ESD TDR 64-511
ESTI FILE COPY

R-64-511

OPERATIONAL SPECIFICATION FOR COMPUTER-DIRECTED INSTRUCTION IN THE OPERATIONAL TRAINING CAPABILITY QUERY LANGUAGE FOR SYSTEM 473L, U.S. AIR FORCE HEADQUARTERS

TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-511

JUNE 1964

ESD RECORD COPY
RETURN TO
SCIENTIFIC & TECHNICAL INFORMATION DIVISION
(ESTI), BUILDING 1211

COPY NR._____ OF_____ COPIES

David P. Yens
Harris H. Shettel

DECISION SCIENCES LABORATORY
IN SUPPORT OF
473L SYSTEM PROGRAM OFFICE
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L. G. Hanscom Field, Bedford, Massachusetts

ESTI PROCESSED

☐ DDC TAB ☐ PROJ OFFICER
☐ ACCESSION MASTER FILE
☐ _____

DATE_____

ESTI CONTROL NR. AL 42188

CY NR. 1 OF 1 CYS

Project 7682, Task 768204

(Prepared under Contract No. AF 19 (628)-2935 by American Institutes For Research, 410 Amberson Avenue, Pittsburgh, Pennsylvania.)

AD606341 ~~AD672005~~

When US Government drawings, specifications or other data are used for any purpose other than a definitely related government procurement operation, the government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

DDC AVAILABILITY NOTICES

Qualified requesters may obtain copies from Defense Documentation Center (DDC). Orders will be expedited if placed through the librarian or other person designated to request documents from DDC.

Copies available at Office of Technical Services, Department of Commerce.

OPERATIONAL SPECIFICATION FOR COMPUTER-DIRECTED INSTRUCTION IN THE OPERATIONAL TRAINING CAPABILITY QUERY LANGUAGE FOR SYSTEM 473L, U.S. AIR FORCE HEADQUARTERS

TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-511

JUNE 1964

David P. Yens
Harris H. Shettel

DECISION SCIENCES LABORATORY
IN SUPPORT OF
473L SYSTEM PROGRAM OFFICE
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L.G. Hanscom Field, Bedford, Massachusetts

Project 7682, Task 768204

(Prepared under Contract No. AF 19 (628)-2935 by American Institutes For Research, 410 Amberson Avenue, Pittsburgh, Pennsylvania.)

FOREWORD

This operational specification for computer-directed training in man-computer communication was prepared for Decision Sciences Laboratory in support of the 473L System Program Office. Dr. Sylvia R. Mayer of Decision Sciences Laboratory served as task scientist and contract monitor, and Major Jack H. Leith of the 473L System Program Office served as personnel subsystem manager. This study was conducted under Task 768204, Automated Training for Information Systems, under Project 7682, Man-Computer Information Processing.

Contract support was provided by the American Institute for Research with Mr. Harris H. Shettel, principal investigator, and Mr. David P. Yens. The technical guidance and support provided by Mr. Anthony Jordano and Mr. Robert Meyer of the IBM Federal Systems Division, Mr. David Miquelon of Dunlap and Associates, and Major Robert Evans of the USAF Command Post are gratefully acknowledged.

ABSTRACT

This specification describes the projected Query Language Computer-Directed Instruction program which permits active on-console training of personnel in the writing and processing of OTC Query Language statements in System 473L. The files, programs, and processes of the program and a sample computer-trainee interaction are detailed. General flow charts for a possible computer program implementing the specifications are provided, designed for the IBM 1401 or 1410 computer.

PUBLICATION REVIEW AND APPROVAL

Publication of this technical documentary report does not constitute Air Force approval. This report is published for experimental use in training Air Force personnel in man-computer communication techniques.

JOSEPH T. BEGLEY
Chief, Applications Division
Decision Sciences Laboratory

ROY MORGAN
Colonel, USAF
Director, Decision Sciences Laboratory

CONTENTS

		Page
Chapter 1	INTRODUCTION	
1.1	Glossary of Terms	1-3
Chapter 2	FUNCTIONAL DATA FLOW	
2.1	Inputs	2-1
2.1.1	System Inputs	2-1
2.1.1.1	Cues	2-1
2.1.1.2	Displays	2-2
2.1.1.3	Latencies	2-2
2.1.1.4	Performance Criteria	2-2
2.1.1.5	Category Codes	2-3
2.1.1.6	Answers	2-3
2.1.2	Operator Inputs	2-3
2.1.2.1	Response to General Cue	2-3
2.1.2.2	Response to Instructional Output	2-3
2.1.2.3	Process Step Key Interrupt	2-4
2.1.2.4	Request Trainee Record Printout	2-4
2.2	Files	2-4
2.2.1	Trainee Record File	2-5
2.2.1.1	Category	2-5
2.2.1.2	Kind of Measurement	2-5
2.2.1.3	Section of Instructional Sequence	2-6
2.2.2	Major Problem File	2-6
2.2.3	Practice Problem File	2-7
2.2.4	Review File	2-7
2.2.5	Text Reference	2-7
2.2.6	General Cue and Display File	2-7

CONTENTS (cont'd)

		Page
2.3	Programs	2-8
2.3.1	Overlay Interpretation Program	2-8
2.3.2	Input-Output Analysis Program	2-8
2.3.3	Query Checker Program	2-9
2.3.4	Retrieval Program	2-9
2.3.5	Trainee Record Maintenance Program	2-10
2.3.6	Output Formatting Program	2-10
2.3.7	Data Load Program	2-10
2.4	Output	2-10
2.4.1	Instructional Outputs	2-11
2.4.2	Supportive Outputs	2-11
2.4.3	Performance Outputs	2-11
Chapter 3	OPERATING PROCEDURES	
3.1	CCC Operating Procedures	3-1
3.1.1	A/N Keyboard Inputs	3-1
3.1.1.1	Inputs in Response to Instructional Cues	3-2
3.1.1.1.1	Response to Problem Cues	3-2
3.1.1.1.2	Response to Review Cues	3-2
3.1.1.2	Inputs in Response to General Cues	3-3
3.1.2	Process Step Key Inputs	3-3
3.1.2.1	Key Input in Response to a Cue	3-3
3.1.2.2	Key Input as an Overriding Function	3-4
3.2	Operator Aids	3-10
3.3	Capability Bounds	3-10
3.4	Error Checks	3-10
3.5	Cue Displays and Output Formats	3-11

CONTENTS (cont'd)

		Page
3.5.1	Specifications Common to All Cues and Displays	3-11
3.5.2	Problem Cues	3-12
3.5.3	Review Cues (Frames)	3-12
3.5.4	Text Reference Displays	3-13
3.5.5	General Cues that Require Inputs	3-13
3.5.5.1	General Cues that Require the Selection of Items (Asterisk Inputs)	3-14
3.5.6	General Cues with Program-Generated Outputs	3-14
3.5.7	General Cues with No Keyboard Input or Variable Output	3-15
3.5.7.1	Special Case	3-15
3.5.8	Printouts	3-15
3.5.8.1	Trainee Performance Summaries	3-15
3.5.8.1.1	Overall Performance Page	3-16
3.5.8.1.2	Pretest Problem Page	3-16
3.5.8.1.3	Primary Problem Page	3-16
3.5.8.1.4	Posttest Problem Page	3-16
3.5.8.2	Trainee-Computer Interaction Record	3-16
3.6	Operational Example	3-16
Appendix A	Procedural Flow Diagram	A-1
Appendix B	General Program Flow Charts	B-1
Appendix C	Computer Communications Console	C-1

ILLUSTRATIONS

Figure		Page
1	A method for storage of problem cues and review cues	2-12
2	The three dimensions of data storage	2-13
3	Arrangement of review sets and frames in a category	2-14
4	Estimated number of cues or cue sets and proposed content for each kind of cue	2-15
5	Query Language Instruction Functional Data Flow Diagram	2-16
6	Query Language Instruction Program Overlay	3-5
7	Introductory Cue - Q_1	3-24
8	Name Entry Cue - Q_2	3-26
9	Pretest Instruction Cue - Q_4	3-27
10	Pretest Problem Cue - Q_5	3-29
11	Procedure Option Cue - Conclusion of Pretest - Q_6	3-30
12	Procedure Option Cue - Q_3	3-31
13	Choice of Direction Cue - Q_{13}	3-32
14	Category Listing Cue - Q_{15}	3-33
15	Text Reference Display - D_4	3-35
16	Continuation Options Cue - Q_{12}	3-37
17	Review Cue - Q_{11}	3-38
18	Answer Display (Confirmation) - D_3	3-39
19	Continuation Option Cue - Q_{14}	3-40
20	Practice Problem Cue - Q_{10}	3-41
21	Confirmation Display - D_{2A}	3-42
22	Negation Display - D_{2B}	3-43
23	Primary Problem Cue - Q_7	3-44
24	Primary Problem Resultant Display (Partial) - D_1	3-45
25	Continuation Option Cue - Q_8	3-46
26	Error Listing - Q_9	3-47
26a	Choice Cue - Error - Q_{9a}	3-48
27	Printout Category Cue - Q_{16}	3-49
28	Printout of Trainee Performance Summary - P/O_1	3-50
29	Test Introduction Cue - Q_{17}	3-54
30	Test Problem Cue - Q_{18}	3-56
31	Completion Display - D_5	3-58
32	Query Language Instruction Program CCC Procedural Flow Diagram	A-3
33	START and RESTART routines	B-2
34	RESTART subroutine	B-3
35	PRETA and PRETB subroutines	B-4
36	PROBA subroutine	B-5
37	POST and POSA subroutines	B-6
38	REMED subroutine	B-7
39	CHOIS subroutine	B-8
40	WAIT subroutine	B-9
41	PERF subroutine	B-10
42	CHOOS subroutine	B-11

ILLUSTRATIONS (Cont'd)

Figure		Page
43	TRUB subroutine	B-12
44	P_9 PRACTICE subroutine	B-13
45	PRAC subroutine	B-14
46	A (for PRAC and P_9 PRACTICE) subroutine	B-15
47	HELP subroutine	B-16
48	P_8 REVIEW subroutine	B-17
49	REVPR subroutine	B-18
50	P_7 TEXT REFERENCE subroutine	B-19
51	TECHB subroutine	B-20
52	QCHEK subroutine	B-21
53	CMPAR subroutine	B-22
54	QUALS subroutine	B-23
55	MISS subroutine	B-24
56	DELS subroutine	B-25
57	SPECS subroutine	B-26
58	GCDQ subroutine	B-27
59	SELS subroutine	B-28
60	GENS subroutine	B-29
61	GCDS subroutine	B-30
62	MACH subroutine	B-31
63	TITL subroutine	B-32
64	PCTS subroutine	B-33
65	STREC subroutine	B-34
66	P_{26} FINISHED and P_{30} CANCEL AND DEACTIVATE subroutines	B-35
67	Computer Communications Console	C-1

TABLES

Table		Page
1	Query Language Instruction Program Cues Displays, and Printouts by Code	x
2	Query Language Instruction Program Subroutines by Subroutine Code	xi
3	Query Language Instruction Process Step Key Functions	3-6

Table 1. Query Language Instruction Program Cues, Displays, and Printouts by Code

Code	Title	Figure	Page
Q_1	Introduction Cue	7	3-24
Q_2	Name Entry Cue	8	3-26
Q_3	Procedure Option Cue	12	3-31
Q_4	Pretest Instruction Cue	9	3-27
Q_5	Pretest Problem Cue	10	3-29
Q_6	Procedure Option Cue - Conclusion of Pretest	11	3-30
Q_7	Primary Problem Cue	23	3-44
Q_8	Continuation Option Cue	25	3-46
Q_9	Error Listing	26	3-47
Q_{9a}	Choice Cue - Error	26a	3-48
Q_{10}	Practice Problem Cue	20	3-41
Q_{11}	Review Cue	17	3-38
Q_{12}	Continuation Options Cue	16	3-37
Q_{13}	Choice of Direction Cue	13	3-32
Q_{14}	Continuation Option Cue	19	3-40
Q_{15}	Category Listing Cue	14	3-33
Q_{16}	Printout Category Cue	27	3-49
Q_{17}	Test Introduction Cue	29	3-54
Q_{18}	Test Problem Cue	30	3-56
D_1	Primary Problem Resultant Display (Partial)	24	3-45
D_{2A}	Confirmation Display	21	3-42
D_{2B}	Negation Display	22	3-43
D_3	Answer Display (Confirmation)	18	3-39
D_4	Text Reference Display	15	3-35
D_5	Completion Display	31	3-58
P/O_1	Printout of Trainee Performance Summary	28	3-50

Table 2. Query Language Instruction Program Subroutines by Subroutine Code.

Subroutine Code	Figure	Page
START	33	B-2
RESTART	33	B-2
PRETA	34	B-3
PRETB	34	B-3
PROB	35	B-4
PROBA	36	B-5
POST	37	B-6
POSA	37	B-6
REMED	38	B-7
CHOIS	39	B-8
WAIT	40	B-9
PERF	41	B-10
CHOOS	42	B-11
TRUB	43	B-12
P_9 PRACTICE	44	B-13
PRAC	45	B-14
A (for PRAC and P_9 PRACTICE)	46	B-15
HELP	47	B-16
P_8 REVIEW	48	B-17
REVPR	49	B-18
P_7 TEXT REFERENCE	50	B-19
TECHB	51	B-20
QCHEK	52	B-21
CMPAR	53	B-22
QUALS	54	B-23
MISS	55	B-24
DELS	56	B-25
SPECS	57	B-26
GCDQ	58	B-27
SELS	59	B-28
GENS	60	B-29
GCDS	61	B-30

Table 2. (con't).

Subroutine Code	Figure	Page
MACH	62	B-31
TITL	63	B-32
PCTS	64	B-33
STREC	65	B-34
P_{26} FINISHED	66	B-35
P_{30} CANCEL AND DEACTIVATE	66	B-35

KEY WORD LIST

1. PROGRAMMING COMPUTERS
2. PROGRAMMING LANGUAGES
3. TEACHING MACHINES
4. PERFORMANCE TESTS
5. PROGRAMMED INSTRUCTION
6. TRAINING

Chapter 1

INTRODUCTION

This Operational Specification describes an instructional program for the Operational Training Capability (OTC) Query Language on the Computer Communications Console and the IBM 1410 computer. It is recognized that some redesigning will be necessary to apply these Operational Specifications to the Mod I and II Query Language on the AN/FYA - 2 Integrated Console and 3055 computer, equipment which is now being readied to replace the present equipment in the 473L system. However, the basic strategy of instruction, and the role played by the computer to implement this instruction, will remain essentially as documented here.

The Query Language Computer - Directed Instruction program was developed to meet the need for a method to train Air Force personnel to prepare and process 473L OTC Query Language statements with speed and proficiency. A computer-directed program provides a large degree of flexibility by tailoring the training procedure to the needs of each individual trainee, and, at the same time, provides actual experience with the Computer Communications Console.

The computerized training program is designed to permit trainees to type and enter Query statements directly into the computer, followed by feedback on the correctness of the entry. An incorrect answer would be followed by a description of the error and corrective material; the problem would be presented again and the cycle would start over. On the whole, the computer would react to the trainee in a manner very much like a human tutor, accepting correct answers and reteaching those items on which an error was made.

As stated in the contract for the development of a QL (Query Language) instructional package, the computer-directed instruction should "... develop operator proficiency on the ... keyboard, and provide intensive controlled practice in keyboard operation and output interpretation." This can be achieved only by providing interaction between the trainee and the equipment. The control of the interaction basically lies with the computer, just as it would were a human tutor used in place of the computer. However, in the QL Instruction program, the trainee is allowed some control over the instruction through the use of a specialized input called the overlay mode. In effect, the trainee is frequently presented with a choice of alternate ways to continue the instruction

which are implemented via this overlay mode (or process step keys, as they are called). These keys also permit him to override portions of the program at certain specified stages of instruction. However, the program has been designed so that it would be difficult for a trainee to miss needed instruction or create a false impression of ability. A sample man-machine interaction is described in Section 3.6.

Prior to the beginning of the computer-directed instruction, the trainee will have undergone approximately 35 hours of training with a programed text covering the QL vocabulary and syntax and will have written a number of basic QL statements.[1]

In addition, before the trainee is allowed to start his work with the computer, he will be given a brief written textual program to prepare him for this unique form of training. This "preprogram" will familiarize the trainee with the structure of the instruction program and the various options available to him and how they are controlled through the use of the overlay. It will also teach him the meaning of the different cues and displays which will appear on the CRT and the method by which he should respond to them.

The first element of the computer-directed instruction itself is a pretest that consists of a set of ten English requests (problems) from which the trainee is to write QL statements and enter them into the computer. This pretest serves two functions: (1) to assess the trainee's ability to write the statements; and (2) to give the computer basic information from which it can organize and present to the trainee an optimum training sequence.

The second, and largest, element of the program is the instructional material. This material is based upon 20 fixed problems of increasing difficulty from which the trainee must compose and enter appropriate Queries. At specified points during the sequence, the trainee may elect remedial sequences of different kinds. If a problem is incorrectly answered, the appropriate remedial sequence is presented, based essentially upon the kind and magnitude of the error and the trainee's performance preceding the error.

---

[1] OTC Query Language (Self-Instructional Course). (ESD-TDR-64-443 Vol. I-XXIII)

The third and final element of instruction is a test set of ten problems. The problems will represent criterion behavior and must be answered in a minimum amount of time. No assistance other than that normally provided an operator will be permitted. If the trainee's performance on the test problems is satisfactory, the problems are presented sequentially until completed, at which point the trainee "graduates." However, if the trainee's overall performance is less than satisfactory by the fifth or any succeeding problem, remedial sequences are automatically initiated which cover the areas in which the trainee is experiencing trouble. The test phase is then repeated until a satisfactory level of performance is attained.

During the progress of the instruction, printouts may be obtained of a trainee's performance. These would be useful to instructional and/or supervisory personnel in evaluating the proficiency of a trainee at any point during training.

1.1 Glossary of Terms

Instructional Cue - The general class of cues used in the active process of instruction. This class includes all problem cues and review cues.

Remedial Material - All material that is generated either by an error made by a trainee or by a request for supportive material to aid the trainee in the answering of a problem. Practice cues, review sequences, help sequences, and text reference displays are included in this category.

Problem Cue - English requests for information from which a trainee composes a QL statement. These may be broken down into two basic classes:

Major Problems - This class is composed of problems given before and after the main sequence of instruction (pretest problems and posttest problems) as well as the 20 primary problems that are the basis of the instructional sequence. These problems range from moderately complicated to quite difficult.

Practice Problems - These are simple problems designed to highlight a specific topic of Query Language such as the Qualifier, Delimiters, etc.

Review Cue (Frame) - A statement or question that requires the trainee to fill in one or more blank words. The proper words can be determined from preceding material and the context within the sentence. A given frame is always one of a set of frames (review sequence) dealing with the same topic.

Text Reference Display - A reference that directs the trainee to that portion of the programed text which covers a particular area of Query Language.

General Cue or Display - An output that is not an instructional cue but is used to provide general information to the trainee such as whether or not an answer was correct or present him with one or more possibilities for continuing with the program. The cue could also request some peripheral information from the trainee such as his name.

Latency - The interval of time from the presentation of an instructional cue to the instant the trainee inserts his answer into the computer.

Answer - The input that a trainee enters into the computer in response to a cue.

Performance Criteria - Externally entered values against which obtained performance values for trainees may be compared to determine how well the trainee is performing and to help determine the best continuation for the instruction. Essentially, these entered values provide a set of limits which define the different levels of performance that may be obtained during training.

CCC (Computer Communications Console) - The console by which the trainee communicates with the computer.

Query Language Categories - A breakdown of words, terms, and concepts in the Query Language.[1] For the purpose of instruction, Query Language is broken down as follows (appropriate abbreviations used later in this specification are provided where necessary):

1. Process Director (PD)
2. Qualifier
3. Selector
4. Major Item Primary (MIP)
5. Major Item Secondary (MIS)
6. Delimiter
7. Attribute
8. Comparator
9. Value
10. GCD (Great Circle Distance)
11. Sum
12. Title
13. Sorting
14. Punctuation
15. General Rules

[1]For definitions of QL terms see: Operator Guide for OTC Query Language Data Retrieval. Rockville, Md.: IBM, Federal Systems Division, 26 July 1963.

Chapter 2

FUNCTIONAL DATA FLOW

This chapter provides a general description of the data flow in the program, i.e., inputs, files, programs, and outputs, with a brief discussion of their interaction. The overall relationship of these parts to each other is shown in the Query Language Computer-Directed Instruction Functional Data Flow Diagram, Figure 5, page 2-16.

2.1 Inputs

2.1.1 System Inputs

Inputs to the program exclusive of operator inputs (i.e., trainee or instructor inputs) would be those to correct or change existing data or to add new data as needed. After the initial implementation of the system, however, there should be relatively little need for data change. Possible inputs would consist of the following types: cues, displays, latencies, performance criteria, category codes, answers. These could be entered either as a unit or individually.

2.1.1.1 Cues

A cue is an output display to the trainee that requires some kind of input. There are three basic kinds of cues: problem cues, review cues, and general cues. Problem cues are of two types, major problems and practice problems. Problem and review cues always require an input on the A/N keyboard; general cues require inputs on the A/N keyboard and/or an overlay key response.

Each problem and review cue has an expected latency, category code, and answer stored along with it. Figure 4 shows a complete list of the kinds of cues, the stored content of each kind, and a tentative estimate of the number of each that will be needed. These latter are discussed in sections 2.1.1.3, 2.1.1.4, and 2.1.1.5, respectively.

A cue would be replaced in the file because it was found in practice to be superfluous to the instruction, or was faulty for some other reason.

Figure 20 (page 3-41) depicts a typical problem cue. Problem cues vary as to the content and difficulty, but all follow this general format. A typical cue is shown in Figure 17, page 3-38; a typical general cue(in this case, a Procedure Option Cue) is presented in Figure 12, page 3-31.

2.1.1.2 Displays

There are two kinds of displays, text reference displays and comments (e.g., "VERY GOOD," "SORRY"). The text reference displays refer the trainee to a reference external to the computer. Stored with a text reference display is its category code.

Comments inform a trainee of his progress or present him with some other bit of information relevant to the instructional sequences. Comments and general cues are usually presented together in the same display.

Examples of each kind of display are presented in Figures 15 (page 3-35) and 21 (page 3-42) respectively.

Displays might be changed if the text material was revised.

2.1.1.3 Latencies

A latency is the expected time a trainee should take to make a computer response to a cue. Each instructional cue has an associated expected latency which is stored along with the cue.

Latencies will initially undergo frequent changes as the optimum mean latency is determined by trial and error. Thereafter they should remain stable. The changes will be empirically determined on the basis of a sampling of trainee performance.

2.1.1.4 Performance Criteria

The performance of a trainee in the computer-directed instruction is used to determine in part the kind of instruction he is to be given and his path through the program. Performance is based upon four measures: pretest results; error rate on instruction; latencies; and length of time since the last instruction. Value ranges are established for each measure, numbers are assigned to each value range, and these numbers are summed to obtain a general performance measure. This general performance measure is compared against criteria to determine how well the trainee is doing. The same procedure is used to determine how well a trainee is doing in each category of Query Language. This arithmetic system into which a trainee's scores may be plugged consists of criterion values and numbers which are placed under the rubic of performance criteria.

Initially, the values used for the performance criteria will be of the "best guess" variety, and may need to be empirically changed many times until the program operates with maximum efficiency.

2.1.1.5 Category Codes

Category codes specify which category of Query Language (e.g., MIS, delimiter, etc.) a cue or display belongs to. Each cue or display that is used in the instructional process has this associated code so that it can be used in the proper place.

Category codes, once assigned, would not be changed.

2.1.1.6 Answers

Each cue which requires a keyboard response has an associated answer or answers that must be compared with the input from the trainee. (See Figure 1, page 2-12). However, after the initial implementation of the program, it may be found that additional answers may be valid for a given cue. Consequently, there is a category of answer inputs to fill this need.

2.1.2 Operator Inputs

There are three discrete kinds of operator (i.e., trainee) inputs: a response to a general cue, a response to an instructional cue (i.e., a problem cue or review cue), and a process step key interrupt of the ongoing instructional process. In addition, an instructor can request a printout of a trainee's record. The CCC Procedural Flow Diagram, Figure 32 (page A-3) indicates the options possible for the operator at each stage of instruction.

2.1.2.1 Response to General Cue

A general cue (2.1.1.1) requires a keyboard or process step key response on the part of the trainee. The input is usually general information, such as the trainee's name, a choice of how the instruction should continue, or peripheral requests such as the selection of a trainee's record output.

2.1.2.2 Response to Instructional Output

The problem cue or review cue (2.1.1.1) is the heart of the instructional process. It requires the trainee to enter the proper QL statement or answer(s) via the keyboard as required by the format of the cue or directions with the cue.

2.1.2.3 Process Step Key Interrupt

There will be times during the instructional process when the trainee may want to break out of an instructional sequence for one reason or another. This will be permitted at times by the lighting of certain process step keys which, when pressed, will interrupt the ongoing sequence and present the material the trainee desires. The lighting of keys will be under program control. The primary example of this is the SKIP (P_{20}) key which is described in Table 3, (page 3-6). Other keys of this type are HELP (P_{12}) and, at times, REVIEW (P_8) and TEXT REFERENCE (P_7).

2.1.2.4 Request Trainee Record Printout

An instructor can obtain the printout of a trainee's record by starting the QL Instruction, pressing OLD TRAINEE (P_3), entering the trainee's name, and pressing TRAINEE RECORD (P_{24}). The resulting display describes different kinds of records. The kind of record desired can be determined by the keyboard entry (see Figure 27, page 3-49).

2.2 Files

Although some data for the instructional process will duplicate that of the Query Language Capability, it must necessarily be kept separate to promote ease of accessing. The data are arranged in six files for ease of description: trainee record file; major problem file; practice problem file; review file; text reference display file; and general cue and display file. (Operationally, these may be divided into two basic files, the trainee record file and a cue file that would include all the other files.) Since the whole instructional program is intended to be separate from the operational programs, the files associated with these programs are kept separate from each other.

The files will be arranged in a combination of serial and matrix file structures, depending upon the individual file considered. However, the basic arrangement will use a serial arrangement of major topics, but with each topic containing a matrix and/or serial arrangement of subtopics. Some samples are diagrammed in Figure 1 (page 2-12). During the use of the program all files will be stored on disc. However, upon termination of the instruction by the CANCEL AND DEACTIVATE (P_{30}) key, all the files may be dumped on a tape used for this purpose to open up disc storage space (if this is necessary). Or the trainee record file may be retained in disc storage and the other files dumped on a tape.

In order to prevent presentation of the same cue twice in the instructional process, the practice problem file and review file are to be arranged so that if a cue is presented to a trainee it will not be presented again to the same trainee. Figuratively, this may be done in the following way. The cues in these files will be arranged serially in categories, and the categories will be arranged serially in disc storage. Cues within the categories will be arranged so that they can be rotated, i.e., so that the cue on "top" is used when a cue from that category is required. After it is used it is rotated to the bottom of the list and an unused cue remains on top. When the program requires a cue of a given type from a given category, the cue "on top" is always used. If the list of cues is exhausted, the first - presented cue may then be used. However, a sufficient number of cues will be stored to limit this possibility to only extreme situations.

Since the rotation of cues within a category will differ with each trainee, depending upon his progress in the instruction, the rotation arrangement will be "remembered" by the computer for each trainee. In practice, the cues themselves would not be moved, but just the pointers.

2.2.1 Trainee Record File

Each trainee record file will contain the data specified in Figure 2, page 2-13, and will be organized in the manner specified by the figure. Three dimensions of data will be used: category, kind of measurement, and section of the instructional sequence. In addition, the trainee's stopping point and the rotational arrangement of cues will be stored in this file.

2.2.1.1 Category

Data will be accumulated for each category of Query Language on the other two dimensions to provide an indication of improvement or weakening of performance within each category at different stages of the program for each trainee.

2.2.1.2 Kind of Measurement

The kinds of measurements used for data collection are the following:

A. Trials attempted
   1. Total number of trials attempted (e.g., cues responded to, number of occurrances within a problem, etc.)
   2. Number of trials incorrect
   3. Percent of trials incorrect

B. Response times (latencies)

1. Sum of assigned maximum response times for trials attempted
2. Sum of obtained response times
3. Number of cues for which a response time exists that were attempted
4. Number of cues on which the maximum time was exceeded
5. Percent of cues on which the maximum time was exceeded

C. Aids used

1. Total number of times an aid (HELP or the use of TEXT REFERENCE or REVIEW) was available
2. Number of times an aid was used
3. Percent of times an aid was used

D. Overall score - a value calculated for each category and over all categories that is a function of the weighted scores of percent trials incorrect, percent cues with excess time, and percent aids used. The weightings given to each measure will be empirically determined.

2.2.1.3 Section of Instructional Sequence

The two dimensions of data described in 2.2.1.1 and 2.2.1.2 will be stored for each of three stages in the instructional program, the pretest, the primary problems, and the posttest, as well as for all the material used (overall). The data for the three stages of the instruction will be stored only on the problems and will not include data on remedial sequences of any kind. This will permit direct comparisons between trainees on identical material and also provide a measure of the improvement of a trainee over time.

2.2.2 Major Problem File

This file will consist of the twenty English Language requests for information (problem cues) from which the Query Language statements are composed by the trainee. These will be numbered and stored in order. In addition, ten preprogram problem cues, presented to a new trainee (one who has not entered the computer-directed training before) to assess his abilities, and ten post-program test problem cues will be stored in order with their answers and expected latencies. Access to these three sets of programs is serial in nature. In addition to the usual information stored with a problem, the primary problem cues also have a partial output display stored which is similar to that which would be generated if the Query had been actually processed.

2.2.3 Practice Problem File

This file will be composed of problem cues which focus on a specific category of the language. These will be stored under their appropriate category. The number stored for each category will be dependent upon the expected number needed throughout the program for that category.

Practice problems are to be stored with their category code, answer, expected latency, and code of the corresponding help sequence.

2.2.4 Review File

The review file will contain sets of review cues that consist of sentences that will require the trainee to fill in a missing word. These review cues, or "frames," are to be used to refresh the trainee's memory on a certain point of Query Language which he may have forgotten. Because a sequence of frames will be required for each review, the frames are to be stored by sets under the proper category code. Access to the frames will be by set rather than by individual frame (diagrammed in Figure 3, page 2-14). Each frame will be stored with its answer and expected response latency and will be stored in a fixed position within the set. The set will be stored with the category code referring to the whole set. Thus, each set will be handled like a practice problem (2.2.3), i.e., the sets will rotate per trainee, the frames will not.

2.2.5 Text Reference Display File

This file will contain the displays which refer the trainee to a specific portion of the programed text. These displays will be stored serially with their category code. Only a few displays would exist for each category, depending upon the number of applicable text references which will exist for the category.

2.2.6 General Cue and Display File

All general information in the form of cues or displays which do not require the matching of a response or reference to some external information is to be stored in this file. Information which is interchangeable (i.e., can be used in equivalent situations) will be stored under a common heading such as Affirmative Responses, Negative Responses, etc. Information stored under headings is to be rotated per trainee when used so that each successive presentation will be different.

2.3 Programs

Seven main programs are shown in the Functional Data Flow Diagram (Figure 5, page 2-16): overlay interpretation program; input-output analysis program; Query checker program; retrieval program; student record maintenance program; output formatting program; and data load program. These programs will be discussed in some detail in the following sections.

The program separation given above is an attempt to break down the computer activities into discrete parts. However, except for the Data Load Program, all the programs must work together as a whole and depend upon each other. The overall instructional activity is shown as it relates directly to the trainee in the Procedural Flow Diagram (Figure 32, page A-3). A possible process for the internal operation and organization of the instructional sequence has been diagrammed in the flow charts found in Appendix B. A description of the purpose and function of these flow charts is provided in the appendix. Although the seven programs discussed here are not directly referenced by the flow charts, their function in the operation of the program should be clarified by the charts.

2.3.1 Overlay Interpretation Program

This program interprets, processes, and codes all inputs from the CCC. It discriminates between A/N keyboard and process step key inputs, encodes the inputs into the proper machine language for processing, and channels the input to the right place in the program according to its form (i.e., A/N keyboard or process step key). It also utilizes all applicable CCC maintenance programs that are required for the operation of the console.

2.3.2 Input-Output Analysis Program

This program deals with cue and overlay inputs from the trainee and all outputs to the trainee. It remembers whether the output was a review cue or a problem cue and passes the resulting input to the proper program. If the input is a problem cue, it passes it on to the Query checker program. If the input is a review cue, this program compares the input with the correct answer. It determines the next output on the basis of the comparison of the input and the trainee's prior performance (if applicable). It also records the result of the input in an internal storage register (the trainee record maintenance program, section 2.3.5).

All instructional outputs are handled by this program. If a set of frames is being presented, the program stores the set and handles the output-input until the set is complete or until some other step is taken.

2.3.3 Query Checker Program

This program dissects and compares in detail all Query Language inputs (i.e., problem cues and practice problems) with a stored answer. The answer is broken down into its component parts and is stored in table form (see Figure 1, page 2-12). The inputted statement is also tabled and the tabled elements are compared. In the event that an input is sufficiently incorrect to prohibit tabling, a letter by letter serial comparison can be used to test for correct elements.

Each element of the answer has a specific category code associated with it. Two sets of accumulators for all the categories and the sum over all categories are established for each Query input on a temporary basis, one to register each error that is found in each category. For example, if an element that belongs in category 6 occurs, the occurrance register for that category as well as the summary register are increased by one. If that element is found in error, the error register for that category and the summary error register are increased by one. This system permits a calculation of the percent of error for each category as well as an overall percentage for the whole input. The results of these calculations of percentages and the measure of the trainee's general performance form the basis for determining the output or sequence of outputs that will follow the Query input. A more detailed picture of these processes may be gained from the flow charts in Appendix B. See especially the subroutine QCHEK (page B-21).

2.3.4 Retrieval Program

All disc file accesses are handled by this program. Inputs from the overlay interpretation program, input-output analysis program, and Query checker program are analyzed by the retrieval program to determine what data is required. These inputs will usually specify the kind and category of the data required, or may specify a specific data location. This data is located and removed from the disc file, assembled, and either passed to the input-output analysis program if the material is to be displayed or to the output formatting program if the material is to be printed. File data is not erased when it is removed.

This program is also responsible for the rotating of the file data if it is appropriate. When a trainee stops the instruction, the rotation arrangement is transferred to the record maintenance file.

2.3.5 Trainee Record Maintenance Program

This program is responsible for the maintenance of a running record of all phases of a trainee's performance which are listed in Section 2.2.1. It receives inputs from the input-output analysis program and Query checker program and is accessed by the retrieval program. This program also keeps a running check on the trainee's general performance category. Every time the value of a running record is changed, the performance value is recalculated and updated.

Upon termination of the instructional period, this program assembles the trainee's record and updates the trainee record file.

2.3.6 Output Formatting Program

This program takes the output from the retrieval program and formats it according to prestored formats for output on the printer. The format to be used is determined by the kind of information specified by the operators input. Two basic formats will be stored, a summary output format for the trainee record, and a complete interaction record that is performed by the standard 1401 (or 1410) logging and data reduction system.

2.3.7 Data Load Program

This is a series of programs that edit and format the input data and store it in the proper files of the disc storage. Data can be inputted on cards, tape, or through the keyboard (using the standard update program). Standard date-load programs may be used for this purpose. However, due to the nature of the storage it will be necessary to have a routine to load data in the proper categories and the proper place in the categories so that no fixed address locations are disturbed. In addition, the data load program is used when data is dumped on tape from disc storage and when it is transferred back to disc from tape.

2.4 Output

The Query Language Computer-Directed Instructional Program is designed to have three kinds of outputs:

Instructional Outputs

Supportive Outputs

Performance Outputs

The instructional and supportive outputs are directed toward the trainee, the performance output is generally used by the instructor. Examples of all the kinds of outputs are found in the display section, Section 3.5.

2.4.1 Instructional Outputs

These outputs are actual instructional or testing material which consist of problem cues (2.1.1.1), review cues (2.1.1.1), or text reference displays (2.1.1.2). The problem cues and review cues require the trainee to make a keyboard entry which is compared with a stored answer; the text reference displays refer the trainee to external textual matter.

2.4.2 Supportive Outputs

All outputs to the trainee that do not require an input which is compared with an answer are classed as supportive outputs. These include general cues (2.1.1.1) and displays (2.1.1.2) which may tell a trainee how he is doing, whether he is correct or incorrect, or give him a choice of alternatives for continuing the instructional process (e.g., practice, review, text reference, or problem). Some of these require some kind of input and others are just informational.

2.4.3 Performance Outputs

These outputs may be called for by the instructor and may be outputted only through the printer. They present in printed form the data that is stored in the trainee record file for a trainee, or in summary form over all trainees. A general record of all trainee-computer interactions may also be obtained, and it may be desirable to obtain a tabulation of the performance of all trainees on a specific cue or set of cues (requested through card input). A sample performance output is depicted in Figure 28, page 3-50.

STORAGE LOCATION	CATEGORY CODE	PROBLEM
Ø18624	Ø6	Find the name of all airfields in Canada that have medical services and fire equipment available and have a longest runway of at least 8000 feet long.

ANSWER					LATENCY
Ø1	LIST - σ				47
Ø2	AFLD - /				
Ø3	1 COUNTRY	1 MEDIC SERVICES	1 FIRE EQUIP	1 LONGEST RNWY	
	2 =	2 =	2 =	2 >	
	3 CANADA	3 AVAIL	3 AVAIL	3 80	
	4 - / or [	4 - / or [	4 - / or [	4 - / or [	
Ø4	1 AFLD NAME				
	2 -]				

A. Problem Cue

STORAGE LOCATION	CATEGORY CODE	REVIEW CUE
823961	Ø6	A delimiter consists of three parts, the _____, the _____, and the _____.

ANSWER	LATENCY
ATTRIBUTE - COMPARATOR - VALUE	23

B. Review Cue

Fig. 1. A method of storage for problem cues and review cues that includes all the information required for each kind.

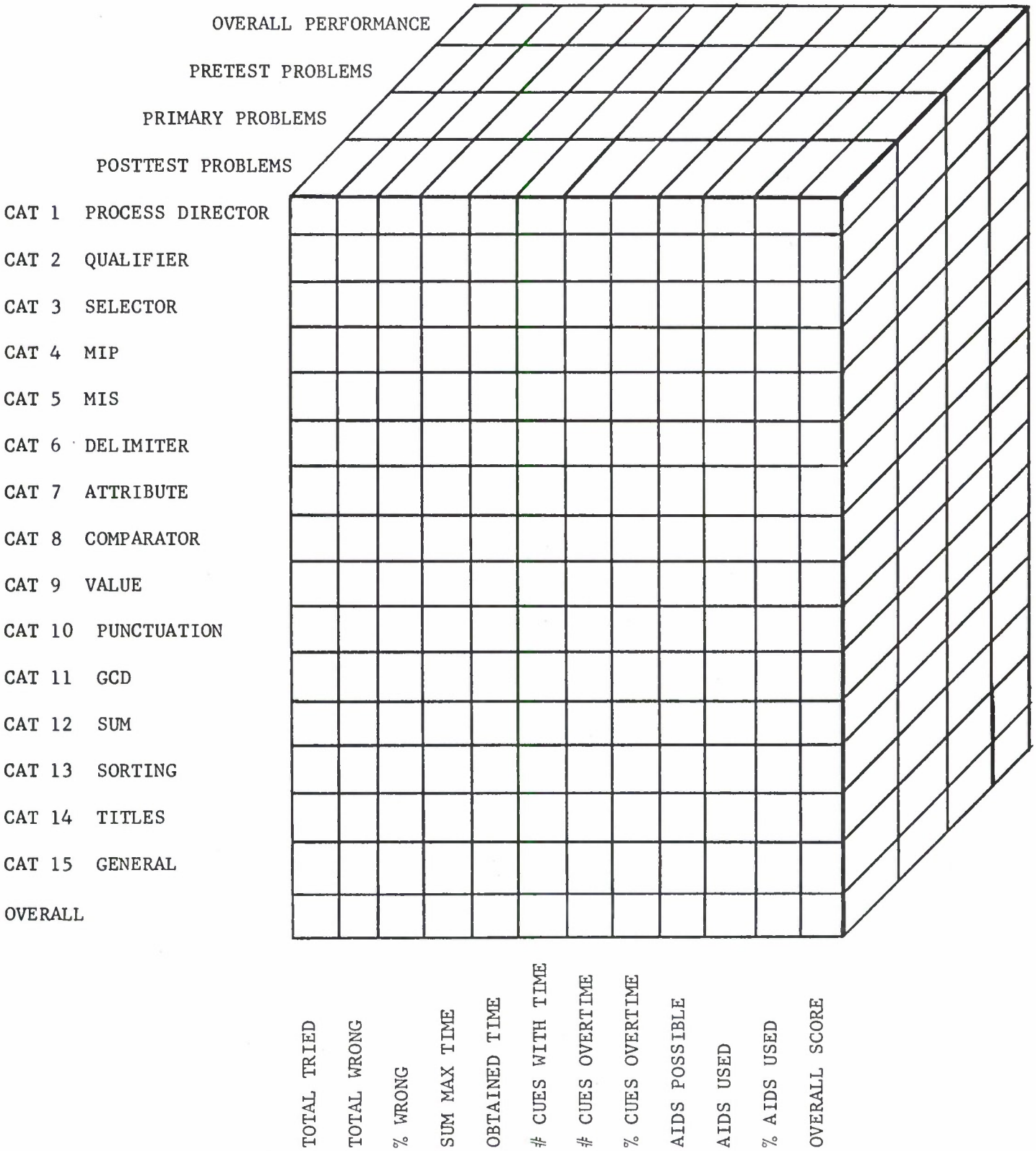


Figure 2. The three dimensions of data storage.

Category Ø6		Category Ø7	
Set 1	Frame 1	Set 1	Frame 1
	Frame 2		Frame 2
	Frame 3		Frame 3
	Frame 4		Frame 4
	Frame 5		Frame 5
			Frame 6
Set 2	Frame 1		Frame 7
	Frame 2		
	Frame 3	Set 2	Frame 1
	Frame 4		Frame 2
	Frame 5		Frame 3
	Frame 6		Frame 4
	.		.
	.		.
	.		.
	.		.
	.		.
	.		.
Set 6	Frame 1	Set 5	Frame 1
	Frame 2		Frame 2
	Frame 3		Frame 3
	Frame 4		Frame 4
	Frame 5		Frame 5
	Frame 6		
	Frame 7		

Fig. 3. Arrangement of review sets and frames in a category. The term "Frame" stands for the stored set of data which consists of the review cue, answer(s), and latency (see Figure 1).

FILE	ESTIMATED NUMBER OF CUES OR CUE SETS REQUIRED	CONTENT
Trainee Record	200 bits of information per trainee	See Section 2.2.1
Major Problem	40	1. Pretest Problems (10) a) Problem #, b) cue, c) latency, d) answer 2. Primary Problems (20) a) Problem #, b) cue, c) latency, d) answer, e) display 3. Posttest Problems (10) a) Problem #, b) cue, c) latency, d) answer
Practice Problem	200	a) category code, b) cue, c) latency, d) answer, e) code of HELP sequence, f) code of review sequence (limited to special cases if unusual content)
Review Sequence	150 sets 900 cues	a) category code, b) cue set code, c) cue, d) latency, e) answer
Text Reference Display	30	a) category code, b) display
General Cue and Display	50	a) topic or heading, b) cue or display

Fig. 4. Estimated number of cues or cue sets and proposed content for each kind of cue.

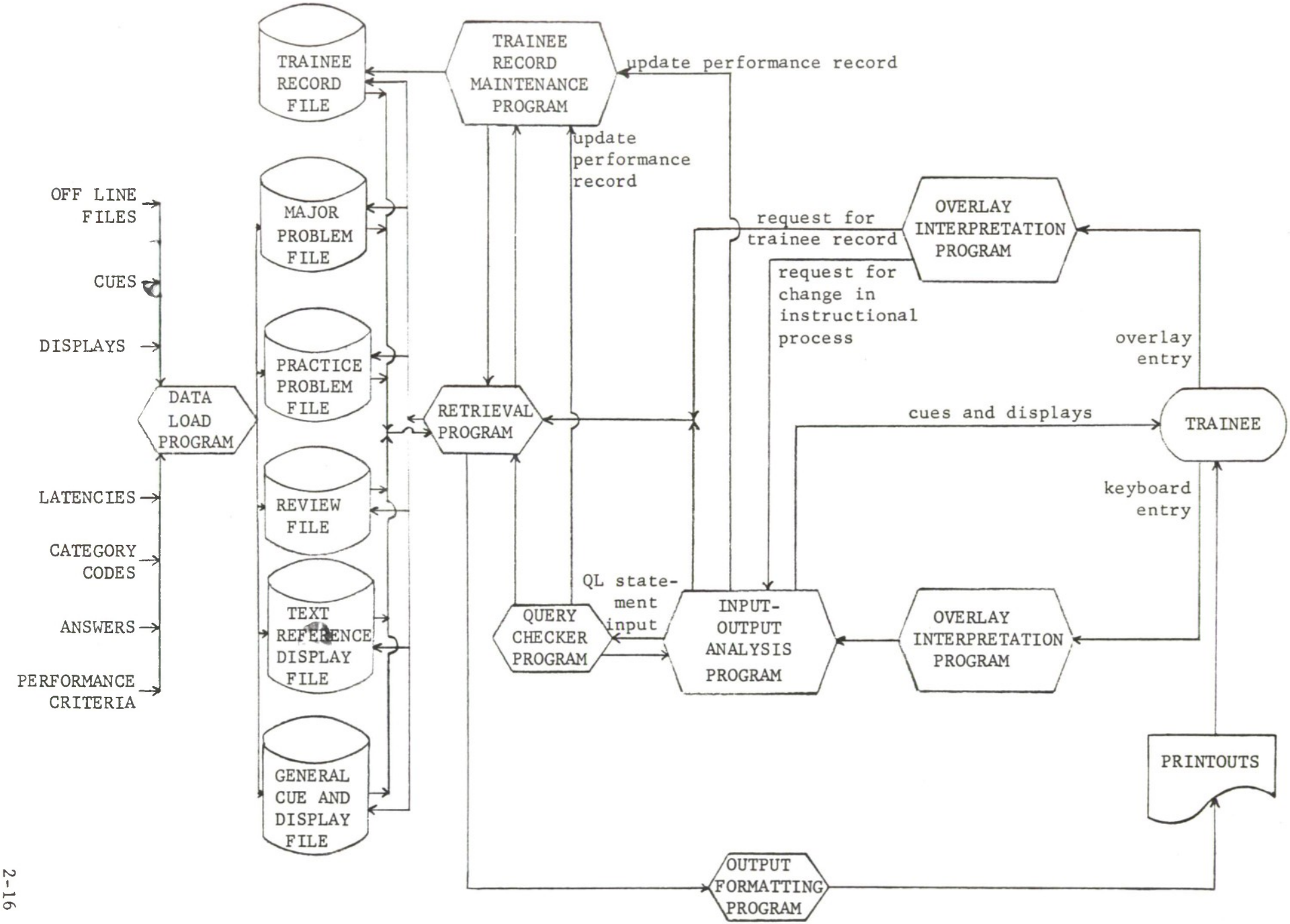


Figure 5. Query Language Computer-Directed Instruction Functional Data Flow Diagram.

Chapter 3

OPERATING PROCEDURES

This chapter describes operating procedures, operating aids, program bounds, and error checking in the Query Language Computer-Directed Instructional Program.

3.1 CCC Operating Procedures

The CCC operating procedures for using the QL instructional program are described in both general and specific detail. Two basic kinds of operator responses are possible: process step key and A/N keyboard. The heart of the instructional process is the presentation of cues and the evaluation of the A/N input. The overlay provides the trainee with a means of controlling the program if he so desires and also permits the simplification of some program processes (such as obtaining trainee records).

The overlay for the program is shown in Figure 6, page 3-5. Table 3, page 3-6, describes the function of each process step key. The CCC Procedural Flow Diagram, shown in Figure 32, page A-3, is a foldout to provide easy reference during reading of the procedural sections. Examples of all outputs are included in Section 3.5.

3.1.1 A/N Keyboard Inputs

A/N keyboard inputs are of two types, responses to instructional cues or responses to general cues. All keyboard entries are made in response to some cue.

The instructional process uses the normal overlay mode input procedures. The trainee reads the cue, decides what he wants to enter, then presses ACTIVATE A/N KEYBOARD (C_2), and types his answer, and finally submits the response by pressing ENTER (A_{57}). The positioning arrow will always be properly placed during typing so that the manipulation of the arrow by the trainee will be held to a minimum. Normal keyboard correction procedures are used.[1]

---

[1] For a description of standard input procedures and correction procedures, see Operational Specification for Common Control Functions for OTC Retrieval Facilities (OS-OTC-22).

The type of input required will be clear from the form of cue displayed, and the cue will be titled to provide identification (e.g., PRACTICE PROBLEM, PRIMARY PROBLEM #5, REVIEW CUE, etc.).

3.1.1.1 Inputs in Response to Instructional Cues

As mentioned earlier, the two basic kinds of instructional cues are problem cues and review cues (2.1.1.1). The A/N input for a problem cue is a Query Language statement. The response to a review cue is a word or words which either fill in blanks left in the cue or give information required by the cue.

3.1.1.1.1 Response to Problem Cues

The input to a problem cue is typed in the space provided below the cue (see Figure 23, page 3-44). Adequate space will be left for the input. The process of making the input will be identical to that of entering a standard QL statement except that the START QUERY (C_1) key will <u>not</u> be used. When the trainee is ready to type the QL statement he presses ACTIVATE A/N KEYBOARD (C_2) and starts typing. When he has finished he presses ENTER (A_{57}). At no time will he have to change the position of the positioning arrow except in the case of errors. The same process is used for both primary problems and practice problems.

3.1.1.1.2 Response to Review Cues

Review cues may contain blanks within the body of the text, but, for simplicity of answering, the blanks are numbered and corresponding blanks are presented vertically below the text (see Figure 17, page 3-38). To answer these cues, the trainee reads the cue, determines the proper answer, presses ACTIVATE A/N KEYBOARD (C_2), and the marker arrow appears at the start of the first blank below the cue. If there is only one blank, he then types his answer, presses ENTER (A_{57}), and finally presses JUDGE (P_{25}) to submit his answer to the computer. A slightly more elaborate procedure is used for multi-response cues.

For a review cue with more than one frame, the trainee types in his answer to the first blank after pressing ACTIVATE A/N KEYBOARD (C_2). He then presses ENTER (A_{57}) and the position marker moves to the next blank, permitting the trainee to type in his answer to that blank. The SKIP ENTRY (C_8) key is lit

to permit the trainee to skip a blank if he desires. All the blanks are filled in in this manner. When the trainee is ready to submit his answers to the computer for judgment, he presses JUDGE (P_{25}) which takes him out of the response loop. This procedure utilizes the standard procedure for filling in a multi-blank cue generated by an overlay.

If the trainee wishes to make any changes in his answers, he simply uses the SKIP ENTRY (C_8) key to get to the blank he wishes to change, and retypes his answer.

3.1.1.2 Inputs in Response to General Cues

The only general cues that require a keyboard input are the initial cue asking the trainee's name (Figure 8, page 3-26) and the cues that request the trainee to pick a category or categories for review practice material (see Figure 14, page 3-33). These cues are self-explanatory to the trainee. For both, entries are made in the manner specified for similar types of entries required by all overlay-generated cues. For cues requiring A/N entries, the input procedure is like that for review cues (3.1.1.1.2). If the output requires the selection of a category or item from a list, the input procedure is similar to that for review cues with multiple entries except that as asterisk (*) is typed in front of the category or item desired. More than one item may be chosen if desired.

3.1.2 Process Step Key Inputs

The functions of each of the process step keys is described in Table 3. These keys may be used in two ways, in response to a cue or as a program override by the trainee. A key may be activated only when it is lighted, and the lighting is under program control. START (P_1) is a special case and is used as in other overlays.

3.1.2.1 Key Input in Response to a Cue

General cues usually require a response via the process step keys. These cues give a trainee a choice of different continuations in the instructional process which may be responded to by pressing YES (P_{13}) or NO (P_{14}); TEXT REFERENCE (P_7), REVIEW (P_8), PRACTICE (P_9), or PROBLEM (P_{10}); NEXT (P_{16}); or CONTINUE (P_{17}). While a cue is displayed only the indicated key choices are

lighted, and only these may be pressed. Upon activation of one of them, the lights for all go out to be replaced by those required by the next display.

3.1.2.2 Key Input as an Overriding Function

During the presentation of an instructional cue, one or more process step keys which interrupt the ongoing sequence may be lighted, indicating that they may be pressed. Examples of these keys are HELP (P_{12}) and SKIP (P_{20}). If a problem was answered wrongly, the TRY AGAIN (P_{19}) key may be available. FINISHED (P_{26}) is usually lighted and CANCEL AND DEACTIVATE (P_{30}) is always available in the event of an emergency. TRAINEE RECORD (P_{24}) is lighted as an option during the early stages of the program but is not referred to directly. JUDGE (P_{25}) is a utility key to permit the trainee to enter a multi-response cue.

These keys have one thing in common - if they are pressed they interrupt the normal sequence of the program to continue on a path determined by the operator. These paths may vary, as can be seen by looking at the descriptions of the keys in Table 3, (page 3-6), but they all give the trainee a degree of flexibility which is designed to let the trainee have some degree of control over the instructional process.

QUERY LANGUAGE INSTRUCTION PROGRAM

START	P_1	TEXT REFERENCE	P_7	YES	P_{13}	TRY AGAIN	P_{19}	JUDGE	P_{25}
NEW TRAINEE	P_2	REVIEW	P_8	NO	P_{14}	SKIP	P_{20}	FINISHED	P_{26}
OLD TRAINEE	P_3	PRACTICE	P_9		P_{15}		P_{21}		P_{27}
	P_4	PROBLEM	P_{10}	NEXT	P_{16}		P_{22}	RESTART	P_{28}
	P_5		P_{11}	CONTINUE	P_{17}		P_{23}		P_{29}
	P_6	HELP	P_{12}		P_{18}	TRAINEE RECORD	P_{24}	CANCEL AND DEACTIVATE	P_{30}

Figure 6. Query Language Computer-Directed Instruction Program Overlay

Table 3

Query Language Computer-Directed Instruction Process Step Key Functions

	Key Designation	Description
P_1	START	This key signals the program to activate the Query Language Computer-Directed Instruction program and transfer all data from tape to disc if necessary.
P_2	NEW TRAINEE	This key signals the program that the trainee signing on has no past record, and that the preprogram set of problems is to be retrieved and displayed one by one. A display requesting the trainee's name is to be displayed next and the name, when entered, will title a new record file.
P_3	OLD TRAINEE	This key signals the program that the trainee signing on has a record in the record file. The display requesting the trainee's name is to be retrieved and displayed. After the trainee's name is entered, the proper record is to be retrieved and the primary problem to be presented is determined for this.
P_7	TEXT REFERENCE	This key signals the program that the trainee wants the presentation of a display referring him to the programed text. If a category is already active in the input-output analysis program, the display for that category is retrieved from the text reference display file and displayed (Figure 15). If no category is active, a cue to determine who chooses the category (Figure 13) is displayed. Once the category is chosen, the material is retrieved and displayed.
P_8	REVIEW	This key signals the program that the trainee wishes the presentation of a review sequence. The determination of the category and retrieval and display process is similar to that which results from the TEXT REFERENCE (P_7) key except that responses to the cues are obtained and the sequence is handled by the input-output analysis program. The sequence is retrieved from the review file. (See Figure 17 for a sample output.)

Table 3 (con't.)

	Key Designation	Description
P_9	PRACTICE	This key signals the program that the trainee wants the presentation of practice problems. The process is similar to that which results from the REVIEW (P_8) key except that retrieval is from the practice problem file and the responses are analyzed by the Query checker program. (See Figure 20 for a sample output.)
P_{10}	PROBLEM	This key signals the program that the trainee desires the presentation of a primary problem. The proper problem is determined and displayed (see Figure 23 for an example) and the input is analyzed and handled by the Query checker program.
P_{12}	HELP	This key signals the program that the trainee wants the help sequence accompanying the practice problem cue being displayed. This cue is removed and the help sequence specified internally by the cue set is retrieved and presented. The input-output analysis program handles the sequencing of the cues and the inputs from the cues and determines the continuation of the instructional process on the basis of the trainee's success with the sequence (i.e., upon successful completion the interrupted cue is again presented, but upon unsuccessful completion, a remedial process may be initiated). (See Figure 17 for a sample output.)
P_{13}	YES	This key signals the program that the trainee will select a category or categories for remedial work. A display listing the categories is retrieved and displayed from which the trainee chooses the category(s) (Figure 14).
P_{14}	NO	This key signals the program that the choice of the next instructional material is to be made internally by the program. This choice is based upon the trainee's prior performance.
P_{16}	NEXT	This key signals the program that the next display in the predetermined sequence is to be presented. Its function is to just move along in the sequence.

Table 3 (con't.)

	Key Designation	Description
P_{17}	CONTINUE	This key signals the program to retrieve the next set of materials in the instructional sequence and display the first of the set, or to present the next display in a sequence already initiated. The key is lighted at choice points where the trainee may either get off the computer or continue the program.
P_{19}	TRY AGAIN	This key signals the program to re-present the cue that was just responded to by the trainee. It is lighted only if the input is incorrect and the input was the first incorrect response to the cue.
P_{20}	SKIP	This key signals the program to present the primary problem cue from which the remedial sequence being presented was derived. It instructs the program to remember where the ongoing process was interrupted until the primary problem is analyzed. If the input to the problem is correct, the remedial material is returned to storage and the instruction sequence continues from the correct input. If the response is incorrect, the sequence resumes where it left off. For the trainee, this key provides the opportunity to skip the remainder of a remedial sequence if he believes he can answer the problem correctly.
P_{24}	TRAINEE RECORD	This key signals the program to retrieve and print out the performance record of the trainee whose name was entered. It is intended for use by the instructor who is interested in the progress of the trainee. The immediate output from this key is a display of choices of output content. The choice is followed by the printout.
P_{25}	JUDGE	This key signals the program to break out of a response loop on the CCC and accept the response for comparison with the stored answer, i.e., "judge" the input, or to take action as specified by the program in control. The continuation is under program control and depends upon the success of the answer and its position within the sequence of cues.

Table 3 (con't.)

	Key Designation	Description
P_{26}	FINISHED	This key signals the program that the trainee is finished with his turn on the computer but that another trainee will follow. The trainee's record is updated; the number of the primary problem on which the trainee is working (or the next one if the current one is completed) is stored with the record. Any material which had been retrieved from the files is restored, and the programs are cleared for the next trainee.
P_{28}	RESTART	This key signals the program to return to the beginning of the sequence of instruction without pressing START (P_1) again.
P_{30}	CANCEL AND DEACTIVATE	This key signals the program to cancel the instruction, update the trainee's record, store the number of the primary problem being worked on (or the next one if the present one is completed), restore the material being worked, cancel any printouts, and deactivate the overlay.

3.2 Operator Aids

Aids to the trainee to assist in his progress through the instructional program are needed in case the trainee needs to determine the proper abbreviation or legal attribute or value in the writing of the QL statements. The following 473L documents will be needed.

· System Vocabulary - This document lists all legitimate computer abbreviations and all legitimate modifiers, attributes, and their respective values and ranges of values.

· Data Base Definition - Defines items, values for items, and the structure in which this data will be formatted in the data base.

3.3 Capability Bounds

The Query Language Computer-Directed Instruction program is designed for maximum speed and flexibility of interaction between the trainee and the computer and has no bounds upon data because of its instructional purpose. The program is, in essence, a closed program with its own data base and its own basic routines, but it does utilize the common input-output routines for the CCC.

Running times for the program are flexible, although a single period of instruction should not exceed two hours or be less than 20 minutes. The scheduling of trainees for successive instructional periods is recommended to minimize the repeated shifting of the program in and out of core which would result if the instructional periods were separated.

The number of cues stored for each QL category is theoretically limited only by the storage space available on disc, but it is practically limited to the maximum expected number needed by any given trainee during the full course of instruction (see Figure 4). Provision is made for the repetition of cues in extreme cases. The repetition of a cue presented earlier in the course of instruction should not be detrimental in any way to the instruction.

3.4 Error Checks

Because the whole design of the Computer-Directed Instruction program is based on checking, processing, and rectifying errors, no additional error checks are needed. The system has been designed to eliminate the possibility of

peripheral operator errors which could defeat the purpose of the program (i.e., typing in the wrong place, wrong word, etc.). If the trainee makes a spelling error, it will be treated as if it were a wrong response and should make the trainee more careful in typing the inputs.

3.5 Cue Displays and Output Formats

In this section, all types of displays used in the Query Language Computer-Directed Instruction program are described, and each format specified. For each kind of output, the format, rules for locating entry positions, and exceptions will be specified, i.e., the location for the start of the text, the start and extent of the entries, beginning column for entries, etc. Samples of each kind of display are provided at the end of this chapter. Each display shown is just a sample from a number of displays, each of which may appear at one or more points during the course of instruction. However, each display possible for a given situation will be similar in format and otherwise conform to the specification stated in the description of the cue type.

3.5.1 Specifications Common to All Cues and Displays

a. All outputs used for the instructional program will be unclassified. The word UNCLASSIFIED will appear in the first and last row starting in column 1.

b. Every output will have a title in the second row starting in column 1.

c. If the cue or display is one of a set of more than one pages, the page number and total number of pages included in the output will be specified on the first row starting on column 29 and will use the format (PAGE NUMBER) OF (TOTAL NUMBER OF PAGES). All cues followed by another page will have the words GO ON TO THE NEXT PAGE in row 19 starting on column 10.

d. The names of process step keys and control keys will appear in quotation marks.

e. The text will be blocked in one sentence units. Each sentence will start in column 1 and on the second row below the previous sentence.

f. The last row that will be used for text will be row 18, unless the last line of text would be line 19 and there are no following pages. If there are no additional pages and row 19 would be the last line of text, that row may be used.

3.5.2 Problem Cues (Q_5, Q_7, Q_{10}, Q_{18})

a. Major problem cues consist of primary problems, pretest problems, and posttest problems.

b. The start of the text will be column 1 of row 4.

c. The input will start on the second row below the end of the text, on column 1.

d. For major problem cues, eight (8) rows will be allotted for the answer.

e. For practice problem cues, five (5) rows will be allotted for the answer.

f. Row 19 may be used for the answer, but not for the text.

g. If there is insufficient room for the answer on the same page as the text, the whole answer should be placed on the next page.

h. Primary problems will be titled "PRIMARY PROBLEM (number of problem)."

i. Pretest problems will be titled "PRETEST PROBLEM (number of problem)."

j. Posttest problems will be titled "POSTTEST PROBLEM (number of problem)."

k. Practice problems will be titled "PRACTICE PROBLEM."

l. The title will appear on each page of the output.

3.5.3 Review Cues (Frames) (Q_{11})

a. The start of the text will be column 1 of row 4.

b. The first part of the text will be standard directions for answering the question.

c. For single response frames, the directions will read: TYPE IN THE ANSWER AND THEN PRESS "ENTER."

d. For multi-response frames (i.e., frames containing more than one blank), the directions will read: PRESS "ENTER" AFTER YOU TYPE IN EACH ANSWER. AFTER YOU HAVE TYPED IN ALL THE ANSWERS, PRESS "JUDGE."

e. If more than one blank appears in a frame, each blank will be numbered sequentially, with a corresponding number associated with an answer blank.

f. Answer blanks will be below the text. The first blank will be on the second row below the end of the text.

g. Answer blanks will be numbered if there is more than one blank. The numbers will be in column 1 and the response will start in column 3. One whole line from column 3 through column 30 will be allowed for each answer.

h. If there is only one answer, it will not be numbered, but the answer will start on column 3.

i. One answer line will be provided for each answer blank in the frame.

j. There will be no row spacing between answers.

k. If there is not enough room for all the answer blanks below the text, all answer blanks will appear on the next page.

l. Row 19 may be used for an answer blank.

m. Review cues will be titled: REVIEW CUE - (category name).

3.5.4 Text Reference Displays (D_4)

a. The text will start on column 1 of row 4.

b. The first part of the text will be standard directions for using the display.

c. The directions will read: PLEASE READ THE FOLLOWING SECTION IN THE PROGRAMED TEXT. COPY THE REFERENCE ON A SHEET OF PAPER.

d. The reference will consist of four parts, the category of the reference, the chapter in the text, the part of the chapter, and the frame numbers referenced.

e. The category listing will start in column 4 on the second row below the directions.

f. The chapter number will start on column 5 on the row beneath the category.

g. The part reference will be on the row beneath the chapter and will start in column 6.

h. The frame numbers will start on column 7 on the row beneath the part.

i. The words GO ON TO THE NEXT PAGE will appear in row 19 starting in column 10.

j. The display will be titled TEXT REFERENCE.

k. The output for the text reference will consist of at least two frames. The last frame will be a listing of continuation options which will be described in Section 3.5.7.

3.5.5 General Cues that Require Inputs (Q_2, Q_{15}, Q_{16})

a. The text will start on column 1 of row 4.

b. The cue title will be stored with the cue.

c. For cues that require alphanumeric input (such as the entry of a name), the input will start on the third row below the end of the text and will extend from column 1 through column 30.

3.5.5.1 General Cues that Require the Selection of Items (Asterisk Inputs) (Q_{15}, Q_{16})

a. The list of items will start on the second row below the end of the descriptive text and will be single spaced.

b. The entry position for the asterisk will be in the first column.

c. The first letter of each item in the list will be in column 3.

d. If an item runs for more than one row, the second row will start with column 3.

e. Row 19 may be used for an item if that item is the last in the list.

f. If more than one page is needed for the output, the directions and descriptive text will appear on the first page and the list of items will appear on the second page.

3.5.6 General Cues with Program-Generated Outputs (Q_6, Q_9, D_{2A}, D_{2B}, D_3)

a. The text will start on column 1 of row 4.

b. The last row used for text will be row 18.

c. The cue title will be stored with the cue.

d. For cues that require a word fill-in, space is left in the stored cue (see Q_6).

e. If a confirmation-negation cue is to be superimposed upon an answer display, the confirmation-negation cue will be presented on row 4 starting on column 1; the answer cue will provide the title and will start on row 7 in column 1 (see D_{2A}, D_{2B}, D_3).

f. If the cue is a list of topics with an indication of the topic to be worked on, the indicator will be the marker arrow in column 1, and the topics will start in column 3. The list of topics will be single spaced. Any text following the list of topics will start on the second row below the last topic (see Q_9).

3.5.7 General Cues with No Keyboard Input or Variable Output (Q_1, Q_4, Q_3, Q_8, Q_9, Q_{12}, Q_{13}, Q_{14}, Q_{17}, D_1, D_4, D_5)

a. The text will start on column 1 of row 4.

b. The last row used for text will be row 18.

3.5.7.1 Special Case (D_1)

a. If the output is a simulated display following the input of a Query statement, the display will start on row 3 and no title will appear in row 2.

b. Titles, if any, will be centered and placed according to directions with the cue.

c. The output, excepting the title, will be double spaced.

d. Data will be left justified.

e. Each column of data will start on the column three columns to the right of the last character of the preceding column.

f. Other rules governing the output of data from inputs on Query mode will be followed for these outputs.

3.5.8 Printouts

3.5.8.1 Trainee Performance Summaries (P/O_1)

a. The trainee performance summary printout will consist of four pages, one each for the overall performance, the pretest problems, the primary problems, and the posttest problems.

b. The title of the page will start in column 1 of row 2.

c. The word UNCLASSIFIED will appear in row 1 starting with column 1.

d. The page number, using a format described in Section 3.5.1 will appear on the first row starting in column 124.

e. The trainee's name or the word SUMMARY will be on row 3 starting in column 50.

f. The column headings will be as shown in P/O_1.

g. The numerical data for each column will start one column to the right of the first character of the column heading and will be right justified. Leading zeroes will be suppressed.

h. The row headings will start in column 1.

i. The first column heading will start on row 8.

j. The basic column headings will consist of OVERALL through CAT 15 and will be single spaced. The headings to be used are shown in P/O_1.

k. The row heading GENERAL PERFORMANCE - (topic of page) will appear on row 25, and will be followed on that row by the SCORE starting in column 50, and the DESCRIPTION starting with column 70.

3.5.8.1.1 Overall Performance Page.

a. The page title will be TRAINEE PERFORMANCE SUMMARY - OVERALL PERFORMANCE.

b. The row heading STOPPING POINT will be on row 27. On the same row, the word PROBLEM NN will start in column 50.

c. The page topic will be ALL MATERIALS.

3.5.8.1.2 Pretest Problem Page

a. The page title will be TRAINEE PERFORMANCE SUMMARY - PRETEST PROBLEMS.

b. The page topic will be PRETEST PROBLEMS.

3.5.8.1.3 Primary Problem Page

a. The title of the page will be TRAINING PERFORMANCE SUMMARY - PRIMARY PROBLEMS.

b. The page topic will be PRIMARY PROBLEMS.

3.5.8.1.4 Posttest Problem Page

a. The page title will be TRAINEE PERFORMANCE SUMMARY - POSTTEST PROBLEMS.

b. The page topic will be POSTTEST PROBLEMS.

3.5.8.2 Trainee-Computer Interaction Record

a. The format for this printout is that determined by the standard 1401 or 1410 logging and data reduction program.

3.6 Operational Example

This material details a representative instructional sequence which a given trainee might follow in taking the Computer-Directed Instructional program.

Since the possible instructional paths increase exponentially once the trainee has started, only a few paths will be followed. The possible variations at the choice points encountered will be discussed, but usually only one variation will be followed.

The following text provides an operational example of the flow of events diagrammed in the Query Language Computer-Directed Instruction CCC Procedural Flow Diagram (Figure 32, page A-3).

1. The trainee places the QL instruction overlay in position, presses the START (P_1) key, and obtains the welcoming display (Figure 7, page 3-24). Because this is his initial entry into the instructional program, he presses the NEW TRAINEE (P_2) key in response to the instructions in Figure 7 (if he had started the instructional program previously, he would have pressed OLD TRAINEE, P_3). In response to the resultant cue (Figure 8, page 3-26) the trainee types his name on the A/N Keyboard and enters it, using the standard entry procedure (Press ACTIVATE A/N KEYBOARD, C_2, type the input, and press ENTER, A_{57}. This procedure is used for all keyboard entries mentioned in this text.). He is then presented with the instruction cue (Figure 9, page 3-27) and presses NEXT (P_{16}) after reading the instructions.

2. A series of 10 pretest problems (Figure 10, page 3-29) are presented one at a time. The trainee reads the first problem, formulates, types, and enters the Query statement he thinks will retrieve the information desired; the next problem then appears. He continues reading and answering until all the problems have been presented. At any time during this (and any other) sequence he may stop by pressing FINISHED (P_{26}) if another trainee is to be next on the console, or CANCEL AND DEACTIVATE (P_{30}) if a trainee is not next or if an emergency occurs. If the trainee stops during the pretest, the problem on which he is working will be remembered by the computer and he will start with that problem when he returns to the program.

3. After the trainee answers the last pretest problem, a cue (Figure 11, page 3-30) appears telling him how he did on the previous problems (VERY WELL, GOOD, YOU NEED SOME PRACTICE) and what options he can choose (i.e., continue or stop). Our trainee wishes to continue with the instruction: he presses CONTINUE (P_{17}) and obtains the next instructional cue (Figure 12, page 3-31).

4. The procedure option cue (Figure 12, page 3-31) tells the trainee that he may review some areas of Query Language (press REVIEW, P_8), practice on some simple QL problems (press PRACTICE, P_9), obtain a text reference (press TEXT REFERENCE, P_7), or proceed with the primary problem (press PROBLEM, P_{10}). The keys accessing these options are lighted until one of them is pressed.[1] He may obtain material on any phase of Query Language he desires. We will look at each of the remedial possibilities before continuing with the primary problem.

   a. The trainee presses the TEXT REFERENCE (P_7) key.

      i. The resultant display (Figure 13, page 3-32) gives the trainee the option of choosing the area of Query Language he would like to study (YES, P_{13}) or letting the computer choose the topic (NO, P_{14}). He presses YES (P_{13}) and types an asterisk by each of his choices on the following display (Figure 14, page 3-33) which lists only the QL categories relevant to the primary problem to be presented. He may choose as many topics as he desires if they are listed. JUDGE (P_{25}) is used to submit his choices to the computer.

      ii. The output (Figure 15, page 3-35) gives the text reference(s) and the option of stopping or continuing. References appear on different frames of the output. In this way, the trainee can obtain the text reference if he wants it but need not take time out from his computer time to read it. Of course, he could stop if he wanted to. Our trainee wants to continue on the computer, so he writes down the text reference and presses CONTINUE (P_{17}). The following cue (Figure 15, page 3-35) lists the different possibilities for continuing (REVIEW, P_8; PRACTICE, P_9; PROBLEM, P_{10}).

   b. The trainee presses REVIEW (P_8) and chooses the category(s) he would like to review by the procedure described in Section 4.a.i above (Figure 13, etc.). After he has chosen the category, the review frames are presented in sequence. A frame (or review cue, Figure 17, page 3-38) is displayed, the answer is typed in the appropriate

[1] If a key option is mentioned in a cue, that key is lighted and available for the duration of the cue.

space(s), and the response is entered by pressing JUDGE (P_{25}). The answer is judged and the correct answer, along with a comment on the correctness of the answer, appears in a display (Figure 17, page 3-38). The trainee presses ADVANCE DISPLAY FRAME (C_{24}), obtains the next cue, and answers it. He continues in this manner until he answers the last frame. If he had made two or more errors on the review sequence, a text reference display (Figure 14, page 3-33) would be presented for that category and, if he had been doing poorly in the instruction, there would be no possibility for continuing with the program (the CONTINUE, P_{17}, key would be unlit). During the succession of frames the SKIP (P_{20}) key is lighted when possible. This permits a trainee who feels that he has had enough review to break out of the review sequence and go directly to the primary problem, and is an important instance in which the trainee is given limited control over his instruction.

If the trainee requested (or the computer programmed) review includes more than one category, the frames for the categories run successively (if the work was satisfactory), the categories being identified by headings on the frames. The last answer display is followed by a cue (Figure 19, page 3-40) that lists the options available for continuing (if the trainee had made two or more errors in any one sequence the final display would be a text reference display). Again, he has the option of stopping, choosing remedial material, or going on to the problem. Our hypothetical trainee would like to try some practice problems before plunging into the primary problem.

c. The trainee presses the PRACTICE (P_9) key and again chooses the categories he would like to work on by the procedure described in Section 4.a.i. (Figure 13, etc.). After the category is chosen, a practice problem (Figure 20, page 3-41) appears. The trainee is not sure he can write the correct Query so he asks for help by pressing the HELP (P_{12}) key (available and lighted only for practice problems). This results in the presentation of a series of frames like Figure 16, page 3-37(similar to the review described in Section 4.b) which will specifically help with the problem he is working. If too many mistakes are made on the "help" sequence,

a review sequence will be initiated which deals more intensively with the trouble area than does the "help" sequence. The review presented is the same as if the REVIEW (P_8) key had been pressed, but the last output would be the practice problem with which the sequence was initiated. Once the help sequence is successfully completed, the same practice problem is presented again. No more help sequences are available (HELP, P_{12}, light out). The trainee composes, types, and enters his answer and it is judged by the computer. If the answer is incorrect, the resulting display (Figure 22, page 3-43), tells the trainee he is incorrect. If this is the first attempt at the problem, the trainee is given the option of attempting the problem again by pressing the TRY AGAIN (P_{19}) key. Pressing this key restores the problem to the display screen. If the answer is incorrect a second time, a review sequence dealing with the trouble area is initiated (there is no option) and the continuation is that described in 4.b above. (The problem which was failed is presented as the last frame of the review sequence.)

If the first or second answer to the problem is correct, the resulting display (Figure 21, page 3-42) tells the trainee he is correct. The next display will be a cue (Figure 19, page 3-40) giving the trainee the different options for continuing. Our trainee feels ready for the primary problem.

5. PROBLEM (P_{10}) is pressed and the primary problem (Figure 23, page 3-44) appears on the display screen. The PRACTICE (P_9), REVIEW (P_8), and TEST REFERENCE (P_7) keys are lighted in case the trainee wants any remedial work on an area in which he is still uncertain. When he activates the keyboard, the key lights go out, and he types and enters the QL statement. If the answer is correct, a partial display (Figure 24, page 3-45) of the data which would be retrieved by the statement is presented as the first frame. (This partial answer would be stored with the problem.) The second page of the output is a cue (Figure 25, page 3-46) displaying the options for continuing. If the trainee wishes to continue, pressing CONTINUE (P_{17}) initiates the sequence starting with Section 4 (Figure 12, etc.). If necessary, of course, he may stop.

6. If the answer to the problem is wrong, the following cue (Figure 26, page 3-47) lists the categories in which errors were made. These categories are dealt with one at a time. The marker arrow indicates which area is being reviewed at a given time. When work on that area is satisfactorily completed, the marker moves down to the next area. The marker is initially placed at a general category in which an error was made (i.e., Process Director, Qualifier, or Selector). The trainee may choose a review sequence or text reference covering the category listed in the cue by pressing REVIEW (P_8) or TEXT REFERENCE (P_7). Or he can let the computer determine the next step by pressing NO (P_{14}).

   The option to try the problem again is available to those trainees who have been doing well in the program and only on the first presentation of the cue.

   a. The trainee presses TEXT REFERENCE (P_7). The text reference is displayed along with instructions for the next step (Figure 15, page 3-35). If the text reference display was chosen as an option or if the trainee had been doing well, the CONTINUE (P_{17}) key will be lighted. Pressing this key will return the trainee to the procedure starting with Section 6, above, but with the omission of the "try again" option (again, this is so that the trainee can utilize the time allotted him on the computer if he so desires). Otherwise, the trainee will be permitted to complete the remedial material that has been programmed, then he must stop and work on the text.

   b. The trainee presses REVIEW (P_8). A frame (review cue, Figure 17, page 3-38) is displayed. The trainee types and enters his answer and receives feedback (Figure 18, page 3-39) in the form of a comment, the correct answer, and instructions to go to the next page. This sequence of frames is continued until completion. Poor performance (i.e., two or more wrong answers) results in the display of the text reference and a stop when the trainee has completed the remedial material. If his performance was satisfactory, the next step in the remedial material is initiated.

      During each display the SKIP (P_{20}) light may be on, permitting the trainee to skip the review if he believes he knows the answer to the primary problem. This option is available only to satisfactory

trainees, and will immediately display the problem (Figure 22, page 3-43). If the answer to the problem is correct, the trainee continues along the "correct" path (see Section 5). If not, he is returned to the frame where he left off.

Upon successful completion of the review sequence, the last answer display is followed by Figure 26, page 3-47, (and the procedure described in Section 6 is repeated) or by the primary problem (Figure 23, page 3-44; Section 5). The choice of continuation is determined by the computer in the following manner.

If the trainee makes errors in a primary problem, all the errors are classified and some kind of remedial material must be presented for each category in which an error was made. The computer will continue to present this material (going through Figure 26 for each category) until every category has been covered. At this point, the primary problem (Figure 23) is re-presented and the trainee attempts to answer it correctly again.

c. If the trainee presses NO (P_{14}) when presented with Figure 26, a variety of displays could occur depending upon the prior performance of the trainee. If his performance was not good, the following display is determined by the program and could be a text reference (Section 6.a.) or a review sequence (Section 6.b.). Otherwise, the trainee is presented with Figure 26 with the marker arrow moved to a specific category in which a mistake was made (e.g., Major Item Secondary) and giving him a choice of continuations. Our trainee lets the computer decide the course of action by pressing NO (P_{14}) again.

The computer may now display a text reference (Section 6.a.) or review sequence (Section 6.b.) dealing with the problem area. It can also present a practice problem (Figure 20, page 3-41) if the trainee has been doing well. Let us look at the practice problem continuation, which is similar to that in Section 4.c. The trainee may ask for help on the problem as he did in Section 4.c., and with the same results. If performance is poor he is given either a text reference (Figure 15, page 3-35) or a review sequence (Figure 17, page 3-38). Successful completion returns the practice problem to the display screen. If the problem is answered incorrectly, Figure 22 appears and the trainee may try again by pressing

TRY AGAIN (P_{19}) (if lighted), or he may be presented with the remedial displays (see Sections 6.a. or 6.b.). If the answer is correct, the SKIP (P_{20}) key is lighted during the confirmation display (Figure 21, page 3-42). If no key is pressed, this display is followed by either Figure 26 (see Section 6) or by the primary problem (see Section 5). The computer determines the display by using the procedure described above.

7. After the trainee has correctly answered all the primary problems, the resultant display (Figure 24, page 3-45) for the last problem is followed by a cue (Figure 29, page 3-54) which informs the trainee that a test consisting of ten problems will follow. It is recommended that the test be taken immediately, but the trainee can stop if necessary. Our hypothetical trainee will take the test; he presses CONTINUE (P_{17})

   The first test problem (Figure 30, page 3-56) is presented, the trainee composes and enters his answer, the next problem is displayed, and so forth. If the trainee's overall test performance is less than satisfactory after the fifth problem is completed, the answer to this problem is followed by the cue (Figure 26, page 3-47) listing the categories in which errors were made for all the posttest problems, and the continuing sequence is that described in Section 6. All errors in all the test problems attempted are dealt with in this remedial sequence.

   Upon completion of the remedial material, all the problems missed are presented again and the test sequence is continued. If the overall performance drops below satisfactory with any problem after the fifth, the remedial sequence is initiated as described above.

   After successful completion of all the test problems, the final display (Figure 31, page 3-58) informs the trainee that he is finished with all the instruction.

```
1 UNCLASSIFIED                                   Ø1 OF Ø2
2 INTRODUCTION
3
4 WELCOME TO THE 473L QUERY LANGUAGE
5 COMPUTER-DIRECTED INSTRUCTIONAL
6 PROGRAM.
7
8 IF YOU HAVE USED THIS COMPUTER
9 PROGRAM BEFORE, PLEASE PRESS THE
10 PROCESS STOP KEY LABELED "OLD
11 TRAINEE."
12
13 IF THIS IS YOUR FIRST TIME FOR THIS
14 PROGRAM, PRESS THE PROCESS STEP KEY
15 LABELED "NEW TRAINEE."
16
17 IF YOU HAVE FINISHED THE PREPROGRAM
18 SUCCESSFULLY, YOU SHOULD HAVE NO
19 GO ON TO THE NEXT PAGE.
20 UNCLASSIFIED
```

Fig. 7. Introduction Cue - Q_1 (Ø1 of Ø2)

```
1 UNCLASSIFIED                                                  Ø2 OF Ø2
2 INTRODUCTION
3
4 TROUBLE WITH THIS PROGRAM.
5
6 IF YOU ARE STILL UNSURE OF SOME OF
7 THE MATERIAL, PLEASE REVIEW IT BEFORE
8 STARTING.
9
10
11
12
13
14
15
16
17
18
19
20 UNCLASSIFIED
```

Fig. 7. (con't.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	1
2	N	A	M	E		C	U	E																												
3																																				
4	P	L	E	A	S	E		T	Y	P	E		Y	O	U	R		N	A	M	E		I	N		T	H	E		S	P	A	C	E		
5	P	R	O	V	I	D	E	D		B	E	L	O	W	,	T	H	E	N		P	R	E	S	S		E	N	T	E	R	.				
6																																				
7	↓																																			
8																																				
9																																				
10																																				
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 8. Name Entry Cue - Q_2

```
1 UNCLASSIFIED                                                  Ø1 OF Ø2
2 PRETEST INSTRUCTION
3
4 IN ORDER TO DETERMINE YOUR CURRENT
5 ABILITY TO WRITE QUERY LANGUAGE
6 STATEMENTS, YOU WILL BE GIVEN A
7 SERIES OF PROBLEMS.
8
9 AFTER YOU HAVE SEEN THE PROBLEM, TYPE
10 AND ENTER THE QUERY LANGUAGE
11 STATEMENT YOU THINK WILL OBTAIN THE
12 INFORMATION REQUESTED.
13
14 AFTER YOU ENTER YOUR ANSWER, ANOTHER
15 PROBLEM WILL BE DISPLAYED FOR YOU TO
16 ANSWER.
17
18 REMEMBER TO PRESS "ACTIVATE A/N
19 GO ON TO THE NEXT PAGE
20 UNCLASSIFIED
```

Fig. 9. Pretest Instruction Cue - Q_4 (Ø1 of Ø2)

```
1 UNCLASSIFIED                                                  Ø2  OF  Ø2
2 PRETEST  INSTRUCTION
3
4 KEYBOARD"  BEFORE  TYPING.
5
6 THERE  ARE  TEN  PROBLEMS  IN  THIS
7 PRETEST.
8
9 NOW  PRESS  "NEXT"  TO  CONTINUE.
10
11
12
13
14
15
16
17
18
19
20 UNCLASSIFIED
```

Fig. 9 (con't.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	1
2	P	R	E	T	E	S	T		P	R	O	B	L	E	M		1																			
3																																				
4	F	I	N	D		T	H	E		M	A	T	S		U	N	I	T	S		W	H	I	C	H		P	O	S	S	E	S	S			
5	M	O	R	E		T	H	A	N		S	I	X		C	-	1	2	1		A	I	R	C	R	A	F	T	,	A	L	O	N	G		
6	W	I	T	H		T	H	E		L	O	C	A	T	I	O	N		A	N	D		C	-	R	A	T	I	N	G		O	F			
7	E	A	C	H		U	N	I	T	.																										
8																																				
9	F	I	N	D		T	H	E		N	U	M	B	E	R		O	F		C	-	1	2	1		A	I	R	C	R	A	F	T			
10	A	C	T	U	A	L	L	Y		P	O	S	S	E	S	S	E	D		A	N	D		T	H	E		N	U	M	B	E	R			
11	R	E	A	D	Y	.																														
12																																				
13	↓																																			
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 10. Pretest Problem Cue - Q_5

```
1 UNCLASSIFIED                                   Ø1 OF Ø1
2 PROCEDURE OPTIONS
3
4 YOU HAVE FINISHED THE PRETEST.
5
6 YOUR PERFORMANCE WAS AAAAAAAAAAAAAAA.
7
8 NOW WE WILL CONTINUE WITH THE
9 PRIMARY PROBLEMS.
10
11 IF YOU MUST STOP HERE, PRESS
12 "FINISHED" (IF ANOTHER TRAINEE IS TO
13 FOLLOW).
14
15 IF THERE ARE NO MORE TRAINEES, PRESS
16 "CANCEL AND DEACTIVATE."
17
18 IF YOU ARE READY TO CONTINUE WITH
19 THE INSTRUCTION, PRESS "CONTINUE."
20 UNCLASSIFIED
```

Fig. 11. Procedure Option Cue - Conclusion of Pretest - Q_6

```
1 UNCLASSIFIED                                   Ø1  OF  Ø2
2 PROCEDURE  OPTION
3
4 BEFORE  WE  START, YOU  MAY  WANT  TO
5 REVIEW  SOME  AREAS  OF  QUERY  LANGUAGE.
6
7 IF  YOU  WOULD  LIKE  TO  WORK  SOME
8 SIMPLE  PROBLEMS  ON  QUERY  LANGUAGE
9 WHICH  FOCUS  ON  CERTAIN  AREAS, PRESS
10 "PRACTICE."
11
12 IF  YOU  WOULD  LIKE  A  BRIEF  REVIEW  OF
13 ONE  OR  MORE  AREAS, PRESS  "REVIEW."
14
15 IF  YOU  WOULD  LIKE  A  REFERENCE  TO  THE
16 TEXT, PRESS  "TEXT  REFERENCE."
17
18 IF  YOU  WOULD  LIKE  TO  START  RIGHT  IN
19                GO  ON  TO  THE  NEXT  PAGE.
20 UNCLASSIFIED
```

Fig. 12. Procedure Option Cue - Q_3 (Ø1 of Ø2)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	2		O	F		Ø	2
2	P	R	O	C	E	D	U	R	E		O	P	T	I	O	N																				
3																																				
4	O	N		A		P	R	I	M	A	R	Y		P	R	O	B	L	E	M	,	P	R	E	S	S		"	P	R	O	B	L	E	M	.
5	"																																			
6																																				
7																																				
8																																				
9																																				
10																																				
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 12. (con't.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	1
2	C	H	O	I	C	E		O	F		D	I	R	E	C	T	I	O	N		C	U	E													
3																																				
4	I	F		Y	O	U		W	O	U	L	D		L	I	K	E		T	O		C	H	O	O	S	E		T	H	E					
5	A	R	E	A	S		F	O	R		S	T	U	D	Y	,	P	R	E	S	S		"	Y	E	S	.	"								
6																																				
7	I	F		Y	O	U		W	O	U	L	D		L	I	K	E		T	H	E		C	O	M	P	U	T	E	R		T	O			
8	C	H	O	O	S	E		T	H	E		A	R	E	A	S		A	S		D	E	T	E	R	M	I	N	E	D		B	Y			
9	Y	O	U	R		P	A	S	T		W	O	R	K	,	P	R	E	S	S		"	N	O	.	"										
10																																				
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 13. Choice of Direction Cue - Q_{13}

```
1 UNCLASSIFIED                                                  Ø1 OF Ø2
2 CATEGORY LISTING
3
4 TYPE AN ASTERISK (*) NEXT TO THE
5 AREAS ON WHICH YOU WOULD LIKE TO
6 WORK.
7
8 PRESS "ENTER" AFTER EACH ENTRY.
9
10 IF YOU DO NOT WISH TO CHOOSE AN AREA
11 , PRESS "SKIP ENTRY."
12
13 WHEN YOU ARE FINISHED WITH YOUR
14 SELECTION, PRESS "JUDGE."
15
16
17
18
19                GO ON TO THE NEXT PAGE
20 UNCLASSIFIED
```

Fig. 14. Category Listing Cue - Q_{15} (Ø1 of Ø2)

1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	2		O	F		Ø	2
2	C	A	T	E	G	O	R	Y		L	I	S	T	I	N	G																				
3																																				
4	↓		P	R	O	C	E	S	S		D	I	R	E	C	T	O	R	S																	
5	_		Q	U	A	L	I	F	I	E	R	S																								
6	_		S	E	L	E	C	T	O	R	S																									
7	_		M	A	J	O	R		I	T	E	M	S		P	R	I	M	A	R	Y															
8	_		D	E	L	I	M	E	T	E	R	S																								
9	_		A	T	T	R	I	B	U	T	E	S																								
10	_		C	O	M	P	A	R	A	T	O	R	S																							
11	_		V	A	L	U	E	S																												
12	_		L	O	N	G	E	S	T		R	N	W	Y																						
13	_		P	U	N	C	T	U	A	T	I	O	N																							
14	_		R	U	L	E	S		O	F		S	T	A	T	E	M	E	N	T		C	O	N	S	T	R	U	C	T	I	O	N			
15	_		G	E	N	E	R	A	L		R	U	L	E	S		O	F		Q	U	E	R	Y		L	A	N	G	U	A	G	E			
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 14. (con't.)

```
1 UNCLASSIFIED                                   Ø1 OF XX
2 TEXT REFERENCE
3
4 PLEASE READ THE FOLLOWING SECTION IN
5 THE PROGRAMED TEXT.
6
7 COPY THE REFERENCE ON A SHEET OF
8 PAPER.
9
10        MAJOR ITEM PRIMARY
11          CHAPTER III
12            PART C
13              FRAMES 8 TO 25
14
15
16
17
18
19                GO ON TO THE NEXT PAGE
20 UNCLASSIFIED
```

Fig. 15. Text Reference Display (Ø1 of XX) - D_4

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	X	X		O	F		X	X
2	C	O	N	T	I	N	U	A	T	I	O	N		C	H	O	I	C	E	S																
3																																				
4	I	F		Y	O	U		W	I	S	H		T	O		S	T	O	P		T	O		R	E	A	D		T	H	E		T	E	X	T
5	R	E	F	E	R	E	N	C	E	,	P	R	E	S	S		"	F	I	N	I	S	H	E	D	"		O	R							
6	"	C	A	N	C	E	L		A	N	D		D	E	A	C	T	I	V	A	T	E	.	"												
7																																				
8	I	F		Y	O	U		W	O	U	L	D		L	I	K	E		T	O		C	O	N	T	I	N	U	E		O	N		T	H	E
9	C	O	M	P	U	T	E	R	,	P	R	E	S	S		"	C	O	N	T	I	N	U	E	.	"										
10																																				
11	I	F		T	H	E		"	C	O	N	T	I	N	U	E	"		K	E	Y		I	S		N	O	T		L	I	G	H	T	E	D
12	Y	O	U		M	U	S	T		S	T	O	P		H	E	R	E	.																	
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 15. (con't.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	1
2	C	O	N	T	I	N	U	A	T	I	O	N		O	P	T	I	O	N	S		C	U	E												
3																																				
4	Y	O	U		M	A	Y		N	O	W		O	B	T	A	I	N		P	R	A	C	T	I	C	E		P	R	O	B	L	E	M	S
5	(	P	R	E	S	S		"	P	R	A	C	T	I	C	E	"	)	,	R	E	V	I	E	W		M	A	T	E	R	I	A	L		
6	(	P	R	E	S	S		"	R	E	V	I	E	W	"	)	,	O	R		T	H	E		P	R	I	M	A	R	Y					
7	P	R	O	B	L	E	M		(	P	R	E	S	S		"	P	R	O	B	L	E	M	"	)	.										
8																																				
9																																				
10																																				
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 16. Continuation Options Cue - Q_{12}

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	X
2	R	E	V	I	E	W		C	U	E		-		D	E	L	I	M	I	T	E	R														
3																																				
4	E	N	T	E	R		T	H	E		A	N	S	W	E	R	S	.																		
5																																				
6	P	R	E	S	S		"	E	N	T	E	R	"		A	F	T	E	R		E	A	C	H		A	N	S	W	E	R	.				
7																																				
8	P	R	E	S	S		"	J	U	D	G	E	"		W	H	E	N		Y	O	U		H	A	V	E		A	N	S	W	E	R	E	D
9	A	L	L		T	H	E		B	L	A	N	K	S	.																					
10																																				
11	A		D	E	L	I	M	I	T	E	R		C	O	N	S	I	S	T	S		O	F		T	H	R	E	E		P	A	R	T	S	,
12	T	H	E		1	_	_	_	_	_	_	_	_	_	_	,	T	H	E		2	_	_	_	_	_	_	_	_	,	A	N	D			
13	T	H	E		3	_	_	_	_	_	_	_	_	_	_	.																				
14																																				
15	1	↓	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
16	2	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
17	3	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 17. Review Cue - Q_{11}

```
1 UNCLASSIFIED                                                  Ø1  OF  Ø1
2 ANSWER  DISPLAY
3
4 YOU  ARE  CORRECT
5
6
7 THE  CORRECT  ANSWER  IS
8
9     ATTRIBUTE
10    COMPARATOR
11    VALUE.
12
13 THEY  MAY  HAVE  BEEN  ENTERED  IN  ANY
14 ORDER.
15
16
17
18
19                GO  ON  TO  THE  NEXT  PAGE
20 UNCLASSIFIED
```

Fig. 18. Answer Display (Confirmation) - D_3

```
1  UNCLASSIFIED                                                  Ø1  OF  Ø1
2  CONTINUATION  OPTIONS
3
4  YOU  HAVE  SUCCESSFULLY  COMPLETED  THE
5  WORK  YOU  WERE  DOING.
6
7  IF  YOU  WISH  MORE  REVIEW  OR  SOME
8  PRACTICE  PROBLEMS, PRESS  "REVIEW"  OR
9  "PRACTICE."
10
11 TO  TRY  THE  PRIMARY  PROBLEM, PRESS
12 "PROBLEM."
13
14 IF  YOU  MUST  STOP, PRESS  "FINISHED"  OR
15 "CANCEL  AND  DEACTIVATE."
16
17
18
19
20 UNCLASSIFIED
```

Fig. 19. Continuation Option Cue - Q_{14}

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	X
2	P	R	A	C	T	I	C	E		P	R	O	B	L	E	M																				
3																																				
4	F	I	N	D		T	H	E		N	A	M	E		O	F		A	L	L		A	I	R	F	I	E	L	D	S		I	N			
5	C	A	N	A	D	A		W	H	I	C	H		H	A	V	E		A		L	O	N	G	E	S	T		R	U	N	W	A	Y		
6	O	F		L	O	N	G	E	R		T	H	A	N		8	0	0	0		F	E	E	T		A	N	D		H	A	V	E			
7	M	E	D	I	C	A	L		S	E	R	V	I	C	E	S		A	N	D		F	I	R	E		E	Q	U	I	P	M	E	N	T	
8	A	V	A	I	L	A	B	L	E	.																										
9																																				
10	↓																																			
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 20. Practice Problem Cue - Q_{10}

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	X
2	C	O	N	F	I	R	M	A	T	I	O	N		D	I	S	P	L	A	Y																
3																																				
4	Y	O	U		A	R	E		C	O	R	R	E	C	T	.																				
5																																				
6																																				
7																																				
8																																				
9																																				
10																																				
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19										G	O		O	N		T	O		T	H	E		N	E	X	T		P	A	G	E					
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 21. Confirmation Display - D_{2A}

```
1  UNCLASSIFIED                                   Ø1  OF  ØX
2  NEGATION  DISPLAY
3
4  UNFORTUNATELY, YOU  ARE  INCORRECT.
5
6  IF  THE  "TRY  AGAIN"  KEY  IS  LIGHTED,
7  YOU  MAY  PRESS  IT  AND  TRY  AGAIN.
8
9
10
11
12
13
14
15
16
17
18
19                GO  ON  TO  THE  NEXT  PAGE
20 UNCLASSIFIED
```

Fig. 22. Negation Display - D_{2B}

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	1
2	P	R	I	M	A	R	Y		P	R	O	B	L	E	M		1																			
3																																				
4	F	I	N	D		T	H	E		N	A	M	E	,	L	E	N	G	T	H		O	F		L	O	N	G	E	S	T					
5	R	U	N	W	A	Y	,	T	Y	P	E		A	N	D		W	I	D	T	H		O	F		T	A	X	I	W	A	Y	,			
6	N	A	V	A	I	D		T	Y	P	E	,	A	N	D		L	I	G	H	T	I	N	G		T	Y	P	E		F	O	R			
7	A	I	R	F	I	E	L	D	S		I	N		J	A	P	A	N		W	I	T	H		L	O	N	G	E	S	T					
8	R	U	N	W	A	Y	S		L	O	N	G	E	R		T	H	A	N		7	0	0	0		F	E	E	T	.						
9																																				
10	↓																																			
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 23. Primary Problem Cue - Q_7

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	2
2																																				
3	A	F	L	D		N	A	M	E						T	O	K	Y	O						Y	O	K	A	H	A	M	A				
4																																				
5	L	O	N	G	E	S	T		R	N	W	Y			1	1									1	2										
6																																				
7	T	W	Y		T	Y	P	E							P	A	R	A	L	L	E	L			C	I	R	C	U	L	A	R				
8																																				
9	T	W	Y		W	I	D	T	H						2	1	0								3	1	4									
10																																				
11	N	A	V	A	I	D		T	Y	P	E				T	O	W	E	R						G	C	A									
12																																				
13	L	T	G		T	Y	P	E							R	N	W	Y							F	L	O	O	D							
14																																				
15																																				
16																																				
17																																				
18																																				
19										G	O		O	N		T	O		T	H	E		N	E	X	T		P	A	G	E					
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 24. Primary Problem Resultant Display (Partial) - D_1

```
1 UNCLASSIFIED                                                  Ø2   OF   Ø2
2 CONTINUATION  OPTIONS
3
4 CONGRATULATIONS  ON  ANSWERING  THE
5 PROBLEM  CORRECTLY.
6
7 IF  YOU  WISH  TO  CONTINUE  WITH  THE
8 NEXT  PROBLEM  OR  REVIEW  MATERIAL,
9 PLEASE  PRESS  "CONTINUE."
10
11 IF  YOU  MUST  STOP  HERE, PRESS
12 "FINISHED"  OR  "CANCEL  AND  DEACTIVATE
13 ,"  WHICH  EVER  IS  APPROPRIATE.
14
15
16
17
18
19
20 UNCLASSIFIED
```

Fig. 25. Continuation Option Cue - Q_8

```
1 UNCLASSIFIED                                  Ø1 OF Ø2
2 ERROR LISTING
3
4 YOU MADE ERRORS ON THE PROBLEM IN
5 THE FOLLOWING AREAS:
6
7 ↓ QUALIFIER
8   DELIMITER
9   SUM
10  SELECTOR
11  MAJOR ITEM SECONDARY
12  PUNCTUATION
13
14 NOTE THE AREA MARKED BY THE ARROW.
15
16
17
18
19                GO ON TO THE NEXT PAGE
20 UNCLASSIFIED
```

Fig. 26. Error Listing (Ø 1 of Ø2) - Q_9

```
1 UNCLASSIFIED                                                  Ø2 OF Ø2
2 CHOICE CUE-ERROR
3
4 IF YOU WOULD LIKE A REVIEW SEQUENCE
5 OR TEXT REFERENCE DEALING WITH THE
6 MARKED AREA,PRESS "REVIEW" OR
7 "TEXT REFERENCE."
8
9 IF NOT,THE COMPUTER WILL DETERMINE
10 THE NEXT STEP ON THE BASIS OF YOUR
11 PAST PERFORMANCE: PRESS "NO."
12
13 IF THE "TRY AGAIN" KEY IS LIGHTED,
14 YOU MAY TRY THE PROBLEM AGAIN.
15
16
17
18
19
20 UNCLASSIFIED
```

Fig. 26a. Choice Cue - Error (Ø2 of Ø2) - Q_{9a}

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	1
2	P	R	I	N	T	O	U	T		C	A	T	E	G	O	R	I	E	S																	
3																																				
4	T	Y	P	E		A	N		A	S	T	E	R	I	S	K		N	E	X	T		T	O		T	H	E		K	I	N	D		O	F
5	P	R	I	N	T	O	U	T		D	E	S	I	R	E	D	.																			
6																																				
7	_		S	U	M	M	A	R	Y		O	F		P	E	R	F	O	R	M	A	N	C	E		O	F		T	R	A	I	N	E	E	
8			N	A	M	E	D	.																												
9																																				
10	_		S	U	M	M	A	R	Y		O	F		P	E	R	F	O	R	M	A	N	C	E		O	V	E	R		A	L	L			
11			T	R	A	I	N	E	E	S	.																									
12																																				
13	_		T	O	T	A	L		I	N	T	E	R	A	C	T	I	O	N		B	E	T	W	E	E	N		T	R	A	I	N	E	E	
14			A	N	D		C	O	M	P	U	T	E	R	.																					
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 27. Printout Category Cue - Q_{16}

0 10 20 30 40 50 60 70 80 90 100 110 120 130

UNCLASSIFIED Ø1 of Ø4

TRAINEE PERFORMANCE SUMMARY - OVERALL PERFORMANCE

JOHN E. DOE

	TOTAL TRIED	TOTAL INCORRECT	% INCORRECT	SUM MAX TIME	OB-TAINED TIME	CUES WITH TIME	TIME EXCEEDED	% TIME EXCEEDED	AIDS POSSIBLE	AIDS USED	% AIDS USED	OVERALL
OVERALL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 1 - PROCESS DIRECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 2 - QUALIFIER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 3 - SELECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 4 - MIP	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 5 - MIS	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 6 - DELIMITER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 7 - ATTRIBUTE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 8 - COMPARATOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 9 - VALUE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 10 - PUNCTUATION	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 11 - COD	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 12 - SUM	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 13 - SORTING	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 14 - TITLES	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 15 - GENERAL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN

GENERAL PERFORMANCE - ALL MATERIALS SCORE - NNN DESCRIPTION - AAAAAAAAAAAAAAAAAAAAAAAAAA

STOPPING POINT PROBLEM NN

Fig. 28. Printout of Trainee Performance Summary - P/O (Ø1 of Ø4)

0 10 20 30 40 50 60 70 80 90 100 110 120 130

UNCLASSIFIED

02 of 04

TRAINEE PERFORMANCE SUMMARY - PRETEST PROBLEMS

JOHN E. DOE

	TOTAL TRIED	TOTAL INCORRECT	% INCORRECT	SUM MAX TIME	OBTAINED TIME	CUES WITH TIME	TIME EXCEEDED	% TIME EXCEEDED	AIDS POSSIBLE	AIDS USED	% AIDS USED	OVERALL
OVERALL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 1 - PROCESS DIRECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 2 - QUALIFIER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 3 - SELECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 4 - MIP	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 5 - MIS	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 6 - DELIMITER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 7 - ATTRIBUTE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 8 - COMPARATOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 9 - VALUE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 10 - PUNCTUATION	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 11 - GCD	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 12 - SUM	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 13 - SORTING	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 14 - TITLES	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 15 - GENERAL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN

GENERAL PERFORMANCE - PRETEST PROBLEMS SCORE - NNN DESCRIPTION - AAAAAAAAAAAAAAAAAAAAAAAAA

Fig. 28. (con't.)

0 10 20 30 40 50 60 70 80 90 100 110 120 130

UNCLASSIFIED

TRAINEE PERFORMANCE SUMMARY - PRIMARY PROBLEMS

JOHN E. DOE

	TOTAL TRIED	TOTAL INCORRECT	% INCORRECT	SUM MAX TIME	OBTAINED TIME	CUES WITH TIME	TIME EXCEEDED	% TIME EXCEEDED	AIDS POSSIBLE	AIDS USED	% AIDS USED	OVERALL
OVERALL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 1 - PROCESS DIRECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 2 - QUALIFIER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 3 - SELECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 4 - MIP	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 5 - MIS	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 6 - DELIMITER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 7 - ATTRIBUTE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 8 - COMPARATOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 9 - VALUE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 10 - PUNCTUATION	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 11 - GCD	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 12 - SUM	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 13 - SORTING	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 14 - TITLES	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 15 - GENERAL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN

GENERAL PERFORMANCE - PRIMARY PROBLEMS SCORE - NNN DESCRIPTION - AAAAAAAAAAAAAAAAAAAAAAAAA

Fig. 28. (con't.)

0 10 20 30 40 50 60 70 80 90 100 110 120 130

UNCLASSIFIED

TRAINEE PERFORMANCE SUMMARY - POSTTEST PROBLEMS

JOHN E. DOE

	TOTAL TRIED	TOTAL INCORRECT	% INCORRECT	SUM MAX TIME	OBTAINED TIME	CUES WITH TIME	TIME EXCEEDED	% TIME EXCEEDED	AIDS POSSIBLE	AIDS USED	% AIDS USED	OVERALL
OVERALL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 1 - PROCESS DIRECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 2 - QUALIFIER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 3 - SELECTOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 4 - MIP	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 5 - MIS	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 6 - DELIMITER	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 7 - ATTRIBUTE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 8 - COMPARATOR	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 9 - VALUE	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 10 - FUNCTION	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 11 - GCD	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 12 - SUM	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 13 - SORTING	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 14 - TITLES	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN
CAT 15 - GENERAL	NNN	NNN	NN	NNN	NNN	NNN	NNN	NN	NNN	NNN	NN	NNN

GENERAL PERFORMANCE - POSTTEST PROBLEMS SCORE - NNN DESCRIPTION - AAAAAAAAAAAAAAAAA

Fig. 28. (con't.)

```
UNCLASSIFIED                                  Ø1  OF  Ø2
TEST INTRODUCTION CUE
CONGRATULATIONS ON ANSWERING THE
PROBLEM CORRECTLY.
WITH THIS PROBLEM YOU HAVE COMPLETED
THE COMPUTER-DIRECTED TRAINING.
A TEST CONSISTING OF TEN PROBLEMS
WILL NOW BE GIVEN.
THE PROBLEMS WILL BE PRESENTED ONE
BY ONE, LIKE THE PRETEST.
IT IS RECOMMENDED THAT YOU START
THIS TEST NOW BY PRESSING "CONTINUE"
GO ON TO THE NEXT PAGE
UNCLASSIFIED
```

Fig. 29. Test Introduction Cue - Q_{17}

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	2		O	F		Ø	2
2																																				
3	I	F		Y	O	U		M	U	S	T		S	T	O	P	,	H	O	W	E	V	E	R	,	P	R	E	S	S		T	H	E		
4	A	P	P	R	O	P	R	I	A	T	E		K	E	Y	.																				
5																																				
6																																				
7																																				
8																																				
9																																				
10																																				
11																																				
12																																				
13																																				
14																																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 29. (con't.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	2
2	T	E	S	T		P	R	O	B	L	E	M		1																						
3																																				
4	Y	O	U		A	R	E		D	E	S	I	G	N	I	N	G		A		P	L	A	N		F	O	R		A	N					
5	A	E	R	I	A	L		B	O	M	B	A	R	D	M	E	N	T		O	F		E	A	S	T	E	R	N		L	U	B	B	I	A
6	W	H	I	C	H		W	I	L	L		I	N	C	O	R	P	O	R	A	T	E		B	5	7	'	S	,	B	5	2	'	S	,	
7	A	N	D	B	5	8	'	S	.																											
8																																				
9	P	O	S	S	I	B	L	E		B	O	M	B	E	R		W	I	N	G	S		F	O	R											
10	C	O	N	T	R	I	B	U	T	I	N	G		A	I	R	C	R	A	F	T		A	R	E		T	H	E		2	3	R	D	,	
11	4	5	T	H		A	N	D		9	6	T	H	.																						
12																																				
13	F	R	O	M		T	H	E	S	E		U	N	I	T	S		Y	O	U		W	A	N	T		T	O		S	E	L	E	C	T	
14	T	H	E		U	N	I	T	S		W	H	I	C	H		C	O	N	T	A	I	N		A	T		L	E	A	S	T		O	N	E
15	O	F		T	H	E		A	I	R	C	R	A	F	T		N	E	E	D	E	D		A	N	D		P	O	S	S	E	S	S		
16	3	5		O	R		M	O	R	E		W	E	A	P	O	N		S	Y	S	T	E	M	S		W	I	T	H		2	8		O	R
17	M	O	R	E		W	S		R	E	A	D	Y	.																						
18																																				
19										G	O		O	N		T	O		T	H	E		N	E	X	T		P	A	G	E					
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 30. Test Problem Cue (Ø1 of Ø2) - Q_{18}

```
1 UNCLASSIFIED                                  Ø2  OF  Ø2
2 TEST PROBLEM 1
3
4 THE UNIT,UNIT LOCATION,TMS'S
5 POSSESSED,NUMBER ON AIRBORNE ALERT,
6 AND THE ACTUAL NUMBER POSSESSED AND
7 READY ARE NEEDED FOR DESIGNING THE
8 PLAN.
9
10 THE OUTPUT SHOULD BE TITLED "UNITS
11 OPTIMAL FOR MISSION X."
12
13 ↓
14
15
16
17
18
19
20 UNCLASSIFIED
```

Fig. 30. (con't.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	U	N	C	L	A	S	S	I	F	I	E	D																	Ø	1		O	F		Ø	1
2	C	O	M	P	L	E	T	I	O	N		D	I	S	P	L	A	Y																		
3																																				
4	C	O	N	G	R	A	T	U	L	A	T	I	O	N	S	.																				
5																																				
6	Y	O	U		H	A	V	E		S	U	C	C	E	S	S	F	U	L	L	Y		F	I	N	I	S	H	E	D		T	H	E		
7	T	E	S	T		A	N	D		T	H	E		C	O	U	R	S	E	.																
8																																				
9	T	H	E		W	R	I	T	E	R	S		A	N	D		D	E	S	I	G	N	E	R	S		H	O	P	E		T	H	A	T	
10	Y	O	U		E	N	J	O	Y	E	D		T	H	I	S		N	E	W		K	I	N	D		O	F								
11	T	R	A	I	N	I	N	G	.																											
12																																				
13	P	L	E	A	S	E		P	R	E	S	S		"	F	I	N	I	S	H	E	D	"		O	R		"	C	A	N	C	E	L		
14	A	N	D		D	E	A	C	T	I	V	A	T	E	.	"																				
15																																				
16																																				
17																																				
18																																				
19																																				
20	U	N	C	L	A	S	S	I	F	I	E	D																								

Fig. 31. Completion Display - D_5

APPENDIX A

Procedural Flow Diagram

The Procedural Flow Diagram has been designed to provide as clear a picture of the various external sequences of events as possible. Decision points are labelled and explained at points where the flow appears to go in many directions at once. This is necessary for this program because there is no one fixed sequence of events. The external displays and choices may vary on the basis of many internal performance factors and the sequence followed by one operator will seldom resemble the sequence taken by another operator.

The numbers below correspond to a numbered line on the Procedural Flow Diagram. The text for each number describes the requirements for the program to take that particular path. Since the normal flow is downward, only the requirements for branches will be described if their purpose is unclear. Since the purpose of some different branches is the same, the same number reference will be used.

1. The trainee has not completed the pretest and must complete it before continuing with the program.
2. The trainee is ready for or is in the posttest.
3. Another problem or cue follows in the sequence.
4. Trainee presses FINISHED (P_{26}) or P_{30}.
5. All problems are completed and the posttest is to start.
6. The trainee made more than a specified percentage of errors and is sent to the remedial sequence.
7. Possible only if CONTINUE (P_6) is lit. P_6 is lit if the trainee's overall performance is rated good or fair or if the sequence was initiated by pressing TEXT REFERENCE (P_7).
8. The trainee may still choose a practice problem or review sequence.
9. An excess percentage of errors were made in the sequence. The trainee is sent to a more intensive sequence (i.e., practice to review and review to teach).
10. The sequence is completed and the next set of material may be presented.

11. The sequence is finished, or the trainee presses a process step key (P_{17}, P_{26}, or P_{30}).
12. Return from a "SKIP" process to a practice problem set.
13. Return from a "SKIP" process to a review cue set, or a continuation to the next category of remedial materials.
14. Possible only if CONTINUE (P_6) is lit. P_6 is lit only if the trainee's overall performance is rated good or if the sequence was initiated by pressing TEXT REFERENCE (P_7), or if remedial material remains.
15. The computer chooses a text reference display.
16. A review sequence is chosen by the computer.
17. If the trainee was doing well, the computer repeats Q_9 but with a more specific category indicated, i.e., Delimiter, Value, GCD, etc.
18. The computer chooses a practice problem set.
19. The remedial material has been completed and the trainee is ready for the problem again.
20. At the completion of a remedial sequence for one category, Q_9 is displayed with the next category marked.
21. Always lit at this point of the program.
22. P_{17} is lit and available if the trainee's overall performance is good, or if the trainee's performance is fair <u>and</u> the sequence was initiated by the trainee. It is lit conditionally if more remedial sequences remain (i.e., a halt is programmed for the point where the remedial sequences are finished).
23. Lit only once for each problem if it is answered incorrectly.
24. Only one HELP sequence available for each problem.
25. The review sequence was initiated by an unsuccessful performance on the HELP sequence, and the problem is to be re-presented as the last cue.

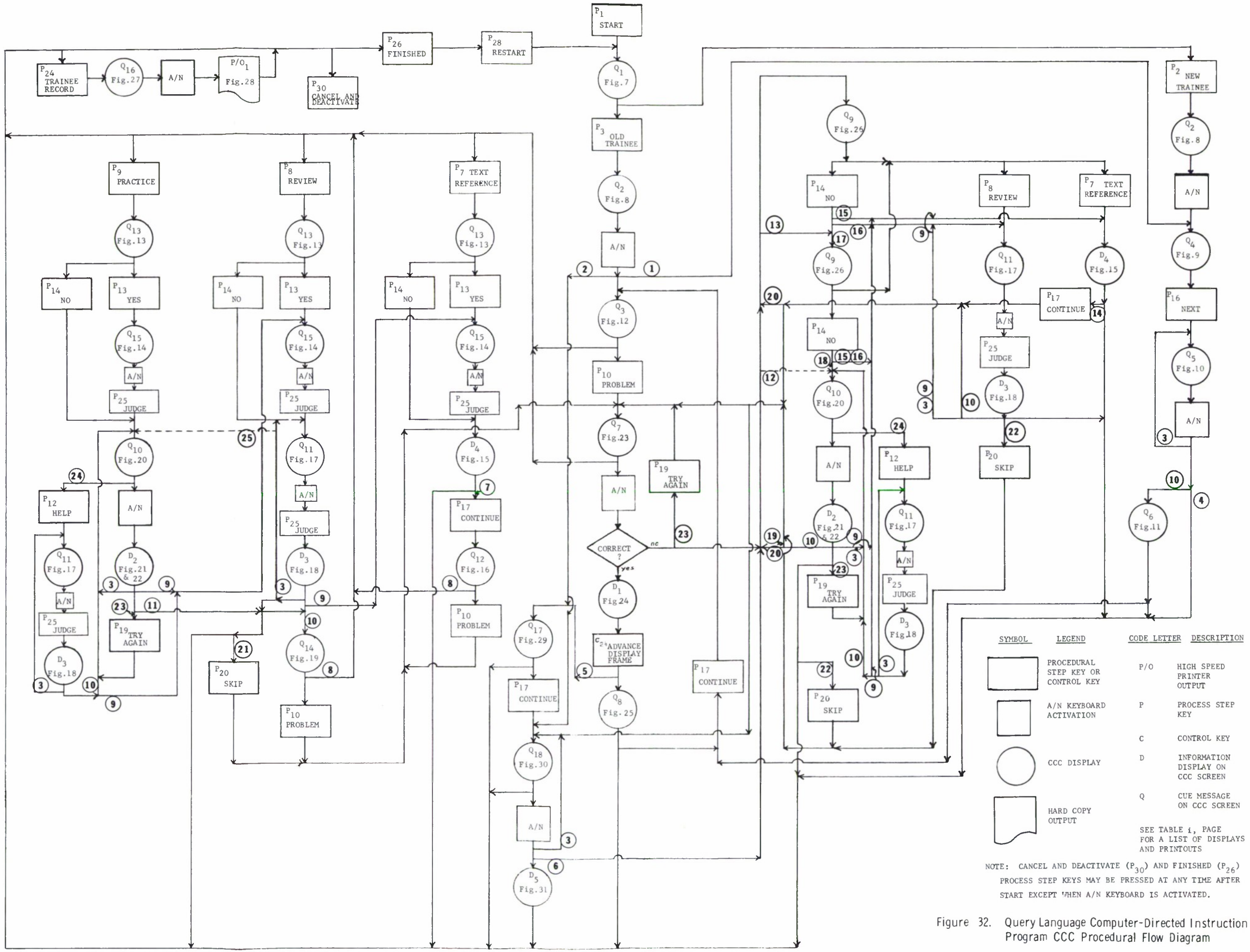


Figure 32. Query Language Computer-Directed Instruction Program CCC Procedural Flow Diagram

APPENDIX B

General Program Flow Charts

These flow charts provide a detailed description of a possible method for programming the sequences described in this Operational Specification. Main routines and subroutines have been designed to attempt to take into account every possible variation that can occur in the program.

The first four charts contain the main sequence of events. The rest of the charts are subroutines that are required by the main routine and/or by other subroutines.

Explanatory notes are added to appropriate pages of the charts to clarify a meaning if it may appear vague or if unusual terms are introduced. However, some common definitions and factors influencing the program are described below.

During the course of the program, CANCEL AND DEACTIVATE (P_{30}) and FINISHED (P_{26}) are lighted at all times that other process step keys are lighted. Thus, this state is not reflected in the flow charts. Also, the automatic rotation of review and practice problem cues is not reflected.

The comparison values provided in the flow are arbitrary and are subject to change on the basis of experience. Therefore, their inclusion is not an indication of the final criteria to be used for comparisons.

When a sequence of cues or a problem is presented to the student and responded to, the number of possible errors in each category for the sequence or problem is added to the appropriate registers automatically. In addition, for each instructional output a set of temporary registers for category and overall accumulation is automatically established. Thus, these are not specified in the following flow diagrams.

The terms "register" and "accumulator" may be used interchangeably at times, but a register is usually used to indicate a storage location where data is temporarily stored, and an accumulator is a storage location that is used to sum, or contain data that may be successively added to.

When the term "word" is used, it is used in the sense of a discrete set of characters that may contain more than one conventional words and that may be separated by some symbol.

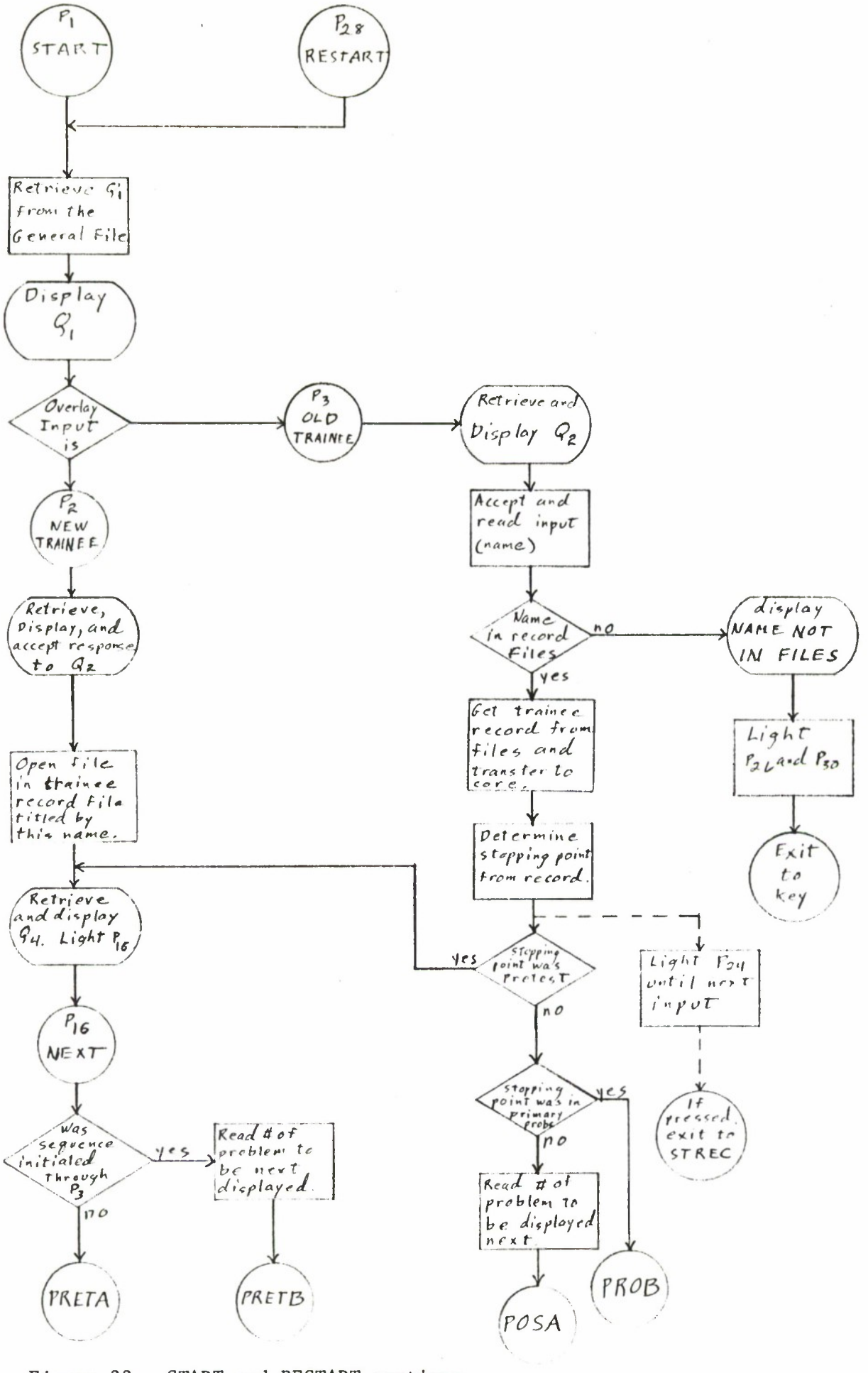


Figure 33. START and RESTART routines

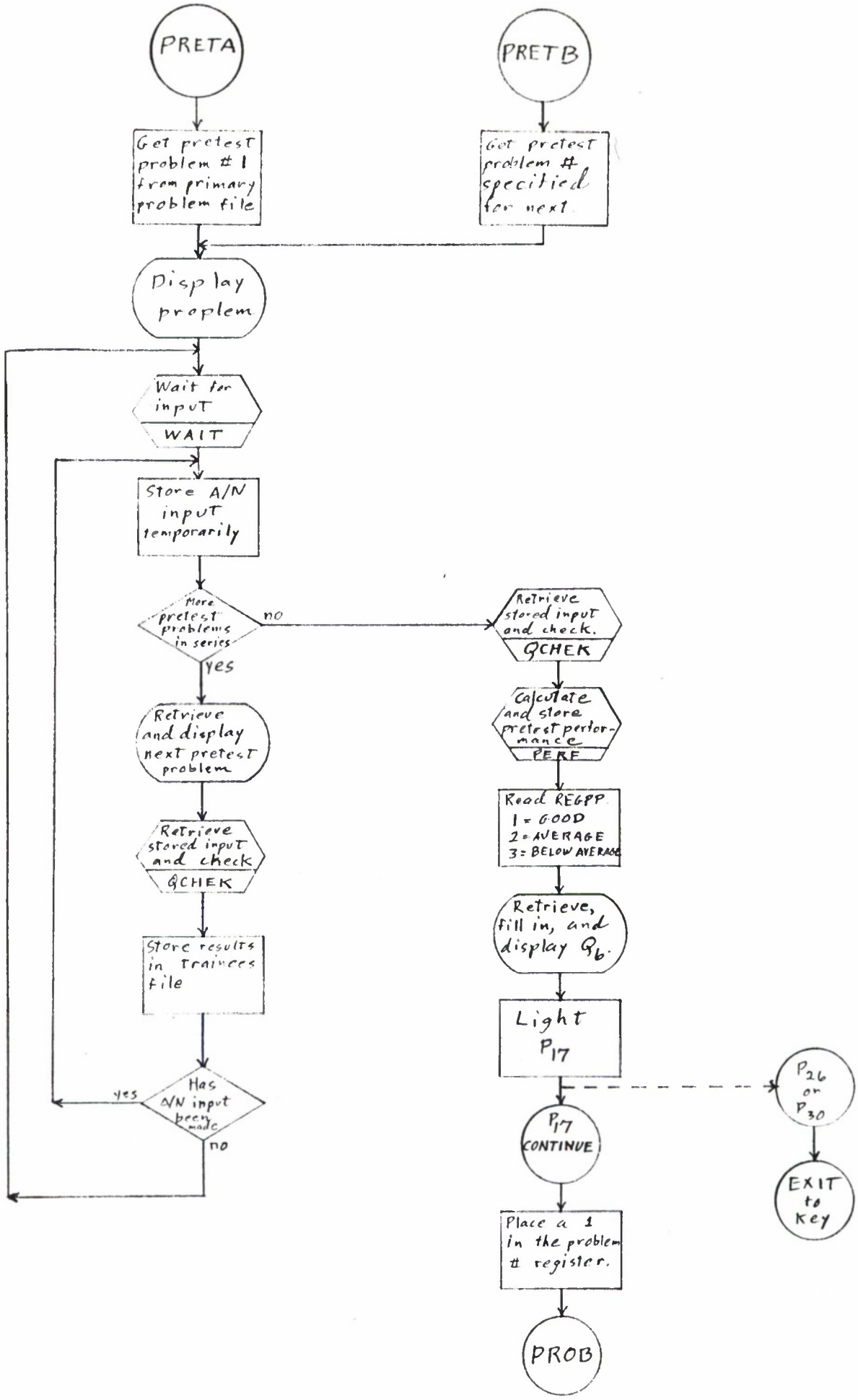


Figure 34. PRETA and PRETB subroutines.

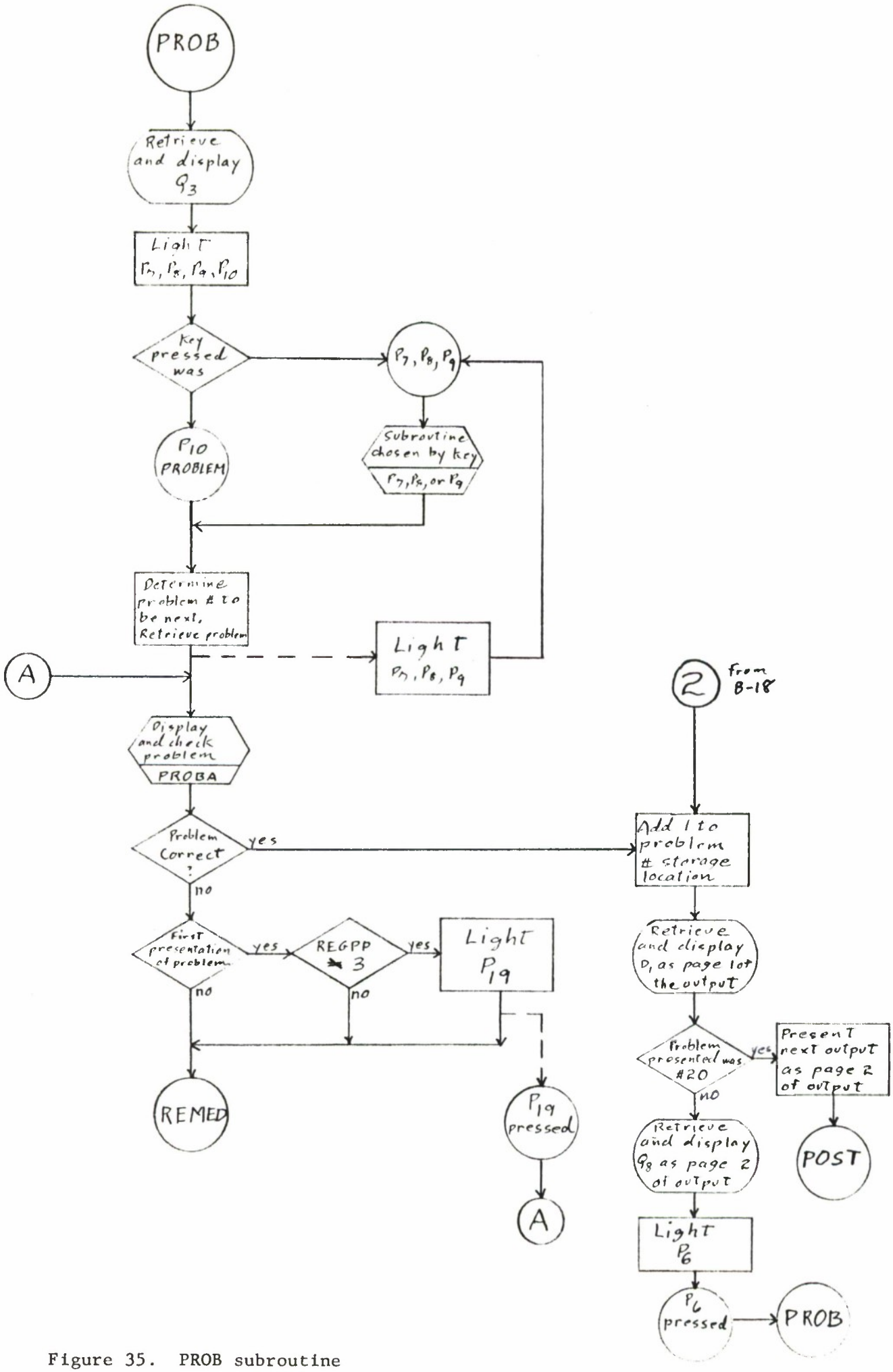


Figure 35. PROB subroutine

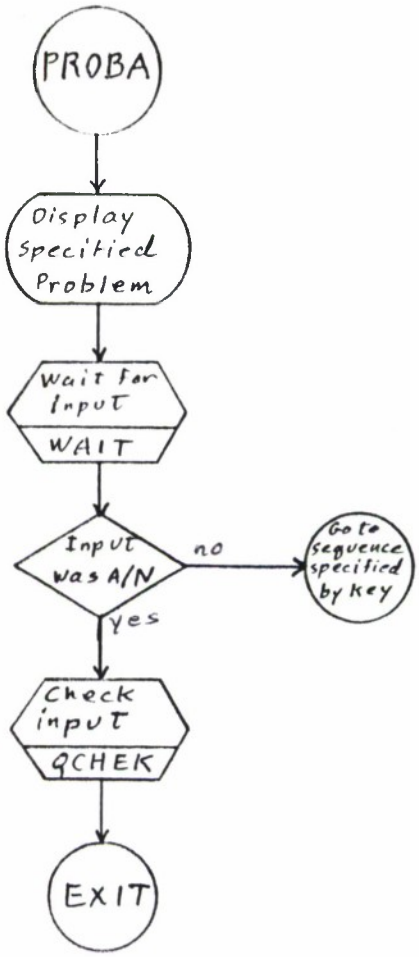


Figure 36. PROBA subroutine

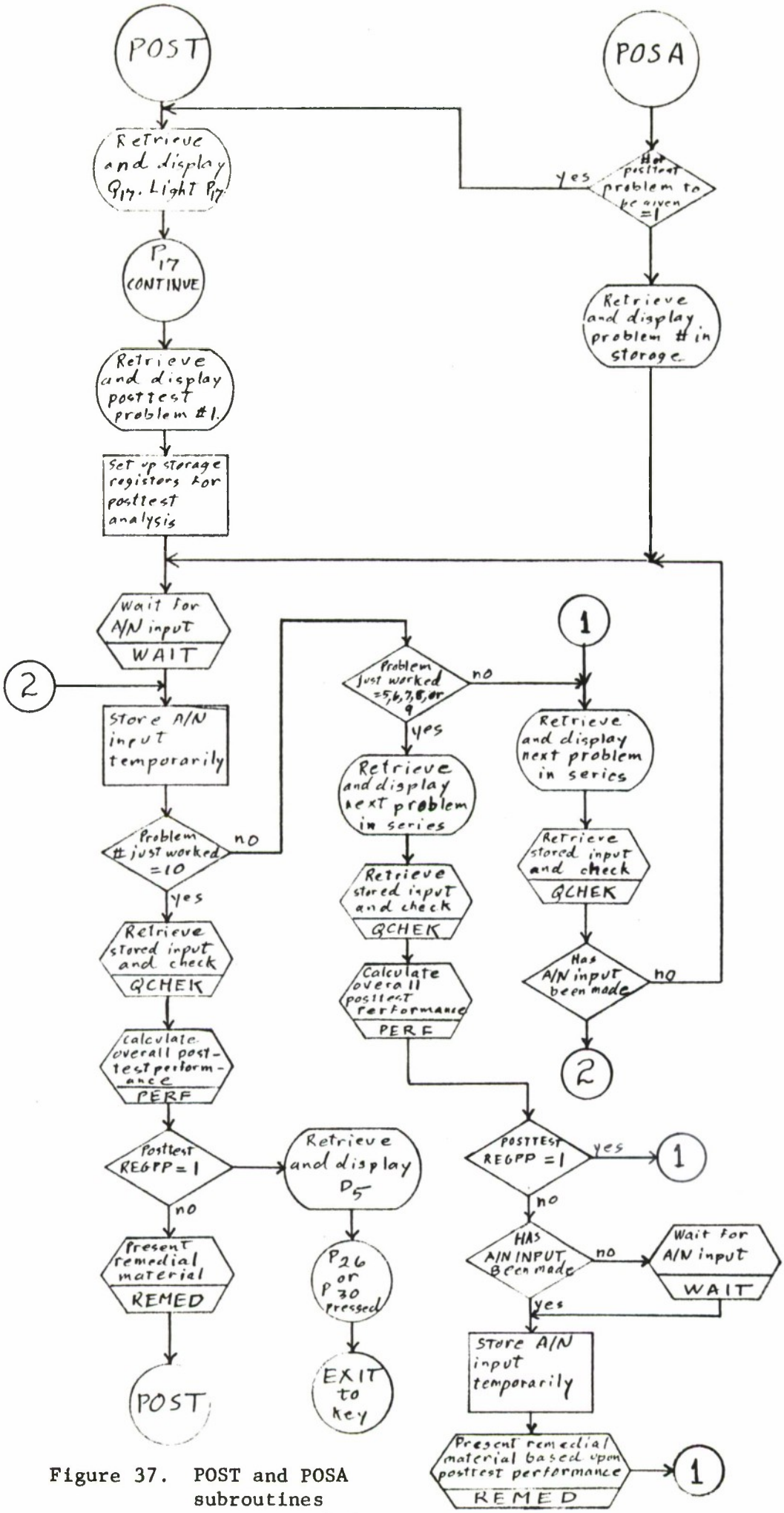


Figure 37. POST and POSA subroutines

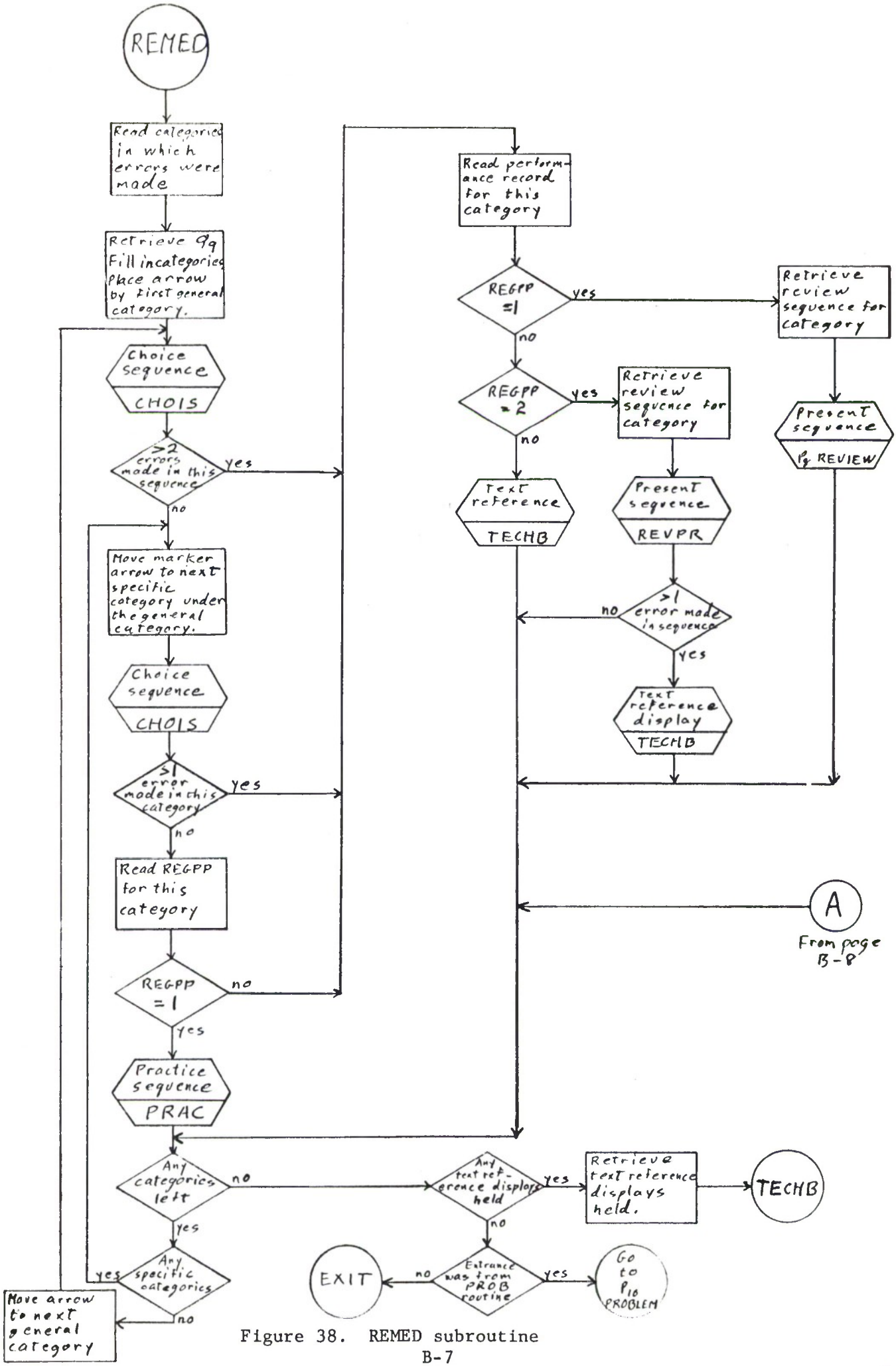


Figure 38. REMED subroutine

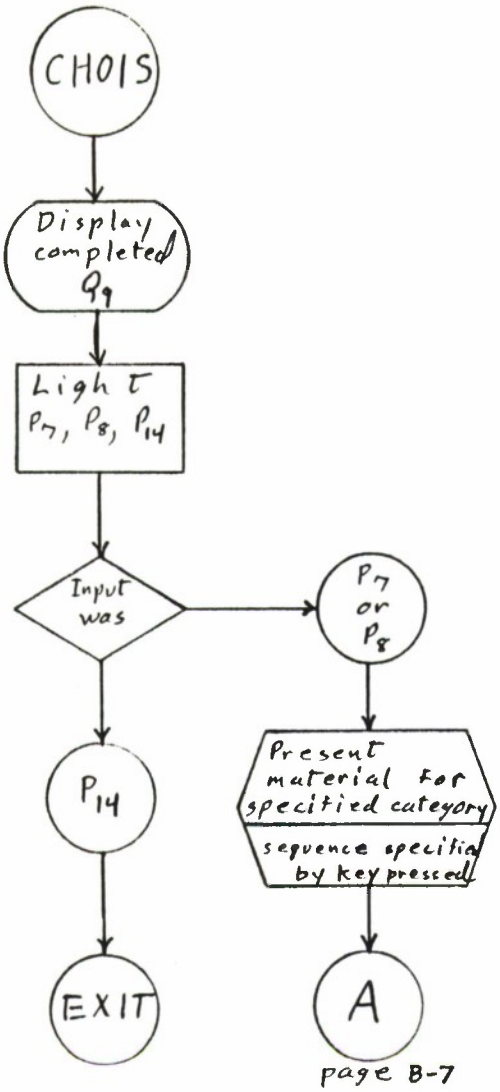
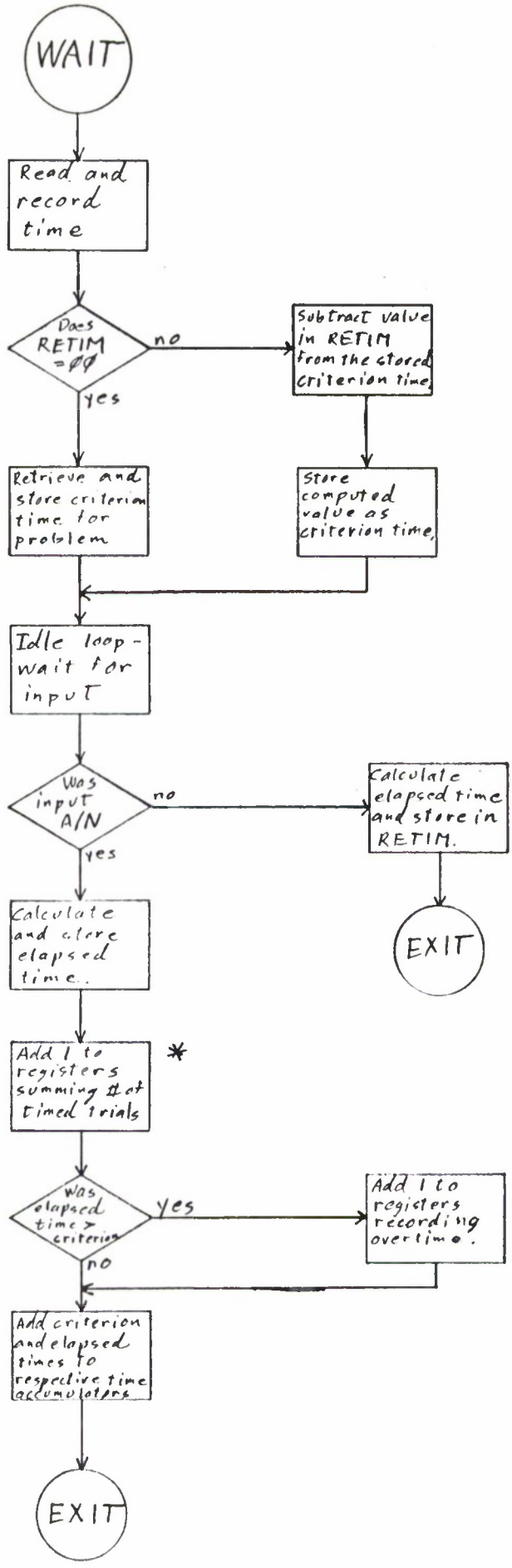


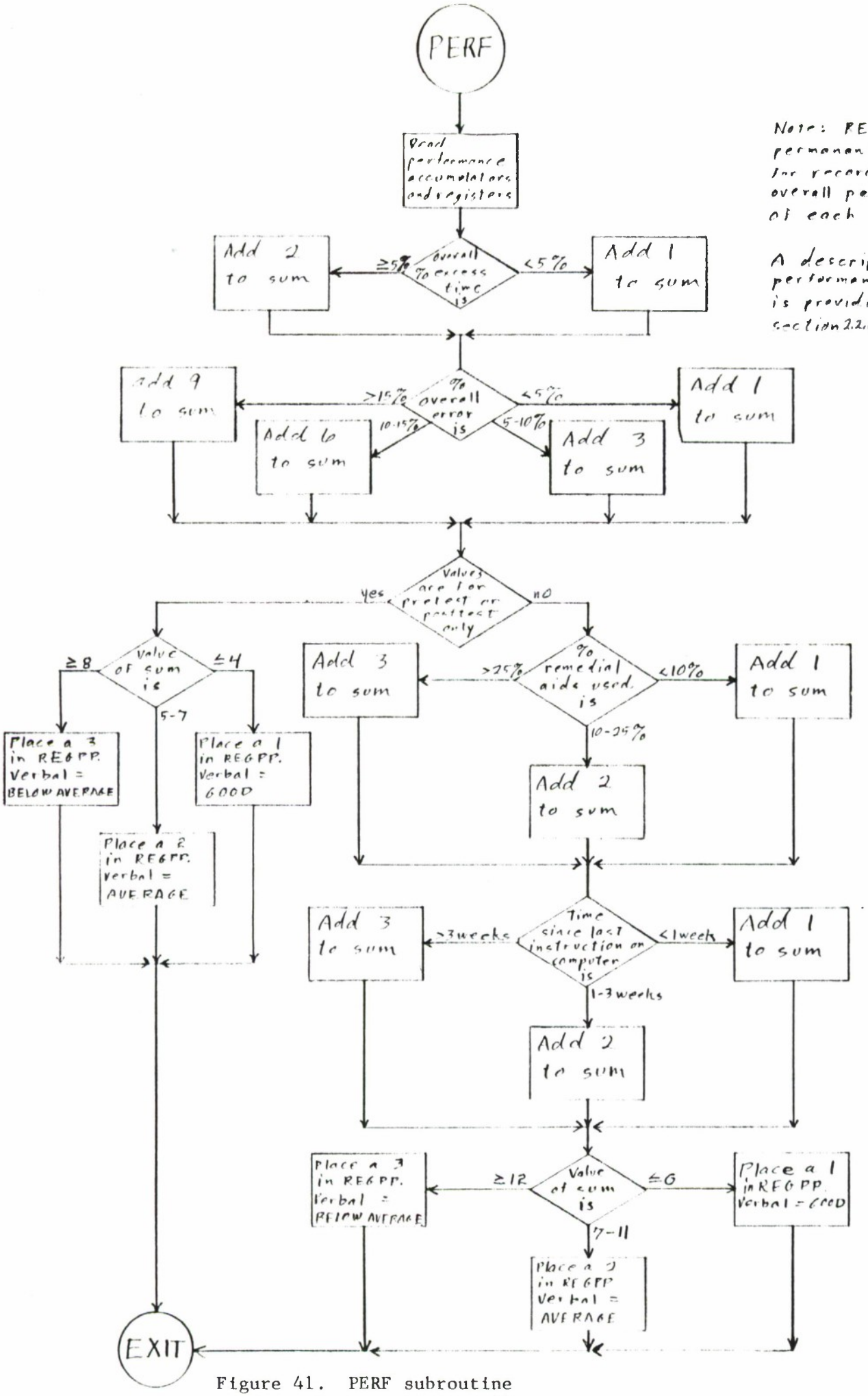
Figure 39. CHOIS subroutine



Note: RETIM is a temporary storage location used to store a time value temporarily when a timed cue is interrupted by a process step key input.

* For an explanation of these processes of record-keeping, see Section 2.3.3, page 2-9.

Figure 40. WAIT subroutine



Note: REGPP is the permanent register for recording the overall performance of each trainee.

A description of each performance accumulator is provided in section 2.2.1.2, page 2-5.

Figure 41. PERF subroutine

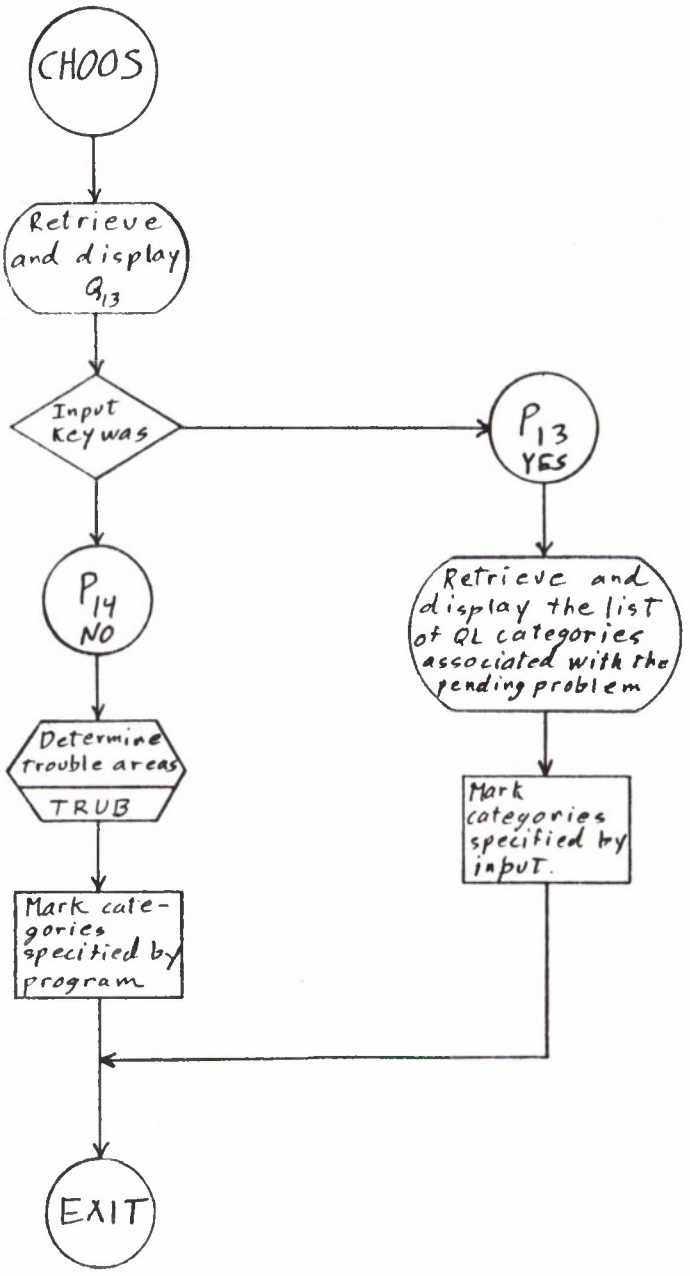


Figure 42. CHOOS subroutine

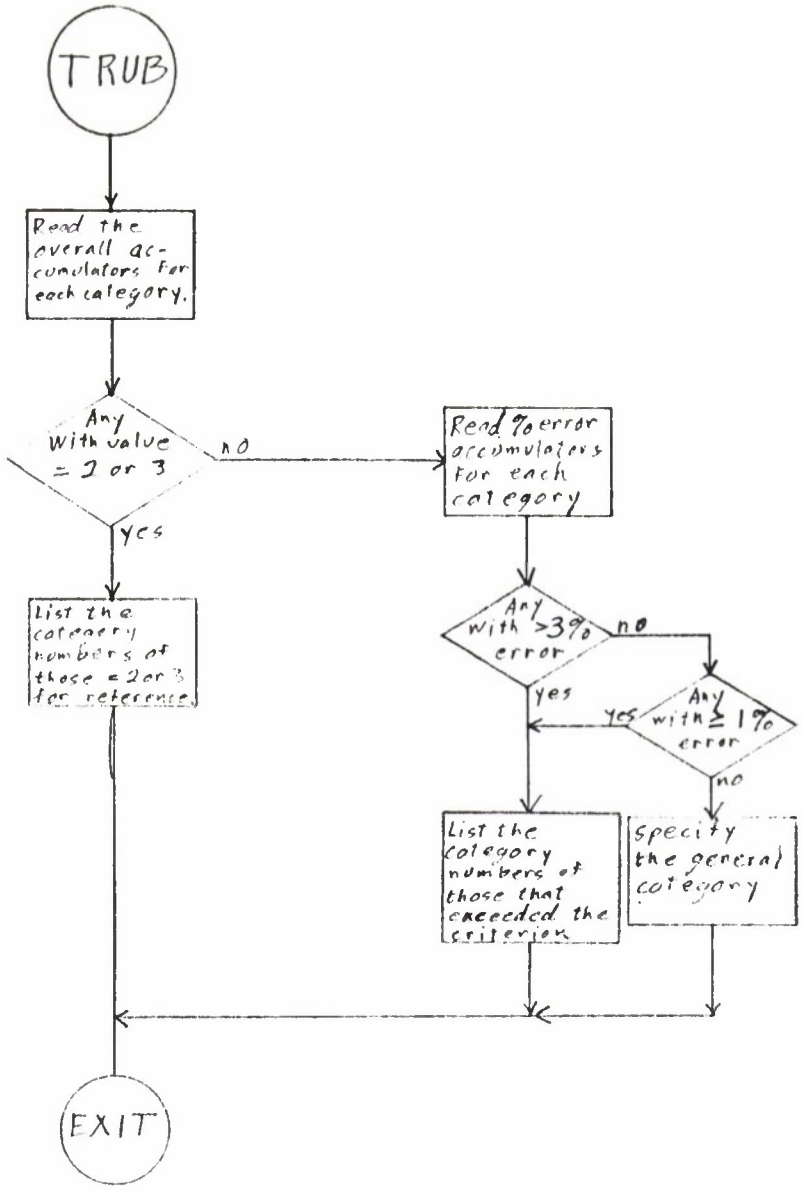


Figure 43. TRUB subroutine

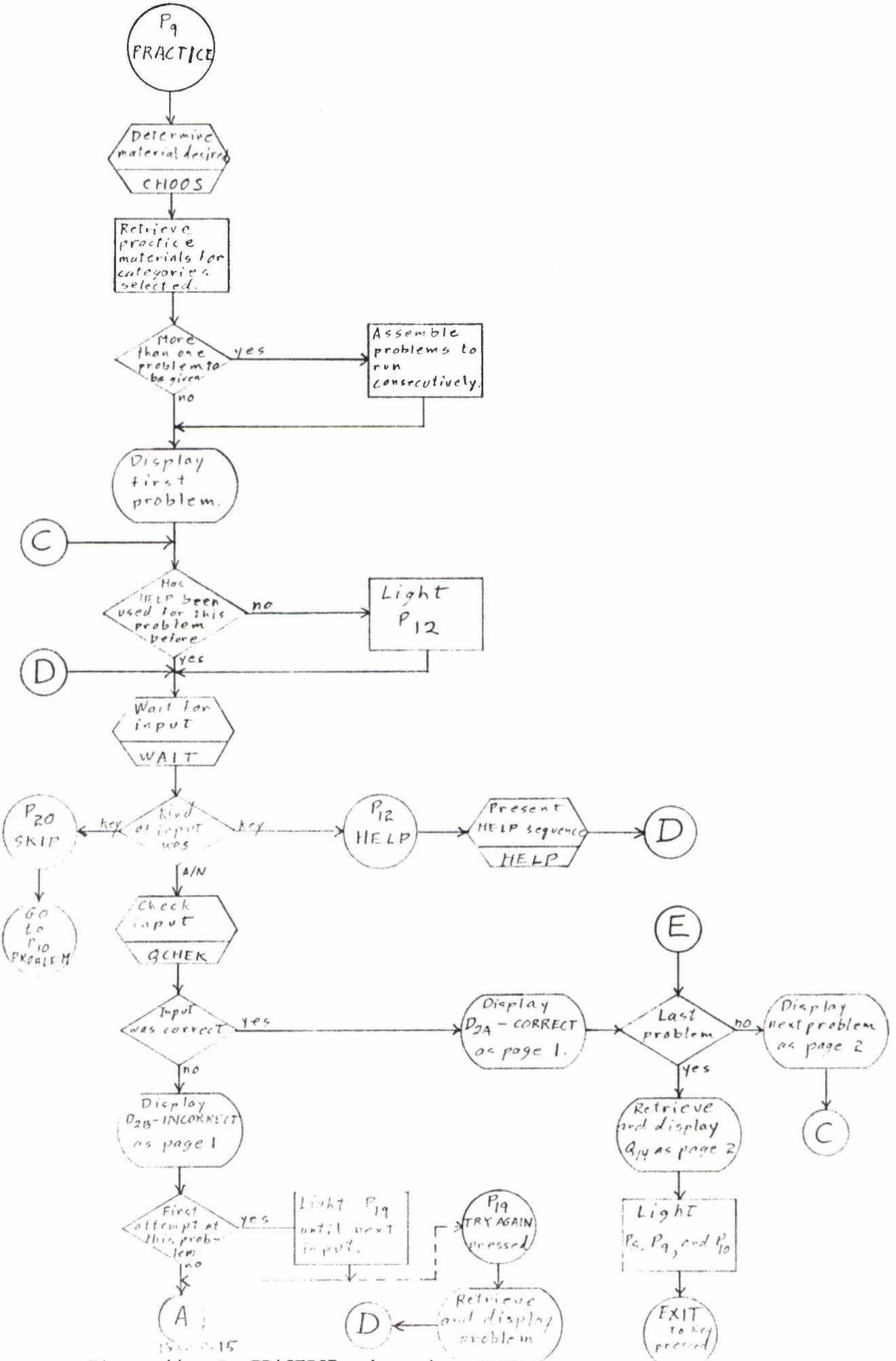


Figure 44. P_9 PRACTICE subroutine

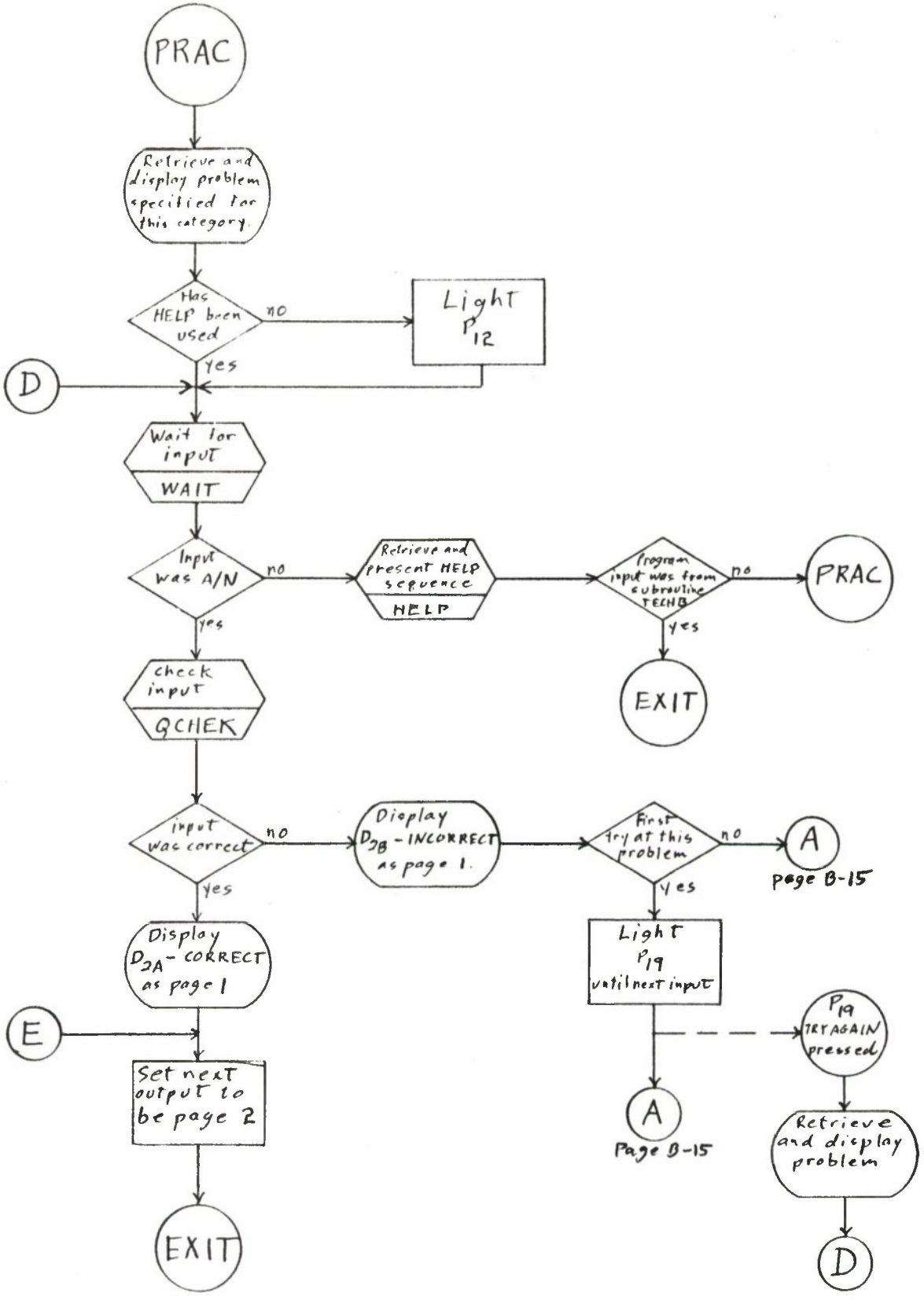


Figure 45. PRAC subroutine

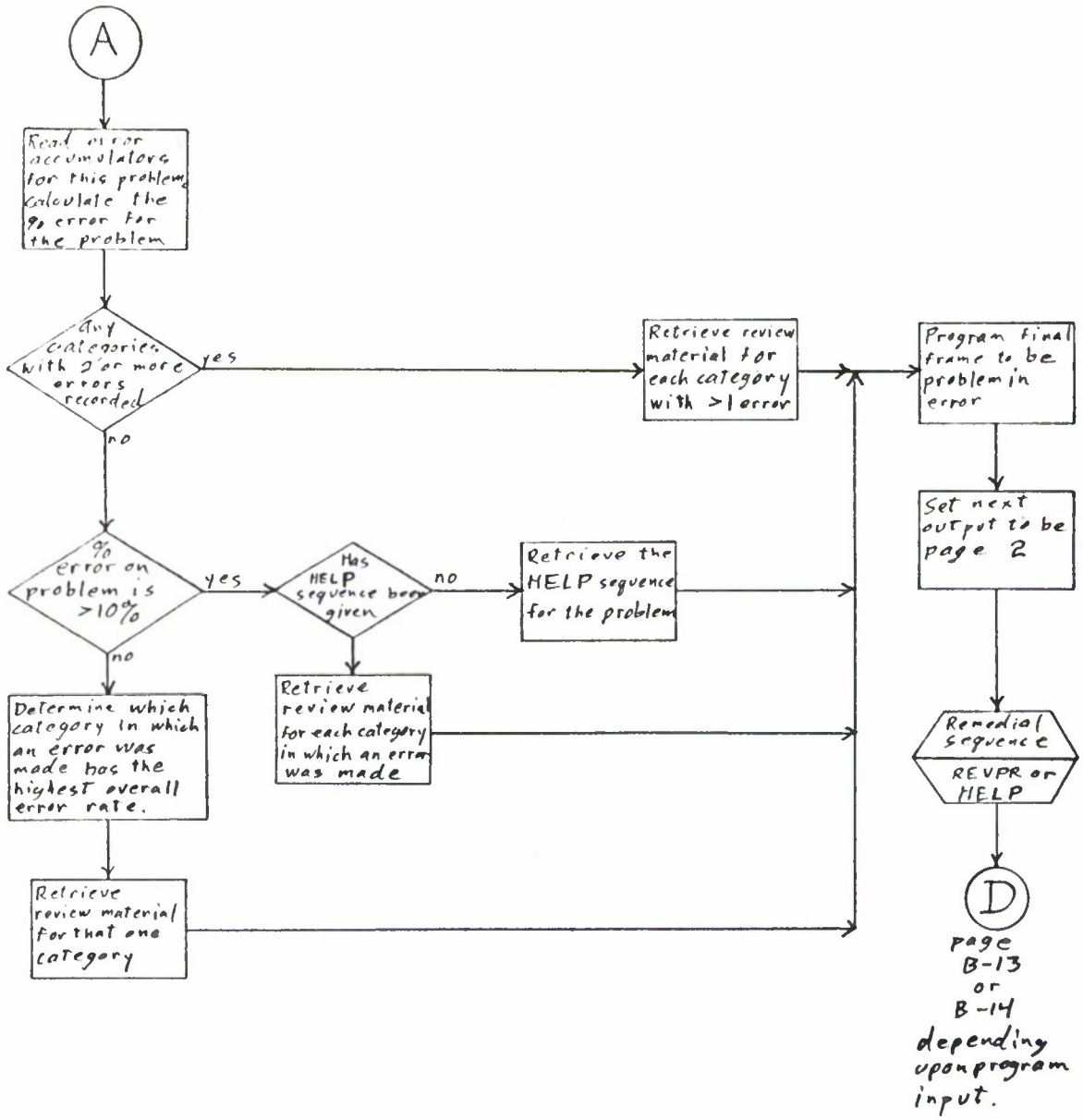


Figure 46. A subroutine (for PRAC and P_9 PRACTICE)

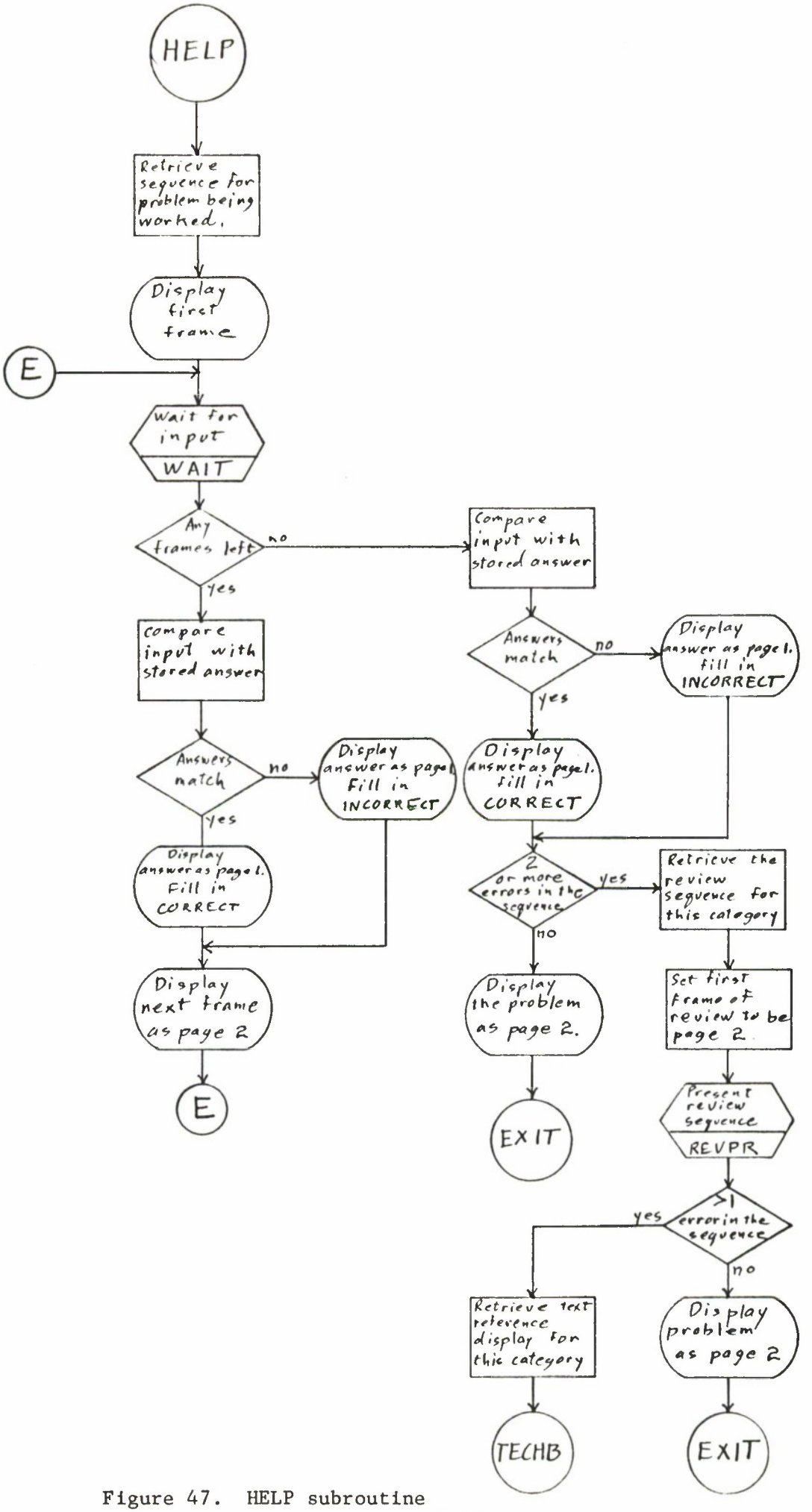


Figure 47. HELP subroutine

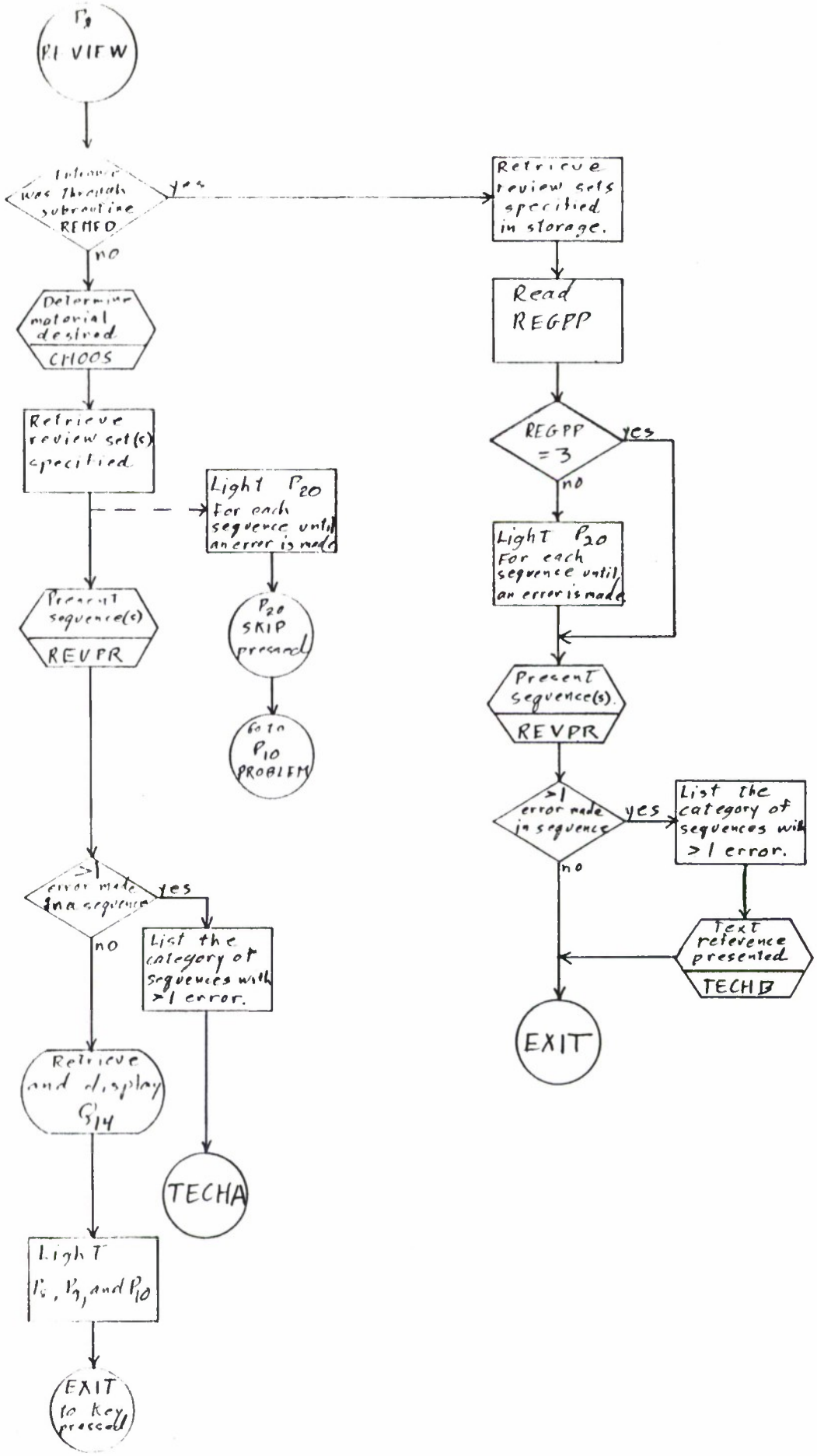


Figure 48. P_8 REVIEW subroutine

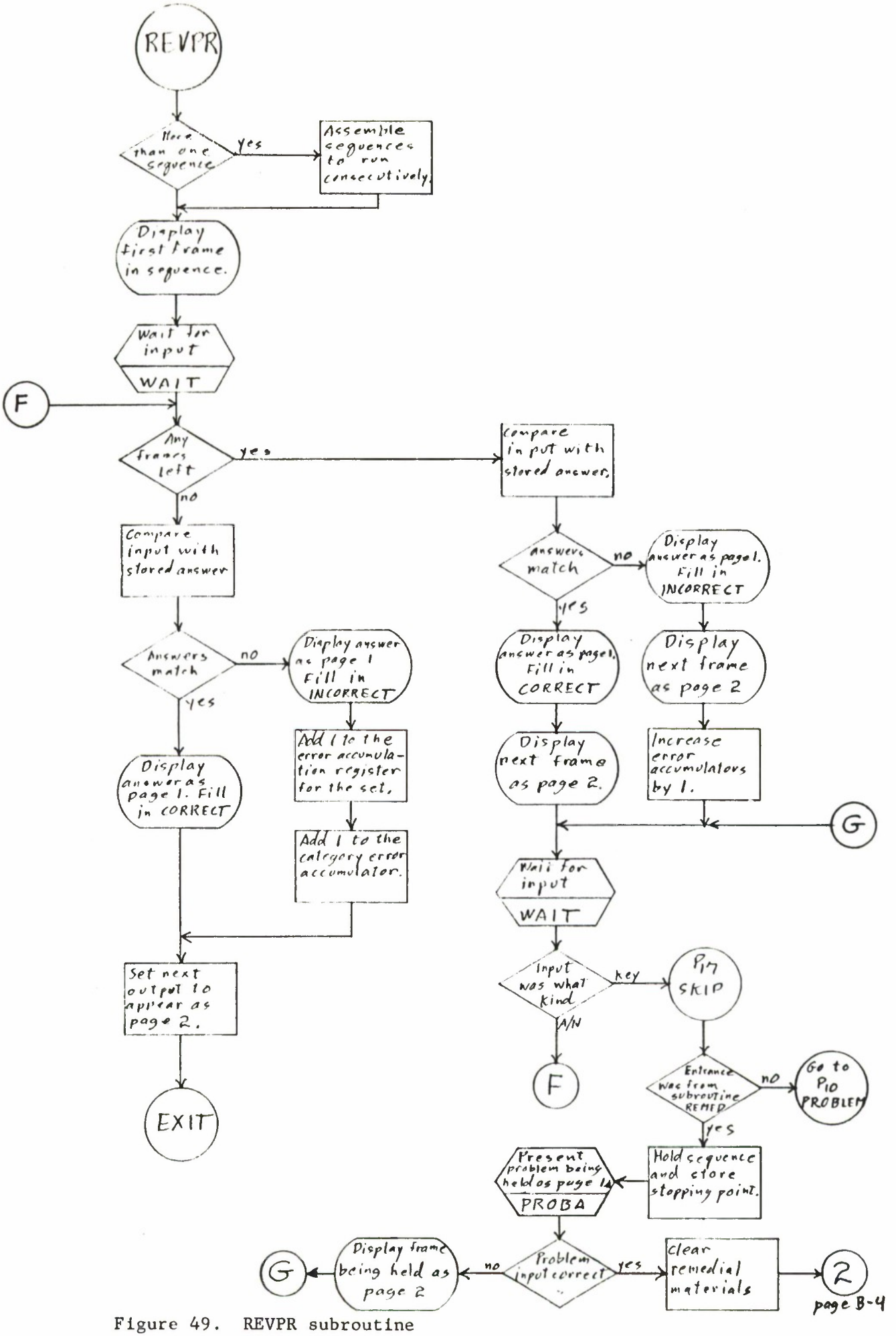


Figure 49. REVPR subroutine

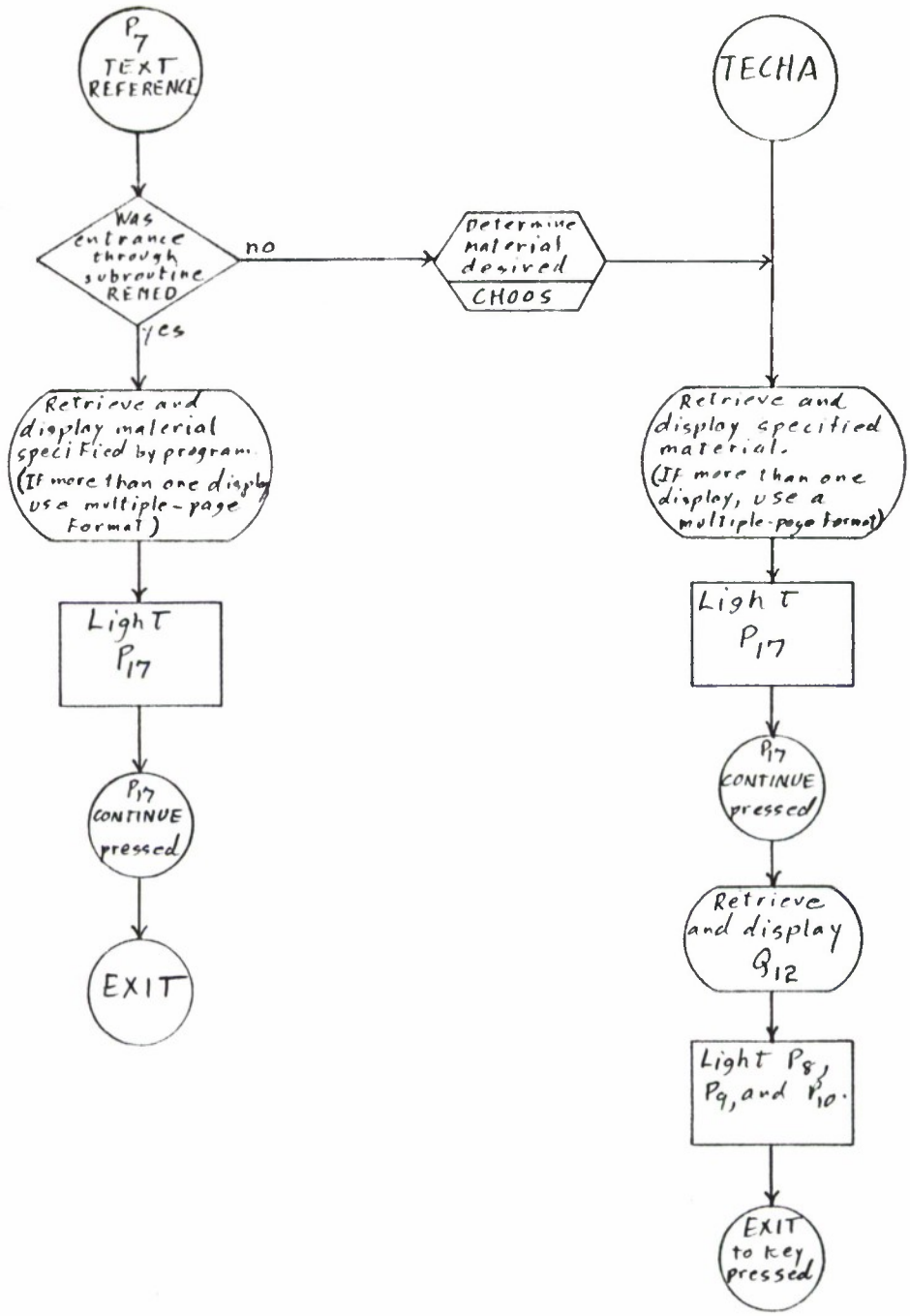


Figure 50. P_7 TEXT REFERENCE and TECHA subroutines

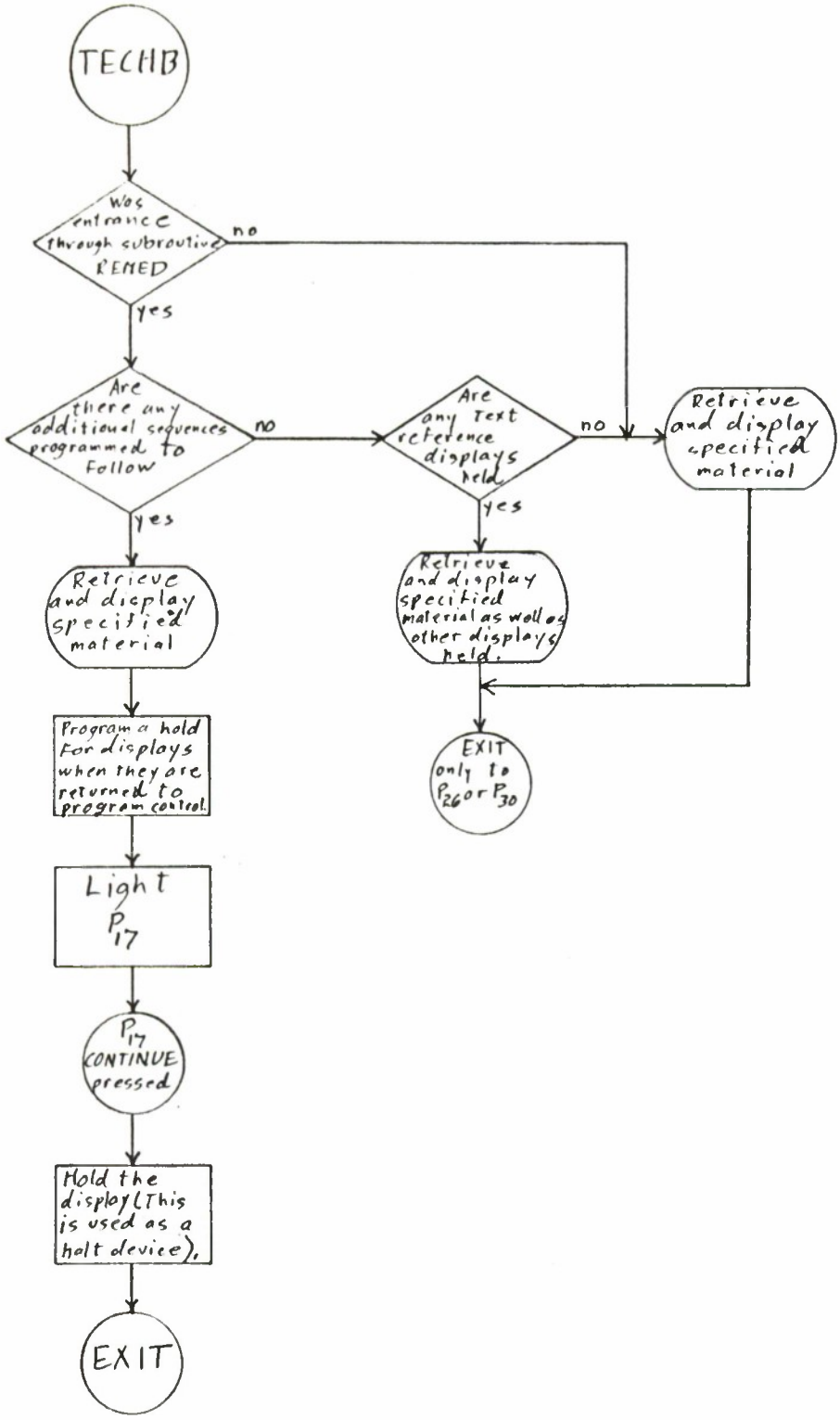


Figure 51. TECHB subroutine

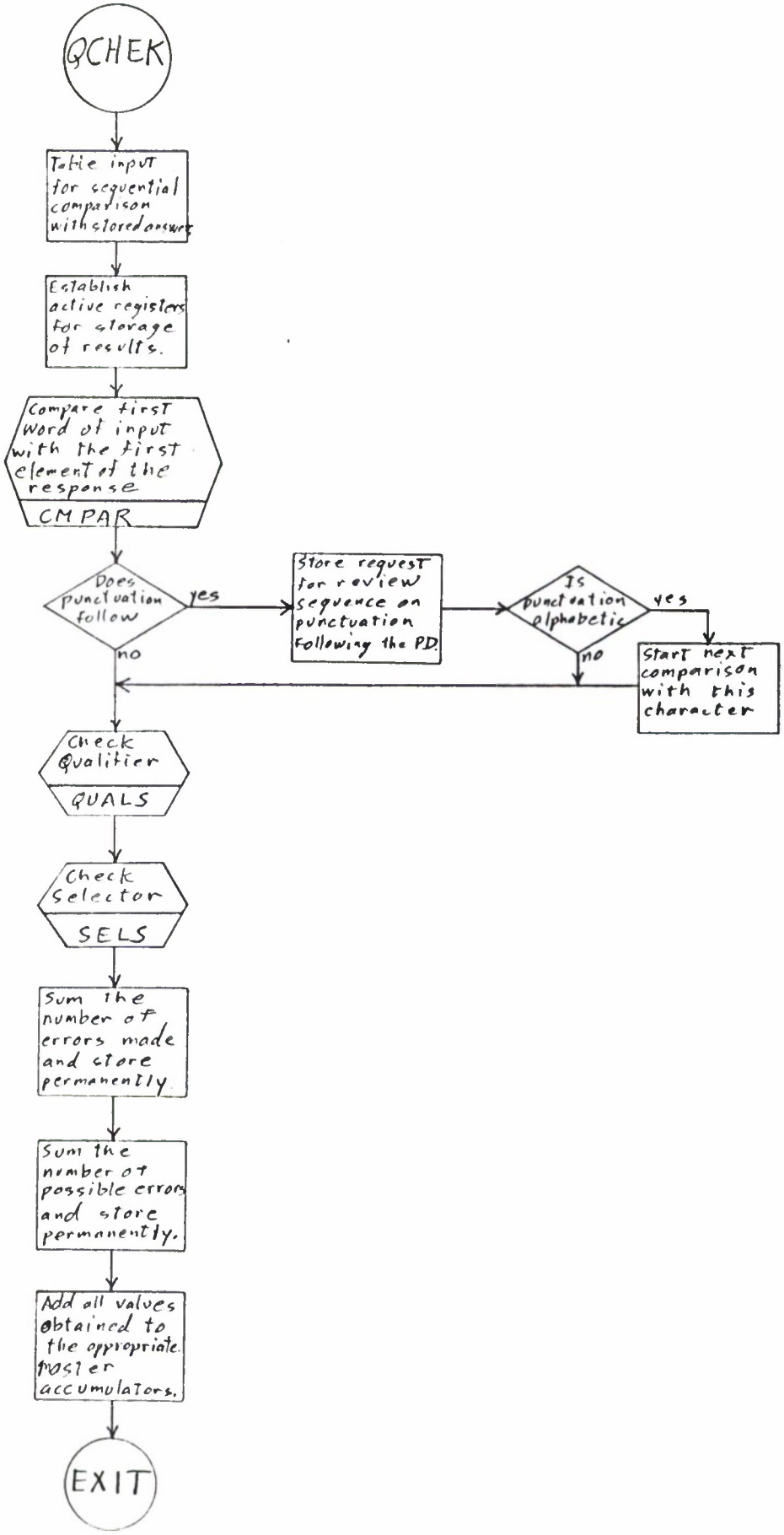


Figure 52. QCHEK subroutine

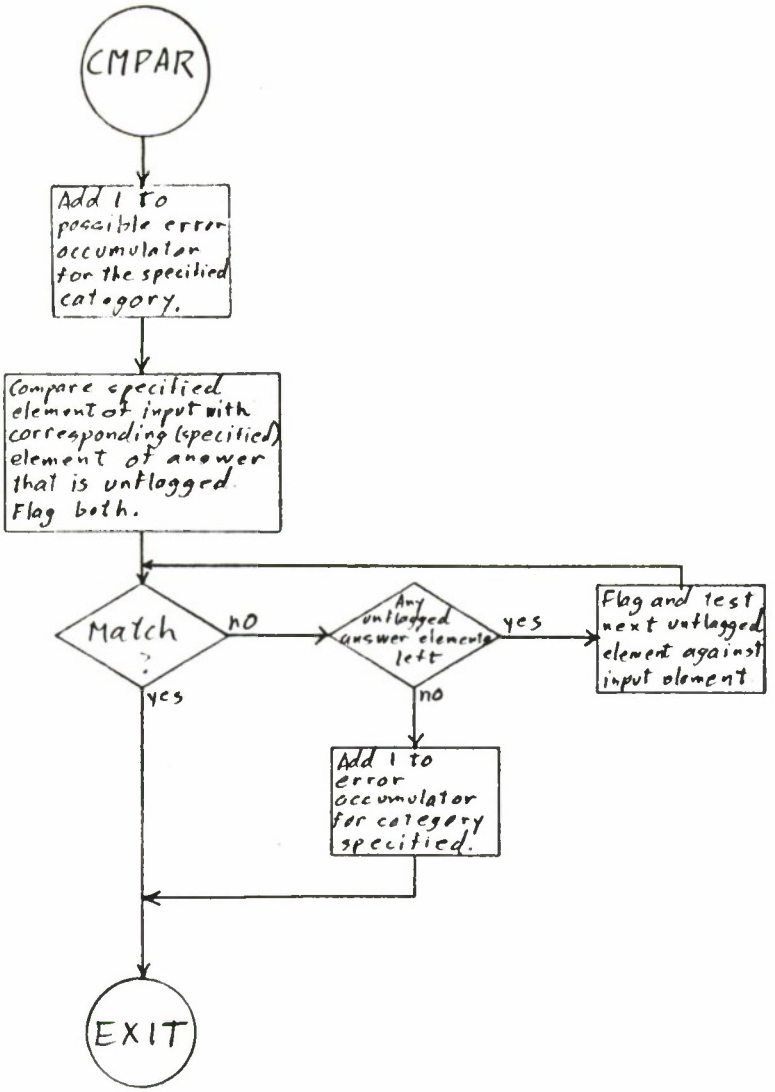


Figure 53. CMPAR subroutine

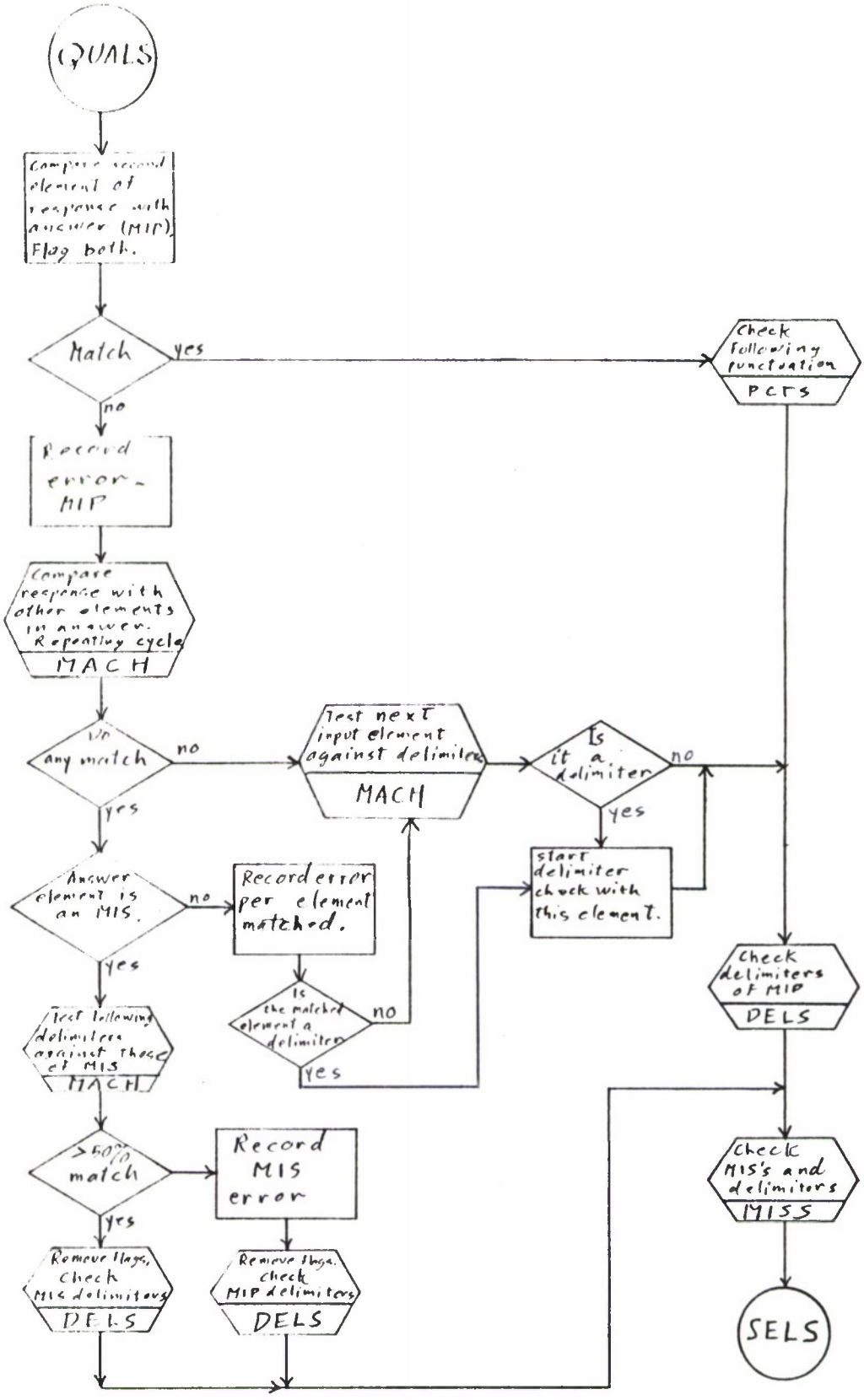


Figure 54. QUALS subroutine

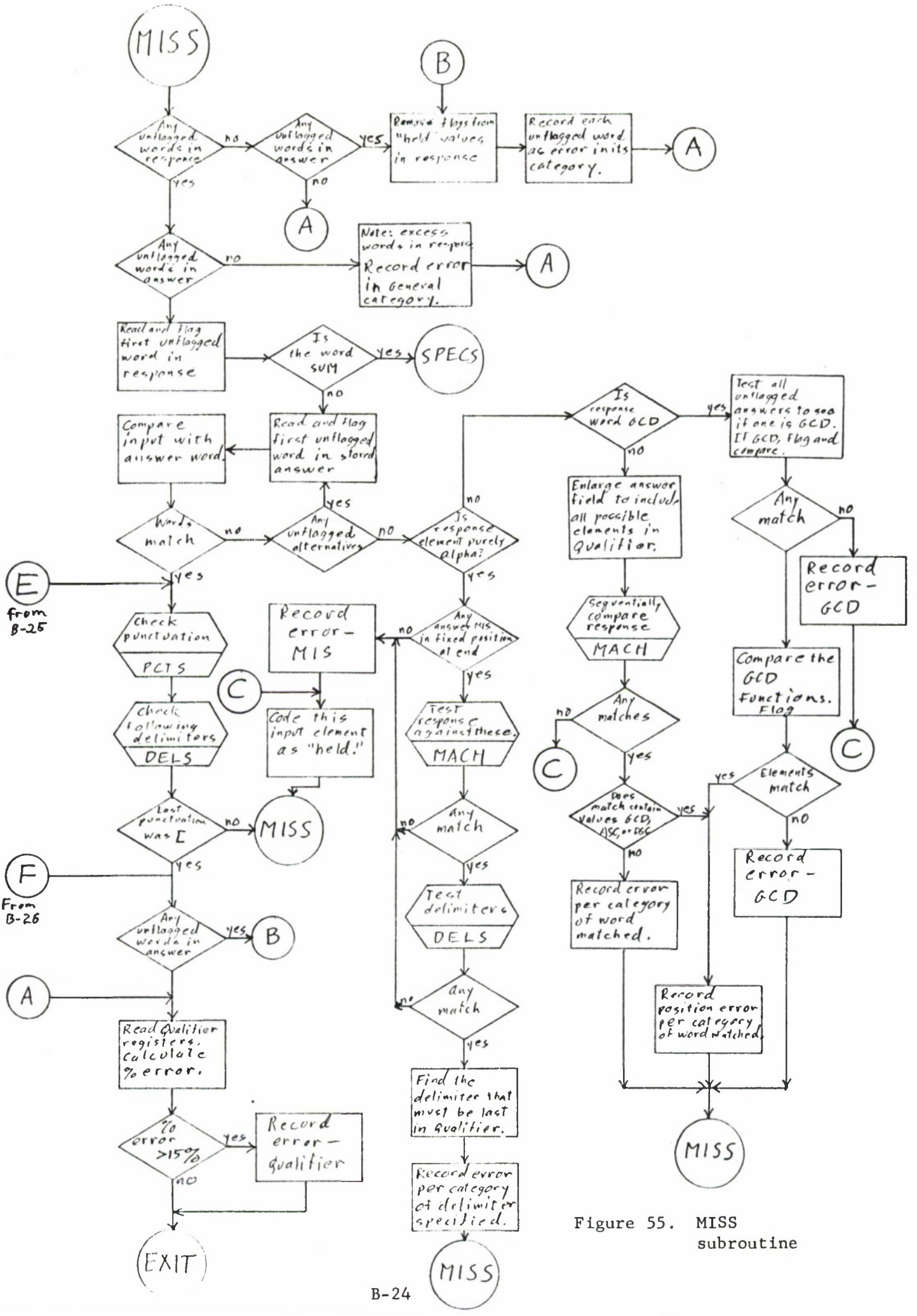


Figure 55. MISS subroutine

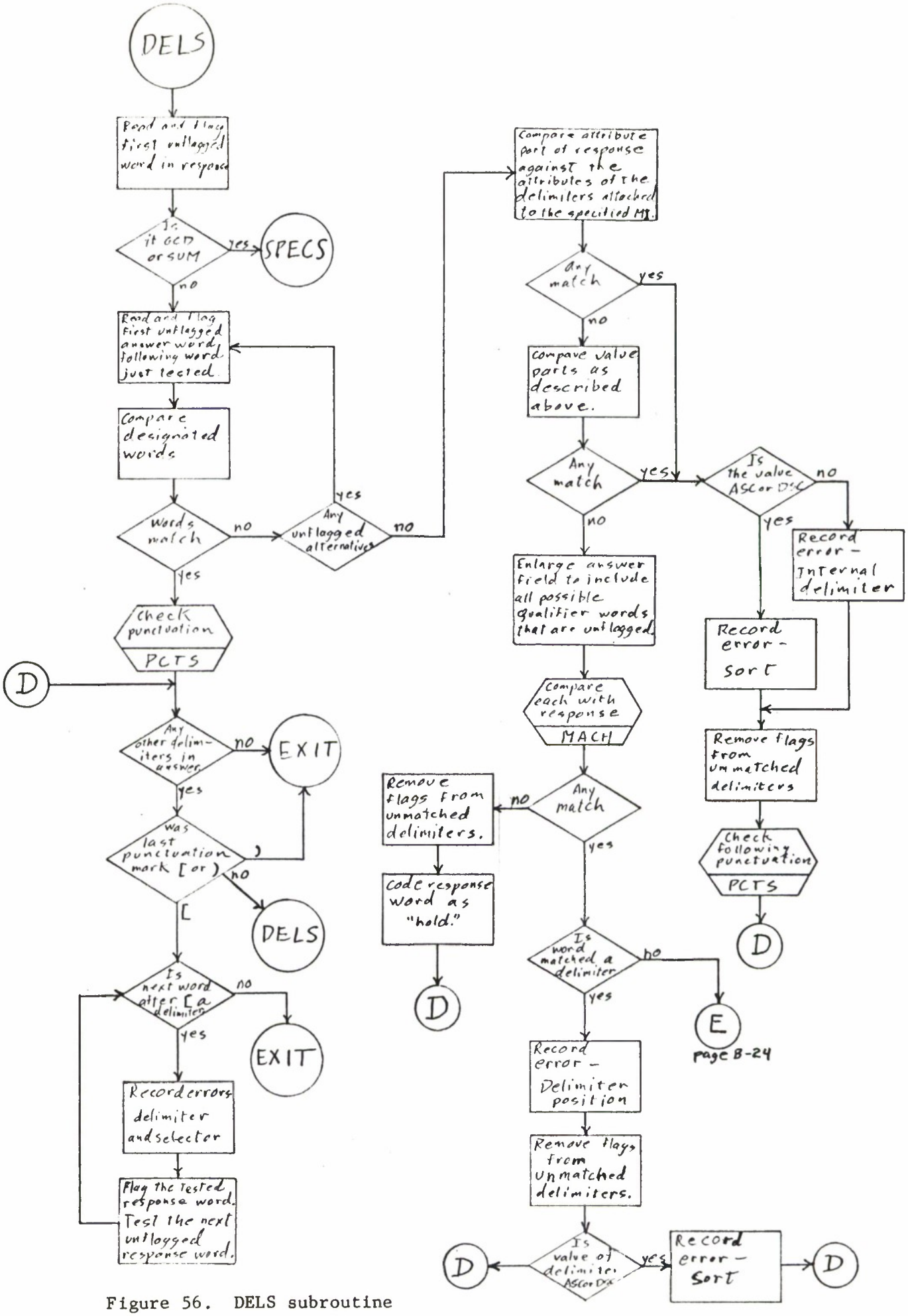
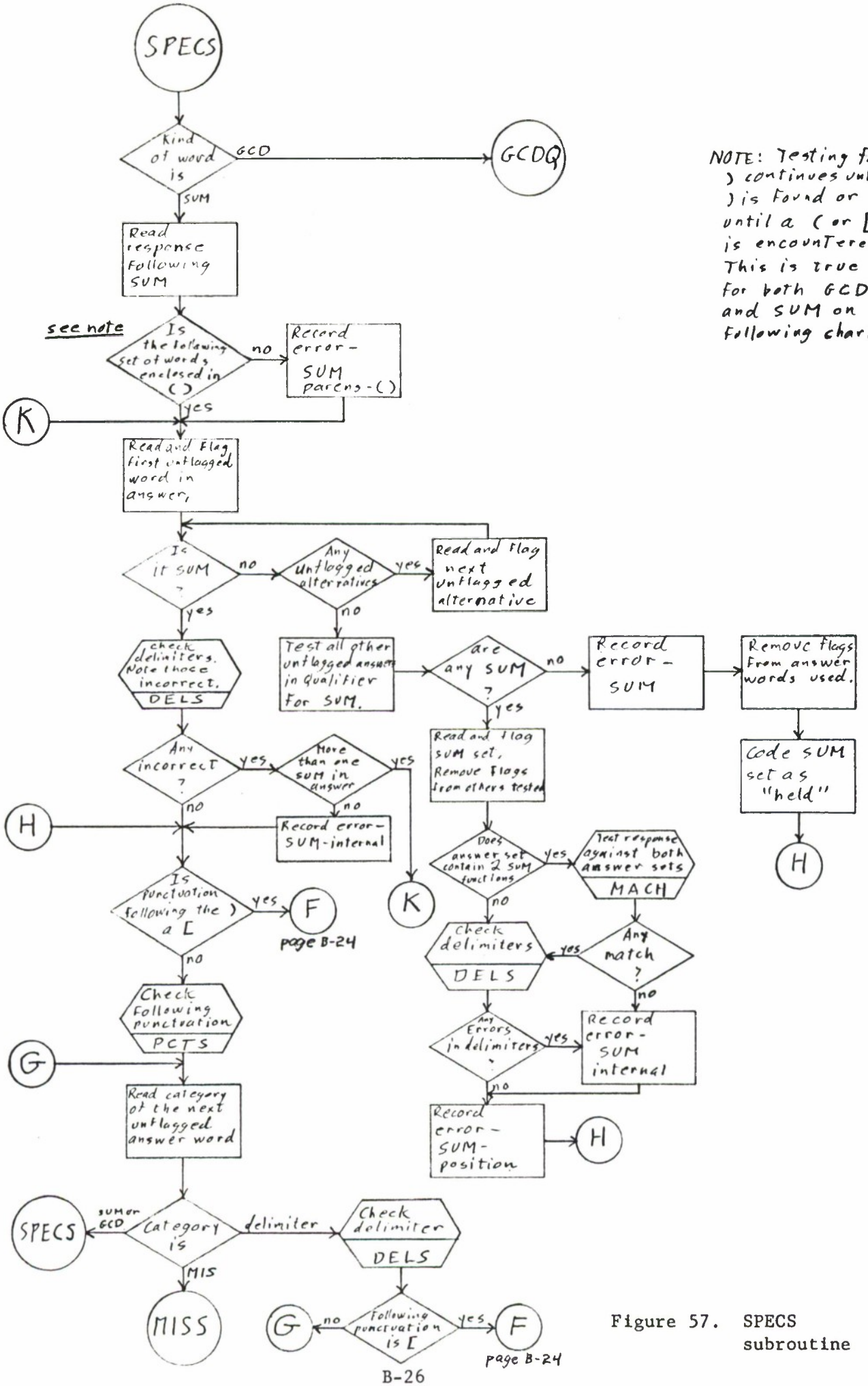


Figure 56. DELS subroutine



NOTE: Testing for) continues until) is found or until a (or [is encountered. This is true for both GCD and SUM on following charts.

Figure 57. SPECS subroutine

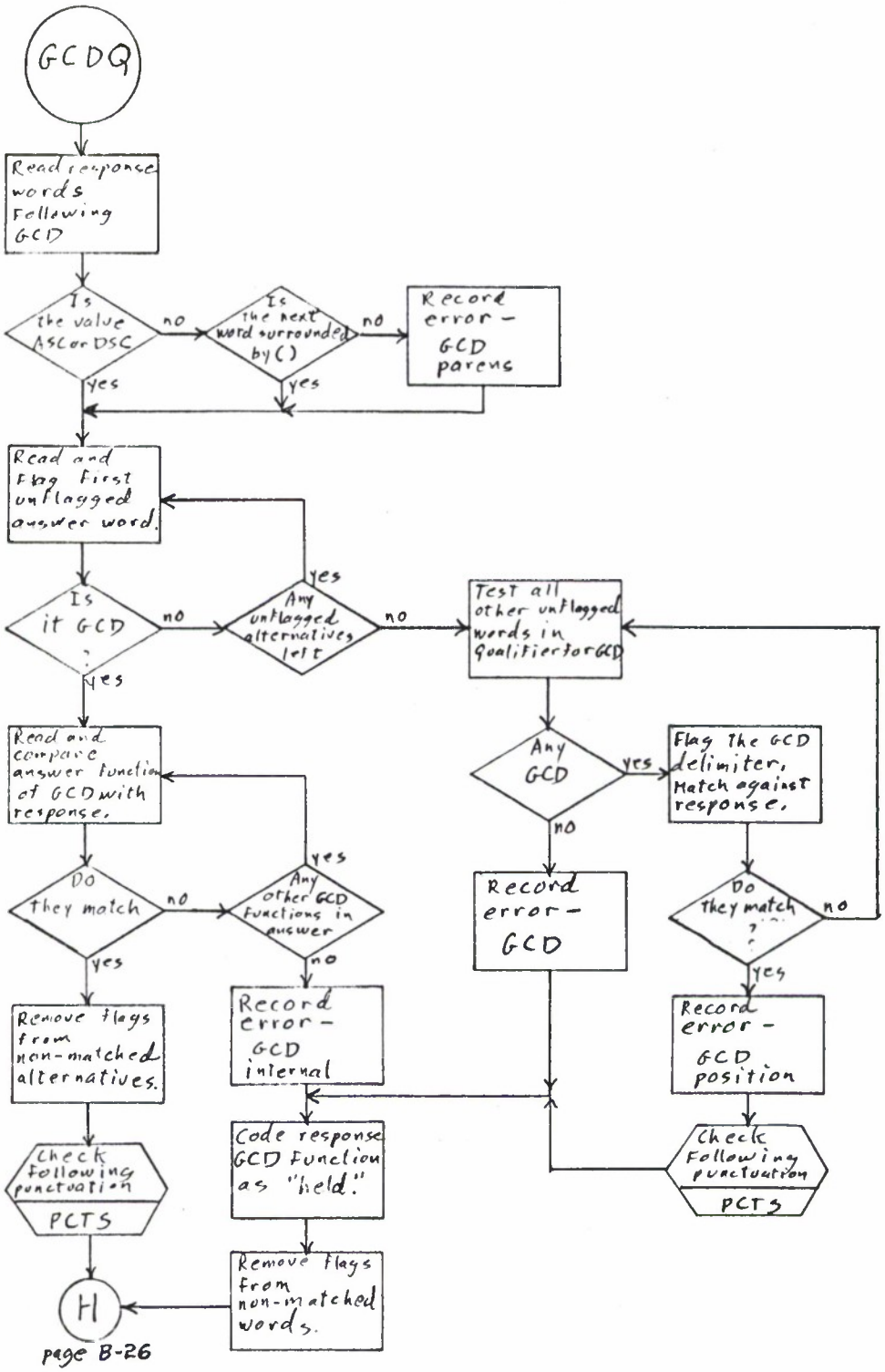


Figure 58. GCDQ subroutine

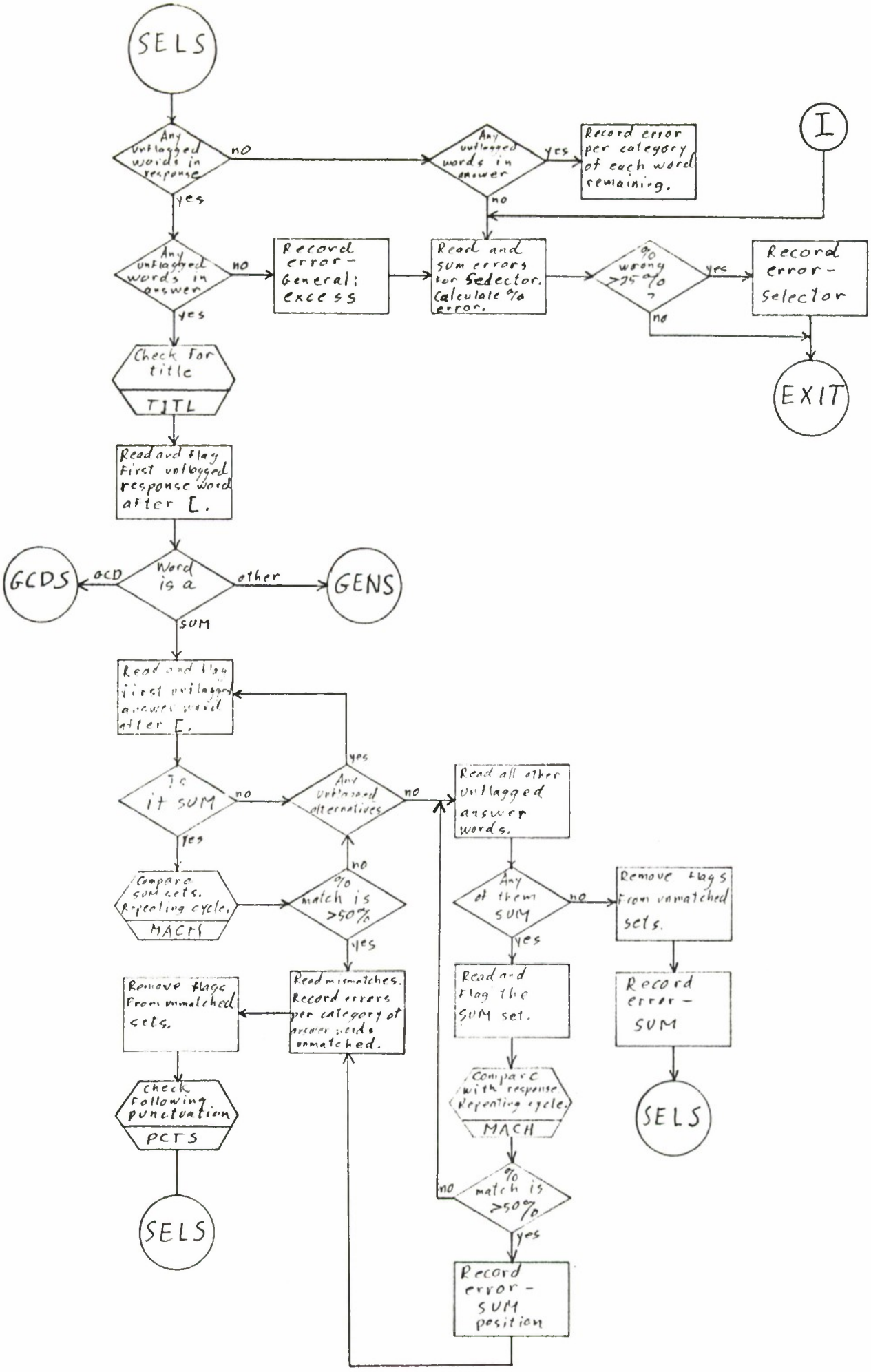


Figure 59. SELS subroutine

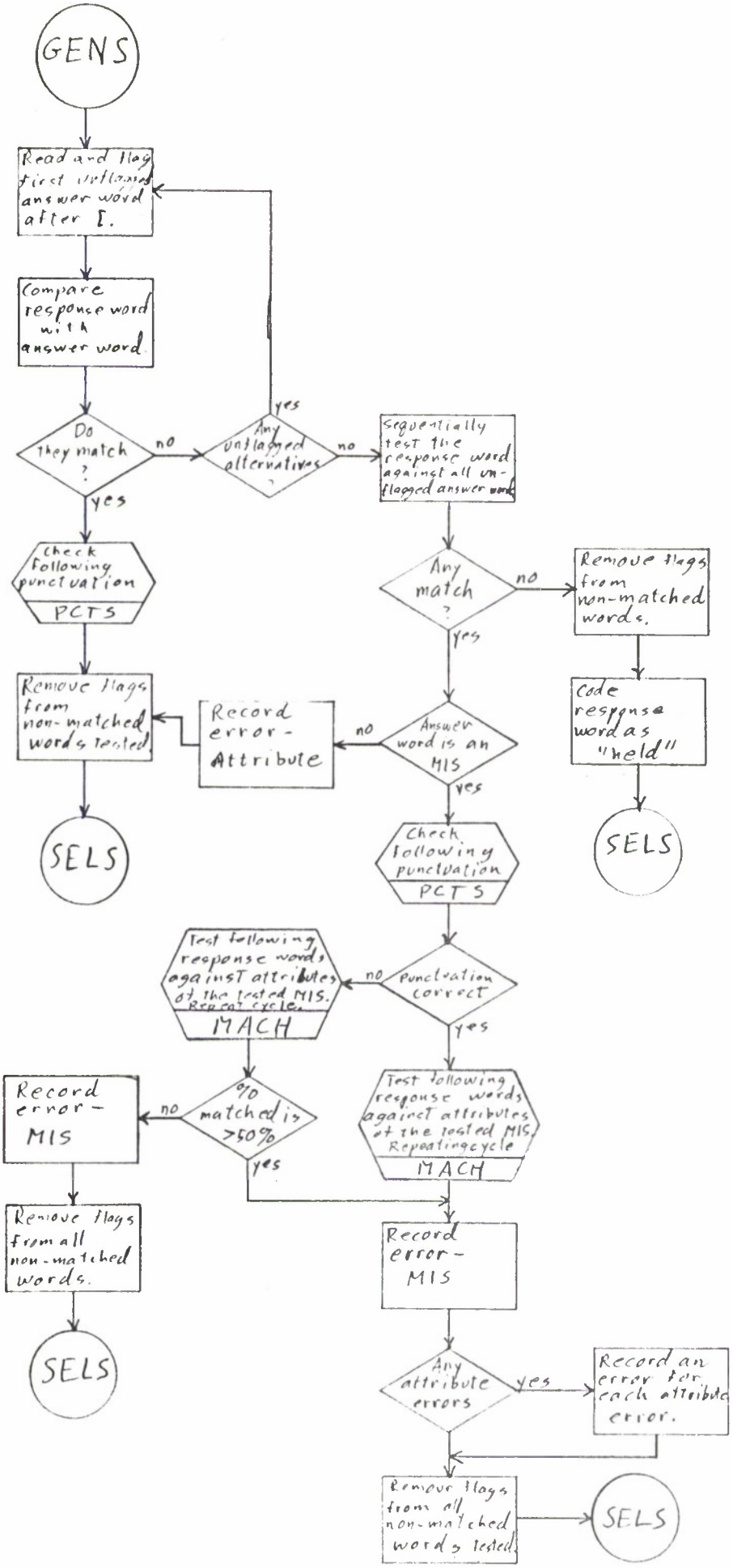


Figure 60. GENS subroutine

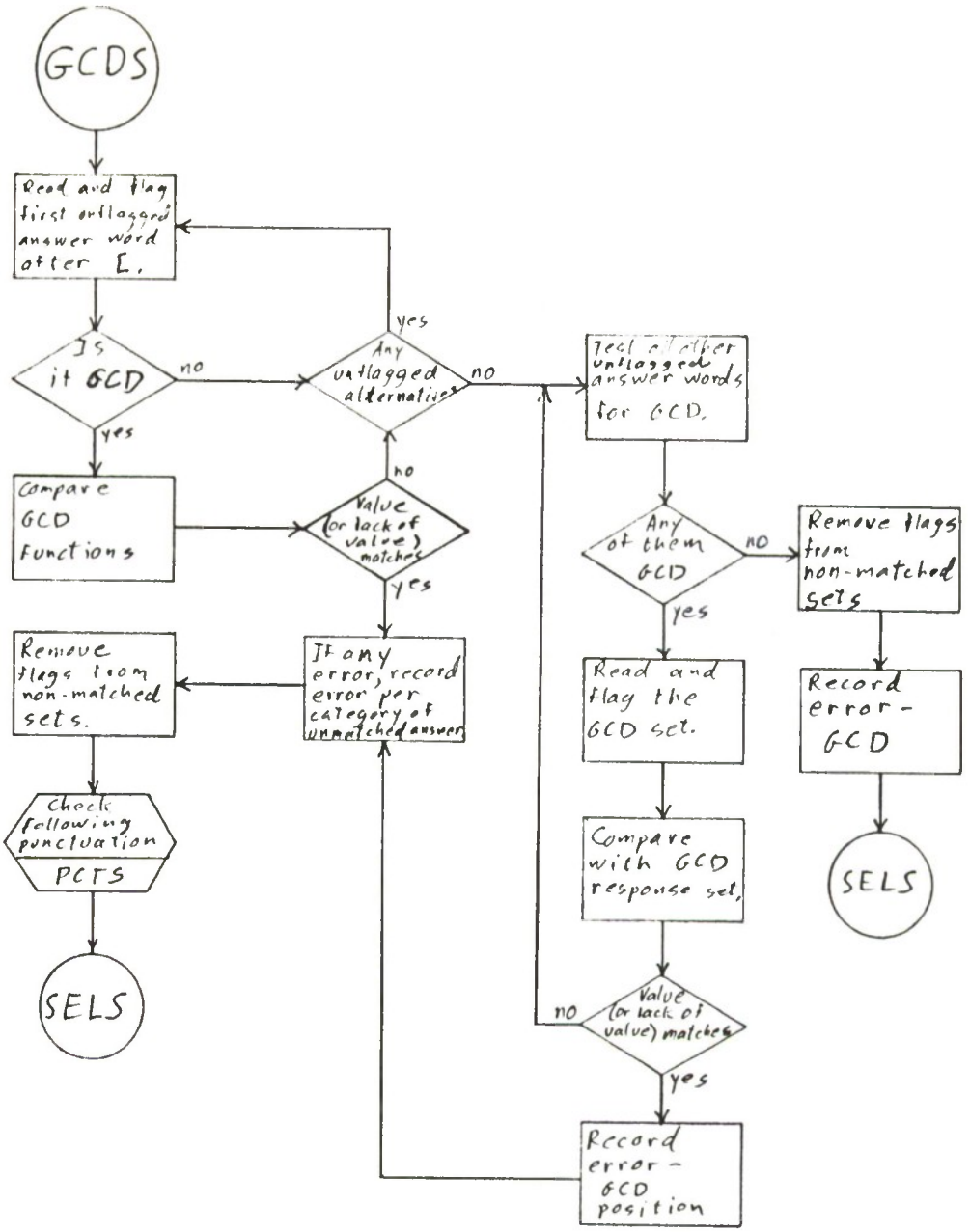


Figure 61. GCDS subroutine

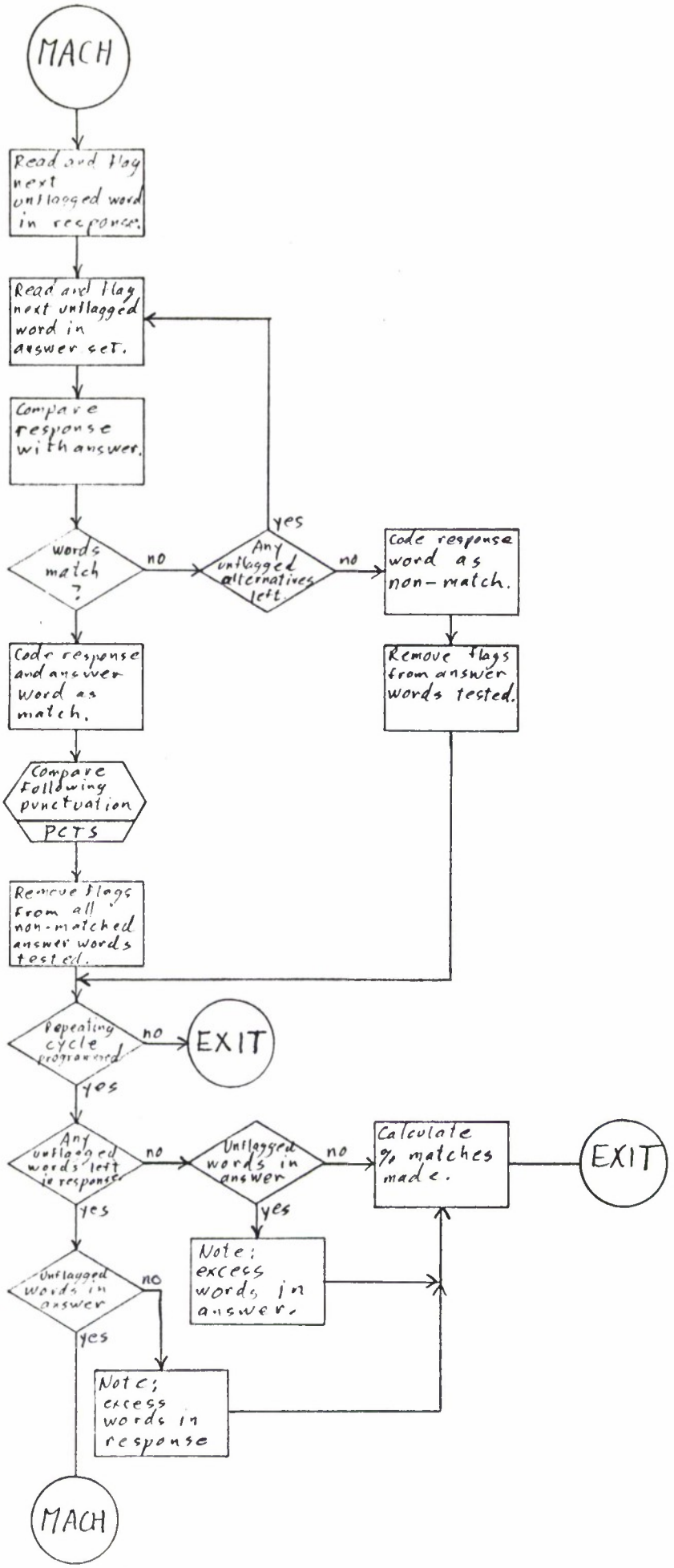


Figure 62. MACH subroutine

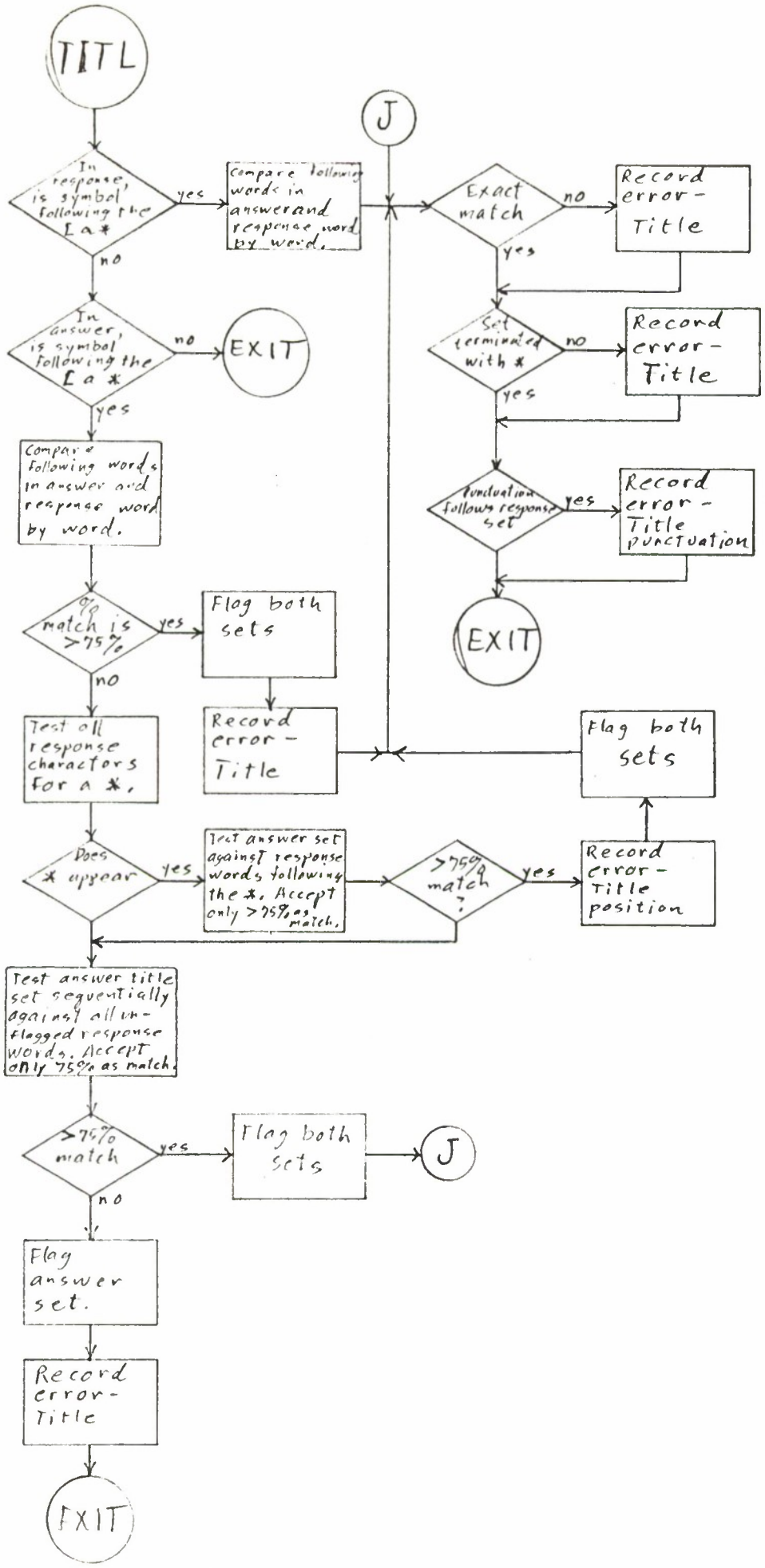


Figure 63. TITL subroutine

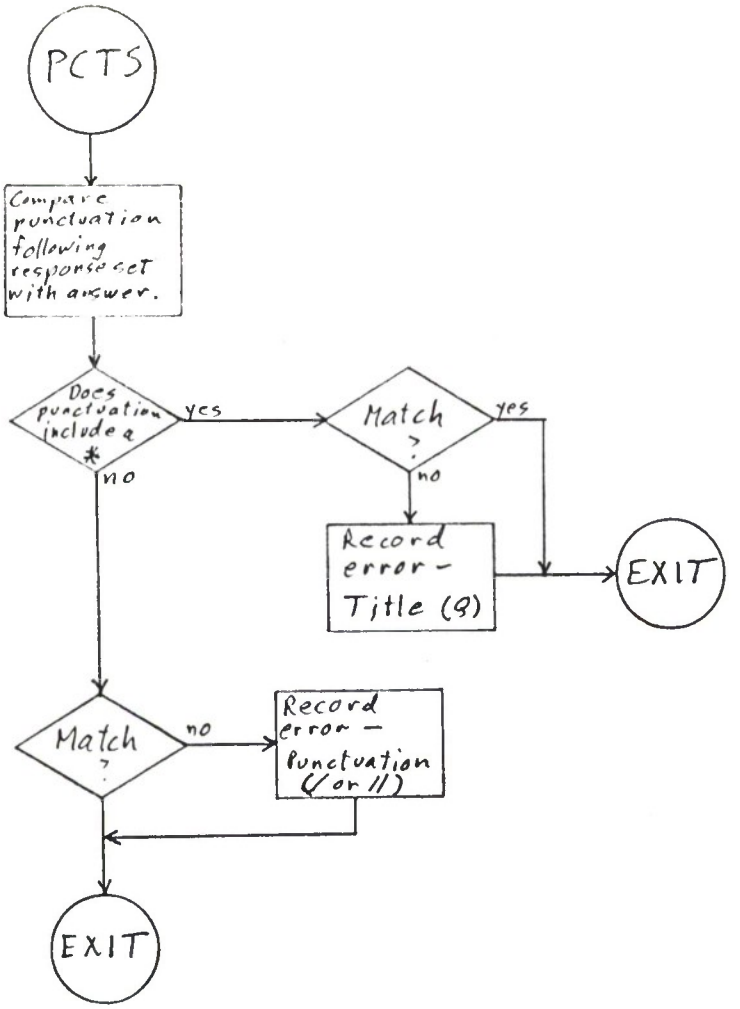


Figure 64. PCTS subroutine

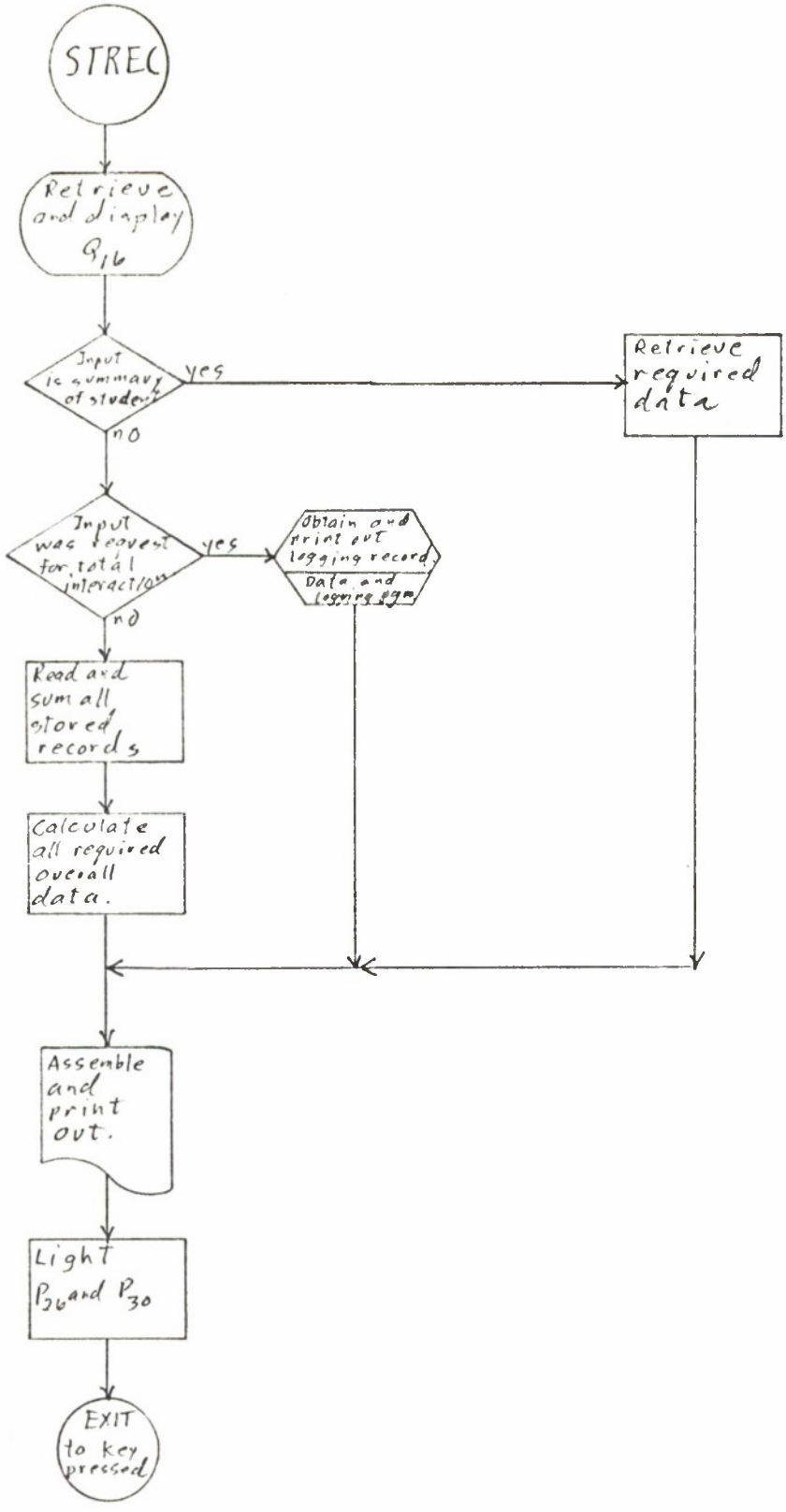


Figure 65. STREC subroutine

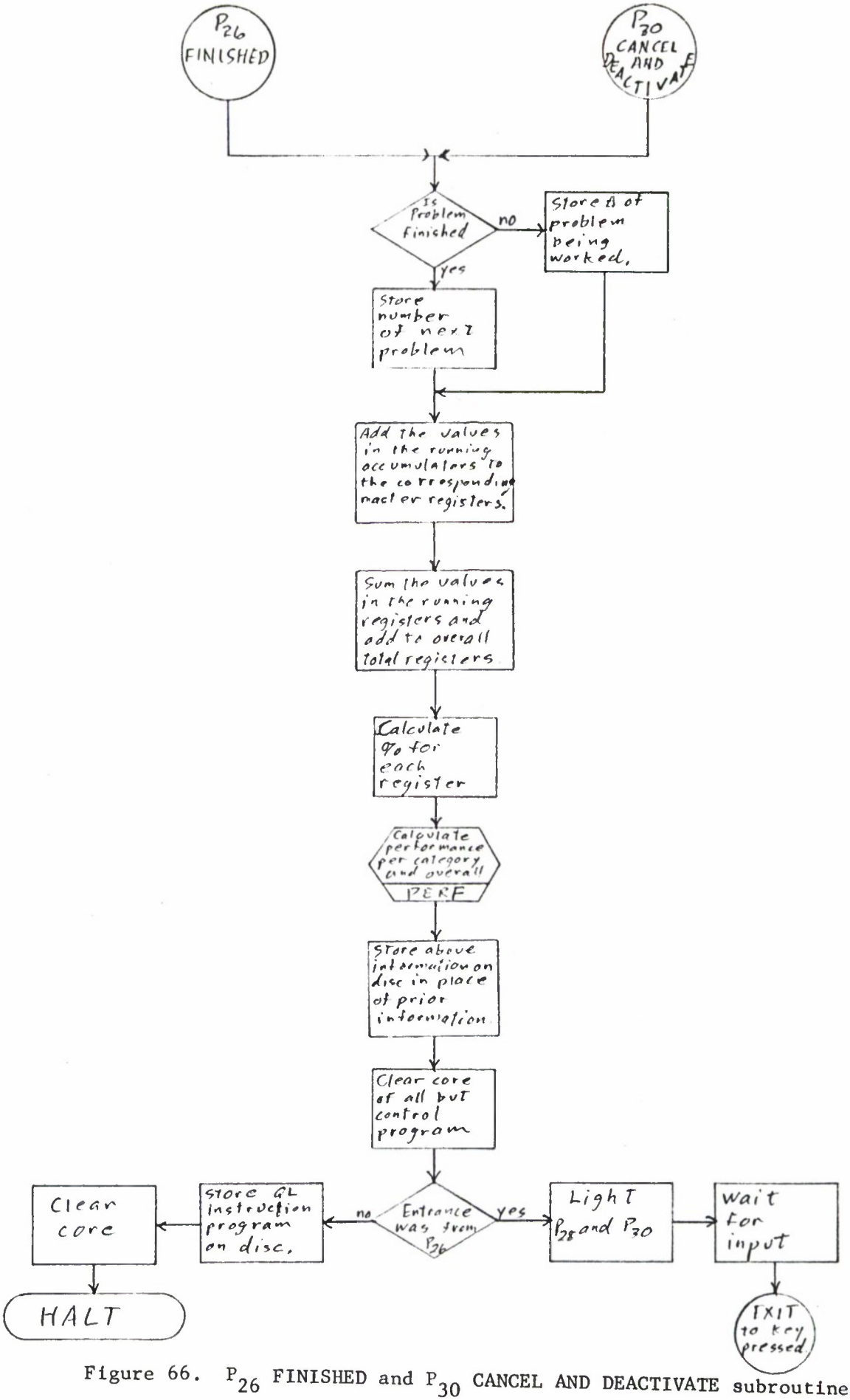


Figure 66. P_{26} FINISHED and P_{30} CANCEL AND DEACTIVATE subroutines

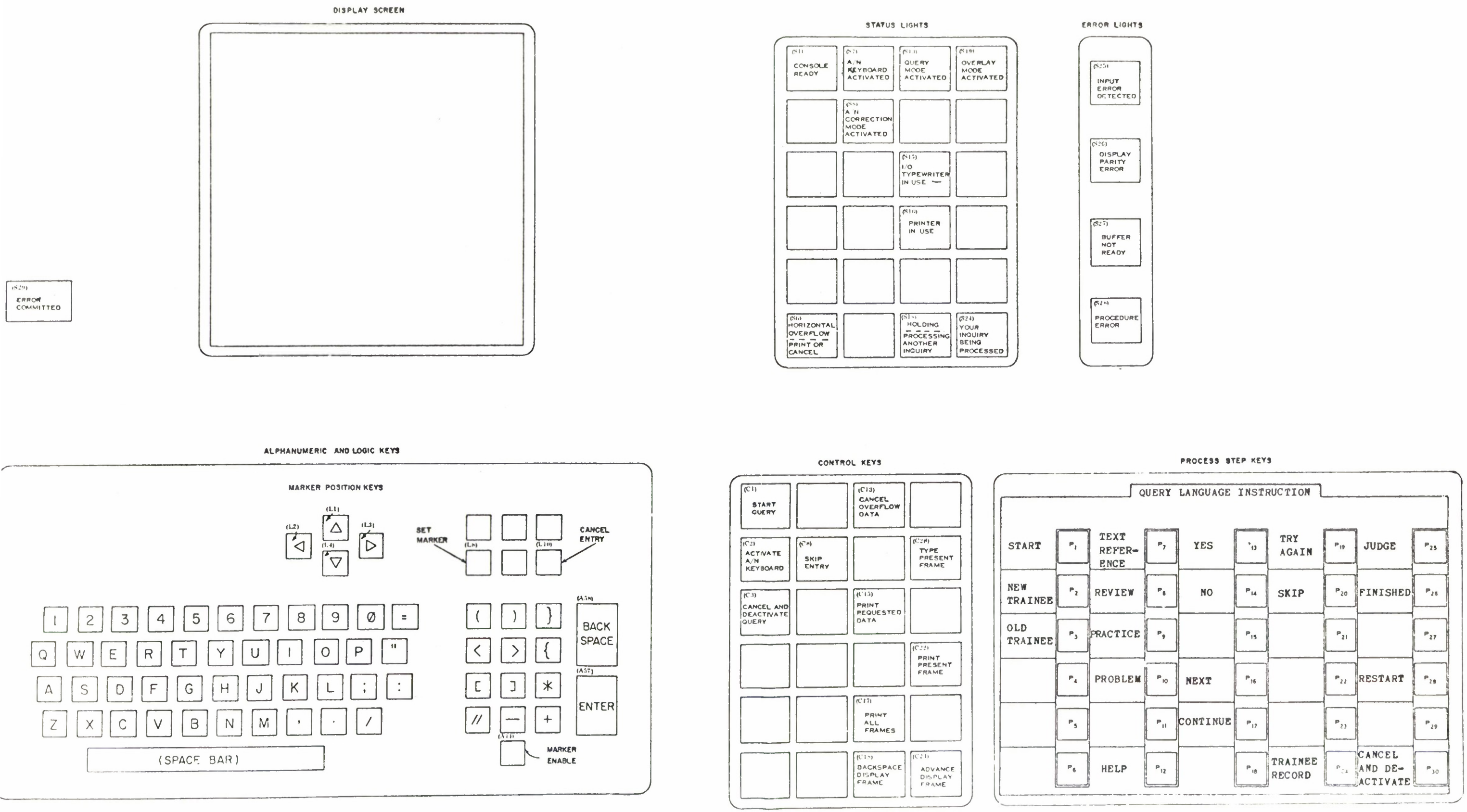


Figure 67. Computer Communications Console Control Panel Diagram with Query Language Instruction Overlay

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*

American Institutes for Research, Pittburgh, Penn.

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

N/A

3. REPORT TITLE

Operational Specification For Computer-Directed Instruction in The Operational Training Capability Query Language for System 473L, U.S. Air Force Headquarters

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5. AUTHOR(S) *(Last name, first name, initial)*

Yens, David P.
Shettel, Harris H.

6. REPORT DATE

Jun 64

7a. TOTAL NO. OF PAGES

128

7b. NO. OF REFS

0

8a. CONTRACT OR GRANT NO.

AF19(628)2935

b. PROJECT NO.

7682

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

ESD-TDR-64-511

10. AVAILABILITY/LIMITATION NOTICES

Qualified Requesters May Obtain Copies From DDC.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

Decision Sciences Labs., ESD, L.G.
Hanscom Field, Bedford, Mass.

13. ABSTRACT

This specification describes the projected Query Language Computer-Directed Instruction program which permits active on-concole training of personnel in the writing and processing of OTC Query Language statements in System 473L. The files, Programs , and processes of the program and a sample computer-trainee interaction are detailed. General Flow charts for a possible computer program implementing the specifications are provided, designed for the IBM 1401 or 1410 computer.

(This Abstract is UNCLASSIFIED)

DD FORM 1 JAN 64 1473

UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Programming Computers						
Programming Languages						
Teaching Machines						
Performance Tests						
Programmed Instruction						
Training						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS)*, *(S)*, *(C)*, or *(U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.