 1.430. ***Clean support bore by removing all dirt/debris*.**

1.500. New inner bearing cups, cones and seals will be installed using a block of wood and hammer to drive them into place (see fig 2-320). The taper will be towards the inner support (see figure 2-325).
- 1.510 Use wood block/hammer to drive new cups into place.
- 1.520 Pack bearing with grease and insert cone into bearing cup. ***(TAPER toward the inner support)***
- 1.530 Coat outside surfaces of seal with "**compound sealer**" and coat lips of seal with "**grease.**"
- 1.540 Drive inner seal into support bracket using a replacer (see fig 2-321).

1.600. Replace outer cup, seal and bearing.
- 1.610 New cup will be driven into place using a wood block/hammer (see fig 2-320).
- 1.620 Inside of bore will be coated with 1/16-inch of **grease.**
- 1.630 Seal will be driven into place using a wood block/hammer (see fig 2-321).
- 1.640 Bearing cone will be packed with grease and driven in with a brass drift/hammer. ***(TAPER away from the spindle**; see fig 2-322)*

1.700. Reinstall spindle wheel drive flange and reconnect to U-joint.

1.800. Reinstall spindle, washer and flange-nut onto wheel drive flange.

1.900. Tightness of bearings will be adjusted using a torque wrench to 30-lbs-ft of torque.
- 1.910 **Tighten flange/nut to 30-lbs-ft** using a torque wrench.
- 1.920 Turn spindle 3 complete turns, then recheck torque to make sure it is at 30-lbs-ft.
- 1.930 Repeat until torque stays at 30-lbs-ft.
- 1.940 Back flange/nut off **one complete turn** with wrench, then **tighten with fingers.**
- 1.950 ***Insert cotter pin through hole of pin over nut, loosen nut the least amount to align two holes in shaft*.**

(APPENDIX II - continued)

1.10.00. Reinstall brake drum on spindle.
   ***CA: If brake shoes were loosened at step one, readjust brake shoes at this point.**
   1.10.10 Insert adjusting tool through adjusting hole and turn adjusting screw until brake drum can not be turned with one hand.
   1.20.10 Back-off on adjusting screw 11-clicks.

1.11.00. Replace tire/wheel on to the spindle, and replace the 5-nuts.
   1.11.10. Reinstall nut and lifting eye.

APPENDIX III.

Table Showing Specific Revision Activities Performed on Selected MOS Tasks

[X] = Indicates Activity was Performed.

TASK Number & Title: Skill Level 1.	REVISION ACTIVITIES PERFORMED: TASK is OK as it Stands.	Corrected Existing TASK Content.	Revised TASK Product Standards.	Divided TASK into SubTasks and Reformatted.
(091-499-1002) Adjust Clutch Pedal Free Travel.		[X]	[X]	
(091-499-1003) Replace Mechanical Fuel Pump.		[X]		
(091-499-1006) Replace Distributor.		[X]		
(091-474-1015) Replace Universal Joint.		[X]	[X]	
(091-499-1017) Replace Front Wheel Bearing.		[X]	[X]	
(091-474-1026) Replace Master Cylinder.	[X]			
(091-499-1028) Replace Upper/Lower Ball Joints.		[X]		
(091-474-1031) Perform Semiannual PM Checks and Services.				[X]
(091-499-1043) Replace Radiator and Hoses.	[X]			
(091-499-1052) Replace Generator/Alternator.			[X]	
(091-499-1057) Replace Service Brakeshoes (Front).		[X]	[X]	
(091-499-1060) Replace Air Hydraulic Cylinder.			[X]	
(091-499-1066) Replace Front Spring.	[X]			
(091-474-1084) Replace Accelerator and Throttle Controls and Linkage.			[X]	
(091-474-1088) Replace Alternator Belts.			[X]	
(091-474-1089) Replace Starter.	[X]			

(APPENDIX III - continued)

[X] = Indicates Activity was Performed.

TASK Number & Title: Skill Level 1 (continued)	REVISION ACTIVITIES PERFORMED: TASK is OK as it Stands.	Corrected Existing TASK Content.	Revised TASK Product Standards.	Divided TASK into SubTasks and Reformatted.
(091-474-1090) Replace Batteries.		[X]		
(091-474-1098) Replace Drag Link Seals and Ball Seats.		[X]	[X]	
(091-474-1126) Replace Brake Pads	[X]			
(091-474-1127) Replace Front and Rear Shock Absorbers.			[X]	
(091-474-1154) Replace Master Switch.	[X]			
(091-474-1159) Replace Transmission Controls and Linkage.		[X]	[X]	
(091-474-1195) Replace Air Compressor.	[X]			
(091-474-1244) Replace Wheel Cylinder.			[X]	
(091-474-1254) Replace Hydraulic Master Cylinder.	[X]			
(091-499-1900) Maintain Assigned Toolkit.	[X]			
(091-499-1902) Recover Disabled Vehicle with 5-ton Wrecker (Using Wrecker Rear Winch/Field Chocks).	[X]			
(091-499-1904) Lift Load with 5-ton Wrecker (Rig for Heavy Lift)	[X]			
(091-499-1906) Tow Disabled Vehicle with 5-ton Wrecker.	[X]		[X]	
(091-499-1908) Cut Metal Using Oxyacetylene Equipment.	[X]		[X]	

(APPENDIX III - continued)

[X] = Indicates Activity was Performed.

TASK Number & Title: Skill Level 2.	REVISION ACTIVITIES PERFORMED: TASK is OK as it Stands.	Corrected Existing TASK Content.	Revised TASK Product Standards.	Divided TASK into SubTasks and Reformatted.
(091-474-2009) VTM Connections and Checkout (STE/ICE).	[X]		[X]	
(091-474-2082) Inspect Exhaust Manifold.	[X]			
(091-474-2085) Adjust Carburetor.	[X]		[X]	
(091-474-2086) Inspect Fuel Lines & Fittings.	[X]			
(091-474-2089) Inspect Front & Rear Brake Hoses.	[X]			
(091-474-2090) Inspect Master Cylinder.	[X]			
(091-474-2104) Repair Center Axle Shaft and U-Joints.	[X]		[X]	
(091-474-2105) Inspect Service Brakes.		[X]	[X]	
(091-474-2163) Test Hydraulic Pump (Steering)	[X]		[X]	
(091-474-2177) Troubleshoot Engine Malfunctions.				[X]
(091-474-2178) Troubleshoot Clutch Malfunctions.			[X]	
(091-474-2180) Troubleshoot Rear Axle Malfunctions.			[X]	
(091-474-2182) Troubleshoot Service Brake Malfunctions.			[X]	
(091-474-2183) Troubleshoot Air System Malfunctions.			[X]	
(091-474-2184) Troubleshoot Steering System Malfunctions.			[X]	
(091-474-2185) Replace Spring Seat.	[X]			

(APPENDIX III - continued)

[X] = Indicates Activity was Performed.

TASK Number & Title: Skill Level 2. (continued)	REVISION ACTIVITIES PERFORMED: TASK is OK as it Stands.	Corrected Existing TASK Content.	Revised TASK Product Standards.	Divided TASK into SubTasks and Reformatted.
(091-474-2187) Troubleshoot Suspension System Malfunctions.			[X]	
(091-474-2188) Adjust Automatic Winch Brake.	[X]			
(091-474-2198) Repair Electrical Wiring.	[X]		[X]	
(091-474-2199) Repair Fuel Tanks-to-Heater Lines and Fittings.	[X]		[X]	
(091-474-2220) Inspect Air Brake Lines, Fittings and Hoses.	[X]		[X]	
(091-474-2231) Inspect Wheel Cylinder.	[X]		[X]	
Skill Level 3.				
(091-474-3021) Supervise Personnel in Recovery and Evacuation Operation (Tow Disabled Vehicle with 5-ton Wrecker).		[X]	[X]	
(091-474-3028) Supervise Clutch Maintenance (Adjust Clutch Pedal Free Travel).		[X]	[X]	
(091-474-3050) Supervise Transmission Mainte Maintenance (Replace Transmission Controls & Linkages).			[X]	
(091-474-3120) Supervise Steering Assembly Maintenance (Replace Drag Link and Ball Seats).			[X]	
(091-474-3130) Supervise Hydraulic System Maintenance, Troublshoot.		[X]	[X]	

NOTE: MOS Tasks for administrative and training functions at SLs 3-4 were not revised.

APPENDIX IV.

Example of MOS TASK Translated into Master Test Items and Clusters of Secondary Items.

3. TASK 091-499-1006: Replace Distributor (1/4-ton)

MASTER JOB ACTIONS: (SEE: FM 63B1/2, page 2-10)

(1) Mark cover to identify spark plug cables for installation.
(2) Remove distributor:
   (a) Disconnect spark plug cables,
   (b) Disconnect primary cable connector at receptable,
   (c) Remove clamps and vent hoses,
   (d) Remove mounting screw and washer,
   (e) Lift distributor out of adapter.
(3) Install new distributor in reverse order of removal.

Test Items for:	On Pages:
(A) FUNCTION of Parts and/or the System:	78-81
(B) SEQUENCED (Procedural) Job Actions:	82-99
(C) SAFETY Precautions:	(none)
(D) TROUBLESHOOTING and/or Diagnostics:	100-101
(E) RELATED (Task) Actions:	102

(APPENDIX IV - continued)

(A) FUNCTION of Parts and/or System

Test Item 3-1

The sparkplug cables are ready to be reconnected to a newly installed distributor on a 1/4-ton truck. It is necessary each sparkplug be reconnected to the same position on the new distributor cap as on the old cap.

QUESTION: Why? (NO FIGURE)

****1. So, a sparkplug will fire when its piston is at the end of its compression stroke.**

2. So, a sparkplug will fire when its piston is at the end of its expansion stroke.

3. So, a sparkplug will fire when its piston is at the end of its fuel intake stroke.

4. So, a sparkplug will fire when its piston is at the beginning of its fuel intake stroke.

Test Item 3-2

Every ignition system on a 1/4-ton truck has an ignition coil.

QUESTION: What is the function of this coil? (see figure 3-2)

****1. The coil transforms the battery voltage to a very high voltage needed to arc across the sparkplug gap.**

2. The coil converts the battery amperage to a very high amperage needed to arc across the sparkplug gap.

3. The coil isolates the battery circuit from the ignition circuit so the high voltage does not damage the low voltage circuit.

4. The coil insures there is a constant voltage supplied to the sparkplug.

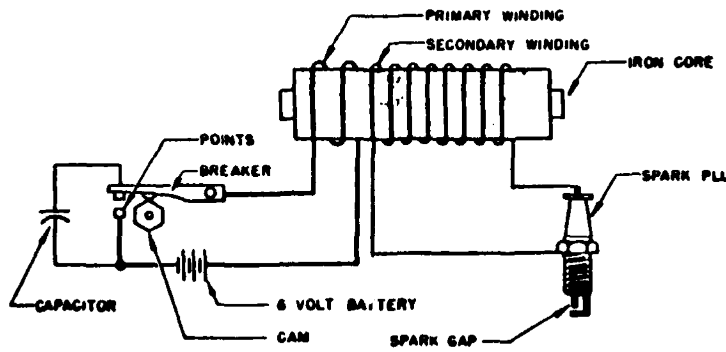


Figure 3-2

(APPENDIX IV - continued)

Test Item 3-3

In order for the mechanic to understand how to correctly install and adjust the distributor, it is important to understand how the current gets from the battery to the sparkplug.

QUESTION: What path does the current follow in the high voltage circuit of the ignition system? (see figure 3-3)

1. From the positive terminal of the battery, the current...
(a) flows through the high voltage side of the coil,
(b) to the rotor in the distributor,
(c) to the sparkplug gap, then
(d) returns to the ground side of the battery.

2. From the positive terminal of the battery, the current...
(a) flows through the distributor breaker points,
(b) to the high voltage side of the coil,
(c) to the sparkplug gap, then
(d) returns to the ground side of the battery.

3. From the positive terminal of the battery, the current...
(a) flows through the distributor breaker points,
(b) to the rotor in the distributor,
(c) to the sparkplug gap, then
(d) returns to the ground side of the battery.

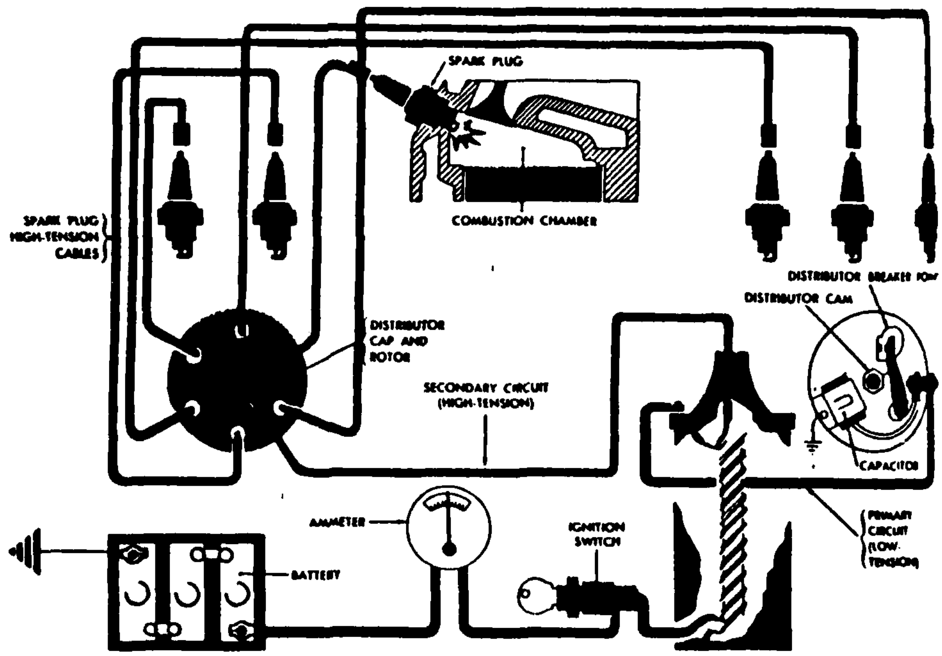


Figure 3-3

Test Item 3-4

The ignition system in a 1/4-ton truck includes a capacitor connected across the breaker points in the distributor.

QUESTION: What is the function of the capacitor in this circuit? (see figure 3-4)

****1. The capacitor absorbs current surges when the points are opened which prevents arcing across these points.**

2. The capacitor absorbs current surges when the points are opened to protect other parts of the low voltage electrical system.

3. The capacitor absorbs current surges when the points are opened to prevent electrical noise in the truck's communication equipment.

4. The capacitor absorbs current surges when the points are opened to prevent electrical shock to personnel working on the ignition system.

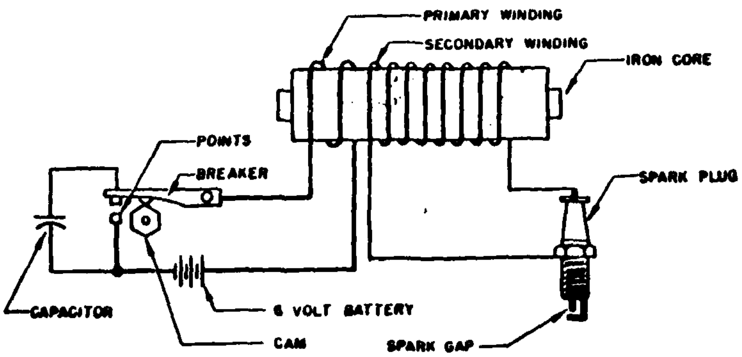


Figure 3-4

(APPENDIX IV - continued)

Test Item 3-5

A major part of the distributor on a 1/4-ton truck is the breaker points.

QUESTION: What is the function of these points? (see figure 3-5 below)

****1. By opening and closing, the breaker points cause the coil to transform low voltage into high voltage so the sparkplug will fire.**

2. By opening and closing, the breaker points can distribute current to the correct sparkplug in time for firing.

3. By opening and closing, the breaker points can control the duration of current so the sparkplugs will not burn out.

4. By opening and closing, the breaker points can prevent injury to a mechanic who is working on the ignition system when the engine is running.

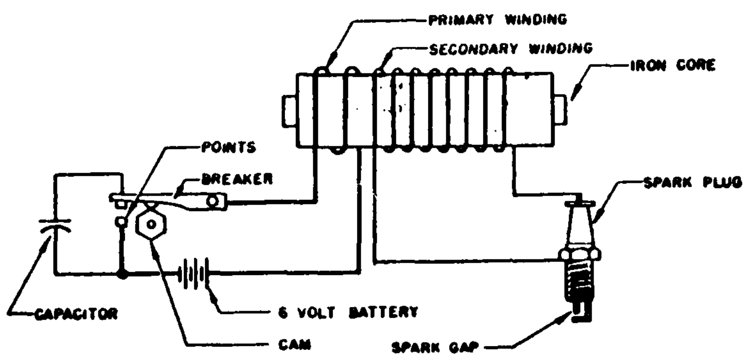


Figure 3-5

(APPENDIX IV - continued)

(B) SEQUENCED (Procedural) Job Actions

Test Item 3-6

SITUATION: You are directed to replace the distributor on a 1/4-ton truck. The truck is parked, the engine is off and the handbrake is set to FULL.

QUESTION: Which group of actions below would you follow to remove the distributor? (see figure 3-6)

****1. (1st) Mark the cover of the new distributor to identify placement of the sparkplug cables,**
(2nd) Disconnect the four sparkplug cables at the distributor,
(3rd) Disconnect the primary cable at the distributor.
(4th) Remove the vent hose.
(5th) Remove the mounting screw and lift the distributor out of the adaptor.

2. (1st) Disconnect the ground cable at the battery.
(2nd) Disconnect the four sparkplug cables at the distributor,
(3rd) Disconnect the primary cable at the distributor.
(4th) Remove the vent hose.
(5th) Remove the mounting screw and lift the distributor out of the adaptor.

3. (1st) Mark the cover of the new distributor to identify placement of the sparkplug calbes,
(2nd) Disconnect the four sparkplug cables at the distributor,
(3rd) Disconnect the primary cable at the coil.
(4th) Remove the vent hose.
(5th) Remove the mounting screw and lift the distributor out of the adaptor.

(APPENDIX IV - continued)

(Test Item 3-6/continued)

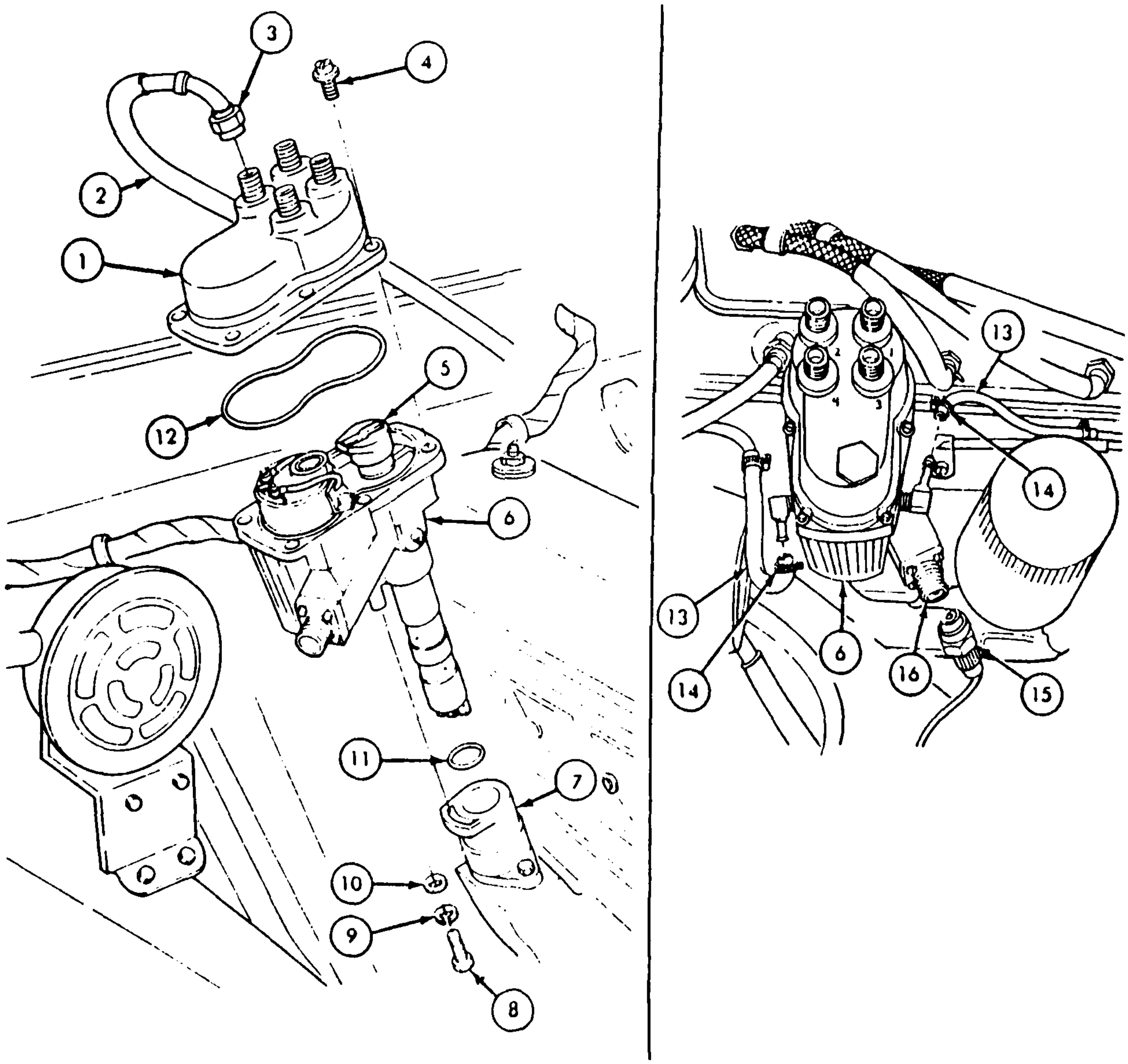


Figure 3-6

(APPENDIX IV - continued)

Test Item 3-7

SITUATION: You are ready to remove the distributor on a 1/4-ton truck.

QUESTION: Which action would you do first? (see figure 3-7)

****1. Mark the new distributor cover to identify where the sparkplug cables will be connected, then disconnect the cables at the distributor.**

2. Disconnect the primary cable, then disconnect the four sparkplug cables.

3. Remove the vent hose, then disconnect the four sparkplug cables.

4. Remove the mounting screw bracket, then disconnect the four sparkplug cables.

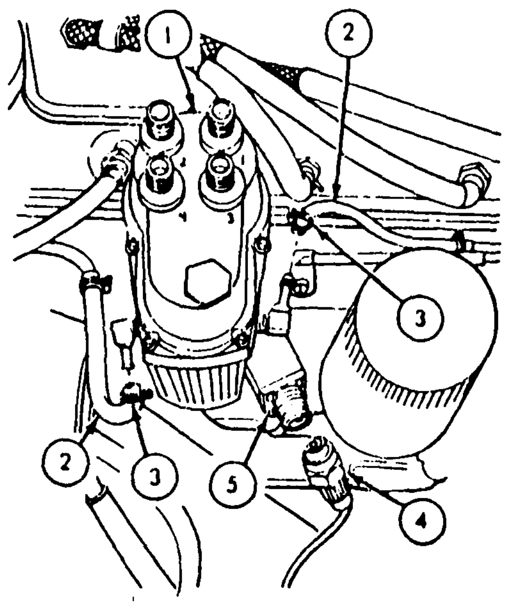


Figure 3-7

(APPENDIX IV - continued)

Test Item 3-8

SITUATION: You have replaced the distributor on a 1/4-ton truck. You have adjusted the breaker point gap and the contact spring tension. You now must adjust the approximate timing of the ignition.

QUESTION: What is the first action you take? (see figure 3-8)

1. First, mark the position of the #1 sparkpug cable on the distributor case.

2. First rotate the distributor case counterclockwise until the breaker points just start to open.

3. First, Rotate the crank shaft until the pointer on the timing gear cover and notch on the crankshaft pulley are aligned.

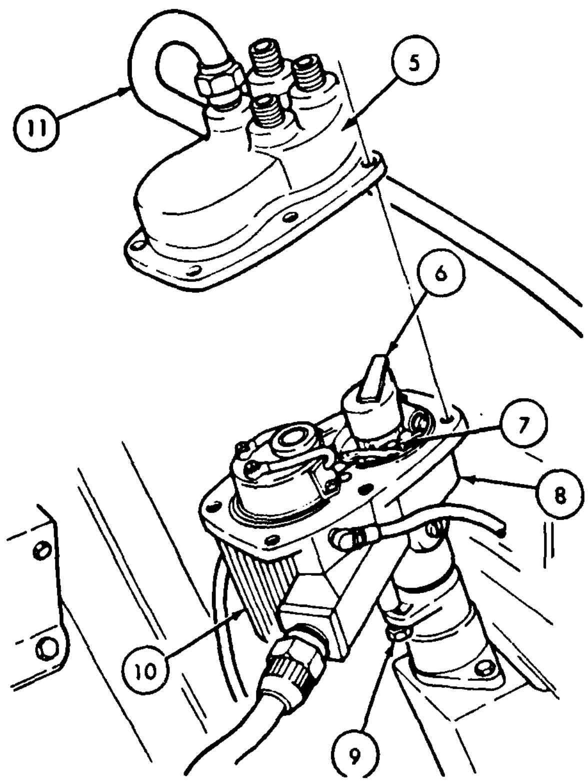


Figure 3-8

(APPENDIX IV - continued)

Test Item 3-9

SITUATION: You have removed the old distributor on a 1/4-ton truck. By mistake, the engine was cranked before the new distributor was installed.

QUESTION: What do you do now? (see figure 3-9)

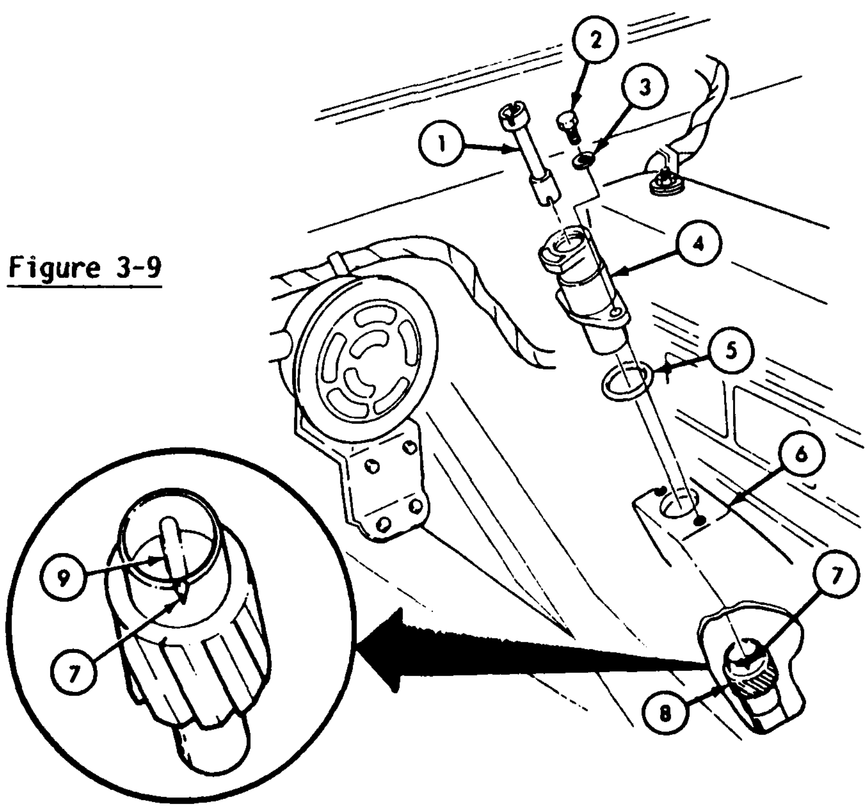
****1. Crank the engine until the notch on top of the oil pump shaft faces towards the front of the engine.**

2. Crank the engine until the notch on top of the oil pump shaft faces towards the rear of the engine.

3. Crank the engine until the notch on top of the oil pump shaft faces towards the engine.

4. Crank the engine until the notch on top of the oil pump shaft faces away from the engine.

Figure 3-9



(APPENDIX IV - continued)

Test Item 3-10

SITUATION: You have replaced the distributor in a 1/4-ton truck. You must now adjust the distributor breaker point gap.

QUESTION: Which group actions below would you follow to adjust the breaker point gap? (see figure 3-10)

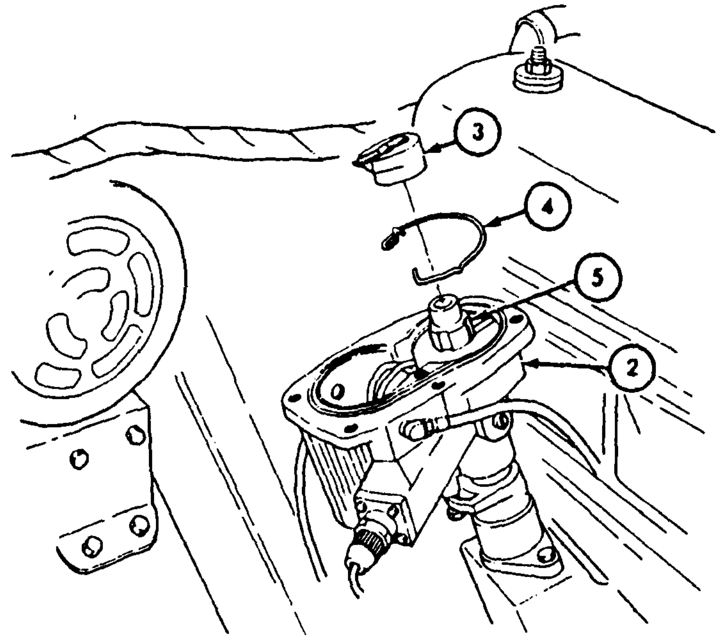
****1. (1st) Remove the distributor cover,**
(2nd) Crank the engine until the rubbing block on the breaker point rests on the peak of a cam lobe,
(3rd) Loosen the stationary breaker point screw and lock washer,
(4th) Adjust the point gap with adjuster screw until the gap is 0.017 to 0.022 inch,
(5th) Tighten contact screw and lockwasher from 5 to 20 inch pounds.

2. (1st) Remove the distributor cover,
(2nd) Crank the engine until the rubbing block on the breaker point rests on the flat of the cam lobe,
(3rd) Loosen the stationary breaker point screw and lock washer,
(4th) Adjust the point gap with the adjuster screw until the gap is 0.017 to 0.022 inch,
(5th) Tighten contact screw and lockwasher to 5 to 20 inch pounds.

3. (1st) Remove the distributor cover,
(2nd) Loosen the stationary breaker point screw and lock washer,
(3rd) Adjust the point gap with the adjuster screw until the gap is 0.017 to 0.022 inch,
(4th) Tighten contact screw and lockwasher to 5 to 20 inch pounds.

(APPENDIX IV - continued)

(Test Item 3-10/continued)



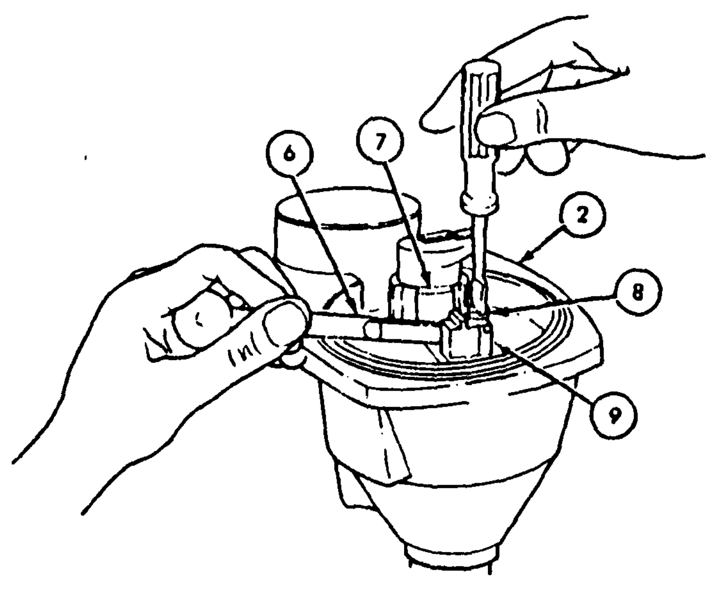


Figure 3-10

(APPENDIX IV - continued)

Test Item 3-12

SITUATION: You have replaced the distributor in a 1/4-ton truck. You have adjusted the point gap.

QUESTION: Which group of actions below would you follow to adjust the contact spring tension? (see figure 3-12 below)

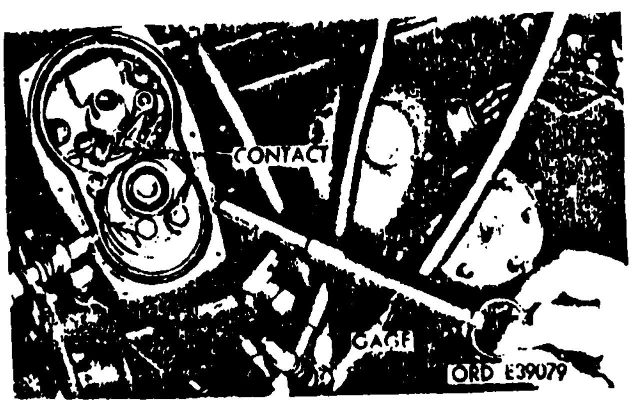
****1. (1st) Attach the spring gage to the end of the movable contact,
(2nd) Pull on the gage at right angles to the movable contact.
(3rd) Adjust the spring tension by positioning the spring slot until 20 to 40 ounces is shown on the gage then tighten the terminal screw.**

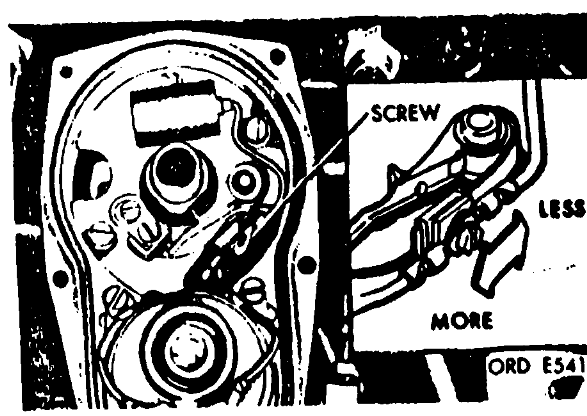
2. (1st) Attach spring gage between the contact and rubbing block.
(2nd) Pull on the gage at right angles to the movable contact.
(3rd) Adjust the spring tension by positioning the spring slot until 20 to 40 ounces is shown on the gage then tighten the terminal screw.

3. (1st) Attach spring gage to breaker rubbing block.
(2nd) Pull on the gage at right angles to the movable contact.
(3rd) Adjust the spring tension by positioning the spring slot until 20 to 40 ounces is shown on the gage then tighten the terminal screw.

4. (1st) Place end of spring gage between the two contact points.
(2nd) Pull on the gage at right angles to the distributor plate.
(3rd) Adjust the spring tension by positioning the spring slot until 20 to 40 ounces is shown on the gage then tighten the terminal screw.

Figure 3-12





(APPENDIX IV - continued)

Test Item 3-11

SITUATION: You have replaced the distributor in a 1/4-ton truck. You must now adjust the breaker point gap in the distributor.

QUESTION: Where would you position the cam when adjusting the breaker point gap? (see figure 3-11)

****1. Crank the engine until the breaker rests on the peak of the cam.**

2. Crank the engine until the breaker rests on the flat of the cam.

3. Crank the engine until the breaker rests on the leading edge of the peak of the cam.

4. Crank the engine until the breaker rests on the trailing edge of the peak of the cam.

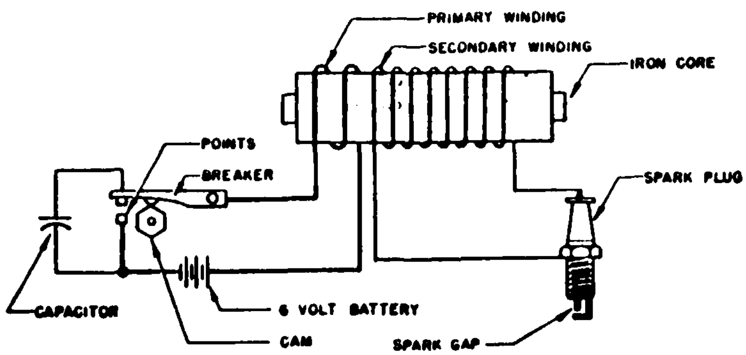


Figure 3-11

(APPENDIX IV - continued)

Test Item 3-13

SITUATION: You have replaced the distributor in a 1/4-ton truck. You have adjusted the point gap.

QUESTION: How would you measure the spring tension on the movable contact breaker arm? (see figure 3-13)

****1. Attach spring gage to end of movable contact and pull at right angles.**

3. Attach spring gage between the contact and rubbing block, and pull at right angles.

3. Attach spring gage between the contact and rubbing block, and pull at right angles.

4. Place end of spring gage between the two contact points and pull at right angles to the distributor plate.

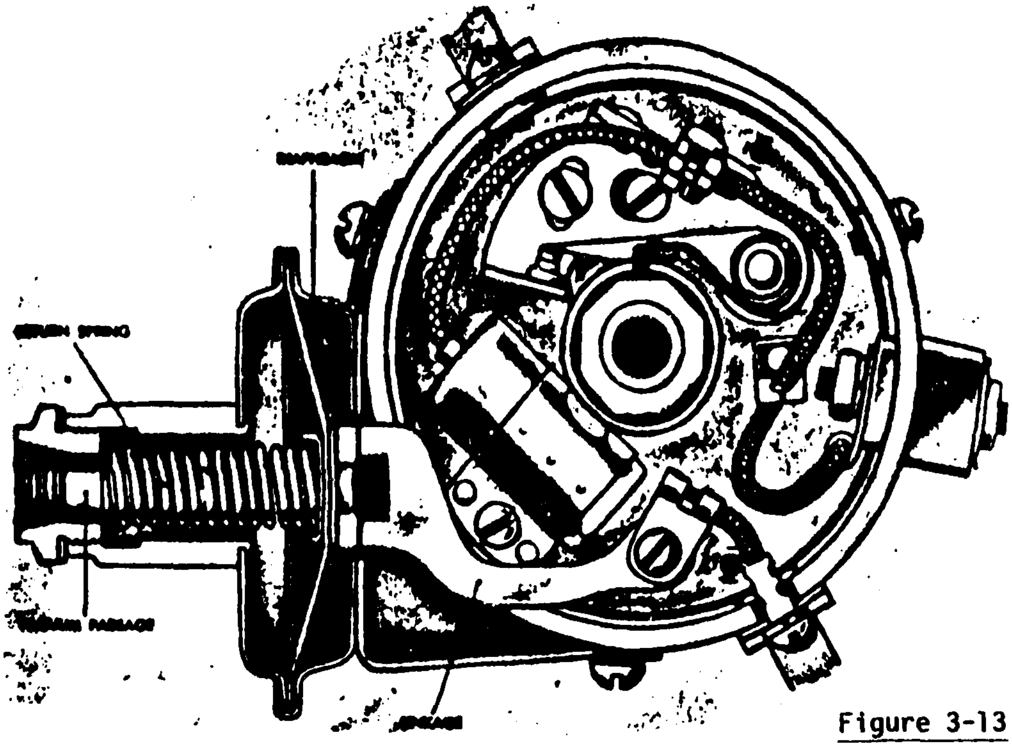


Figure 3-13

(APPENDIX IV - continued)

Test Item 3-14

SITUATION: You have replaced the distributor in a 1/4-ton truck. You have adjusted the breaker point gap and the contact spring tension.

QUESTION: Which group actions below would you follow in order to adjust the approximate timing of the ignition? (see figure 3-14)

****1. (1st) Mark the position of the #1 sparkplug cable on the distributor case,**
(2nd) Rotate the crank shaft until the rotor is positioned to the #1 sparkplug cable mark, and observe that the pointer on the timing gear cover and notch on the crankshaft pulley are aligned,
(3rd) Slowly rotate the distributor counterclockwise until the breaker points just start to open,

2. (1st) Mark the position of the #1 sparkplug cable on the distributor case,
(2nd) Rotate the crank shaft until the rotor is positioned to the #1 sparkplug cable mark,
(3rd) Slowly rotate the distributor counterclockwise until the breaker points just start to open,

3. (1st) Mark the position of the #1 sparkplug cable on the distributor case,
(2nd) Rotate the crank shaft until the rotor is positioned to the #1 sparkplug cable mark, and observe the pointer on the timing gear cover and notch on the crankshaft pulley are aligned,
(3rd) Slowly rotate the distributor clockwise until the breaker points just start to open,

(APPENDIX IV - continued)

(Test Item 3-14 continued)

Parts Named:

1. Timing Gear Cover
2. Timing Pointer
3. Timing Notch
4. Crankshaft Pulley

5. Distributor Cap
6. Rotor
7. Breaker Points
8. Distributor Housing
9. Adaptor Mounting Screw

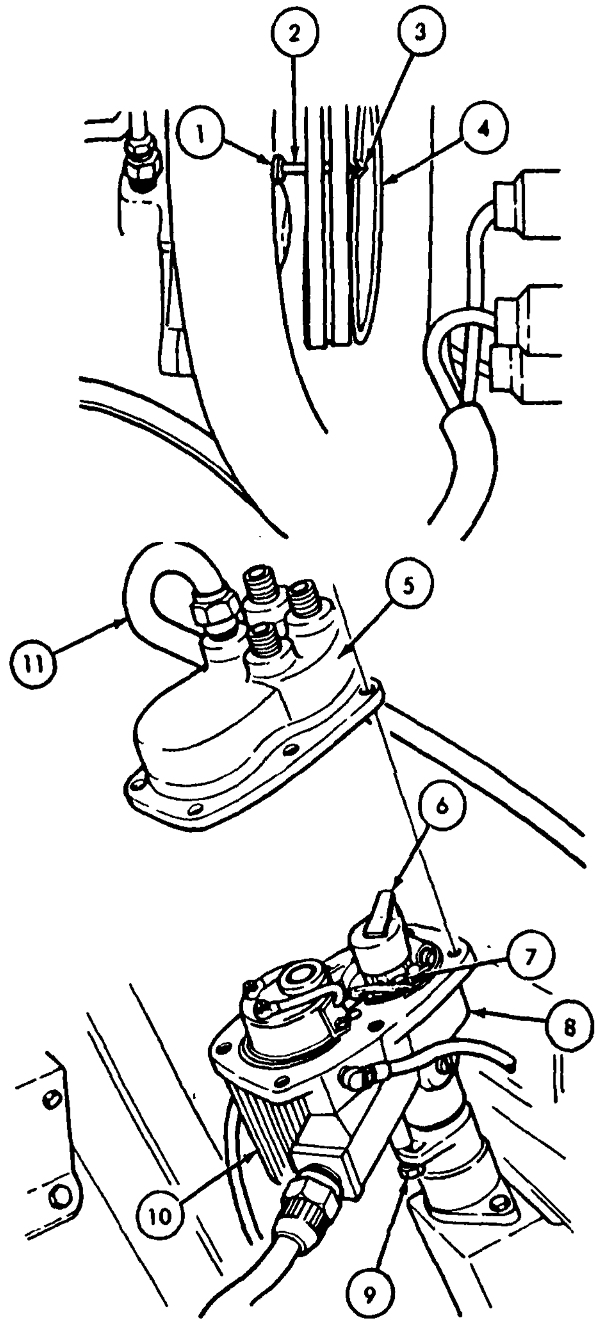


Figure 3-14

(APPENDIX IV - continued)

Test Item 3-15

SITUATION: You have replaced the distributor in a 1/4-ton truck. You have adjusted the breaker point gap, adjusted the contact spring tension, and have completed an approximate timing of the ignition.

QUESTION: Which group actions below would you follow to connect the timing light and tachometer in order to complete a precise timing adjustment of the ignition? (see figure 3-15)

****1. (1st) Remove #1 sparkplug cable from the sparkplug.**
(2nd) Place the timing light adaptor on the sparkplug and attach the sparkplug cable to the timing light adaptor.
(3rd) Connect the timing light leads to the timing light adaptor, to the ground, and to the battery positive terminal.
(4th) Attach the tachometer to the primary connector of the distributor and ground.

2. (1st) Remove #1 sparkplug cable from the distributor.
(2nd) Place the timing light adaptor on the distributor and attach the sparkplug cable to the timing light adaptor.
(3rd) Connect the timing light leads to the timing light adaptor, to the ground, and to the battery positive terminal.
(4th) Attach the tachometer to the primary connector of the distributor and ground.

3. (1st) Remove #1 sparkplug cable from the sparkplug.
(2nd) Place the timing light adaptor on the sparkplug and attach the sparkplug cable to the timing light adaptor.
(3rd) Connect the timing light leads to the timing light adaptor, to the ground, and to the battery positive terminal.
(4th) Attach the tachometer to the primary connector of the distributor and the battery positive terminal.

(APPENDIX IV - continued)

(Test Item 3-15/continued)

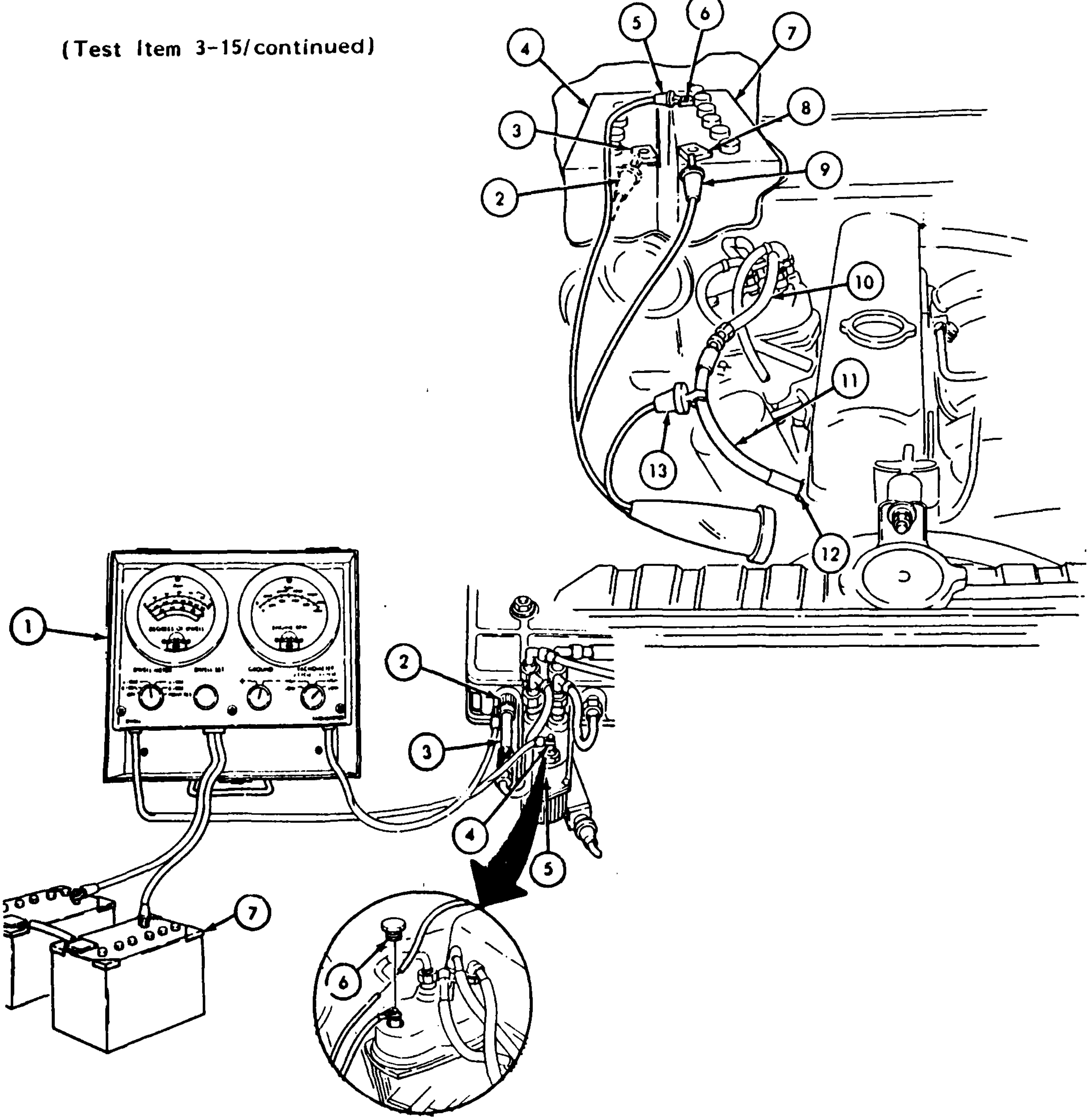
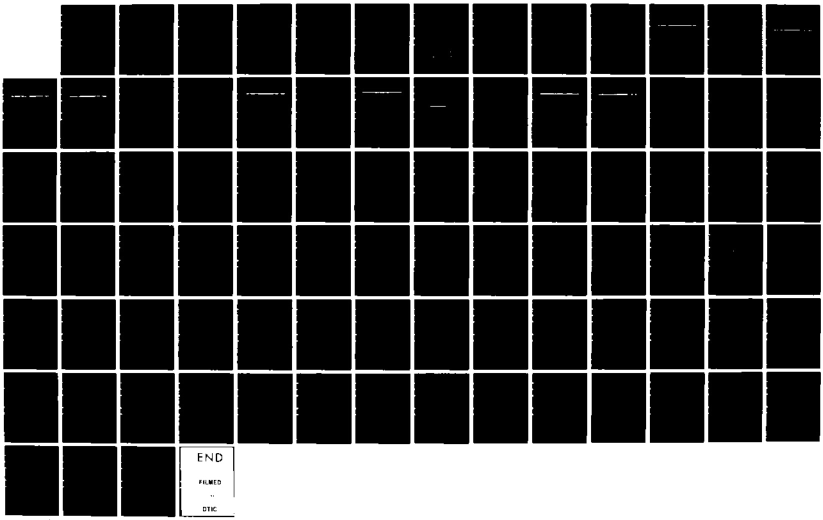
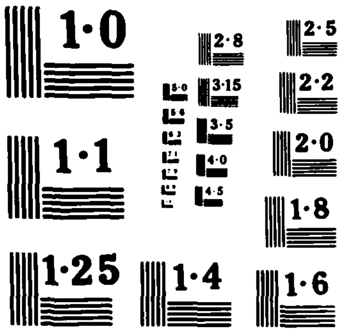


Figure 3-15
for Test Item 3-15

AD-A144 973 A PLATO-BASED TEST ITEM BANK FOR ARMY VEHICLE MECHANICS (MOS63B-SERIES)(U) INSTRUCTIONAL SYSTEMS DESIGN ISSAQUAH WA S R PATTON 30 MAR 84 MDA903-83-C-0221 2/2

UNCLASSIFIED F/G 5/10 NL




1·0
2·8
2·5
3·15
2·2
3·5
2·0
1·1
4·0
4·5
1·8
1·25
1·4
1·6

(APPENDIX IV - continued)

Test Item 3-16

SITUATION: You have replaced the distributor in a 1/4-ton truck. You have adjusted the breaker point gap, adjusted the contact spring tension, and have completed an approximate timing of the ignition.

QUESTION: Where would you attach the timing light? (see figure 3-16)

****1. Remove the cable from #1 sparkplug, and install the timing light adaptor; then connect the timing light leads to the timing light adaptor, to the ground and to the battery positive terminal.**

2. Remove the primary cable at the distributor, and install the timing light adaptor; then connect the timing light leads to the timing light adaptor, to the ground and to the battery positive terminal.

3. Disconnect the primary cable at the distributor and install the timing light adaptor; then connect the timing light leads to the sparkplug cable #1, to the ground and to the battery positive terminal.

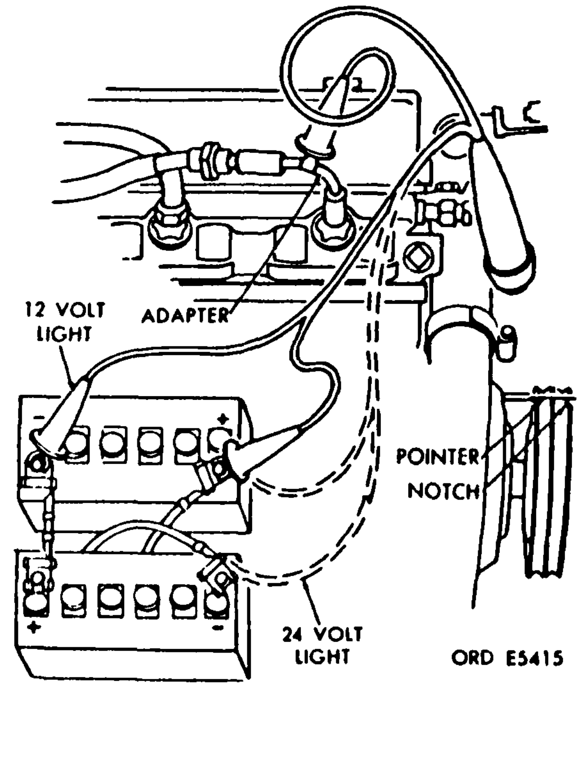


Figure 3-16

(APPENDIX IV - continued)

Test Item 3-17

SITUATION: You have replaced the distributor in a 1/4-ton truck. You have adjusted the breaker point gap, have adjusted the contact spring tension, have completed an approximate timing of the ignition, and have connected the timing light and tachometer in preparation for completing the ignition timing.

QUESTION: Which group of actions below would you follow in order to complete precise timing of the ignition? (see figure 3-17)

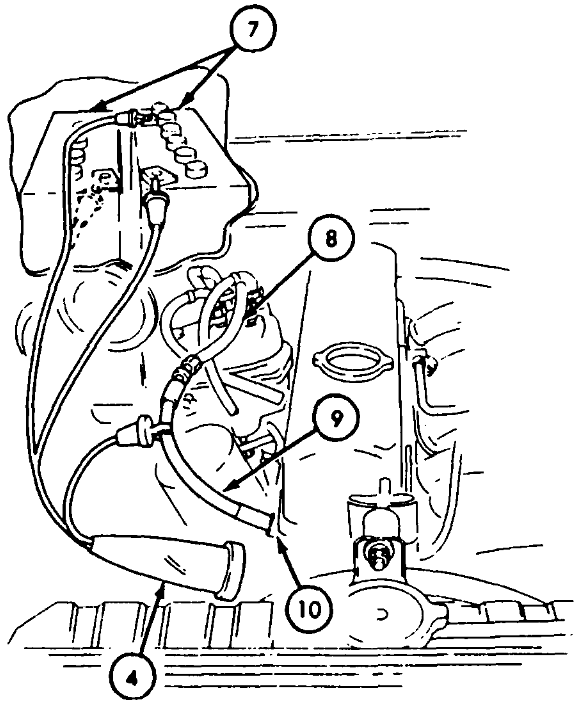
****1. (1st) Adjust the engine idle speed to 450 - 500 rpm.**
(2nd) Direct the timing light at the timing pointer on the timing gear cover and rotate the distributor until the pointer and the pulley notch are aligned.
(3rd) Tighten the distributor adaptor mounting screw.
(4th) Increase idle speed while pointing the timing light to the pointer on the timing gear cover. Observe the pulley notch moves away from the pointer if the distributor centrifugal advance is functioning.

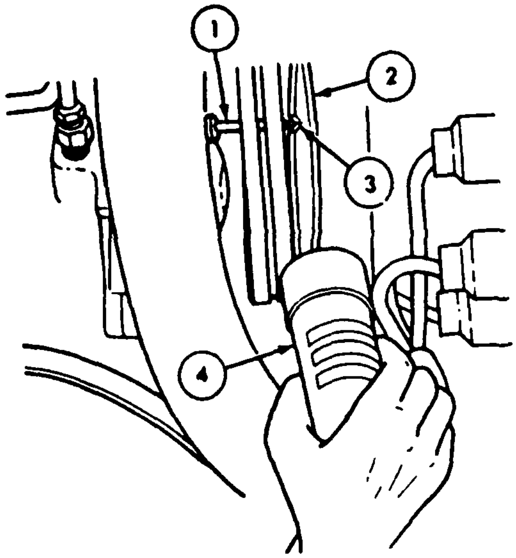
2. (1st) Direct the timing light at the timing pointer on the timing gear cover and rotate the distributor until the pointer and the pulley notch are aligned.
(2nd) Tighten the distributor adaptor mounting screw.
(3rd) Increase idle speed while pointing the timing light to the pointer on the timing gear cover. Observe the pulley notch moves away from the pointer if the distributor centrifugal advance is functioning.

3. (1st) Adjust the engine idle speed to 450-500 rpm.
(2nd) Direct the timing light at the timing pointer on the timing gear cover and rotate the distributor until the pointer and the 10-degree BTDC mark on the pulley are aligned.
(3rd) Tighten the distributor adaptor mounting screw.
(4th) Increase idle speed while pointing the timing light to the pointer on the timing gear cover. Observe the pulley notch moves away from the pointer if the distributor centrifugal advance is functioning.

(APPENDIX IV - continued)

(Test Item 3-17/continued)





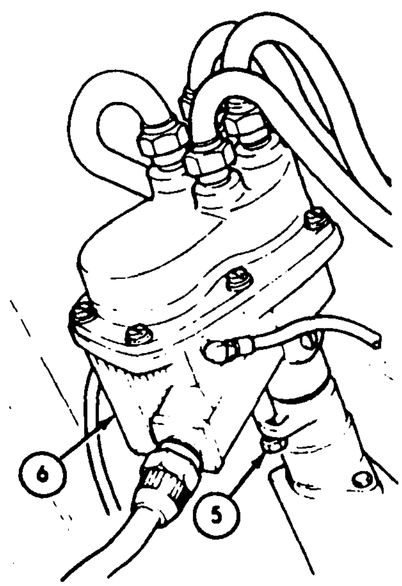


Figure 3-17

(APPENDIX IV - continued)

Test Item 3-18

SITUATION: You have replaced the distributor in a 1/4-ton truck. You have adjusted the breaker point gap, have adjusted the contact spring tension, have completed an approximate timing of the ignition, and have connected the timing light and tachometer in preparation for completing the ignition timing.

QUESTION: How would you set the timing of the ignition? (see figure 3-18)

****1. Direct the timing light at the crankshaft pulley and rotate the distributor until the pointer and the pulley notch are aligned.**

2. Direct the timing light at the crankshaft pulley and rotate the distributor until the pointer and the 10-degree BTDC* mark on the pulley are aligned.

3. Direct the timing light at the crankshaft pulley and rotate the distributor until the pointer and the 6-degree BTDC* mark on the pulley are aligned.

(*BTDC = Before Top Dead Center)

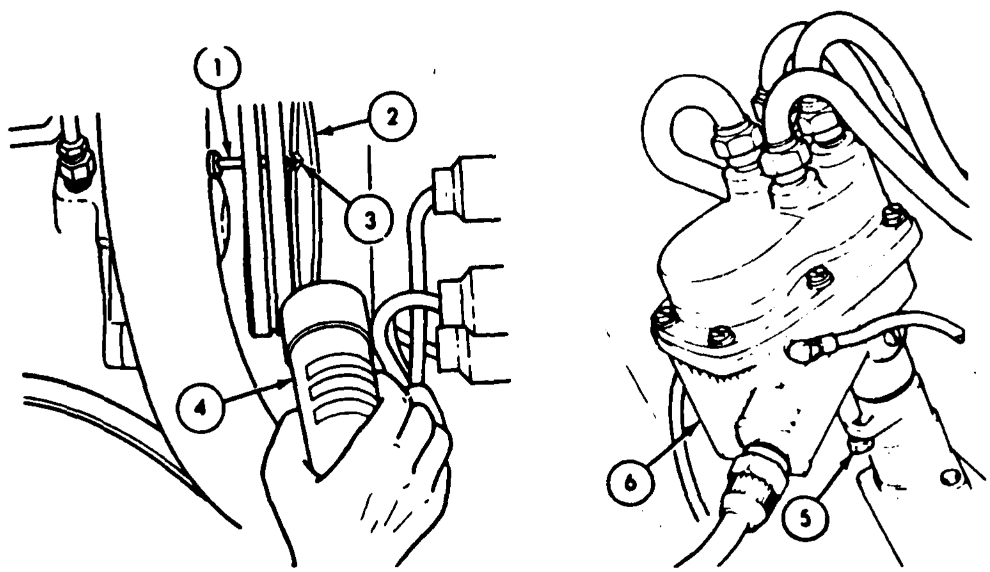


Figure 3-18

(APPENDIX IV - continued)

(NOTE: There are NO test items for SAFETY Precautions)

(D) TROUBLESHOOTING and/or Diagnostics

Test Item 3-19

SITUATION: It has been reported the engine on a 1/4-ton truck starts but fails to keep running. You have been directed to troubleshoot this problem.

QUESTION: What would you do to troubleshoot this problem? (NO FIGURE)

****1. Check the distributor breaker points to see if they are gapped at about 0.020 of an inch.**

2. Check the ignition timing to see if sparkplug #1 fires when the notch in the pulley and timing pointer are aligned.

3. Check the compression ratio of all the cylinders to see if there is a burned valve.

4. Remove the sparkplugs and check each one for carbon buildup and a gap of about 0.030 of an inch.

Test Item 3-20

SITUATION: You have been directed to troubleshoot a 1/4-ton truck reported to have poor acceleration.

QUESTION: What would you do to troubleshoot this problem? (NO FIGURE)

****1. Check the ignition timing to see if sparkplug #1 fires when the notch in the pulley and timing pointer are aligned.**

2. Check the fuel pump pressure at the fuel filter for pressure of 4 to 6 psi.

3. Check to see if the choke is fully opened when the engine reaches its operating temperature.

4. Check the compression ratio of all cylinders to see if there is a burned valve.

(APPENDIX IV - continued)

Test Item 3-21

SITUATION: A 1/4-ton truck has been reported to start hard and stall easily. You have been directed to do a "breaker point resistance test" to see if the points, internal primary connections and distributor ground are normal. You have set-up the test by connecting the voltmeter as shown in Figure 3-21 (below).

With the breaker points closed, the voltmeter reads more than 0.2 volts.

QUESTION: What does this information indicate to you? (see figure 3-21 below)

****1. There is a poor distributor ground connections and/or burned and pitted breaker points.**

2. There is carbon buildup on the sparkplug points causing a decreased spark at firing.

3. There is a defective capacitor across the breaker points causing excess arcing.

4. There is a defective primary winding in the coil causing a lower than normal voltage at the sparkplugs.

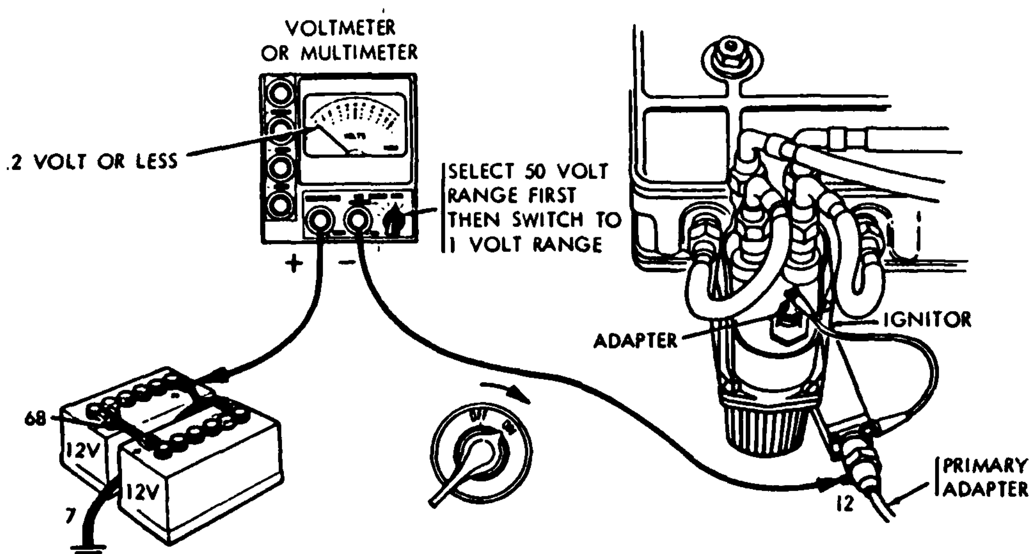


Figure 3-21

(APPENDIX IV - continued)

(E) RELATED (Task) Actions

Test Item 3-22

SITUATION: It has been reported the engine on a 1/4-ton will NOT start. You have been directed to do a "secondary current test" in order to locate the problem.

You remove each sparkplug cable, one at a time, and crank the starter over with the ignition switch ON while holding the end of the cable 1/4-inch from the engine block.

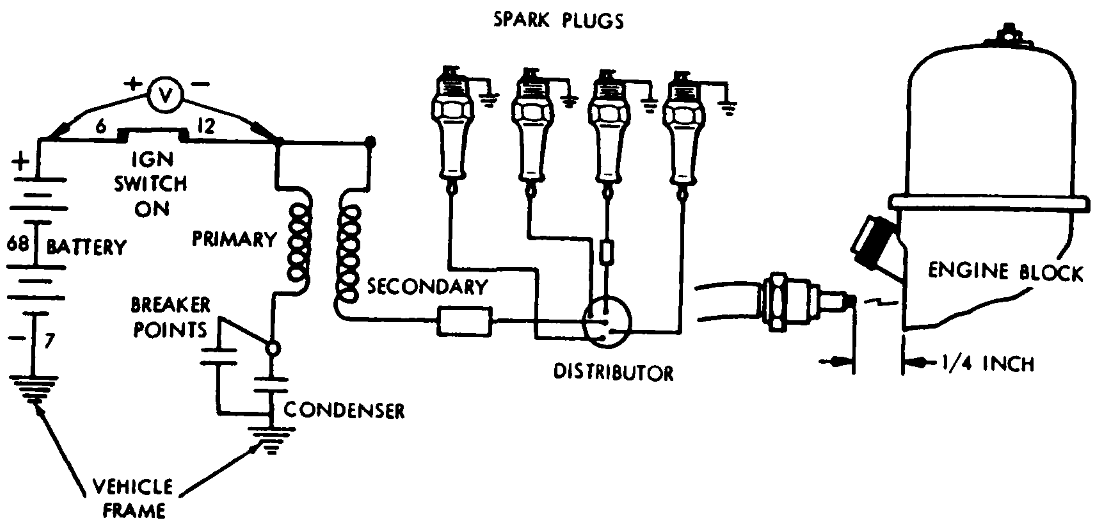
QUESTION: Which statement is correct? (see figure 3-22)

1. If the spark jumps the gap, then the secondary circuit up to the sparkplug is normal and the cause of the problem may be a defective or dirty sparkplug.

2. If the spark jumps the gap, the secondary circuit is normal and the cause is not in the ignition system.

3. If the spark jumps the gap, the voltage in the secondary circuit may not be high enough to fire the sparkplug when the piston is under compression.

4. If the spark jumps the gap, the voltage in the secondary circuit may be too high causing an arc-to-ground when the piston is under compression.



TEST SECONDARY CURRENT TEST

Figure 3-22

APPENDIX V.

Authoring Options for the PLATO Learning Management System.

Press DATA if you want this person to have
the same options you have.

or enter the letter of the type of individual
options you want to set:

a. Primary Instructor Options

b. File Editing & Printing

c. Roster Options

d. General Record Editing Options

e. Student Record Editing Options

f. Active User Options

g. Messages and Notes

h. Data Collection Options

i. "mrouter" options

j. PLM options

PLM Author Options Displays

(APPENDIX V - continued)

KEY	ACTION
NEXT	Advance to next activity.
SHIFT-NEXT	Advance to next major activity.
BACK	Cancel last request or go back to the previous display.
SHIFT-BACK	Return to previous major display.
HELP	Display available HELP information
SHIFT-HELP	Delete item.
DATA	Replot display.
COPY	Each press of the COPY key copies one work of an entered string of words into the text being edited.
SHIFT-COPY	Pressing SHIFT-COPY copies the entire string or remainder of the string into the text being edited.
EDIT	The first press of the EDIT key removes the entire string of words from the screen. Subsequent presses of the EDIT key brings back one word.
SHIFT-EDIT	After the EDIT key has been pressed, pressing SHIFT-EDIT returns the entire string or remainder of the string to the screen.
ACCESS (□)	Each press of the □ key copies or brings back one letter into the text being copied or edited.
ERASE	Each press of the ERASE key removes one character, beginning with the last character entered on the screen.
SHIFT-ERASE	Pressing SHIFT-ERASE removes the entire word.
SHIFT-STOP	Exit from PLATO Learning Management.
ANS	Defined for each question type.

PLM Key Conventions

(APPENDIX V - continued)

CURRICULUM: Army [illegible]

ARMY SGT DEVELOPMENT

COURSES:

Enter an option letter ≫

L for curriculum Library
G for student Groups
M to edit Management strategies
C to add Courses

SHIFT-DATA for Curriculum Directory

PLM Curriculum Options Display (Blank)

(APPENDIX V - continued)

Curriculum -----Army

Account -------- isdqw

Press the associated number to change an entry.

ACCESS / USAGE CODEWORDS

1. to modify curriculum -- **********
2. to inspect curriculum - **********
3. to use curriculum ----- **********

ACCESS TO FILE BY:

4. System personnel ------ ALLOWED

5. Students -------------- ALLOWED

6. to take a test -------- blank--OPEN TO ALL

NEXT for Curriculum Specifications

PLM Access/Usage Codewords Display

(APPENDIX V - continued)

CURRICULUM: army　　　　sqts

VARIABLE MANAGEMENT STRATEGY	COURSES 1 2 3 4 5 6

■ = verified　□ = not verified　- = course not used in VMS

SHIFT-DATA to add a VMS

PLM Curriculum VMS Selection Display (Blank)

(APPENDIX V - continued)

CURRICULUM-LEVEL VMS OPTIONS VMS #2: Army

ARMY SQT DEVELOPMENT

a. Curriculum Welcome Message............ Entered

b. Course Hierarchy....................... Entered

c. Placement Testing...................... Yes

d. Estimated Course and Module Durations.. Entered

e. Feedback for Mastery of Curriculum..... Entered

f. Grade Names

g. Lesson Interface Controls

h. Course List Controls

i. Module List Controls

j. Advisory Message Controls

k. System Message Controls

l. Feedback Message Controls

m. Student/Test Interaction Controls

Press item letter SHIFT-DATA for another VMS

PLM Curriculum-level VMS Options Display

(APPENDIX V - continued)

COURSE HIERARCHY VMS #2: army

1 SQT/SL-1
2 SQT/SL-2

COURSE	PREREQUISITES	COURSE	PREREQUISITES
1			
2			

STATUS OPTIONS: Used, Not used
PREREQUISITE OPTIONS: Add, Delete, Clear, Sequence

SHIFT-NEXT for Placement Test
SHIFT-BACK for Welcome Message

SHIFT-COPY to copy from another VMS

PLM Course Hierarchy Display

(APPENDIX V - continued)

PLACEMENT TEST

The first thing to do in this curriculum is the "PLACEMENT" test. The placement test is used to determine which courses you should take.

Press **NEXT** to begin the test.

PLM Curriculum Placement Test (Student View)

(APPENDIX V - continued)

End of Test

The PLACEMENT test is now over.

You are now ready to begin your study of:

WHAT DO YOU WANT TO DO NEXT?

a. Continue

b. See how well you're doing

c. Sign off

PLM Curriculum Placement Test Results

(APPENDIX V - continued)

CURRICULUM RULES VMS #2: army

SYSTEM MESSAGE OPTIONS

1. Display Student Curriculum Instructions .... yes
2. Display Student Course Instructions .... yes
3. Display Module Testing Strategy and Scoring Procedure at the Beginning of a Test .... yes
4. Display Each Objective Before it is Tested ..... yes
5. Display IU Testing Strategy and Scoring Procedure Before Testing the Objective .... yes
6. Identify each Question by Module, Objective, and Question Name .... yes

Select an Option

SHIFT-COPY to copy from another VMS
SHIFT-NEXT for Feedback Message Controls
SHIFT-BACK for Module Advisory Messages

PLM System Message Options Display

(APPENDIX V - continued)

Testing Procedure for Module A

This test covers 5 objectives.
To master this module, you must master 4 objectives.

NEXT to continue

PLM Module Testing Strategy (Student View)

(APPENDIX V - continued)

CURRICULUM RULES VMS #2:

FEEDBACK MESSAGE OPTIONS

1. Display Module Score .... yes

2. Display IU Score .... yes

3. Display Question Score .... yes

4. Give Feedback For Each IU .... yes
   ✔ Following Each Objective Test
   At End of the Whole Test

Select an Option

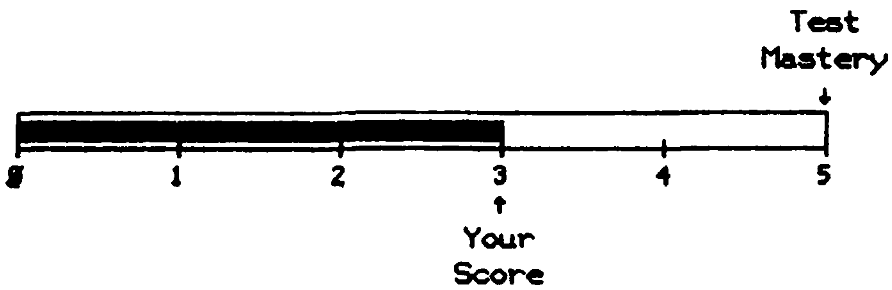
SHIFT-COPY to copy from another VMS
SHIFT-NEXT for Student/Test Interaction
SHIFT-BACK for System Message Controls

PLM Feedback Message Options Display

(APPENDIX V - continued)

Test Results for Module: A

There were 5 objectives tested;
you mastered 3.



Now on the basis of these test results, you'll get a study prescription especially suited to your needs.

First let's see which objectives you've mastered and which ones you haven't,

NEXT to see which objectives you mastered and did not master

LAB to see your study assignment

PLM Module Score Display

(APPENDIX V - continued)

Module A	Objective: Task 7

You mastered this objective.

Objective mastery is based on the number of questions you answered correctly. The following shows your performance:

4 Questions presented
4 Correct answers required for mastery
4 Questions mastered

NEXT to continue

PLM IU Score and Feedback Message

(APPENDIX V - continued)

PLATO learning management

1. Title: Army SQTs
   (module file = cells)
2. IUs/Questions
   (7 IUs entered)
3. Lesson used as a test
   (option not in use)
4. Learning Resources
   (21 LRs entered)
5. Testing Strategy
   Randomly measure all objectives.
6. Scoring Procedure
   Module Mastery is assigned when student masters 90% of the Module IUs.

7. Messages
   - Student Introduction: entered
   - Mastery Feedback: entered
   - Non-Mastery Feedback: entered

Module Space Used = 69%

ENTER ITEM NUMBER.

(now verified for on-line testing)

SHIFT-DATA for Directory   COPY to take test
INSPECT ONLY

PLM Module Options Display (Inspect Only)

(APPENDIX V - continued)

OVERRIDE STATUS MODULE: army

VMS #	TESTING STRATEGY	SCORING PROCEDURE
1	A module	H module
2	B override	I module
3	C module	J module
4	D module	K module
5	E module	L module
6		
7		

T. MODULE TITLE:
SQT-1/MOS63B1,Ver #2

Touch an option or type an option letter to select.

BACK when finished

HELP is available

O. All VMSs are using the Student Introduction Message contained in the .... override

P. All VMSs are using the Mastery Feedback Message written in the .... module

Q. All VMSs are using the Non-Mastery Feedback Message written in the .... module

PLM Override Status Display

APPENDIX VI.

PLATO Coding Sequences for Authoring the Task/Test Item Bank as Structured on the TDQT Model and Coding Required to Enter MOS Test Items into the Completed Bank.

(APPENDIX VI - continued)

```
Lesson  tdqt / pws printed at  9/07/82 10:31 am



--------------------------------------block 1-b    'box'
          last edited  8/24/82     space left  75


unit      intro
box       4,502;500,9
size      3,5
at        714
write     T
at        725
write     D
at        736
write     Q
at        747
write     T
size      2,2 5
at        1225
write     A R M Y
at        1503
size      1.25,2
write     TEST DEVELOPMENT for QUALIFICATION and TRAINING
at        2505
size      0
write     Instructional Systems Design
          Army Research Institute
          Aberdeen Proving Grounds
          Fort Eustis
          Fort Ord
          1982
at        3037
write     press NEXT to continue
define    spot=n1
unit      tdqt
draw      0302;0363,1563,1542,3042,3024;1524,1502;0302
draw      06,466;498,466;498,270;330,270;330,30;182,30,
          182,270,06,270,06,270,06,466
```

(APPENDIX VI - continued)

```
box      0403;1415
         0416;1430
         0431;1447
         0448;1462
box      0403;0505
         0416;0518
box      0431;0533
         0448;0550
box      1525;1627
box      2325;2427
box      1525;2241
box      2325;2941
size     0
at       0805
write    Job
at       1005
write    Inventory
at       0817
write    Job


at       1017
write    Performance
at       1217
write    Requirements
at       0832
write    Testing-
at       1032
write    Training
at       1232
write    Specifications
at       0849
write    Performance
at       1049
write    Testing
at       1827
write    Training
at       2027
write    Requirements
at       2627
write    Validation
at       0504
write    1
at       0517
write    2
at       0532
```

(APPENDIX VI - continued)

```
write    3
at       0549
write    4
at       1626
write    5
at       2426
write    6
at       1805
write    Touch area of
         interest
at       2805
write    press BACK for
         Introduction
back     intro
1pause
pause    keys=touch,term,back
keytype  spot,t(1403,14,20),t(1417,14,20),t(1431,14,20),
         t(1446,14,20),t(2225,16,10),t(2925,16,10)
branch   spot,1pause,x
jump     spot-1,job inv, jpr,testtra,perftest,train,valid
***


-----------------------------------block 1-c    'box1'
         last edited: 8/25/82     space left: 192


unit     perftest
box      4,502;500,9
at       1520
size     0
write    PERFORMANCE TESTING
```

(APPENDIX VI - continued)

```
Lesson  tdqt / pwa printed at  9/07/82 10:31 am

at      2508
write   press NEXT for sqt1
        press SHIFT-NEXT for sqt2
        press BACK to return
back    tdqt
unit    train
box     4,502;500,9
size    1.5,1.5
at      0417
write   TRAINING REQUIREMENTS
        (not yet developed)
at      2808
write   Press  next for T
next    tdqt
unit    valid
box     4,502;500,9
size    3,2
at      0518
write   VALIDATION
size    0
at      1008
write   Select the appropriate activity to learn to:
                  1.  Validate testing and training component
                  2.  Validate MOS tasks
                  3.  Validate JPR's
                  4.  Validate testing and training blueprints
                  5.  Validate performance activities
                  6.  Validate training requirements

                  (above items not yet developed)
at      2808
write   press BACK to return
back    tdqt
```

(APPENDIX VI - continued)

```
-----------------------------------------block 1-d    'box2'
                 last edited: 8/27/82     space left: 2


define   square=n1
unit     job inv
box      4,502;500,9
at       0523
size     1.25,1.25
write    JOB INVENTORY
size     0
at       0708
write    Please touch the appropriate square
at       0912
write          Construct a Job Inventory


               Create a Job Inventory


               Validate a Job Inventory





                Translate Job Inventory into Tests
 box      100,390;129,362
          100,342;129,314
          100,294;129,266
          100,246;129,218
 at       2808
 write    Press DATA for definition of Job Inventory
          Press BACK to return
          press SHIFT-BACK for Introduction
 back     tdqt
 back1    intro
 data     defin1
 1pause
 pause    keys=touch,next,back,data,lab,term
 keytype  square,t(1013,4,2),t(1313,4,2),t(1613,4,2),
          t(1913,4,2)
```

(APPENDIX VI - continued)

```
branch   square,1pause,x
jump     square-1,const,create,val,trans
unit     defin1
box      4,502;500,9
at       1208
write    Job Inventory definition will be displayed in
         this frame
at       2808
write    press BACK to return
back     job inv
***
unit     const
box      4,502;500,9
at       0510
write    Job Inventory Construction
at       0708
write    1.  Introduction to Task Analysis and Course
             Pre-Test
         2.  Identifying the BAsic Unit of Work--the TASK.
         3.  Relationship of the Task Action to its Product
             (including Common Errors in Writing Task
             Actions)
         4.  Identifying Task Steps and Key Steps.
         5.  Using the Key Steps to Write Interim Standards
             for  the Task Action (including Common Errors
             in writing interim standards).
         6.  Writing Standards for the Task Product (includ-
             ing Common Errors in writing product standards).
         7.  Writing Task Conditions (including Common
             Errors in writing Task Conditions).
         8.  How to Handle Contingency Actions.
         9.  Checklist for validating New MOS Job Tasks.
         0.  Post-Test for the Task Training Prograam.
                 (ABOVE ITEMS NOT YET DEVELOPED)
at       2808
write    Press LAB for Pre-Test
lab      pretest
at       3008
write    Press BACK to return
back     job inv
```

(APPENDIX VI - continued)

```
unit    pretest
box     4,502;500,9
at      1008
write   This is a Pre-Test to determine level of
        understanding for construction of Job Inventory
at      2808
write   Press NEXT to continue
next    const
unit    val
at      0508
write   Validate a Job Inventory
at      2808
write   press BACK to return
back    job inv

define  area=n1
unit    create
box     4,502;500,9
at      0510
write   TO CREATE JOB INVENTORY
at      0708
write   To select the activity, touch the appropriate square
at      1008
write           Prepare Job Description


                Prepare Duty Statement


                Prepare Task Statement


                Cluster tasks around Common Product


                Distribute tasks to field sites


                Rewrite tasks for updating
box     80,372;112,348
        80,324,112,300
        80,276;112,252
        80,228;112,204
        80,180,112,156
        80,132;112,108
at      2808
```

(APPENDIX VI - continued)

```
write    Press BACK to return
back     job inv
lpause
pause    keys=touch, term, next, back
keytype  area, t(1011, 4, 1), t(1311, 4, 1), t(1611, 4, 1),
         t(1911, 4, 1), t(2211, 4, 1), t(2511, 4, 1)


branch   area, lpause, x
jump     area-1, descrip, duty, taskstm, cluster, distr, rerite
***
unit     descrip
box      4, 502, 500, 9
at       0508
write    How to prepare Job Description
         (Not yet developed)
at       2808
write    Press BACK to return
back     create
***
unit     duty
box      4, 502; 500, 9
at       0508
write    How to prepare Duty Statements
         (not yet developed)
at       2808
write    Press BACK to return
back     create
***
unit     taskstm
box      4, 502; 500, 9
at       0508
write    Do you want to prepare:

         1.   Action and Product
         2.   Task Steps
         3.   Task Key steps
         4.   Interim Standards
         5.   Standards for Product
         6.   Task Conditions
         7.   Contingency Actions

            (Above items not yet developed)
```

(APPENDIX VI - continued)

```
at       2808
write    Press BACK to return
back     create
***
unit     cluster
box      4,502,500,9
at       0508
write    How to cluster tasks around a common product.

                   (Not yet developed)
at       2808
write    Press BACK to return
back     create
***
unit     distr
box      4,502,500,9
at       0508
write    How to distribute tasks to field sites
                   (not yet developed)
at       2808
write    Press BACK to return
back     create




***
unit     rerite
box      4,502,500,9
at       0508
write    How to rewrite tasks for updating

                   (not yet developed)
at       2808
write    Press BACK to return
back     create
```

(APPENDIX VI - continued)

```
unit     tib
box      4,502;500,9
at       0508
write    Test Item Bank

                   (not yet developed)
at       2808
write    Press BACK to return
next     trans
***
define   dot=n1
unit     jpr
box      4,502;500,9
at       0505
write    JOB PERFORMANCE REQUIREMENTS
                   (JPRs)
at       0812
write    Do you want to learn how to construct JPRs?


         Do you want to construct JPRs?


         Do you want JPRs for:

                   Personnel Management


                   Test Construction


                   Training Construction


                   Validation Studies

box      48,408;80,376
         48,360;80,328
         112,277;144,253
         112,229;144,205
         112,181;144,157
```

(APPENDIX VI - continued)

```
         112,133;144,109
at       2808
write    press BACK to return
back     tdqt
1pause
pause    keys=touch,back,term
keytype  dot,t(907,4,4),t(1207,4,4),t(1715,4,3),
         t(2015,4,3),t(2315,4,3),t(2615,4,3)
branch   dot,1pause,x
jump     dot-1,want1,want2,want3,want4,want5,want6
***
unit     want1
box      4,502;500,9
at       0508
write    This unit will teach how to construct JPRs.
                   (not yet developed)
at       2808
write    Press BACK to return
back     jpr
***
unit     want2
box      4,502;500,9
at       0508
write    This unit will allow construction of JPRs
                   (not yet developed)
at       2808
write    Press BACK to return
back     jpr
***
unit     want3
box      4,502;500,9
at       0508
write    This unit will set requirements for personnel
         management Job Performance Requirements.
                   (not yet developed)
at       2808
write    Presss BACK to return
back     jpr
***
unit     want4
box      4,502;500,9
at       0508
write    This unit will set requirements for Test
         Construction.
                   (not yet developed)
```

(APPENDIX VI - continued)

```
at        2808
write     Press BACK to return
back      jpr
***
unit      want5
box       4,502,500,9
at        0508
write     This unit will set requirements for Training
          Construction
                    (not yet developed)
at        2808
write     Press BACK to return


back      jpr
***
unit      want6
box       4,502;500,9
at        0508
write     This unit will set requirements for Validation
          Studies
                    (not yet developed)
at        2808
write     Press BACK to return
back      jpr


define    block=n1
unit      testtra
box       4,502,500,9
at        0508
write     TESTING-TRAINING SPECIFICATIONS
at        0810
write     Please touch the appropriate block:

          Learn how to develop Testing and Training Blueprint


          Learn how to write Test Blueprint
```

(APPENDIX VI - continued)

```
                Learn How to write Training Blueprint
box             905;1209
                1305;1609
                1705;2009
at              2808
write           Press BACK to return
back            tdqt
lpause
pause           keys=touch,back,term
keytype         block,t(1205,4,3),t(1605,4,3),t(2005,4,3)
branch          block,lpause,x
jump            block-1,learn1,learn2,learn3
***
unit            learn1
box             4,502;500,9
at              0508
write           Training on  Blueprint
at              2808
write           Press BACK to return
back            testtra
***
define          brake=n1
unit            learn2


box             4,502;500,9
at              0508
write           How to write Test Blueprints
at              0812
write           1. Testing Criteria
                2. Analysis of Criteria
                3  Performance Ojectives
                4. Test Specifications
                5. Test Administration
                6. Scoring Specifications
                7. Test Validation
at              1708
write           Press the appropritate numbered key
at              2808
write           Press BACK to return
back            testtra
lpause
pause           keys=all,back,term
keytype         brake,1,2,3,4,5,6,7
branch          brake,x,lok
at              2708
write           Press only 1,2,3,4,5,6 or 7
branch          lpause
lok
```

(APPENDIX VI - continued)

```
jump      brake-1, testcrit, analcrit, perfobj, testspec,
          testadm, scorspec, test val
unit      testcrit
box       4,502;500,9
at        0508
write     Testing Criteria
          (Not yet developed)
at        2808
write     press back to return
back      learn2
unit      analcrit
box       4,502;500,9
at        0508
write     Analysis of Criteria
          (not yet developed)
at        2808
write     Press back to return
back      learn2
unit      perfobj
box       4,502;500,9
at        0508
write     Performance Objective
          (not yet developed)
at        2808
write     press BACK to return
back      learn2
unit      testspec
box       4,502;500,9
at        0508
write     Test Specifications
          (not yet developed)
at        2808
write     Press BACK to return
```

(APPENDIX VI - continued)

```
back     learn2
unit     testadm
box      4,502,500,9
at       0508
write    Test Administration
         (not yet developed)
at       2808
write    Press BACK to return
back     learn2
unit     scorspec
box      4,502,500,9
at       0508
write    Score Specifications
         (not yet developed)
at       2808
write    Press BACK to return
back     learn2


unit     learn3
box      4,502,500,9
at       0508
write    How to Write Learning Blueprints
at       0712
write          1. Training Criteria
               2. Analysis of Criteria
               3. Performance Objectives
               4. Training Specifications
               5. Training Administration
               6. Training Evaluation
               7. Training Validation

               (above items not yet developed)
at       2808
write    Press BACK to return
back     testtra
***
define   joke=n1
unit     trans
box      4,502,500,9
at       0508
write    To translate Job Inventory into Tests for
at       0817
write    MOS 63S1/2  Heavy Wheel Vehicle Mechanic
```

(APPENDIX VI - continued)

```
          MOS 63B  Light Weight Vehicle/Power
          Generator Mechanic


          MOS 63Y1/2  Track Vehicle Mechanic
at        2408




write     TOUCH appropriate square
at        2808
write     Press BACK to return
back      [illegible]
box       77,410;113,374
          77,354;113,318
          77,298;113,262
lpause
pause     keys=touch,term,back,next
keytype   joke,t(910,5,5),t(1310,5,5),t(1610,5,5)
branch    joke,lpause,x
jump      joke-1,mos63s,mos63b,mos63y
unit      mos63s
box       4,502;500,9
at        0508
write     MOS 63S1/2 is not developed.
at        2808
write     Press BACK to return
back      trans
define    leap=nl
unit      mos63b
box       4,502;500,9
at        0508
write     Select the appropriate vehicle or stationary
          equipment by pressing the corresponding key.
```

(APPENDIX VI - continued)

```
                1.  Vehicles

                2.  Stationary Equipment
        at      2808
        write   Press BACK to return
        back    trans
        1pause
        pause   keys=all,back,term
        keytype leap,1,2
        branch  leap,x,1ok
        at      2708
        write   Press only 1 or 2
        branch  1pause
        1ok
        jump    leap-1,veh,equip
        unit    veh
        box     4,502;500,9
        at      0508
        write   Select the appropriate category or system by
                pressing the corrsponding key.

                a.  Axle System
                b.  Body, Cab and Hull
                c.  Brake System
                d.  Clutch System
                e.  Cooling System
                f.  Electrical System
                g.  Engine System
                h.  Exhaust System
                i.  Frames and Towing
                j.  Fuel System

                k.  General Maintenance
                l.  Propeller System
                m.  Springs and Shock Absorbers
                n.  Steering System
                o.  Transmission System
                p.  Transmission Transfer
                q.  Wheel System
                r.  Winch, Hoist, and PTO
        at      2808
        write   Press BACK to return
        back    mos63b
        1pause
        pause   keys=back,all,next,term
```

(APPENDIX VI - continued)

```
keytype leap, a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r
branch  leap, x, lok
at      2708
write   press only a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q or r
branch  lpause
lok
jump    leap-1, axle, body, brake, clutch, cool, elect, engine,
        exhaust, frame, fuel, genm, prop, springs, steer,
        trans, transt, wheel, winch
define  frog=n1
unit    genm
box     4, 502, 500, 9
at      0508
write   Select the appropriate vehicle by pressing
        the corresponding numbered key.
0715
write
        1.  Truck, 1/4-ton Series
        2.  Truck, 1 1/4-ton Series
        3.  Truck, 2 1/2-ton Series
        4.  Truck, 5-ton Series
at      2808
write   Press BACK to return
back    mos62b   VEH
lpause
pause   keys=all, back, term
keytype frog, 1, 2, 3, 4
branch  frog, x, lok
at      2708
write   Press only 1, 2, 3 or 4
branch  lpause
lok
jump    frog-1, truck1, truck2, truck3, truck4
unit    truck1
box     4, 502, 500, 9
at      0508
write   General Maintenance Task for 1/4-ton truck
```

(APPENDIX VI - continued)

```
                    TASK 091-474-1031
            Reference:  TM 9-2320-218-

            Perform Semiannual PM Checks and Services

            Select the appropriate item

                    1.   Subtasks
                    2.   Study Aids
at          2808
write       Press BACK to return
at          2008
write       Select 1 or 2 and press NEXT
back        genm
arrow       1808
answer      1
jump        staski
answer      2
jump        aidsi
pause
pause       keys=next,back
unit        test val
box         4,500;502,9
at          0506
write       Test Validation
            (not yet developed)
at          2808
write       Press BACK to return
back        learn2
define      probe=n1
unit        stask1
box         4,502;500,9
at          0508
write       SEMIANNUAL PM CHECKS  and SERVICES
at          0712
write
            a.   Inspect Linkage and Lines
            b.   Inspect Oil Filter for Leaks and Damage
            c.   Check Fuel System for Leaks and Damage
            d.   Check BAtteries, Compartment, and connections
            e.   Inspect all Safety Devices
            f.   Remove Wheel and Inspect Service Brake System
            g.   Inspect Clutch System
            h.   Inspect Transmission and Transfer Assembly
            i.   Inspect Towing Pintle and Syspension System
            j.   Inspect Propeller Shafts and U-joints
            k.   Check Engine Performance and Final Road Checks
```

(APPENDIX VI - continued)

```
at       2808
write    Press BACK to return
back     truck1
ipause
pause    keys=all,back,term
keytype  probe,a,b,c,d,e,f,g,h,i,j,k
branch   probe,x,iok
at       2708
write    Press only a,b,c,d,e,f,g,h,i,j,k
branch   ipause

iok
jump     probe-1,pm1,pm2,pm3,pm4,pm5,pm6,pm7,pm8,pm8,pm9,
         pm10,pm11

-----------------------------------block 2-c    'box12'
         last edited  9/1/82     space left  7

unit     pm1
box      4,502;500,9
at       0508
write    PM Subtask
         Inspect Linkage and Lines

         1.   Steps, Conditions and Standards

         2.   Test Items
at       2808
write    Press BACK to return
back     stask1
at       2008
write    Select 1 or 2 and press NEXT
arrow    1808
answer   1
jump     step1
answer   2
jump     test1
pause
pause    keys=back,next
unit     step1
box      4,502,500,9
at       0208
write              TASK 071-474-1031
```

(APPENDIX VI - continued)

Subtask: Inspect Linkage and Lines

Conditions. Task will be performed in a maintenance shop or field environment with supervision.

Standards. Choke and throttle valves shall be open
Engine vacuum test shall read_______
Fuel pump pressure shall be ____
There shall be no leaks in fuel lines connections
Ventilation lines shall be tight
Ventilation control valve shall be cleaned and inspected every 12,000 annually, whichever comes first

Task Steps:

I. Manifold Vacuum Test
   A. Remove pipe plug from top rear of intake manifold.
   B. Install adapter on end of vacuum gage hose (fig 2-47)
   C. Start engine and run at idle speed until

(APPENDIX VI - continued)

```
                minimum operating temperature (160F) is
                reached.
at      3008
write   Press NEXT to continue
unit    step1a
box     4,502;500,9
at      0208
write
            D.  Make carburetor adjustments.
                1.  Idle Mixture.
                    a  Turn idle mixture adjusting screw
                       until it just touches the needle
                       seat or until engine begins to lag.
                       Then turn screw OUT until engine
                       operates smoothly (amount one turn).
                 2.  Idle Speed
                    a.  The idle speed adjusting screw
                       (fig. 2-91) should be set at idle
                        speed  of 550 to 600 rpm.
            E.  At engine speed of 600 rpm, vacuum gage
                shall read 17 to 21 inches of mercury.
                As a further check, open and close throttle
                quickly.  If the engine is in good condition
                vacuum should drop to 2 inches of mercury
                at open throttle and quickly return to
                about 25 inches of mercury at closed
                throttle
at      2808
write   Press NEXT to continue
```

(APPENDIX VI - continued)

```
unit     step1b
box      4,502,500,9
at       0208
write    II.  Fuel Pump Pressure Test
                    A.  Disconnect tube at carburetor
                    B   Using a pressure gage, hold tapered
                        adapter to fuel tube
                    C   Start engine  Engine should normally
                        operate due to sufficient fuel in
                        carburetor  If engine does not start
                        continue operating starter until
                        maximum reading on pressure gage is
                        obtained  Correct pressure is from
                        4.9 to 5.4 psi
at       2808
write    Press BACK to return
back     pm1
unit     test1
box      4,502;500,9
at       0508
write    This frame will display a set of questions


         about Preventive Maintenance.
at       2808
write    Press BACK to return
back     pm1
unit     aids1
box      4,502;500,9
at       0508
write    STUDY AIDS

         Training Extension Course (TEC)

         1-944-441-0005F 2 1/2-ton Truck Checks and Services
         1-944-441-0006F 2 1/2-ton Truck Before-Operation
                         Checks and Services
         1-944-441-0007F 2 1/2-ton Truck During, and After-
                         Operation Checks and Services
```

(APPENDIX VI - continued)

```
at       2808
write    Press BACK to return
back     truck1
unit     wheel
box      4,502,500,9
at       0508
write    Select the appropriate vehicle by pressing
         the corresponding numbered key.

         1.  1/4-ton, Utility Truck
         2.  1 1/4-ton Truck
         3.  2 1/2-ton Truck
         4.  5-ton Truck

at       2808
write    Press BACK to return
at       2008
write    Select 1, 2, 3 or 4 and press NEXT
arrow    2208
answer   1
jump     truck1a
answer   2
jump     truck2a
answer   3
jump     truck3a
answer   4
jump     truck4a
pause
pause    keys=back,next
unit     Stask2
box      4,502,500,9
at       0208
write               REPLACE FRONT WHEEL BEARING

                         TASK 091-499-1017
                       1/4-ton Utility Truck

         CONDITIONS: Task will be performed in a miaintenance
         shop or field environment with supervision.
```

(APPENDIX VI - continued)

```
at      0908
write
        EQUIPMENT REQUIRED. Toolkit, general mechanic's;
        Bearing puller; replacement bearings, cups, M151
        series vehicle; and TM 9-2320-218-20

        NOTE The vehicle must be place on a jack stand
        and one front tire and wheel removed prior to
        performing this task.

        STANDARD: You must, within 1 hour and 15
        minutes, replace the front wheel bearings in
        accordance with the tachnical manual.

        REFERENCES. TM 9-2320-218-20, Truck, Utility,
        1/4-ton. 4x4, chap. 2, sec XIX, para 2-138 to
        2-142

        STUDY AIDS: Army Correspondence Course: HB6306-
        Wheeled Vehicle Drive Lines, Axles, and Suspension
        Systems
at      3008
write   Press NEXT to continue
unit    step1c
box     4,502;500,9
at      0408
write   Step 1.100 Remove Spindle
```

(APPENDIX VI - continued)

```
                          1.110 Remove nut and lifting eye. (fig. 2-309)
                          1.120 Jack up front of vehicle.
                          1.130 Remove 5 nuts and wheel.
                          1.140 Remove brake drum.  (fig. 2-310)
                         *1.141 Retract brake shoes by backing off
                                adjusting screws.  (fig. 2. 367);
                          1.150 Remove cotter pin.
                          1.151 Remove flanged nut (fig.  2-311)
                          1.152 Remove washer
                          1.153 Remove spindle
                     *Step 1.200 Remove wheel drive flange. (fig. 2-313)
                          1.210 Remove 4 nuts and lock washers
                                on U-joints.
                          1.220 Move drive shaft out of the way.
                          1.230 Pull flange off of support.
                     *Step 1.300 Remove outer seal, bearing and cup
                             from spindle.
                          1.310 Pry off outer seal and retainer.
                         *1.320 Use Brass Drift to knock out bearing
                                cup from support bracket.
                          1.330 Clean spindle shaft and bore shaft.
at         2608
write                     1.340  Using puller, remove bearing cone


                                (Fig. 2-319)
at         3008
write      Press NEXT to continue
unit       step3c
box        4,502;500,9
at         0208
write      Step 1 400 Remove inner seal, bearing and cup
                     from cup support bracket.
                          1.410 Loosen and remove  baring and seal
                                (with block of wood or brass drift)
                                (Fig. 2-323)
```

(APPENDIX VI - continued)

```
at      0708
write             1.420 With your hand take out bearing
                        cone from support bracket. (fig. 2-325)
                  1.430 Clean support bore.  Remove all dirt.
at      1008
write   Step 1.500 Replace new inner cup bearing and seal.
                  1.510 Use block of wood and hammer to drive
                        new bearing cups (out and inner) into
                        place  (fig.  2-320)
                  1.520 Pack bearing with grease and insert
                        cone into bearing cup.
                        *Tapered end toward inner support.
                  1.530 Coat outside surfaces of seal with
                        "compound sealer", and coat lips of
                        seal with grease.
                  1.540 Drive inner seal into support brake
                        using replacer.  (fig.  2-321)
        Step 1.600 Replace outer cup, seal and bearing
                  1.610 Put new cup in place, and drive
                        into place with block and hammer.
                        (fig.  2-320)
                  1.620 Coat inside of bore with grease 1/16"
                  1.630 Drive in new seal using wood block and
                        hammer (fig.  2.321)
at      3106
write   Press NEXT
unit    step4c
box     1,500;500,1
at      0408
write             1.640 Pack  bearing cone with grease and
                        drive bearing with brass drift and
                        hammer.  *TAPERED END AWAY FROM SPINDLE
        Step 1.700 Re-install spindle wheeldrive flange
                   and re-connect to u-joint
        Step 1.800 Re-install spindle, washer, and
                   flanged nut onto wheel drive flange
        Step 1.900 Adjust tightness of bearings
                  1.910 Using torque wrench, tighten flanged
```

(APPENDIX VI - continued)

```
                 nut to 30 lbs-ft. with torque.
        1.920 Turn spindle 3 complete turns, then
                 recheck torque to make sure it is at
                 30 lbs-ft.
        1.930 Repeat until torque stays at 30 lbs-ft
        1.940 Back flanged nut off one complete
                 turn with wrench, and tighten with
                 finger.
        1.950 Insert cotter pin thru hole in shaft
                 of flanged nut, (spread each half of
                pin over nut) (loosen nut the least
                 amount to align to holes in shaft)
```

punt step 4D

```
-----------------------------------block 2-g   'box16'

at       3006
write    Press NEXT
unit     step5c
box      1,500;500,1
at       0408
write    Step 1.10.00 Re-install brake drum on spindle
                      If brake shoes were loosened at
                      step 1.141, re-adjust brake shoes.
                1.10.10 Insert adjust tool thru adjusting
                        hole and turn adjusting screw until
                        brake drum can be turned with one
                        hand
                1.10.20 Back off adjusting screw 11 clicks.
         Step 1.11.00 Replace Tire/wheel onto spindle and
                      replace 5 nuts
                1.11.10 Re-install nut and lifting eye.

at       2025
write    END OF TASK

at       2808
write    Press BACK to return
back     pm1
```

(APPENDIX VI - continued)

```
at       1615
write    Loading special characters
chartst  sqt,lin
branch   zreturn=-1,10char,x
charset  sqt,lin
10char
erase
pause    2
unit     a1
at       0425
write    WELCOME
size     2
at       0725
write    REMEMBER
size     0
at       922
write    when in doubt..........

         Press the "next" button
pause    5
at       3129
write    Do It Now!
unit     a2
at       910
write      Congratulations!!  You have been selected to
           participate in a study of computer developed
           and administered SQTs.

         The emphasis of this study is on test development
         and administration. We are interested in how this
         SQT compares to the paper and pencil type.  There
         will be no permanent record of your performance
         made or kept.
unit     a3
at       910
write    This SQT is made up of multiple choice questions
```

```
        with three or four possible answers.  Only 1 of
        the possible answers is right.  To answer a question
        press the button representing the answer you feel
        is correct.

        Always be sure of your answer before going to
        the next question.  You may change your answer by
        pressing the "erase" button, and then your new
        answer.  It will not be possible for you to
        change your answer after advancing to the next
        question.
unit    a4
at      910
write   When you are sure of your answer press the
        "next" button.  Your answer will be recorded and
        a new question will appear.

        You will have 90 minutes to complete this SQT.

        When you have answered the last question the
        screen will go blank.  Call the test administrator
        at that time.  He will program the computer to
        score your performance and provide you with a
        copy.

        Thank you for your participation!
```

(APPENDIX VI - continued)

```
*
unit      choice
*jump      alpha
calc      v1⇐0
at        0820
write     WRITTEN TESTS
at        1026
write     MOS 63B
at        1417
write     Which test do you want to see?



          a.  SQT 3        b.  SQT 4
at        1917
write     Press a cr b, and then press next.
arrow     2120
answer    A,a
calc      v1⇐1
answer    B,b
calc      v1⇐2
wrong
at        3016
write     Press ONLY a or b, please.
endarrow
jump      v1,x,x,intro, intro1,
unit      intro
next      name
calc      v4⇐0
          v5⇐0
```

(APPENDIX VI - continued)

```
zero     n5Ø,4Ø
join     pic2
at       1427
write    SQT 3
at       1823
write    MOS 63B30
at       2Ø31
write
```

```
unit     intro1
next     name
calc     v4⇐Ø
         v5⇐Ø
join     pic2
at       1427
write    SQT 4
at       1823
write    MOS 63B40
size     Ø
at       2Ø31
write
```

```
unit     intro2
next     name
calc     v4⇐Ø
```

```
          v5⇐Ø
  size    2
  at      1Ø19
  write   WRITTEN TEST
  at      1427
  write   SQT 3
  at      1823
  write   MOS 63B3Ø
  size    Ø
  *join    box
- unit    intro3
  next    name
  calc    v4⇐Ø
          v5⇐Ø
  size    2
  at      1Ø19
  write   WRITTEN TEST
  at      1427
  write   SQT 4
  at      1823
  write   MOS 63B4Ø
  size    Ø
  *join    box
- unit    name
  at      12Ø3
  write   Before we begin your SQT, please type your name in.
  arrow   1414
  storea  n2Ø
  ok
  at      16Ø3
  write   And now, please give me your Social Security Number,
          or (Army Serial Number).
  arrow   1914
  storea  n21
  ok
  *jump    a1
  jump    v1,x,x,c1,c1ØØ,
  *jump    v1,x,x,c57,c153
```

(APPENDIX VI - continued)

```
*
unit     bypass
*jump     c5Ø
unit     resp1
write    Select only A, B, or C.
unit     resp2
write    Select only A, B, C, or D.
unit     sit1
*jump    c48
at       31Ø
write    SITUATION:  You are supervising a mechanic who is
         replacing the brake pad(s) on an M88Ø.
box      2Ø9;46Ø;3
unit     c1
add1     v4
join     sit1
at       61Ø
write    1.  Your mechanic reports that he has found only
             one excessively worn brake pad on a front wheel.
             You instruct the mechanic to replace the pad(s)

             A.  on one front wheel.

             B.  on both front wheels.

             C.  on all four wheels.
at       1615
join     resp1
arrow    183Ø
storea   n4Ø
answer   B,b
add1     v5
jump     c2
answer   A,a,C,c
jump     c2
unit     c2
```

(APPENDIX VI - continued)

```
addl     v4
join     sitl
at       6Ø6
write    2.
at       61Ø
write    When the mechanic removes the inside brake pad(s),
         you should insure that he supports the caliper to
         prevent damage to the

         A.   flange.

         B.   caliper finger.

         C.   flexible brake hoses.
at       1615
join     respl
arrow    183Ø
storea   n41
answer   C,c
addl     v5
jump     c3
answer   A,a,B,b
jump     c3
unit     c3
addl     v4
join     sitl
at       6Ø6
write    3.
at       61Ø
write    The mechanic has replaced the brake pad(s) and
         reports that the brake pedal is not firm.  You
         should instruct the mechanic to

         A.   bleed the brakes.

         B.   adjust the calipers.

         C.   replace the rotors.
```

(APPENDIX VI - continued)

```
at        1615
join      resp1
arrow     183Ø
storea    n42

answer    A,a
add1      v5
jump      c4
answer    B,b,C,c
jump      c4
*
unit      c5
add1      v4
join      sit2
at        8Ø6
write     5.
at        81Ø
write     Which of the following must the mechanic remove
          prior to adjusting the governor?

          A.  Front throttle housing cover and gasket.

          B.  Front control rod assembly and gasket.

          C.  Front bellcrank assembly and gasket.
at        1715
join      resp1
arrow     193Ø
storea    n44
answer    A,a
add1      v5
jump      c6
answer    B,b,C,c
jump      c6
unit      c6
add1      v4
join      sit2
at        81Ø
```

(APPENDIX VI - continued)

```
write   6.  To eliminate surging or poor speed regulation
            after adjusting the governor control assembly,
            the mechanic must adjust the

            A.  governor control rod.

            B.  idle adjustment needle.

            C.  governor flyweights.
at      1815
join    resp1
arrow   2030
storea  n45
answer  B,b
add1    v5
jump    c7
answer  A,a,B,b
jump    c7

unit    sit3
at      310
write   SITUATION:  You are supervising a mechanic who is
        adjusting the carburetor on a 1.5-kilowatt generator
        set.
box     209;562;3
unit    c7
add1    v4
join    sit3
at      710
```

(APPENDIX VI - continued)

```
write   7.  While the mechanic is adjusting the carburetor,
            the engine starts to overheat. The mechanic
            asks why overheating could occur when adjusting
            the carburetor.  You tell him it is because the

            A.  carburetor idle speed is too high.

            B.  carburetor idle mixture is too rich.

            C.  carburetor fuel/air mixture is too lean.
at      2215
join    resp1
arrow   243Ø
storea  n46
answer  C,c
add1    v5
jump    c8
answer  A,a,B,b
jump    c8
unit    c8
add1    v4
join    sit3
at      71Ø
write   8.  While the carburetor is being adjusted, you
            notice that the exhaust is black.  You  should
            direct the mechanic to adjust the

            A.  adjust the main adjustment needle.

            B.  adjust the idle speed regulating screw.

            C.  adjust the idle mixture screw.
```

(APPENDIX VI - continued)

```
at      1815
join    resp1
arrow   2030
storea  n47
answer  A,a
add1    v5
jump    c9
answer  B,b,C,c
jump    c9

unit    c9
add1    v4
join    sit3
at      810
write   9.  The mechanic asks how the engine idle RPM is
            adjusted. You tell he should turn the carburetor

            A.  idle speed regulating screw.

            B.  idle mixture needle.

            C.  main adjustment needle.
at      1815
join    resp1
arrow   2030
storea  n48
answer  A,a
add1    v5
jump    c10
answer  B,b,C,c
jump    c10
unit    sit4
at      310
write   SITUATION:  A driver has brought his M561 into
        your shop.  He complains that the brakes are not
        functioning properly.  You must supervise the
        mechanic who is inspecting the service brakes.
```

(APPENDIX VI - continued)

```
box      2Ø9;66Ø;3
unit     c1Ø
addl     v4
join     sit4
at       81Ø
write    1Ø.  Prior to inspecting the brake drum, which
              of the following should be used to clean
              the brakedrums?

              A.   A soft brush and water.

              B.   A wire brush and solvent.

              C.   Compressed air and rag.
at       1815
join     resp1
arrow    2Ø3Ø
storea   n49
answer   A,a
addl     v5
jump     c11
answer   B,b,C,c
jump     c11
unit     c11
addl     v4
join     sit4
at       81Ø
```

(APPENDIX VI - continued)

```
write    11.  While inspecting the brakedrum, the mechanic
              finds gouges in the drum surface.  You should
              instruct him to

            A.  replace the brakedrum.

            B.  file the gouges.

            C.  turn the brakedrum.
at       2Ø15
join     resp1
arrow    223Ø
storea   n5Ø
answer   A,a
add1     v5



jump     c12
answer   B,b,C,c
jump     c12
unit     c12
add1     v4
join     sit4
at       81Ø
```

(APPENDIX VI - continued)

```
write    12. When inspecting the service brakes, you should
             instruct the mechanic to check the wheel
             cylinders for

           A.  leaks.

           B.  wear.

           C.  adjustment.
at       1915
join     resp1
arrow    213Ø
storea   n51
answer   A,a
add1     v5
jump     c13
answer   B,b,C,c
jump     c13
unit     sit5
at       31Ø
write    SITUATION:  You are supervising a motor pool
         mechanic who is troubleshooting clutch malfunctions
         on a 5-ton truck (M8Ø9 series).
box      2Ø9;562;3


*
unit     c13
add1     v4
join     sit5
at       71Ø
```

(APPENDIX VI - continued)

```
write   13.  With the transmission in low gear and the
             clutch pedal fully depressed, the vehicle
             creeps forward.  This situation is caused by

             A.  insufficient clutch pedal free travel.

             B.  excessive clutch pedal free travel.

             C.  no clutch pedal free travel.
at      1915
join    resp1
arrow   213Ø
storea  n52
answer  B,b
add1    v5
jump    c14
answer  A,a,C,c
jump    c14
unit    c14
add1    v4
join    sit5
at      71Ø
```

(APPENDIX VI - continued)

```
write   14.  The mechanic has adjusted the clutch pedal
             free travel but the vehicle still creeps
             forward with the clutch fully depressed.
             This may be caused by a

             A.  bent linkage.

             B.  a  worn disk.

             C.  a  damaged bearing.
at      1815
join    resp1
arrow   2Ø3Ø
storea  n53
answer  A,a
add1    v5
jump    c15
answer  B,b,C,c
jump    c15
unit    c15

 add1    v4
 join    sit5
 at      71Ø
```

```
write    15.  With the transmission in low gear and the
              clutch pedal fully depressed, the clutch is
              noisy.  The most probable cause of the noise
              is a

              A.  worn clutch release bearing.

              B.  broken pressure spring.

              C.  bent release shaft.
at       1815
join     resp1
arrow    2030
storea   n54
answer   A,a
add1     v5
jump     c16
answer   B,b,C,c
jump     c16
unit     sit6
at       310
```

(APPENDIX VI - continued)

```
write   SITUATION:  A driver has reported to you with a
        DA Form 24Ø4 indicating that his vehicle (M8Ø9
        series) steers hard.  You must supervise the
        mechanic who is troubleshooting the steering system.
box     2Ø9;662;3
unit    c16
add1    v4
join    sit6
at      81Ø
write   16.  When checking the power steering pump, the
             mechanic should first check for

             A.   broken belts.

             B.   fluid leaks.

             C.   loose bolts.
at      1715

join    resp1
arrow   193Ø
storea  n55
answer  A,a
add1    v5
jump    c17
answer  B,b,C,c
jump    c17
```

(APPENDIX VI - continued)

```
*
unit    c17
addl    v4
join    sit6
at      81Ø
write   17.  After determining that the power steering
             is "OK" the  mechanic should check the
             steering gear control valve for

             A.  maladjustment.

             B.  leaks.

             C.  pressure
at      2Ø15
join    resp1
arrow   223Ø
storea  n56
answer  B,b
addl    v5
jump    c18
answer  A,a,C,c
jump    c18
unit    c18
addl    v4
join    sit6
at      81Ø
write   18.  If the power steering pump has been found
```

(APPENDIX VI - continued)

```
                defective, what level of maintenance should
                replace it?

                A.  Organizational.

                B.  Direct Support.

                C.  General Support.
at      1915
join    resp1
arrow   213Ø
storea  n57
answer  B,b
add1    v5
jump    c19
answer  A,a,C,c
jump    c19
unit    sit7
at      31Ø
```

(APPENDIX VI - continued)

```
write   SITUATION:  A driver brings his vehicle into the
        shop and tells you that his front winch does not
        seem to be working properly.  You must supervise
        the mechanic who is adjusting the winch.
box     2Ø9;661;3
unit    c19
add1    v4
join    sit7
at      81Ø
write   19.  The mechanic is preparing to operate and
             adjust the winch.  In which position should he
             put the  transmission gear shift lever?

             A.   Neutral (N)

             B.   Second gear (2)

             C.   Third gear (3)
at      1815
join    resp1
arrow   2Ø3Ø
storea  n58
answer  A,a

add1    v5
jump    c2Ø
answer  B,b,C,c
jump    c2Ø
unit    c2Ø
add1    v4
join    sit7
at      81Ø
```

(APPENDIX VI - continued)

```
write   2Ø.  When the mechanic is adjusting the automatic
             winch brake, you must insure that he turns the
             winch brake adjustment bolt one-half turn to
             the right to

             A.  increase brake tension.

             B.  decrease brake tension.

             C.  maintain brake tension.
at      2215
join    resp1
arrow   243Ø
storea  n59
answer  A,a
add1    v5
jump    c21
answer  B,b,C,c
jump    c21

*
unit    c21
add1    v4
join    sit7
at      81Ø
```

(APPENDIX VI - continued)

```
write   21.  When the mechanic has adjusted the winch
             brake correctly, you should be able to touch
             the brakedrum cover immediately after testing,
             and find that it is


              A.  cold.

              B.  warm.

              C.  hot.
 at      1915
 join    resp1
 arrow   213Ø
 storea  n6Ø
 answer  B,b
 add1    v5
 jump    c22
 answer  A,a,C,c
 jump    c22
 unit    sit8
 at      31Ø
 write   SITUATION:  You are a motor sergeant in a
         transportation battalion, and you must prepare
         a Materiel Readiness Report (DA Form 24Ø6) for
         your company.
 box     2Ø9;66Ø;3
 unit    c22
 add1    v4
 join    sit8
 at      81Ø
```

(APPENDIX VI - continued)

```
write   22.  When preparing the 2406, equipment on loan
             should be reported by the unit

             A.   owning the equipment.

             B.   supporting the equipment.

             C.   using the equipment.
at      1715
join    resp1
arrow   1930
storea  n61
answer  A,a
add1    v5
jump    c23
answer  B,b,C,c

jump    c23
unit    c23
add1    v4
join    sit8
at      810
```

(APPENDIX VI - continued)

```
write    23.  The number of possible days listed on the
              24Ø6 is determined by totaling the number
              of days the equipment is

              A.   in use during a 6-month period.

              B.   in use during a 3-month period.

              C.   on hand during a reporting period.
at       1815
join     resp1
arrow    2Ø3Ø
storea   n62
answer   C,c
add1     v5
jump     c24
answer   A,a,B,b
jump     c24
unit     c24
add1     v4
join     sit8
at       81Ø
```

(APPENDIX VI - continued)

```
write    24.  The number of nonavailable days listed on
              the 24Ø6 is extracted from

              A.  DA Form 24Ø4.

              B.  DA Form 24Ø7.

              C.  DA Form 314.
at       1715
join     resp1
arrow    193Ø
storea   n63
answer   C,c
add1     v5
jump     c25

answer   A,a,B,b
jump     c25
unit     sit9
at       31Ø

write    SITUATION:  You must supervise personnel who are
         rigging and towing a disabled 2-1/2 ton vehicle
         with a 5-ton wrecker.
box      2Ø9;56Ø;3
*
unit     c25
add1     v4
join     sit9
at       71Ø
```

(APPENDIX VI - continued)

```
write   25.  What is the purpose of having the soldier
             put the boom shipper braces in travel position
             before driving away with a load?


             A.   Reduce strain on the boom hoist.

             B.   Lessen strain on the swing gears.

             C.   Prevent damage to the boom.
at      1815
join    resp1
arrow   2030
storea  n64
answer  C,c
add1    v5
jump    c26
answer  A,a,B,b
jump    c26
unit    c26
add1    v4
join    sit9
at      710
```

(APPENDIX VI - continued)

```
write   26.  In a cross-country tow, the front wheels of

             a vehicle should be approximately

             A.  1 foot above the ground.

             B.  2 feet above the ground.

             C.  3 feet above the ground.
at      1815
join    resp1
arrow   2Ø3Ø
storea  n65
answer  A,a
add1    v5
jump    c27
answer  B,b,C,c
jump    c27
unit    c27
add1    v4
join    sit9
at      71Ø
```

(APPENDIX VI - continued)

```
write    27.  When the crane of the wrecker is in operation,
              which position should the transmission selector
              be in prior to lifting the disabled vehicle?
              vehicle?

              A.  First.

              B.  Fifth.

              C.  Neutral.
at       1815
join     resp1
arrow    2Ø3Ø
storea   n66
answer   B,b
add1     v5
jump     c28
answer   A,a,C,c
jump     c28
unit     sit1Ø
at       31Ø
```

(APPENDIX VI - continued)

```
write   SITUATION:  You are supervising the mechanic who

        who is performing hydraulic system maintenance on a
        4ØØØ-lb-capacity gasoline engine forklift.
box     2Ø9;562;3
unit    c28
add1    v4
join    sit1Ø
at      81Ø


write   28.  If a tilt cylinder assembly is leaking oil,
             your mechanic should

             A.  replace the cylinder.

             B.  tighten the packing nut.

             C.  install new gaskets.
at      1715
join    resp1
arrow   193Ø
storea  n67
answer  B,b
add1    v5
jump    c29
answer  A,a,C,c
jump    c29
unit    c29
add1    v4
join    sit1Ø
at      81Ø
```

(APPENDIX VI - continued)

```
add1    v5
jump    whoa2
answer  B,b,C,c
jump    whoa2
*
unit    finish
calc    v6⇐Ø
        v8⇐5Ø4
at      Ø114
showa   n2Ø
at      Ø143
showa   n21
at      Ø3Ø3
write   QUES  STUD  CORR  QUES  STUD  CORR  QUES  STUD  CORR
        NUM   ANS   ANS   NUM   ANS   ANS   NUM   ANS   ANS
at      2813
write   The student responded to     questions.

              He gave     correct responses.

             He achieved a score of      %.
calc    v9⇐(v5÷v4)1ØØ
at      324Ø
show    v9
at      2838
show    v4
at      3Ø26
show    v5
do      score,v7⇐1,21
unit    score
add1    v6
calc    v8⇐v8+1ØØ
at      v8
show    v6
at      v8+22
show    v6+2Ø
at      v8+42
show    v6+42
```

(APPENDIX VI - continued)

```
at      v8+14
writec  v7,x,x,b,c,a,a,a,b,c,a,a,a,a,a,b,a,a,a,b,b,a,a,b,
at      v8+35
writec  v7,x,x,a,c,c,c,a,b,b,a,a,a,a,c,c,c,a,a,b,a,c,b,b,
at      v8+56
writec  v7,x,x,b,a,c,b,a,a,b,b,a,a,c,a,a,c,a,b,a,b,c,c,b,
at      v8+7
writec  v7,x,x,<a,n4Ø>,<a,n41>,<a,n42>,<a,n43>,<a,n44>,
        <a,n45>,<a,n46>,<a,n47>,<a,n48>,<a,n49>,
        <a,n5Ø>,<a,n51>,<a,n52>,<a,n53>,<a,n54>,<a,n55>,
        <a,n56>,<a,n57>,<a,n58>,<a,n59>,
        <a,n6Ø>,
at      v8+28
writec  v7,x,x,<a,n61>,<a,n62>,<a,n63>,<a,n64>,<a,n65>,<a,n66>,<a,n67>
        ,
        <a,n71>,<a,n72>,<a,n73>,<a,n74>,<a,n75>,<a,n76>,<a,n77>,<a,n78
        <a,n81>,
at      v8+49
writec  v7,x,x,<a,n82>,<a,n83>,<a,n84>,<a,n85>,<a,n86>,<a,n87>,<a,n88>
        ,
        <a,n92>,<a,n93>,<a,n94>,<a,n95>,<a,n96>,<a,n97>,<a,n98>,<a,n99
        <a,n1Ø2>,
end     lesson
unit    finish2
calc    v6⇐Ø
        v8⇐5Ø4
at      Ø114
showa   n2Ø
at      Ø143
showa   n21
at      Ø3Ø3
write   QUES   STUD   CORR   QUES   STUD   CORR   QUES   STUD   CORR
        NUM    ANS    ANS    NUM    ANS    ANS    NUM    ANS    ANS
at      2813
write   The student responded to     questions.
```

(APPENDIX VI - continued)

```
                He gave    correct responses.

               He achieved a score of      %.
calc    v9⇐(v5÷v4)100
at      3240
show    v9
at      2838
show    v4
at      3026
show    v5
do      score2,v7⇐1,20
unit    score2
add1    v6
calc    v8⇐v8+100
at      v8
show    v6
at      v8+21
show    v6+20
at      v8+42
show    v6+40
at      v8+14
writec  v7,x,x,a,a,b,a,a,a,b,a,a,a,b,b,a,c,c,c,a,b,b,a,
at      v8+35
writec  v7,x,x,a,a,a,c,c,c,a,c,b,b,b,a,c,b,a,a,b,b,a,a,
at      v8+56
writec  v7,x,x,c,a,a,b,a,c,b,c,a,a,a,c,d,a,b,c,d,c,c,a,
at      v8+7
writec  v7,x,x,<a,n40>,<a,n41>,<a,n42>,<a,n43>,<a,n44>,
        <a,n45>,<a,n46>,<a,n47>,<a,n48>,<a,n49>,
        <a,n50>,<a,n51>,<a,n52>,<a,n53>,<a,n54>,<a,n55>,
        <a,n56>,<a,n57>,<a,n58>,<a,n59>,
at      v8+28
writec  v7,x,x,<a,n60>,<a,n61>,<a,n62>,<a,n63>,<a,n64>,<a,n65>,
        ,
        <a,n70>,<a,n71>,<a,n72>,<a,n73>,<a,n74>,<a,n75>,<a,n76>
at      v8+49
writec  v7,x,x,<a,n80>,<a,n81>,<a,n82>,<a,n83>,<a,n84>,<a,n85>,
        ,
        <a,n90>,<a,n91>,<a,n92>,<a,n93>,<a,n94>,<a,n95>,<a,n96>,
end     lesson
```

10-8

DTI