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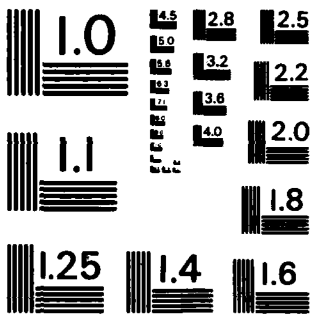

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HUMAN RESOURCES

MAINTENANCE TECHNICAL MANUALS: FORMAT DESCRIPTIONS AND GUIDELINES FOR AUTOMATED PRESENTATION

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The Air Force has a long-range program to automate the storage and presentation of maintenance technical orders. Effective presentation of technical data on a computer system display requires special formats and human/computer interaction techniques. The effort described in this paper was accomplished to develop the necessary formats and techniques. An analysis of the information needs of the maintenance technician was made to determine what types of information must be presented on the automated system. In addition, reviews were made of advanced techniques for presenting technical information for maintenance and of requirements and techniques for presenting technical information on a computer display. Based on the results of these analyses, appropriate data presentation formats and human/computer interaction techniques were developed. Presentation formats were developed to present all types of information required for maintenance, including procedural information, theory of operation, schematics and other large drawings, and illustrated parts breakdown information. [illegible] IAMS ([illegible]) [illegible]

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SUMMARY

The steadily increasing volume of technical orders and the increasing costs of maintaining a paper-based system make it essential that a more economical and efficient medium be found. The use of a computer-based system has the potential of reducing costs and providing a more efficient technical order system. The work described in this paper is an essential step toward the development of a computer-based technical data system. The effective presentation of technical data by computer display requires special presentation formats and man/computer interaction techniques to ensure the most effective and efficient presentation of information. The work described in this paper was accomplished to provide the required formats and techniques.

A review was made of research and of recent developments for the presentation of technical data for maintenance. The results of prior studies of techniques for automating technical data were also reviewed. In addition, reviews were made of requirements and procedures for presenting technical information on a computer display. Presentation formats and man/computer interaction techniques were then developed based on the results of these reviews. In developing the techniques and formats, an emphasis was placed on defining a system that is easy to use and that the technicians will like to use. The presentation formats that were developed included formats for presenting procedural information, theory of operation, large drawings such as schematics, and illustrated parts breakdown information. The man/computer interaction techniques emphasized ease of use and rapid location of information in the database. The formats and man/computer interaction techniques developed are described in this paper.

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FIGURES (Continued)

FIGURES (Continued)

FIGURES (Continued)

TABLES

SECTION 1.0
INTRODUCTION, BACKGROUND, AND APPROACH

1.1 INTRODUCTION

This report represents one product of an ongoing research and development program being sponsored by the Air Force Human Resources Laboratory (AFHRL) that is directed toward development of a computer-based system for the storage, retrieval, and presentation of technical data for use by all levels of maintenance technicians. The steadily increasing volume of Technical Orders (TOs) and increasing costs of maintaining a paper-based system make it essential that a more economical and efficient medium be used. The use of a computer-based system for maintaining and presenting TOs has the potential for reducing costs and for promoting more efficient operation of the Air Force TO System. In addition, a computer-based system has the promise for enhancing the performance of maintenance technicians through the use of performance-aiding techniques which are not available with paper-based systems. AFHRL has recognized, however, that if such a system is to be effective, it must be designed specifically to meet the needs of the technician and take advantage of the unique capabilities of a computer-based system. Accordingly, emphasis has been placed on defining a system that is easy to use and will attain a high level of motivation by the technicians for its use.

1.1.1 Background

For several years AFHRL has conducted research programs to develop improved types of technical data for aircraft maintenance. The emphasis has been placed on developing data that are designed for easy use by maintenance technicians and has resulted in the development of a type of maintenance data known as job performance aids (JPAs). JPAs present technical data in a proceduralized step-by-step format, which provides detailed illustrations of referenced components. Emphasis is on ensuring that instructions are complete and presented in clear, easily understood language. Available research indicates that the use of JPAs can result in significant improvements in maintenance performance and that JPAs generally are well received by maintenance personnel.

One problem associated with the use of JPAs is that many more pages are required to cover a system using JPAs than is required using conventional TOs. Increasing system complexity, with the consequent necessity for more extensive TOs, and increasing costs for technical data necessitate the development of a more economical Technical Order System.

An automated job performance/maintenance aid system which uses computer terminals to store and present technical data has the potential for meeting the needs of field technicians by presenting JPA-type technical data while also alleviating some of the massive problems of keeping the present TOs current. Previous work (under contracts F33615-77-C-0043 and F33615-78-C-0030) to identify the human factors problems associated with an automated job performance maintenance aid system and to determine the overall feasibility of such a concept has continuously emphasized that any automated maintenance aid system must first meet the needs of the technicians. Traditionally, many hardware systems have been built without primary consideration for suitability to the intended user population. Consequently, features have been included which may not be necessary or desirable for the user.

The purpose of the work accomplished under contracts F33615-77-C-0043 and F33615-78-C-0030 was to investigate the feasibility of developing a computer-based job performance-aiding system. The primary objective was to evaluate formats and presentation techniques for technical data with the maintenance technician in mind. Areas of investigation included the design and management of the man-machine dialogue for technician-system communications, technical data content in text form, and supportive graphics. A study of supervisor-technician discourse in an actual maintenance environment as a model for the presentation of text material also was investigated.

In the study of technical data content, two areas of concern emerged: matching technical data to general skill levels of maintenance technicians and filling the gaps in individual behavioral repertories of skills. The first area was addressed by the concept of information "tracks" and the second by information "pools."

The need for three distinct informational tracks was proposed, each track implementing a different level of instructional (aiding) detail and proceduralization of instructions:

Track 1--Notes about technical aspects of the job, including tolerance information and problems which might be encountered in the course of the job, as well as reminders of some correct procedural aspects of the job and special procedures. This track is intended for use by very senior (skill level 7) technical maintenance personnel.

Track 2--A checklist of tasks to be performed to complete the job, presented one at a time, with access to pools. This track includes only information about what tasks are to be performed (within the track), reference data and tolerances, and notices of pool availability for further aid when necessary. This track is intended for primary use by skill level 5 or 3 technical maintenance personnel.

Track 3--Complete proceduralized instructions regarding each defined step of each job task, with all available data, heavy graphic support for parts location, and extensive pool availability for informational gap filling. This track was intended for lower skill level technical maintenance personnel performing this job for the first time.

Extensive opportunities for switching between tracks were defined so that technical maintenance personnel receiving more or less information than was desired could conveniently move from one track to another, as the information mismatch was discovered.

The concept of pools refers to the strategy for supporting the performance of technicians who are of a given skill level but retain gaps in their knowledge regarding specific aspects of the performance of a particular job. It provides a complementary approach to information tailoring to meet specific individuals' information support needs. It is intended to provide helpful support, including embedded training in prerequisite skills not well established.

Examples of types of pool information are theory of operation of equipment, use of special tools, tolerances, methods and procedures technical information, lists of suitable substitutes for test equipment, and use of test equipment.

Ways of reducing supporting graphics complexity were investigated. The graphics were simplified through modularization and removal of extraneous detail, thus increasing the value of the graphics. Other issues that were dealt with in this research included the possibility of several levels of complexity of graphics, graphics data supplemented by associated textual descriptions, and the use of pseudoanimation techniques.

1.1.2 Project Overview

This guideline document is based on analyses originated under Contract Number F33615-79-C-0021, Subcontract 1000122, and continued under Contract Number F33615-82-C-0006, Task 002. The sample formats and preparation guidelines contained herein are a result of reviews of format state-of-the-art to identify formats appropriate for use in an automated delivery system.

The overall program for the automated delivery system included considerations of hardware and software, in addition to formatting of technical data, integrated into a user-oriented, computer-based presentation system. The working name for the integrated system is Versatile Automated Maintenance Information System (VAMIS) and, as the name implies, is directed toward support of USAF maintenance activities. Air Force maintenance is performed in accordance with official AF Technical Orders (TOs). Data in current, paper-based maintenance TOs encompass many different types of format and levels of detail, depending on when the TO was prepared, the type of maintenance to be performed, the types of equipment to be maintained, the expected skill levels of the maintenance technicians, and the specifications determined to be applicable.

In this program, formats are required for procedural data, in three differing levels of detail (both graphic and text), and for all major types of non-procedural information. Certain decisions were made during the program regarding the characteristics of the automated delivery system which have influenced the selection of recommended formats and the characterization of the formats.

1.2 PURPOSE

This guidelines document is intended to provide a common baseline for the rationale used in selecting formats and their characteristics, identification of factors which are dependent on the selected delivery system, samples of specific data formatted for presentation by a computer-based system, and guidelines for their preparation. At present, these guidelines must be considered preliminary since they have yet to be demonstrated with an electronic presentation system. It is hoped, however, that they will provide interim guidance for further R&D and for preparers of technical manuals to be presented on an automated delivery system. Following the conduct of field tests, it is expected that the guidelines herein will be updated and revised to provide a firm basis for preparation of computer-based maintenance aids data.

1.3 APPROACH TO FORMAT SELECTION

1.3.1 Identification of Format Selection "Drivers"

Basic requirements that affect the selection of formats were contained in the Statement of Work (SOW) for contract F33615-79-C-0021. While not requiring the use of specific formats, the SOW did specify building on the results of previous related efforts (see paragraph 1.1.1), and establish requirements for certain types of data and certain characteristics that the selected formats are expected to exhibit. Some of the requirements were modified during the course of that program, and several new requirements were added. Review of the requirements has resulted in the identification of the following characteristics, which acted as "drivers" to format selection.

a. Designed specifically to meet the needs of the technician and take advantage of the unique capabilities inherent in a computer-based system to enhance performance.

b. Provide all of the information that a technician needs to perform intermediate level maintenance on Air Force systems.

c. Meet technician needs for information without providing more or less information than desired.

d. Present all data at a level of reading skill consistent with the normal reading ability of the AFSC selected, per MIL-M-38784A.

e. Provide the same procedure at three levels of detail. Each level, or "track," will be for use by technicians with one of three levels of experience, defined as follows:

   1. Track 1, minimum detail. Track 1 instructions shall be for use by technicians who are highly experienced in performing the task. These technicians will have performed the task many times and will require only refresher information. Track 1 instructions shall contain information such as warnings, cautions, tolerances (e.g., torque values), parts/supplies information, and reminders regarding critical or difficult aspects of the procedure.

   2. Track 2, medium level detail. Track 2 instructions shall be for technicians who have performed the task before but still require step-by-step instructions to ensure correct performance. The step-by-step procedure shall provide minimum detail for each task. A representative instruction for this track is "Remove the retaining bracket."

3. Track 3, high level detail. Track 3 instructions shall be for technicians with limited experience who require detailed instructions on how to perform the task. Detailed step-by-step instructions keyed to supporting illustrations shall be provided for each task. Representative instructions for this track are: "1. Remove three screws [2]. 2. Slide bracket [3] forward and lift out." (Numbers in brackets refer to illustration callouts.)

f. Provide pools of information to supplement the basic task instructions in the three tracks, either as needed or as desired by the technician.

g. Pool information should include the following, as a minimum: supplemental procedures (e.g., use of tools and test equipment), illustrations, specifications, theory of operation, functional diagrams, illustrated parts breakdown (IPB) information, wiring diagrams, and schematic diagrams.

h. Provide illustrations to support all maintenance activities, as appropriate.

i. All illustrations must be line drawings.

j. In procedural instructions, text and illustrations are to be presented simultaneously with text above and illustrations below.

k. Provide illustrations that are no more detailed than is necessary to support the specific task to be performed.

l. Provide the following types of illustrations, as a minimum: locator diagrams, IPB illustrations, wiring diagrams, schematic diagrams, and functional block diagrams.

m. Provide an index.

n. Provide for interaction (including visual) between the technician and the system from a minimum distance of 6 feet for procedures and 3 feet for pool data. All displayed characters must be legible at the specified minimum distance.

o. Provide format options based on sound human factors considerations in the design of visual displays.

p. For purposes of determining format characteristics, the baseline automated data presentation system will consist of a Digital Equipment Co. VAX computer and a Megatek 7000 display.

q. Formats will be compatible with the use of color.

r. User interface with the system will be available in either of two access modes: standard (TOC/PROC) or user request.

s. TOs to be used as content references include, but are not limited to, TO 12R2-2ARC164-2 (Maintenance Instructions, Intermediate, Radio Set AN/ARC-164(V)) and TO 11B29-3-25-2 (Field Maintenance and Overhaul Instructions with Illustrated Parts Breakdown, Aircraft Bomb Ejector Rack Assembly).

1.3.2 Identification of Formats Based On Content Requirements

In order to ensure that all format-related factors have been anticipated, a review was conducted of the applicable specification governing preparation of TOs for intermediate maintenance of avionics equipment and systems, MIL-M-25095A(USAF). Although this specification deals primarily with the types of information to be provided in the TO (a "content" specification), and the manner of its organization and arrangement, it also requires--either directly or indirectly--certain format characteristics. MIL-M-25095A(USAF) is the most frequently applied "content" specification for intermediate maintenance of Air Force systems, and will most likely be applicable to the hard-copy manuals for any test bed system which is selected.

Table 1-1 contains the results of the MIL-M-25095A review. Format-related requirements contained in the specification are identified by paragraph number and description, together with the TO section (hard copy) where it would normally be placed. The right-hand side of the table identifies the relationship of the MIL-M-25095A requirement with the automated delivery system data categories. In effect, this shows the probable location of the "specification format" in the automated data base.

1.3.3 Format Selection Criteria

The approach to format selection that is followed herein is to establish (to the extent feasible) a "system" of formats which:

a. Satisfies the requirements of MIL-M-25095A.

b. Is compatible with video display capabilities and has the potential for effective use of computer system capabilities.

c. Has been tested (in paper-based form) and shown to be effective as an aid to performance.

d. Exhibits continuity and compatibility between tracks, between TS and NTS procedures, and between procedural data and pool data.

e. Can be indexed effectively, for ease of access.

f. Imposes the least amount of duplication of effort, to promote economy of preparation.

g. Already enjoys some measure of familiarity to, and acceptance by, Air Force maintenance technicians.

Table 1-1
Content Requirements of MIL-M-25095A Related to Formats

Paragraph Number	Subject	Procedural: Maintenance Tracks 1	Procedural: Maintenance Tracks 2	Procedural: Maintenance Tracks 3	Procedural: Troubleshooting Tracks 1	Procedural: Troubleshooting Tracks 2	Procedural: Troubleshooting Tracks 3	Pool: Support	Pool: Reference
3.3.1	Front Matter (per Mil-M-38784A)								●
a	Cover/Title/Title Block Page								●
b.	Warning Page								●
c.	List of Effective Pages								●
d.	Promulgation Page								●
e.	Change Record								●
f.	Foreword/Preface								●
g.	Table of Contents								●
h.	List of Illustrations								●
i.	List of Tables								●
j.	Safety Summary								●
3.3.2	Section I. Description								●
3.3.2.1	Composite Illustration								●
3.3.2.2	Major Characteristics of equipment								●
3.3.2.3	Equipment purpose, limitations, & general information								●
3.3.2.4	Condensed factual data (table)—physical								●
3.3.3	Section II. Special Tools & Test Equipment							●	
3.3.3.1	Special Tools List							●	
3.3.3.2	Test Equipment List							●	
3.3.4	Section III. Theory of Operation								●
–	Functional Block Diagrams (3 levels, A/R)								●
–	Explanatory Text								●
3.3.5	Section IV. Description of System Tie-In of Equipment and Accessories								●
–	Block Diagrams								●
–	Explanatory Text								●
3.3.6	Section V. System Checkout & Troubleshooting				●	●	●		
3.3.6.1	Bench Test Set-up				●	●	●		
3.3.6.2	Malfunction Isolation Guide				●	●	●		
3.3.6.3	Test Equipment Operating Instructions				?	?	?	●	
3.3.6.4	Alternate Methods of Presentation								

NOTE: Question mark (?) indicates applicability or category assignment is not firm.

Table 1-1
Content Requirements of MIL-M-25095A Related to Formats
(Continued)

Paragraph Number	Subject	Procedural: Maintenance Tracks 1	Procedural: Maintenance Tracks 2	Procedural: Maintenance Tracks 3	Procedural: Troubleshooting Tracks 1	Procedural: Troubleshooting Tracks 2	Procedural: Troubleshooting Tracks 3	Pool: Support	Pool: Reference
3.3.7	Section___. Maintenance Instructions (Each LRU)								
3.3.7.1	Limited Maintenance Instruction Table								
3.3.7.2	Inspection Instructions	●	●	●					
3.3.7.3	Malfunction Isolation Procedures				●	●	●		
3.3.7.3.1	Prefunctional Checks				●	●	●		
3.3.7.3.2	Functional Checks				●	●	●		
3.3.7.4	Disassembly Procedures	●	●	●					
3.3.7.5	Detail Parts & Assembly Checkout	?	?	?					
3.3.7.6	Cleaning Instructions	●	●	●					
3.3.7.7	Lubrication Instructions	●	●	●					
3.3.7.8	Reassembly & Final Inspection Instructions	●	●	●					
3.3.7.9	Alignment Checkout Instructions				●	●	●		
3.3.7.10	Circuit Analysis (Detailed)				?	?	?		
–	Signal Flow & Schematic Diagrams							●	
3.3.7.11	Final Test Instructions				●	●	●		
3.3.8	Alphabetical Index								●
General Requirements Related to Formats									
3.2.6.3	Diagrams								
3.2.6.3.1	Explanatory Text (for diagrams)							●	
3.2.6.3.3	Schematic Diagrams							●	
3.2.6.3.3.1	Interconnection diagrams							●	
3.2.6.3.3.2	Power/control circuit & signal flow							●	
3.2.6.3.4	Equipment schematics							●	
3.2.6.3.5	Overall schematic diagrams							●	
3.2.6.3.6	Power & control schematics							●	
3.2.6.3.6.A	Logic diagrams				?	?		●	
3.2.6.3.7	Waveform diagrams				?	?	?	●	
3.2.6.3.8	Interconnection cable diagrams							●	
3.2.6.3.9	Combination (waveform/interconnect) diagrams							●	
3.2.6.3.10	Module schematic diagrams							●	
3.2.6.5	Test Point Identification				?	?	?	●	
3.2.7	Cable Fabrication Instructions							●	

NOTE: Question mark (?) indicates applicability or category assignment is not firm.

In order to satisfy these criteria, a core system of formats was selected that comes closest to meeting the collective goals, and that can be adapted and modified to meet the needs of each category of data in the automated delivery system. The core system selected was the Job Guide Technical Order System (JGTOS), basic requirements for which are contained in specification MIL-M-38800A(USAF). The specific formats which are, or may be, included in the JGTOS are identified in Table 1-2.

1.3.4 JGTOS Selection Rationale

The justification for selection of JGTOS as the core JPA system is as follows:

a. JGTOS encompasses, or provides for, most of the specific format candidates believed to be appropriate for automated technical data.

b. JGTOS is compatible with the conduct of detailed task analysis as a prerequisite for preparation of technical data.

c. JGTOS is compatible with other primary specifications containing guidance for selected format candidates.

d. Although JGTOS is a JPA system for organizational level maintenance, it is compatible with the applicable specifications for intermediate level maintenance for the types of equipment anticipated in this program (i.e., MIL-M-25095A; MIL-C-38720A).

e. JGTOS is already widely used in the Air Force, so its characteristics--even when applied to intermediate level and converted to automated delivery form--will be familiar to many USAF technicians.

Table 1-2

Formats Included in Job Guide Technical Order System (JGTOS)

- ★ JGTOS — Job Guide Technical Order System
  - ◆ CL[a] — Check Lists
- ▲ JGIM — Job Guide Index Manual
- ● JGM — Job Guide Manuals
  - ▲ JOBGUIDE
    - ◆ ICP — Input Conditions Page
    - ◆ MJG — Maintenance Job Guide
  - ▲ TDC[b] — Troubleshooting Data Charts
  - ▲ TLT[b] — Troubleshooting Logic Trees
  - ▲ SBD[b][c] — Schematic Block Diagrams
  - ▲ MDC[b][c] — Maintenance Dependency Charts
- ● MSIM — Maintenance Support Information Manual
- ● GAEM — General Aircraft Equipment Manual
- ● WDM — Wiring Diagrams Manual
  - ◆ DCR — Designation Cross Reference
  - ◆ PLDG — Physical Location Drawings
  - ◆ WD — Wiring Diagrams

Notes: (a) Checklists are optional; when provided, MIL-C-9927 and MIL-C-38778 apply.
(b) Troubleshooting data may be *either* TDC, TLT, or SBD and MDC.
(c) SBDs and MDCs per MIL-M-38799.

Source: AFHRL TR-80-50 (Ref. 1)

1.3.5 Specific Format Candidates

The core system encompassed by JGTOS will be supplemented and modified by the addition and/or substitution of other specific format candidates in order to provide the following:

a. The optimum data format considering the needs of the users.

b. Satisfaction of the content/format requirements of MIL-M-25095A.

c. Compatibility with automated delivery system capabilities.

The specific formats recommended for use in the automated delivery system are identified in Table 1-3, together with the specifications that provide procedures preparation guidance and the location (as categories of data) in the automated data base. As shown, many formats are based directly on the requirements in MIL-M-38800A for JGTOS. Others will use JGTOS formats, but will be prepared to the basic requirements of other specifications. In a few cases, formats not encompassed by JGTOS will be used, either as substitutes for, or supplements to, JGTOS formats.

For example, while JGTOS (per MIL-M-38800A) provides for the use of logic trees as troubleshooting procedures, very little preparation guidance is provided and there are no provisions for differences in level of detail. Consequently, logic trees to be used will conform to the concepts defined in AFHRL TR-79-49. Similarly, some specific formats in JGTOS will be more appropriate for the automated delivery system if they are prepared to the requirements of MIL-M-83495(USAF), which is similar in many respects to MIL-M-38800A.

Table 1-3

Candidate Formats, Requirements Specifications, and Categories of Data

Format Candidates	Data Base Location: Procedural: Maintenance Tracks 1	Maintenance Tracks 2	Maintenance Tracks 3	Trouble-shooting Tracks 1	Trouble-shooting Tracks 2	Trouble-shooting Tracks 3	Pool: Support	Pool: Reference	Other	Requirements Documents: MIL-M-38800A	MIL-M-63038A	AFHRL TR-74-12	MIL-C-38720A	MIL-M-83495	AFHRL TR-79-49	MIL-M-38807	MIL-STD-863A	DOD-STD-1685	MIL-M-38799	MIL-M-24100B	MIL-HDBK-242	NAVAIR 00-25-700	MIL-M-81927	MIL-M-81929	MIL-M-38784A	MIL-HDBK-63038-1	MIL-M-25095A
Job Guide Input Conditions Page (ICP)	▲	▲	▲	△	△	△				●				○											○		
Summary Maintenance Procedure (SUMP)	▲	▲	▲								○														○	○	
Job Guide Maintenance Instruction Frame, Dual Level			▲							●		○													○		
Job Guide Maintenance Instruction Frame, Partially Proc.		▲								○		○	○												○		◇
Job Guide Keyed Illustration		▲	▲		▲	▲				●				○											○		
LTTA Enriched Checkout Procedure						▲									●										○		
LTTA Enriched Logic Tree						▲									●										○		
LTTA Checkout Procedure				▲	▲										●										○		
LTTA Logic Tree				▲	▲										●										○		
Fault Code/Cross Reference Index				△	△	△								○	●										○		
USAF Illustrated Parts Breakdown (IPB)							▲									●								○	○		
Function Diagrams (Schematics; wiring; etc.)							▲	△									●	○	○	○	○	○	○		○		◇
Access and Locator Data							▲							○			●								○		
Specification Tables							△																		○		
Test Setup Diagrams							△																		○		◇
Front Matter: Title Page; Safety Summary; etc.									▲	○															●		◇
Front Matter: Other								▲		○															●		◇
Principles/Theory of Operation								▲		○															○		◇
Lists of Tools and Test Equipment								▲																	○		◇
System Tie-In of Equipment and Accessories								▲																	○		◇

Legend: Type or Location: ▲ Probable, △ Possible; Format Req'ts: ● Primary Guidance, ○; Content: ◇

SECTION 2.0
BASELINE REQUIREMENTS FOR SELECTED FORMATS

2.1 FORMAT DESCRIPTIONS

This section contains brief descriptions of the formats recommended for use in the automated delivery system. These descriptions deal with the formats as they are used in a paper-based, or hard-copy, technical manual program. Formats for non-troubleshooting maintenance procedures are discussed in Subsection 2.2. Formats for troubleshooting and fault isolation procedures are discussed in Subsection 2.3. Procedural support and reference-type pool data formats are described in Subsection 2.4.

Specific changes that will/may be required to convert these formats for videoscreen presentation are addressed in more detail beginning in Section 3.0.

2.2 NON-TROUBLESHOOTING MAINTENANCE PROCEDURE FORMATS

2.2.1 Intermediate Level Maintenance Functions

Although the specific non-troubleshooting (NTS) maintenance functions to be performed will vary with the particular system/equipment to be maintained and the applicable maintenance concept, the following functions should be anticipated:

- Inspection
- Cleaning
- Disassembly or removal
- Assembly or installation
- Lubrication

- Alignment, adjustment, and calibration
- Pre-operational check
- Repair.

2.2.2 Input Conditions Format

The input conditions format is common to all Job Guide-type procedural data. It contains all of the information required by the technician in order to prepare for the conduct of a specific maintenance task. Input Conditions Pages (ICPs) (see Figure 2-1) are required in the JGTOS, per MIL-M-38800A, and in the OMMS* system, per MIL-M-83495. A nearly identical format, termed Preliminary Information Page (PIP), is required in the AF/FPJPA** system, per AFHRL TR-73-43. A slightly different approach is the Summary Maintenance Procedure (SUMP), used by the Army in the SPA*** system. While format and content are somewhat different, the SUMP serves the same purpose as the ICP and PIP. Requirements for SUMP are contained in MIL-M-63038A. For the automated delivery system, the ICP format and the task list as used in the SUMP format will be combined. A typical Summary Maintenance Procedure is illustrated in Figure 2-2.

The input conditions frames will contain the following types of information, as applicable:

- Task title
- Applicability
- Supplies
- Personnel required

---

*OMMS: Organizational Maintenance Manual Set.

**AF/FPJPA: Air Force Fully Procedural Job Performance Aid.

***SPA: Skill Performance Aid.

T.O. 1C-141A-2-4JG-4

REMOVE AND INSTALL FUEL PUMP

INPUT CONDITIONS

Applicable Serial Nos: All

Supplies:

Engine oil, MIL-L-7808

Grease, VV-P-236

Five-gallon plastic container

Hose caps and plug, assorted sizes

Wiping cloths or towels (Kimwipes)

Plastic bags, Ziploc

Plastic sheet, Two feet by two feet

Personnel Required: Two

Assistant stationed at applicable engine to aid in removal and installation of fuel pump.

Specialist required to motor affected engine upon request from technician.

2-1

T.O. 1C-141A-2-4JG-4

REMOVE AND INSTALL FUEL PUMP

Equipment Condition:

Left-hand and right-hand aft cowl doors opened per T.O. 1C-141A-2-4JG-1.

Left-hand and right-hand forward cowl doors opened per T.O. 1C-141A-2-4JG-1.

Fuel shut off and drained from fuel pump inlet lines and deicer filter per Section 1 of this T.O.

WARNING

Be sure electrical power to system remains off during this activity.

2-2

T.O. 1C-141A-2-4JG-4

REMOVE AND INSTALL FUEL PUMP

Special Tools & Test Equipment:

Torque wrenches, calibrated to 500 inch-pounds and 1500 inch-pounds: tightens hardware to specified torque.

Maintenance Stand, Type B-4A; elevates technician to fuel pump. (Alternate: Type B-1A.)

Machinist Scale, six-inch, locally procured; measures distance between pad nut and mount bracket.

2-3

T.O. 1C-141A-2-4JG-4

REPLACEMENT PARTS:

Fuel Pump (1)

Refer to Illustrated Parts Breakdown, T.O. 2J-TF33-14, Figure 44

2-4

Figure 2-1. Example of Input Conditions Pages (ICPs) in Air Force Job Guide Manual (reduced size).

List of Tasks			
Task No.	Task	Task Ref	Troubleshooting Ref No. * (Para)
1.	Maintain Battery:		
	a. Check electrolyte level	3-9	3-10
	b. Check specific gravity	3-9	3-10
2.	Service tracks and rollers	5-7	5-8
3.	Service radiator:		
	a. If temperature can go below + 32 deg F., check antifreeze	. . .	Add antifreeze, if necessary
	b. Check coolant level	. . .	Add coolant, if necessary
4.	Install and adjust fan belt	4-6	4-7
5.	Clean winch and oil screen	5-7	5-9

Figure 2-2. Example of Summary Maintenance Procedure (SUMP) (from MIL-HDBK-63038-1).

- Replacement parts
- Equipment conditions
- Support equipment
- Special tools and test equipment
- Safety and warning statements
- Task summary.

Input conditions may be complete in one frame, or may use multiple frames. Baseline requirements are those contained in MIL-M-38800A, supplemented by MIL-M-83495 and MIL-M-63038A.

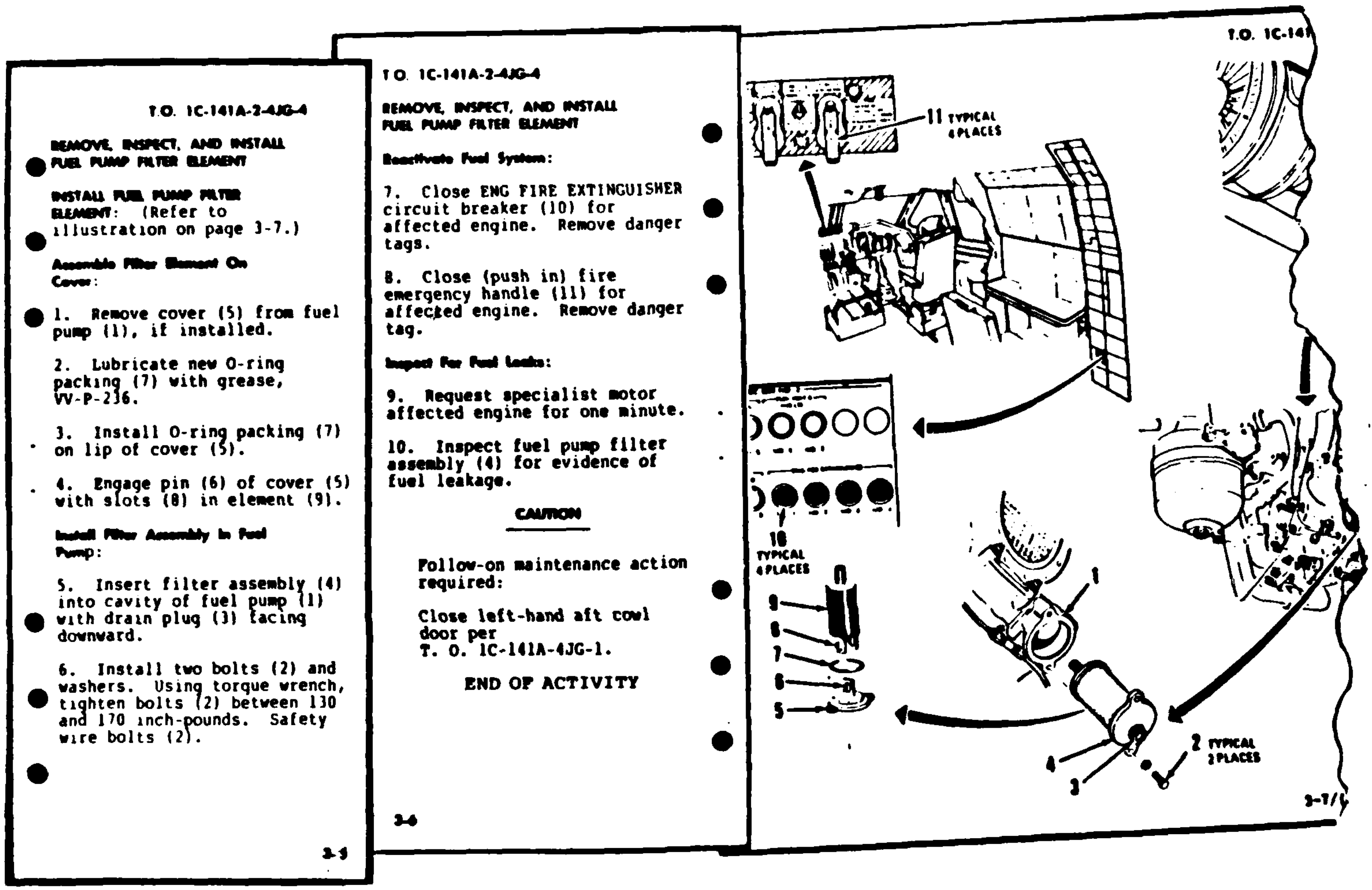
The input conditions format will be used for all three tracks of nontroubleshooting maintenance procedures. For Track 2 and Track 3 maintenance, the input conditions frame(s) is preliminary to the actual procedural data. For Track 1 maintenance, the input conditions frame(s) including the summary of tasks--may be used by experienced technicians to perform maintenance.

The ICP format has not been specifically tested, since it contains no procedural data. Tests of Job Guide procedural formats have included the ICP, however. Relevant descriptions, illustrations, and requirements information for the input conditions format for the electronic delivery system are contained in Section 7.0.

2.2.3 Dual-Level Maintenance Instruction Format

The dual-level maintenance instruction frame format is a hybrid of fully proceduralized and partially proceduralized maintenance instructions, accompanied by specific illustrations of the equipment being maintained. In this approach, primary steps are in bold face type (or underlined), with detailed steps in normal type. Callouts in the text steps reference specific components in the accompanying illustration (see Figure 2-3).

This combination provides (in the detailed steps) specific instructions on what to do and how to do it. The primary steps serve to alert the technician to the scope of the underlying detailed steps, and can be used as a checklist by technicians with enough experience to not need the detailed, fully proceduralized steps. The dual-level presentation mode, containing both primary and detailed steps, is required by MIL-M-38800A; additional guidance is contained in AFHRL TR-74-12 and DOD-STD-1685.


T.O. 1C-141A-2-4JG-4

REMOVE, INSPECT, AND INSTALL FUEL PUMP FILTER ELEMENT

INSTALL FUEL PUMP FILTER ELEMENT: (Refer to illustration on page 3-7.)

Assemble Filter Element On Cover:

1. Remove cover (5) from fuel pump (1), if installed.

2. Lubricate new O-ring packing (7) with grease, VV-P-236.

3. Install O-ring packing (7) on lip of cover (5).

4. Engage pin (6) of cover (5) with slots (8) in element (9).

Install Filter Assembly In Fuel Pump:

5. Insert filter assembly (4) into cavity of fuel pump (1) with drain plug (3) facing downward.

6. Install two bolts (2) and washers. Using torque wrench, tighten bolts (2) between 130 and 170 inch-pounds. Safety wire bolts (2).

3-5

T.O. 1C-141A-2-4JG-4

REMOVE, INSPECT, AND INSTALL FUEL PUMP FILTER ELEMENT

Reactivate Fuel System:

7. Close ENG FIRE EXTINGUISHER circuit breaker (10) for affected engine. Remove danger tags.

8. Close (push in) fire emergency handle (11) for affected engine. Remove danger tag.

Inspect For Fuel Leaks:

9. Request specialist motor affected engine for one minute.

10. Inspect fuel pump filter assembly (4) for evidence of fuel leakage.

CAUTION

Follow-on maintenance action required:

Close left-hand aft cowl door per T. O. 1C-141A-4JG-1.

END OF ACTIVITY

3-6

Figure 2-3. Example of dual-level maintenance instruction and illustration (reduced size).

The dual-level format, with fully keyed illustrations, will be used for Track 3 non-troubleshooting maintenance. In addition, it is the basis for preparing the instructions to support Track 2 maintenance. The latter will use only the primary (boldface) steps of the dual-level presentation, without the detailed steps. To these primary steps will be added such other, more specific information as is needed to make the step complete or to provide critical data. Keyed illustrations may be used, but will contain less detail than in the Track 3 level. Figure 2-4 illustrates the change to the dual-level format when the detailed steps are deleted. The Track 2 format will be somewhat similar to that required by MIL-C-38720A, for Intermediate Maintenance Checklists. As mentioned earlier, Track 1 non-troubleshooting maintenance will rely on the Summary Maintenance Procedure format that is part of the input conditions for all tracks.

Sample formats and preparation guidelines for automated maintenance procedures are contained in Section 7.0.

2.3 TROUBLESHOOTING AND FAULT ISOLATION PROCEDURE FORMATS

2.3.1 Intermediate Level Troubleshooting Functions

Specific troubleshooting functions to be performed will vary with the particular system/equipment and the maintenance concept. The following functions should be anticipated at both the system level and the equipment/component level:

- Checkout
- Test
- Fault isolation.

REMOVE, INSPECT, AND INSTALL FUEL PUMP FILTER ELEMENT

INSTALL FUEL PUMP FILTER ELEMENT: (Refer to illustration on page 3-7.)

Assemble Filter Element (9) and Lubricated O-Ring (7) on Cover (5).

Install Filter Assembly (4) in Fuel Pump (1). Torque bolts (2) between 130 - 170 inch-pounds and safety wire.

Reactivate Fuel System (10)(11) for affected engine.

Inspect for fuel leaks at filter assembly (4).

CAUTION

Follow-on maintenance action required:

Close left-hand aft cowl door per T. O. 1C-141A-4JG-1.

END OF ACTIVITY

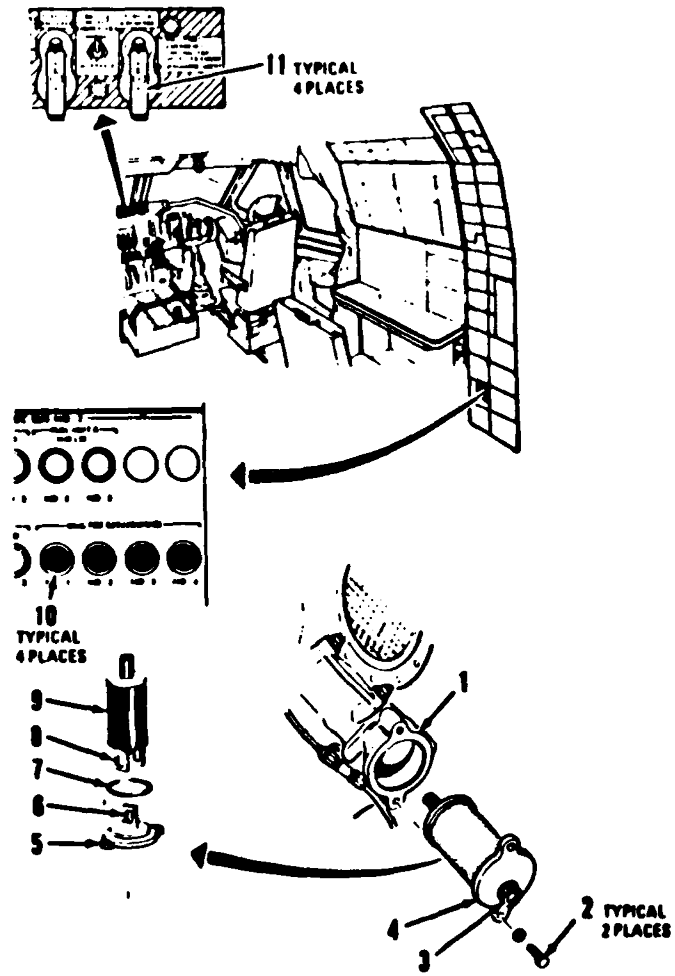


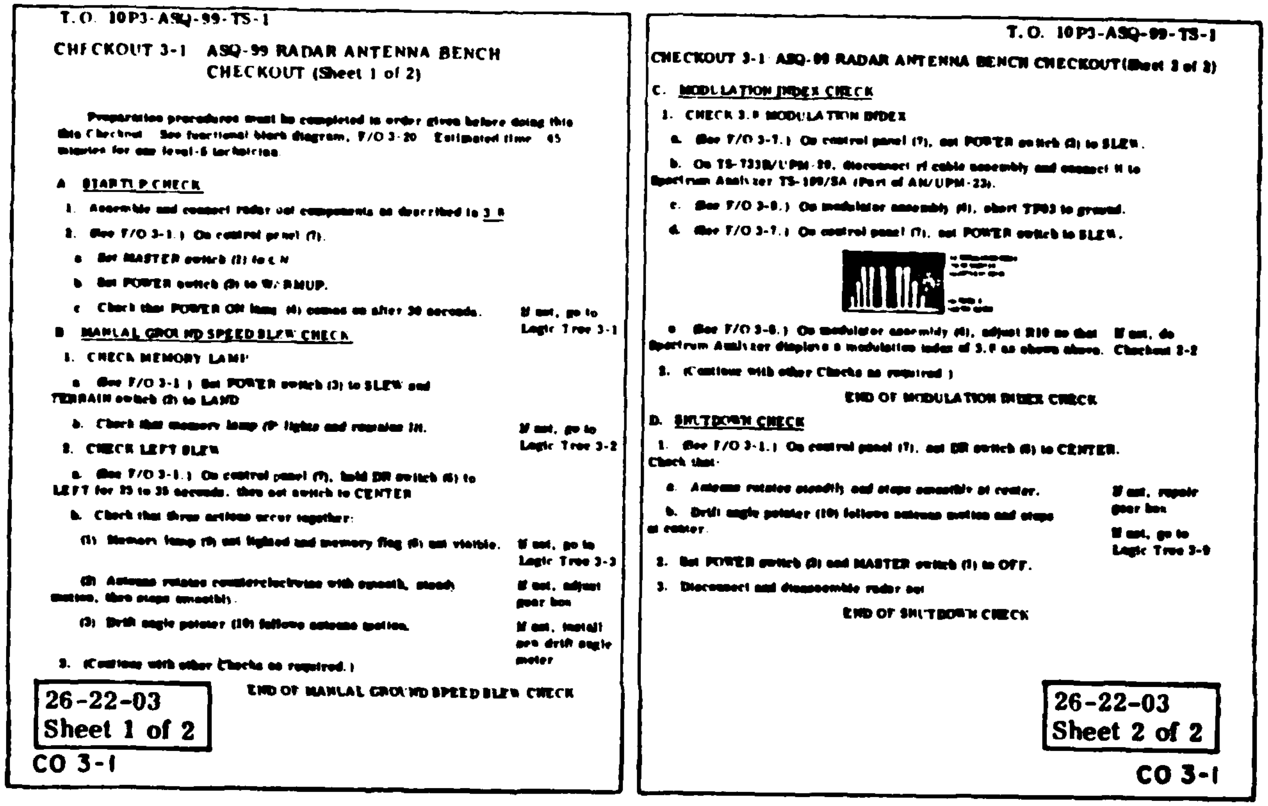
Figure 2-4. Example of dual-level maintenance instruction with detailed steps removed.

2.3.2 Logic Tree Troubleshooting Aid (LTTA) Formats

Logic Tree Troubleshooting Aids (LTTAs) have two essential components: checkout procedures and logic trees. Checkout procedures are a series of sequential steps, or checks, to identify the existence of a malfunction in a particular portion of a system or equipment. Logic trees are "branching" steps arranged in a sequence that will quickly isolate the cause of the fault to a particular component or assembly; the quantitative or qualitative results/observations of each step determine which of the branches to follow in the next step. Logic trees are almost always binary; i.e., there are always two, but not more than two, possible next steps.

LTTAs can be presented in many forms: all narrative, charts, tabular, flowcharts, or combinations of each. For this program, troubleshooting will be accomplished using versions of the LTTA format prepared according to AFHRL TR-79-49. These LTTAs combine the use of checkout procedures (in narrative form) to identify a malfunction, symptom tables to provide a cross-reference, and logic tree flowcharts to isolate the cause of the malfunction and direct corrective action. Further, this approach provides for varying the level of detail in the check-out procedures and logic trees according the the skill level and experience of the intended users. (Although MIL-M-38800A authorizes the use of LTTAs, the guidance therein is not sufficient for preparation.)

Track 3 troubleshooting will use the fully enriched version of the checkout procedures, in dual-level presentation, as shown in Figure 2-5. Fault isolation in Track 3 will use the fully enriched logic trees, illustrated in Figure 2-6. Full enrichment, as used in this specification, means that the detailed steps



T.O. 10P3-ASQ-99-TS-1

CHECKOUT 3-1 ASQ-99 RADAR ANTENNA BENCH CHECKOUT (Sheet 1 of 2)

Preparation procedures must be completed in order given before doing this Checkout. See functional block diagram, F/O 3-20. Estimated time 65 minutes for one level-5 technician.

A. STARTUP CHECK

1. Assemble and connect radar set components as described in 3.8

2. (See F/O 3-1.) On control panel (7).

a. Set MASTER switch (1) to ON.

b. Set POWER switch (3) to WARMUP.

c. Check that POWER ON lamp (4) comes on after 30 seconds. — If not, go to Logic Tree 3-1

B. MANUAL GROUND SPEED SLEW CHECK

1. CHECK MEMORY LAMP

a. (See F/O 3-1.) Set POWER switch (3) to SLEW and TERRAIN switch (2) to LAND

b. Check that memory lamp (9) lights and remains lit. — If not, go to Logic Tree 3-2

2. CHECK LEFT SLEW

a. (See F/O 3-1.) On control panel (7), hold DR switch (6) to LEFT for 25 to 35 seconds, then set switch to CENTER

b. Check that three actions occur together:

(1) Memory lamp (9) not lighted and memory flag (8) not visible. — If not, go to Logic Tree 3-3

(2) Antenna rotates counterclockwise with smooth, steady motion, then stops smoothly. — If not, adjust gear box

(3) Drift angle pointer (10) follows antenna motion. — If not, install new drift angle meter

3. (Continue with other Checks as required.)

END OF MANUAL GROUND SPEED SLEW CHECK

26-22-03
Sheet 1 of 2

CO 3-1

T.O. 10P3-ASQ-99-TS-1

CHECKOUT 3-1 ASQ-99 RADAR ANTENNA BENCH CHECKOUT (Sheet 2 of 2)

C. MODULATION INDEX CHECK

1. CHECK 3.9 MODULATION INDEX

a. (See F/O 3-7.) On control panel (7), set POWER switch (3) to SLEW.

b. On TS-733B/UPM-20, disconnect rf cable assembly and connect it to Spectrum Analyzer TS-100/SA (Part of AN/UPM-23).

c. (See F/O 3-8.) On modulator assembly (4), short TP03 to ground.

d. (See F/O 3-7.) On control panel (7), set POWER switch to SLEW.

e. (See F/O 3-8.) On modulator assembly (4), adjust R10 so that Spectrum Analyzer displays a modulation index of 3.9 as shown above. — If not, do Checkout 3-2

2. (Continue with other Checks as required.)

END OF MODULATION INDEX CHECK

D. SHUTDOWN CHECK

1. (See F/O 3-1.) On control panel (7), set DR switch (6) to CENTER. Check that:

a. Antenna rotates steadily and stops smoothly at center. — If not, repair gear box

b. Drift angle pointer (10) follows antenna motion and stops at center. — If not, go to Logic Tree 3-9

2. Set POWER switch (3) and MASTER switch (1) to OFF.

3. Disconnect and disassemble radar set

END OF SHUTDOWN CHECK

26-22-03
Sheet 2 of 2

CO 3-1

FIGURE 3. Sample intermediate level checkout for electronic system.

Figure 2-5. Example of LTTA fully enriched checkout procedure (from AFHRL TR-79-49).

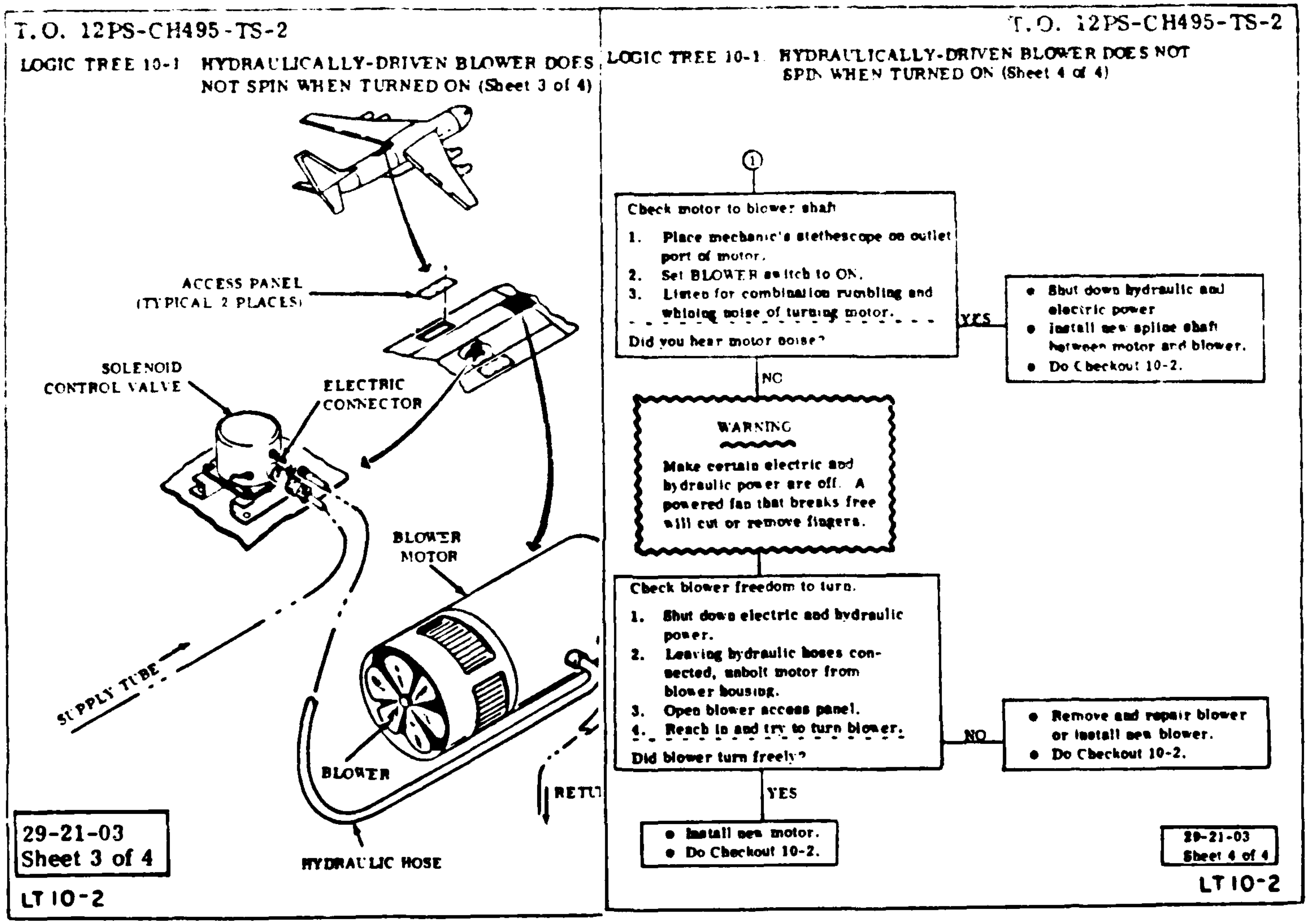


Figure 2-6. Example of LTTA fully enriched logic tree (from AFHRL TR-79-49).

involved in accomplishing the task are clearly described in their proper sequence, and accompanied by detailed and appropriately keyed illustrations.

Track 2 troubleshooting will be accomplished with minimally enriched checkout procedures and logic trees. The level of detail in the checkout procedure will approximate that specified for the Track 2 maintenance procedure (see paragraph 2.2.3 and Figure 2-4). An example of a minimally enriched logic tree is shown in Figure 2-7. Illustrations will also be provided in Track 2, but with less detail and minimum use of callouts.

Track 1 troubleshooting will use completely unenriched versions of the LTTAs in narrative checklist form. Checkout procedures will not be significantly different from those shown in Figure 2-5 except that the level of detail will be much reduced. Fault isolation procedures will use a "logic checklist" for each fault found in the checkout. The sequence of fault isolation steps will be the same as in the more detailed tracks but the logic will be transparent to the technician. As in the checkout procedures, guidance for performing each check will be limited to essential information which even these more skilled technicians may require. In addition, Track 1 technicians may obtain pool data such as schematics and test specification charts, and use them either as supporting data or as substitutes for the logic checklists.

Sample formats and preparation guidelines for automated troubleshooting procedures are contained in Section 8.0.

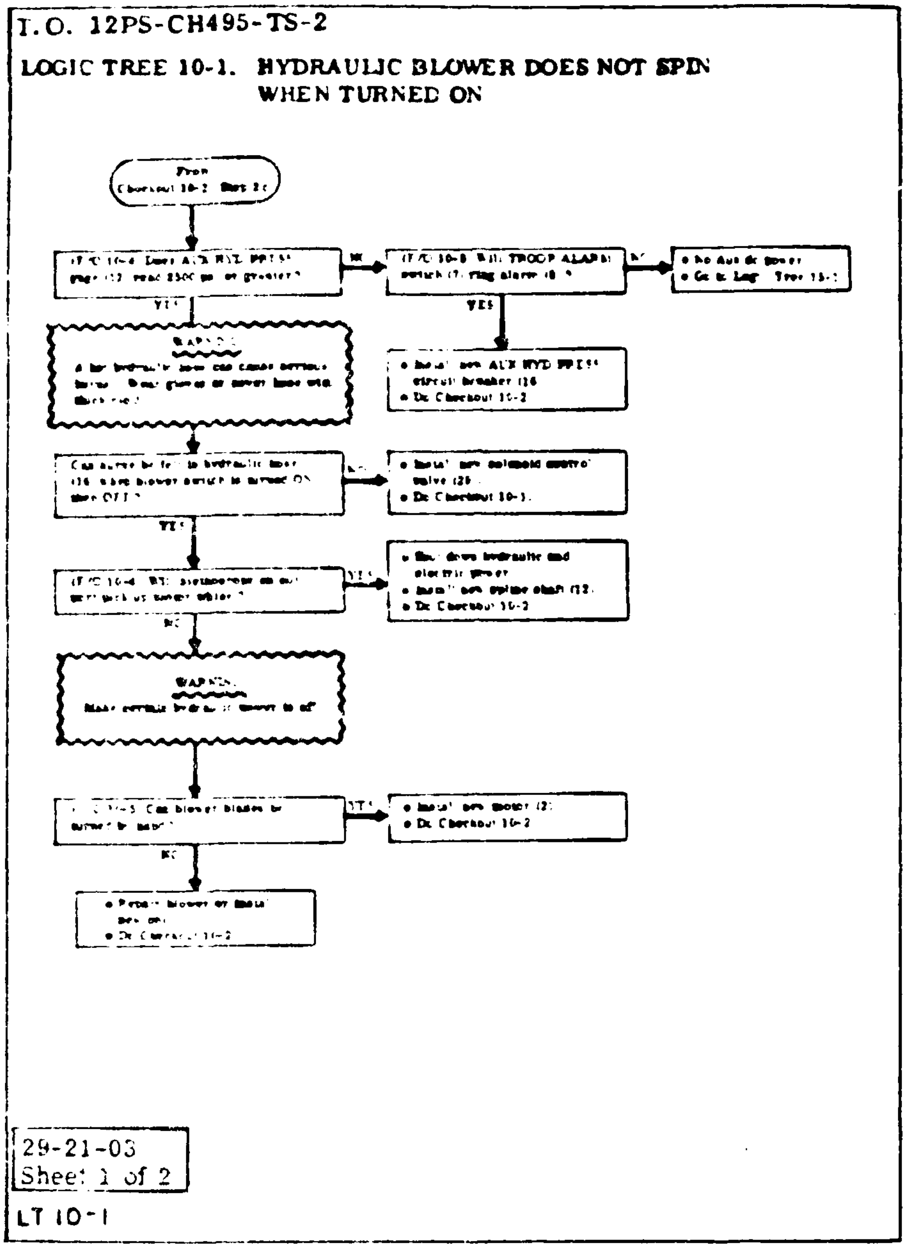


Figure 2-7. Example of LTTA minimally enriched logic tree (from AFHRL TR-79-49).

2.3.3 Fault Code/Cross-Reference Index

This format, illustrated in Figure 2-8, may be used in all three troubleshooting tracks if the fault code reporting system specified in MIL-M-83495 is in use with the system/equipment. Level of detail will be the same for all three tracks. Guidance regarding the Fault Code/Cross-Reference Index is contained in AFHRL TR-79-49.

TABLE A-1. ASQ-000 radar set fault code cross index.

FAULT CODE	FAULT SYMPTOM	CHECKOUT & STEP NO.	LOGIC TREE	L.T. PAGE
2920/A1B1Z	Hydraulically Driven Blower Does Not Spin When Turned On	CO 10-2, 3c	10-1	LT 10-1

Figure 2-8. Example of Fault Code/Cross-Reference Index (from AFHRL TR-79-49).

2.3.4 Other Troubleshooting Formats

All other information which may be used to support troubleshooting is part of the pool data, discussed in Section 5.0.

2.4 POOL DATA FORMATS

2.4.1 General Considerations

The range of formats comprising "pool data" is extremely broad, varying from that for a technical manual title page to a schematic diagram. For convenience, pool data has been arbitrarily divided into two categories:

a. Procedural support data, which are used primarily to amplify or clarify a specific maintenance or troubleshooting procedure, or otherwise assist in accomplishing a task.

b. Reference data, which provide general information about the system or equipment, or about the TO itself.

The discussion in this section will deal primarily with the procedural support pool data formats, with brief mention of the reference pool data formats.

2.4.2 Illustrated Parts Breakdown (IPB)

Although MIL-M-25095A contains no requirement for preparation of an IPB, it is frequently a part of intermediate maintenance manuals, and it must be assumed that an IPB will be required. Content specifications frequently do not mention the IPB requirement since it is often in a separate manual (from the maintenance/troubleshooting procedures) and is prepared to the requirement of a different specification. The TO manager of the acquisition agency may make a determination that the IPB manual can be combined with the maintenance manual--the likely (and preferred) approach in the automated delivery system. Nevertheless, it is suggested that the IPB be considered as a discrete "section" of the automated data base since, in practice, it will often be used as an entirely separate manual.

For many years all three military services used the same specification (MIL-M-8910) as the basis for IPB preparation. Currently, however, IPBs procured by the Air Force must conform with MIL-M-38807(USAF). Although basic requirements are similar, there are significant differences in terminology and format. It is possible that the existing IPB for a system was originally prepared to MIL-M-8910, but it should be assumed that the requirements of MIL-M-38807 will apply to this program.

The principal parts of the IPB are:

a. Introductory materials (Figures 2-9, 2-10, and 2-11).

b. Maintenance Parts List (including breakdown illustrations) (Figure 2-12).

c. Numerical index of part numbers (Figure 2-13).

d. Reference designation index (Figure 2-14).

Although formats and arrangements may vary from MIL-M-38807 requirements to some degree, the automated IPB must satisfy the intent of those requirements. Section 6.0 contains sample formats and preparation guidelines for IPB pool data in the automated delivery system, including some additional formats and types of data not needed in a paper-based IPB.

2.4.3 Function Diagrams

As defined in DOD-STD-1685(SH), a function diagram is:

TABLE OF CONTENTS

*Note: Current terminology for the "Group Assembly Parts List" is Maintenance Parts List.

Figure 2-9. Example of IPB introductory material, Table of Contents.

by the caption (Attaching Parts). To determine the next higher assembly for any item appearing in column one of the breakdown, refer to the figure in parenthesis after the item nomenclature. Reference figure numbers following assemblies or subassemblies in the breakdown indicate that it has been impracticable to illustrate the complete subassembly on the illustration for the breakdown and that a separate illustration and parts listing is provided by the reference figure.

1-15. Special Descriptive Information. Following the nomenclature of each part in the Description column, additional applicable information is given for Manufacturer's Federal Supply Codes, altered parts, alternate parts, Specification Control Drawings, superseding parts and applicable government publications.

1-16. Repair Parts Kits. This publication reflects the listing of repair parts kits. Such listings provide information concerning replacement parts usable at major overhaul and minor repair. Certain replacement parts are stocked only in kits. Standard parts and parts having multi-application are stocked in their appropriate classes and may also be stocked in kits. Kit parts should not be ordered from separate stock to make up a kit.

NOTE

A note, indicating that a parts kit(s) is available is shown in the Description column following the nomenclature of the repairable unit and will read. Parts kit(s) available. Detail parts which are components of a kit are identified by a symbol and keyed to a footnote. The symbol appears to the right in the Part Number column. Kit codes appear in the Description column for each component and are defined in the following paragraphs.

1-17. Parts Kit Codes.

a. Code C - Cure-Dated Parts Kit. Code C is applied to kits containing parts that have a specific period of time (cure-date) to remain in storage without affecting their serviceability and are subject to deterioration due to ageing or exposure. The cure-date for the kit is established on the shortest lived item within the kit. C-kit contains parts required for maintenance and overhaul and will be used in conjunction with overhaul (code D) repair kits and/or minor or field (code F) repair kits, as applicable.

b. Code D. Code D is applied to kits which are available only to those activities authorized to perform depot or major overhaul.

c. Code F - Minor or Field Parts Kit. Code F is applied to kits which are available to maintenance activities authorized to perform base level repair of the end item, including overhaul activities in support of field activities.

d. Code KC - Component of C-Kit. Code KC is applied to items which are components of a C-kit.

e. Code KD. Code KD is applied to items which are components of a D-kit.

f. Code KF. Code KF is applied to items which are components of an F-kit.

g. Code KB. Code KB is applied to items which are components of both an F-kit and a D-kit.

1-18. Items which are source coded KC, KD, KF or KB and for which the application of such items are peculiar to repair kits are not stocked separately and are not assigned any additional source codes.

1-19. Items which are source coded KC, KD, KF or KB and for which the application of such items are common to repair kits and to other repair or overhaul applications are stocked separately in the appropriate commodity class if followed by the letter P; however, military and industrial standard items and bulk materials (defined in AMCR 67-35) which have multi-purpose application (repair kits as well as other repair and overhaul purposes) are stocked separately but are not assigned source codes.

1-20. UNITS PER ASSEMBLY COLUMN. This column lists the quantity of units required per next assembly. The letters AR indicate the quantity to be As Required: The letters Ref in this column indicate the part is repeated from another location or listed as a reference item for clarity. Refer to the numerical index for other locations.

1-21. USABLE ON CODE COLUMN. This column indicates by code all articles covered by this publication, on which a part is usable. Since there are differences in the components parts, a simple alphabetical code has been provided. Refer to paragraph 1-35 for explanation of codes. For usability of a part in different locations, see the other figure and index numbers listed in the Numerical Index. See the next higher assembly for usability of simple hardware.

NOTE

Absence of coding indicates that the part is usable, in relation to a particular assembly, on all articles covered by this publication.

1-22. NUMERICAL INDEX.

1-23. The Numerical Index is arranged into one continuous alphanumerical list containing all contractor, standard and vendor part numbers used on the article.

1-24. PART NUMBER COLUMN. This column lists all parts used on the article. An alphanumerical system provides uniformity of listing to permit rapid location of part numbers.

1-25. FIGURE AND INDEX NUMBER COLUMN. This column reflects the figure and index number of the illustration on which the part may be located. For government and contractor's standard parts only the figure and index number of the first illustration on which the part appears is listed.

1-26. SOURCE CODE COLUMN. The source codes in this column are assigned in accordance with AFLCM 65-3 and AFSCM 65-2. Policies, general information and procedures for changing source coding are contained in TO 00-25-195. Generally, the source codes herein (see source code column) were assigned by Air Force personnel when this equipment was purchased. Assignment of codes was influenced by (a) maintenance policies of the Air Force Base self sufficiency program, (b) predicted maintenance actions, (c) base facilities and capabilities, (d) economic considerations. Parts listed without source codes will be coded on revision. The definition of each source code is explained in the following paragraphs.

1-27. P Series - Parts Procured and Under Inventory Stock Control.

a. Code P identifies parts which may be requisitioned and installed by any level of maintenance consistent with the activity's authorized scope of maintenance. Code P is applied to parts on which usage is anticipated or known. Restricted (emergency) service manufacture of code P items is considered practical but may be accomplished only after confirmation of non-availability from supply sources.

b. Code PD identifies parts which may be requisitioned and installed by AF activities authorized depot-level maintenance only. Code PD is applied to parts on which usage is anticipated or known. Restricted (emergency) service manufacture of code PD parts is considered practicable but may be accomplished only after confirmation of non-availability from supply sources.

c. Code P1 identifies parts which may be requisitioned and installed by any maintenance level consistent with the activity's authorized scope of maintenance. Code P1 is supplied to parts on which usage is anticipated or known, and service manufacture is considered impractical.

d. Code P1D identifies parts which may be requisitioned and installed by AF activities authorized depot-level maintenance only. Code P1D is applied to parts on which usage is anticipated or known, and service manufacture is considered impractical.

e. Code P2 identifies insurance-type spare parts which can be installed by any AF activity consistent with the activity's authorized scope of maintenance. This code is applied to such parts which are basically structural and for which no usage is anticipated or known, require special tools, templates and/or jigs and are very difficult, impractical or uneconomical to manufacture by AF activities. These items are not subject to periodic replacement or wearout but may require infrequent replacement as a result of accidents or other unexpected occurences. Delayed procurement items are included under this code.

f. Code P2D identifies insurance-type parts which may be installed by AF activities which are authorized depot-level maintenance only. This code is applied to parts as described under code P2 and to delayed procurement items.

1-28. M Series - Manufacture, Parts Not Procured.

a. Code M identifies parts, the manufacture and installation of which is within the capabilities of field maintenance activities; and to which all of the following conditions apply:

(1) Procurement is not justified because of low usage or peculiar storage and installation factors. Needs are to be met by local manufacture only as required.

(2) Their manufacture does not require tools, equipment or skills not normally authorized at field maintenance level.

(3) Does not require test equipment not normally authorized at field maintenance level.

(4) Does not require material not normally available in Air Force inventory.

b. Code M1 identifies parts which can be manufactured at activities authorized depot-level maintenance facilities and to which all of the following conditions apply:

(1) Procurement is not justified because of low usage or peculiar storage and installation factors. The need of base activities are to be met by requisitioning from the geographical SSM AMA, or DM AMA.

(2) Their manufacture is beyond capabilities of field maintenance activities as outlined above.

(3) Their manufacture does not require tools or equipment not normally authorized at all AMA's.

1-29. A Series - Assemble, Assembly Not Procured.

a. Code A identifies items capable of being assembled at any level of maintenance and is applied to assemblies of two or more parts, the majority of which are purchased and/or service manufactured.

Figure 2-10. Example of IPB introductory material, text.

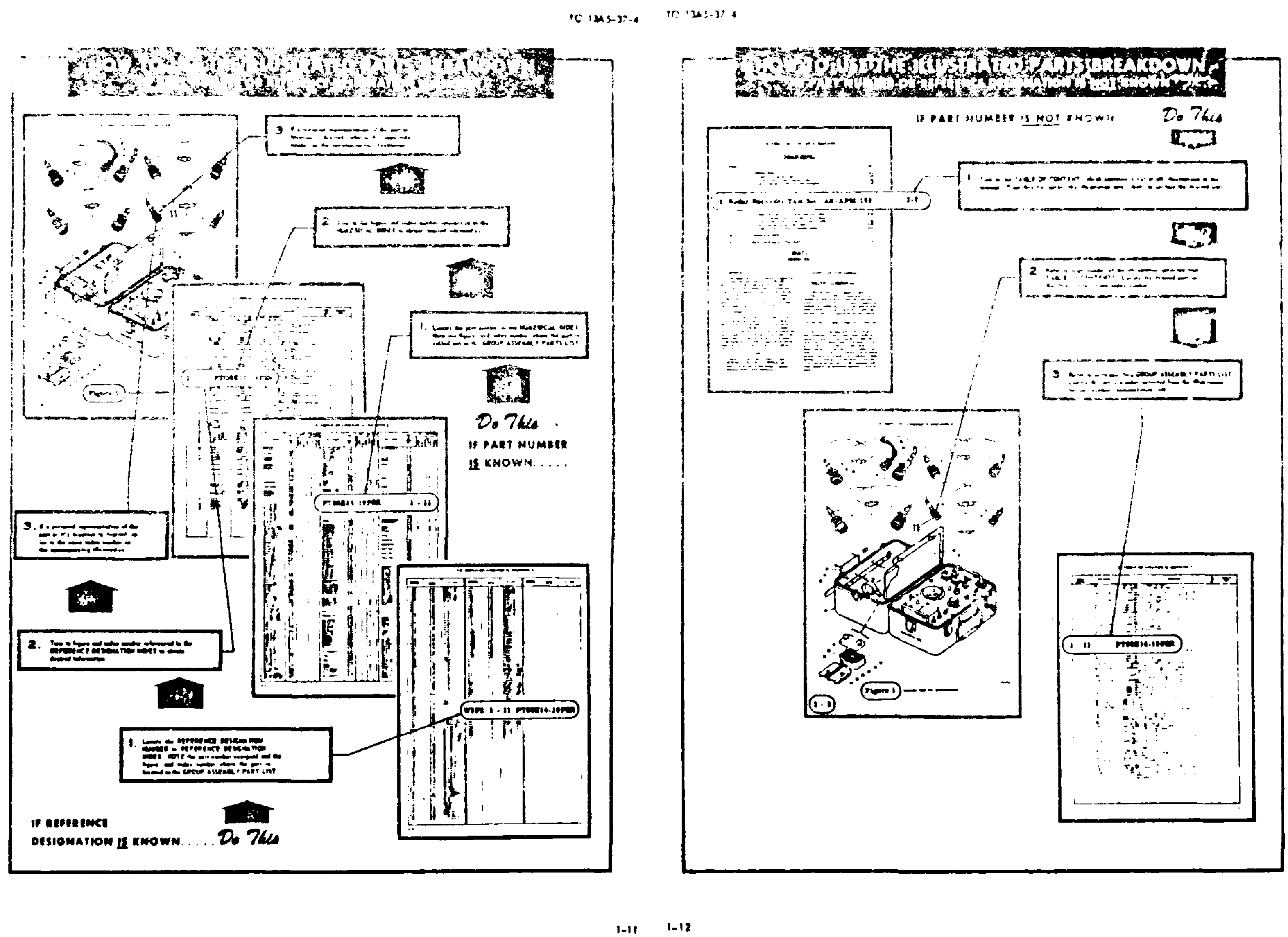


Figure 2-11. Example of IPB introductory material, "How to Use This IPB."

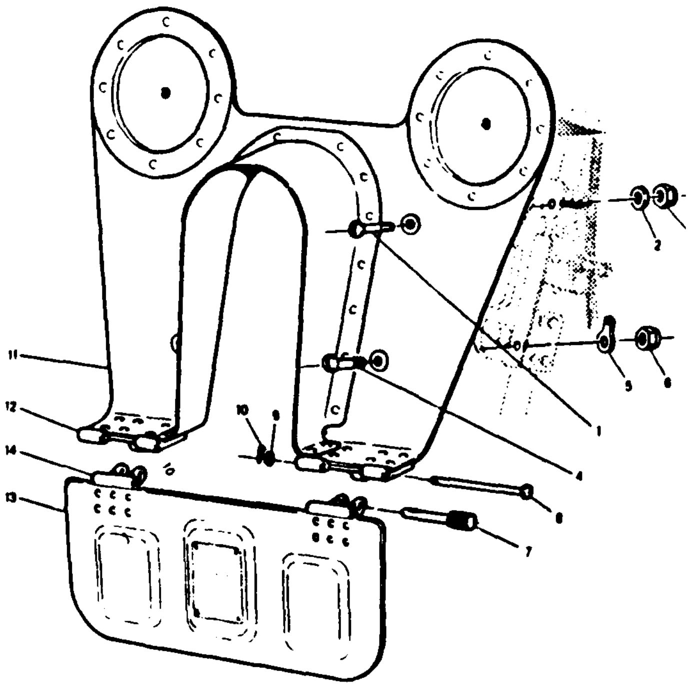


Figure 10. Backrest Installation

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
10-	MBEU1374N5	BACKREST INSTL (04253) (see fig. 9-1 for NHA)	Ref	
	MBEU1480N5	. PLATE ASSY, Back (04253)	1	
		(ATTACHING PARTS)		
-1	A113-1E	. SCREW, Machine (05901)	2	
-2	SP122E	. WASHER, Flat (05901)	2	
-3	A125E	. NUT, Self-locking (05901)	2	
-4	A113-1E	. SCREW, Machine (05901)	2	
-5	SP122E	. WASHER, Flat (05901)	2	
	MBEU2775V	. WASHER, Time release & drogue gun trip rod cord attach (LONG) (04253)	2	A,B,AC,AD C-H,N-Q,S-AB
-6	A125E	. NUT, Self-locking (05901)	2	
		---*---		
-7	MBEU1493N5	. . PIN ASSY (04253)	2	
-8	MBEU1490N5	. . PIN, Flathead (04253)	2	
-9	SP127D	. . WASHER, Flat (05901)	2	
-10	SP9C4	. . PIN, Cotter (05901)	2	
-11	MBEU1486N5	. . PLATE ASSY, Upper (04253)	1	
-12	MBEU1492N5	. . . HINGE HALF, Upper (04253)	2	
-13	MBEU1557N5	. . PLATE ASSY, Lower (04253)	1	
-14	MBEU1491N5	. . . HINGE HALF, Lower (04253)	2	

(2-27 blank)/2-28

9-29

Figure 2-12. Example of IPB Maintenance Parts List (MPL) with breakdown illustration.

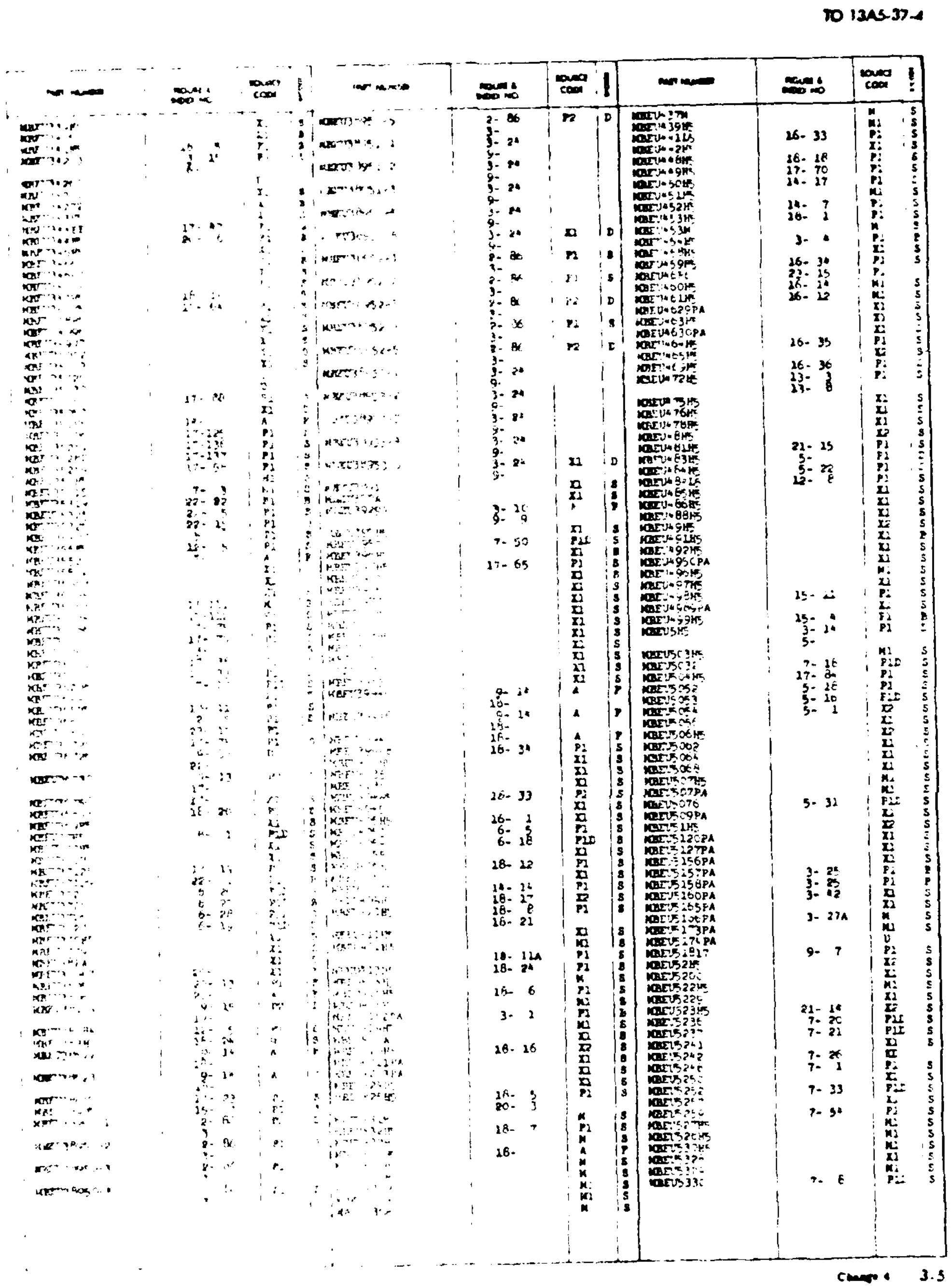


Figure 2-1[illegible]. Example of IPB numerical index [illegible] part numbers.

T.O. 00-000-0 Section IV

Reference Designation Index

REFERENCE DESIGNATION	FIGURE & INDEX NO	PART NUMBER
A6001	10	8313415-515
A6101	14	8313415-527
A6201	24	8313415-514
A6301	23	8313415-516
A6401	11	8313415-528
A6501	22-11	8313415-532
A6601	16	8313415-526
A6701	47-10	8313415-512
A7001		8313415-529
A7002		8313415-530
A7101	22-9	8313415-523
A7201	13	8313415-525
A7301	22-10	8313415-522
A7401	22-8	8313415-511
A7501	8	8313415-518
A7601	7	8313415-517
A7701	40-1	8611520-501
A8101	36-9	8313415-520
A8801	36-8	8313415-502
A8901	9	8313415-501
A9201	48-9	8725125-501
A9301	31	8613491-501
A9401	47-12	8613482-501
A9801	22-7	8612265-511
R401	[illegible]	KS1504

REFERENCE DESIGNATION	FIGURE & INDEX NO	PART NUMBER
C101	22-38	HC2540
C102	22-38	HC2540
C103	22-19	8418388-1
C201	36-62	8974342-110
C202	36-21	8418386-1
C301	47-17	894342-105
C304	47-18	CP09A1EB473K
C401	6-15	8418388-1
C402	17-11	CP54B1EF105K
C501	30-13	8418386-1
C601	40-76	CP55B6EF104K
C602	40-94	8430263-3
C603	40-94	8430263-3
C604 thru C606	40-95	84030263-1
C607	40-109	8430263-1
C608	40-24	CP70B1EF405K
C801		8418386-1
C1001		CP54B1EF105K
C1101	52-94	CP54B1EF105K
C1102	52-64	8418386-1
C6001	10-13	DM15F391J100VDC
C6002	10-13	DM15F391J100VDC
C6003 thru C6005	10-18	DM15F561J100VDC
C6006	10-13	DM15F391J100VDC
C6007	10-13	[illegible]

Block Type Reference Designation Index

Section IV T.O. 00-000-0

Reference Designation Index

REFERENCE DESIGNATION	FIGURE & INDEX NO	PART NUMBER
360A4	2-17	645751-501
360A4CR1 thru 360A4CR6	6-5	8950093-3
360A4C1	6-8	DM15F561J100V
360A4P1	6-10	47B24620
360A4Q1 thru 360A4Q6	6-2	2N404
360A4R1	6-4	8977933-268
360A4R2	6-6	8977933-318
360A4R3	6-7	8977933-210
360A4R4	6-4	8977933-268
360A4R5	6	8977933-318
360A4R6	6-7	8977933-210
360A4R7	6-4	8977933-268
360A4R8	6-6	8977933-318
360A4R9	6-7	8977933-210
360A4R10	6-4	8977933-268
360A4R11	6-6	8977933-318
360A4R12	6-7	8977933-210
360A4R13	6-4	8977933-268
360A4R14	6-6	8977933-318
360A5)	2-18	8977933-210
360A[illegible]	6-4	8977933-268

REFERENCE DESIGNATION	FIGURE & INDEX NO	PART NUMBER
360A6 thru 360A18		(Same as 360A5)
360A19	2-15	645752-501
360A19CR1 thru 360A19CR2	4-11	8950093-3
360A19C1 thru 360A19C4		DM15F561J100VDC
360A19C5 thru 360A19C6	4-8	CP09A1KD473K
360A19E1 thru 360A19E3	4-14	2010105-20
360A19P1	4-12	47B24620
360A19Q1 thru 360A19Q6	4-3	2N404
360A19R1 thru 360A19R5	4-7	8977933-268
360A19R6	4-6	8977933-237
360A19R7	4-5	8977933-226
360A19R8	4-7	8977933-268
360A19R9	4-1	8977933-318
360A19R10	4-2	8977933-210
360A19R11	4-7	8977933-268
360A19R12	4-1	8977933-318
360A19R13	4-7	[illegible]

Unit Type Reference Designation Index

Figure 26. Typical Reference Designation Index Page (MIL-M-8910)

Note: The "Part Number" column is not required per current specification, but may be present in the TO for the system, if prepared to older specifications.

Figure 2-14. Example of IPB reference designation index.

> A type of illustration . . . in which symbols are connected by lines to show relationships among the symbols. The symbols may be rectangles or other shapes, standard symbols representing components or functions, or pictorials representing equipment or components. The lines may represent physical things, such as wires, or ideas, such as logic flow. This category includes schematics, wiring and piping diagrams, logic diagrams, flow charts, and block diagrams.

This definition (except as it applies to logic trees) is being used herein, and "function diagrams" are discussed as a group, since terminology varies considerably from one source to the next and the distinction between the types is not always clear. For example, wiring diagrams (Figure 2-15) may be called interconnection diagrams (Figure 2-16), and schematic diagrams (Figure 2-17) may be called schematic block diagrams (Figure 2-18) or just block diagrams (Figure 2-19).

The primary use of function diagrams is as procedural support information although they may also be used as reference data (as in the Theory of Operation section of the manual). In order to achieve a common baseline for all function diagrams, MIL-STD-863A(USAF) will be the baseline requirements document to the extent that it contains applicable requirements. Types not adequately covered by MIL-STD-863A will be treated as exceptions, with supplementary guidance provided. For example, the comprehensibility standards of DOD-STD-1685 apply to all function diagrams, as additional requirements.

MIL-STD-863A also includes requirements for certain text, lists, and tables which supplement the diagrams. Whether these specialized sub-formats will be included will depend to a great extent on the complexity and overall size of the diagrams in relation to the capabilities of the automated delivery system hardware.

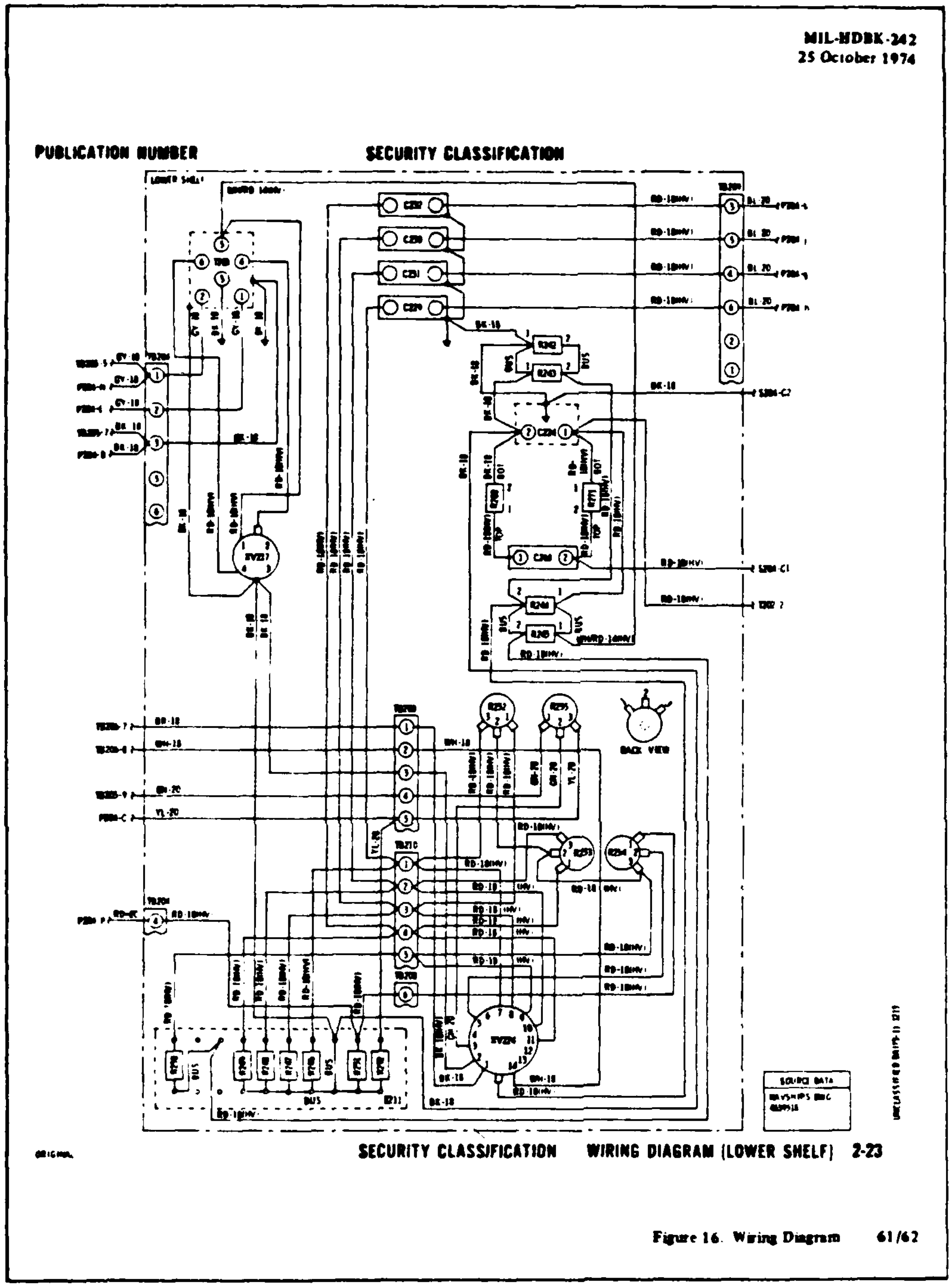


Figure 2-15. Example of function diagram (wiring diagram).

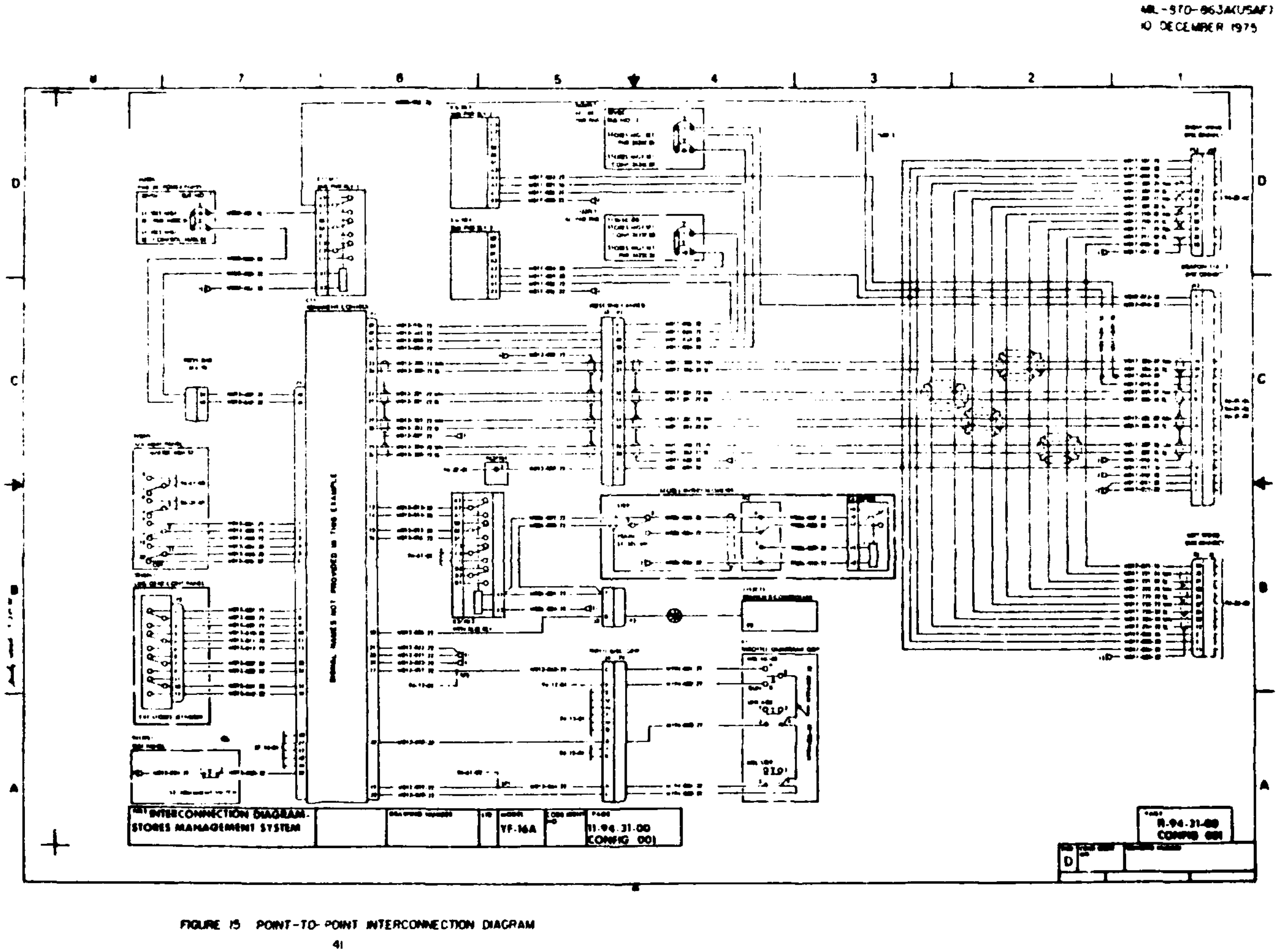


Figure 2-16. Example of function diagram (interconnection diagram).

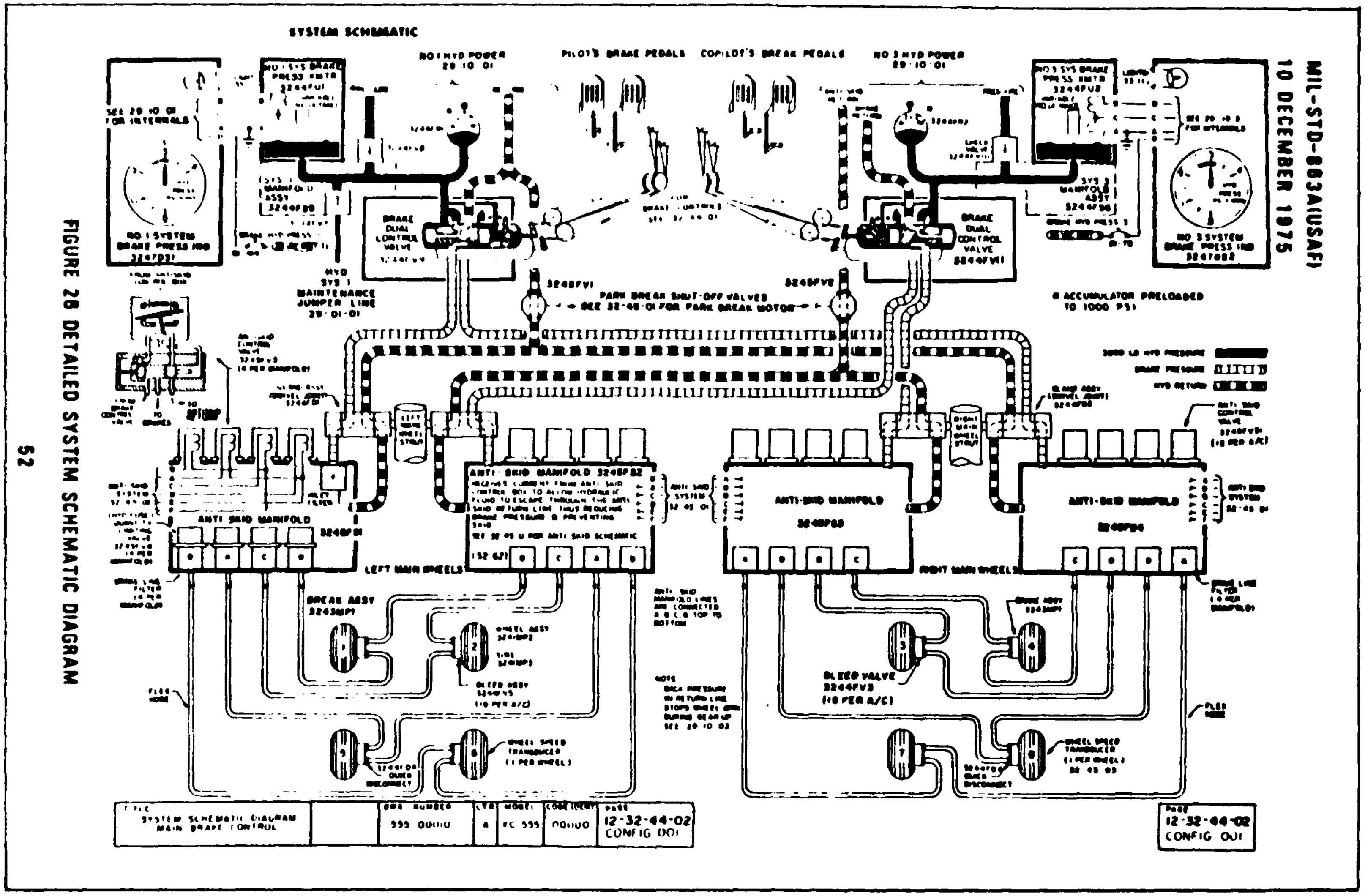


Figure 2-17. Example of function diagram (schematic diagram).

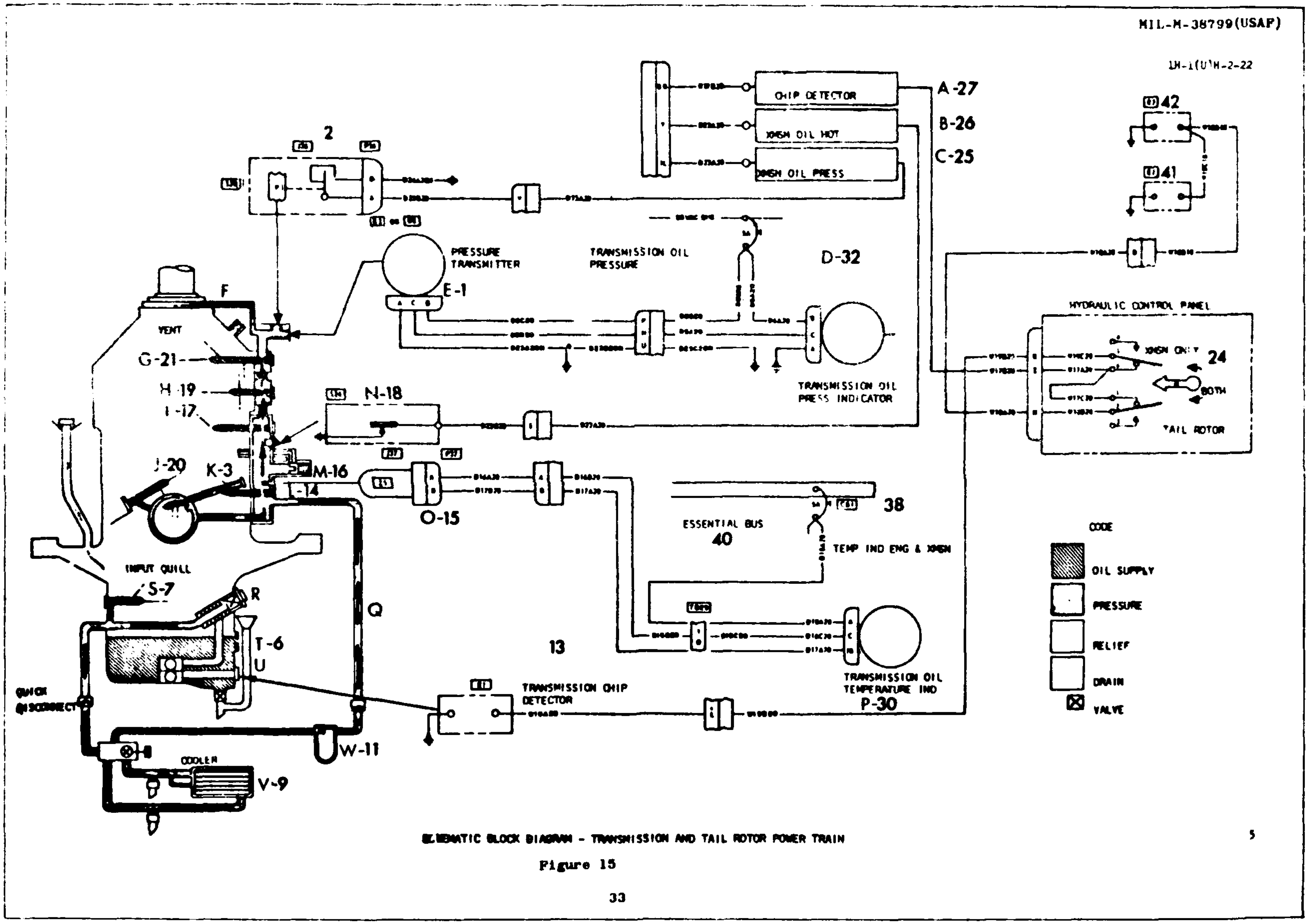


Figure 2-18. Example of function diagram (schematic block diagram).

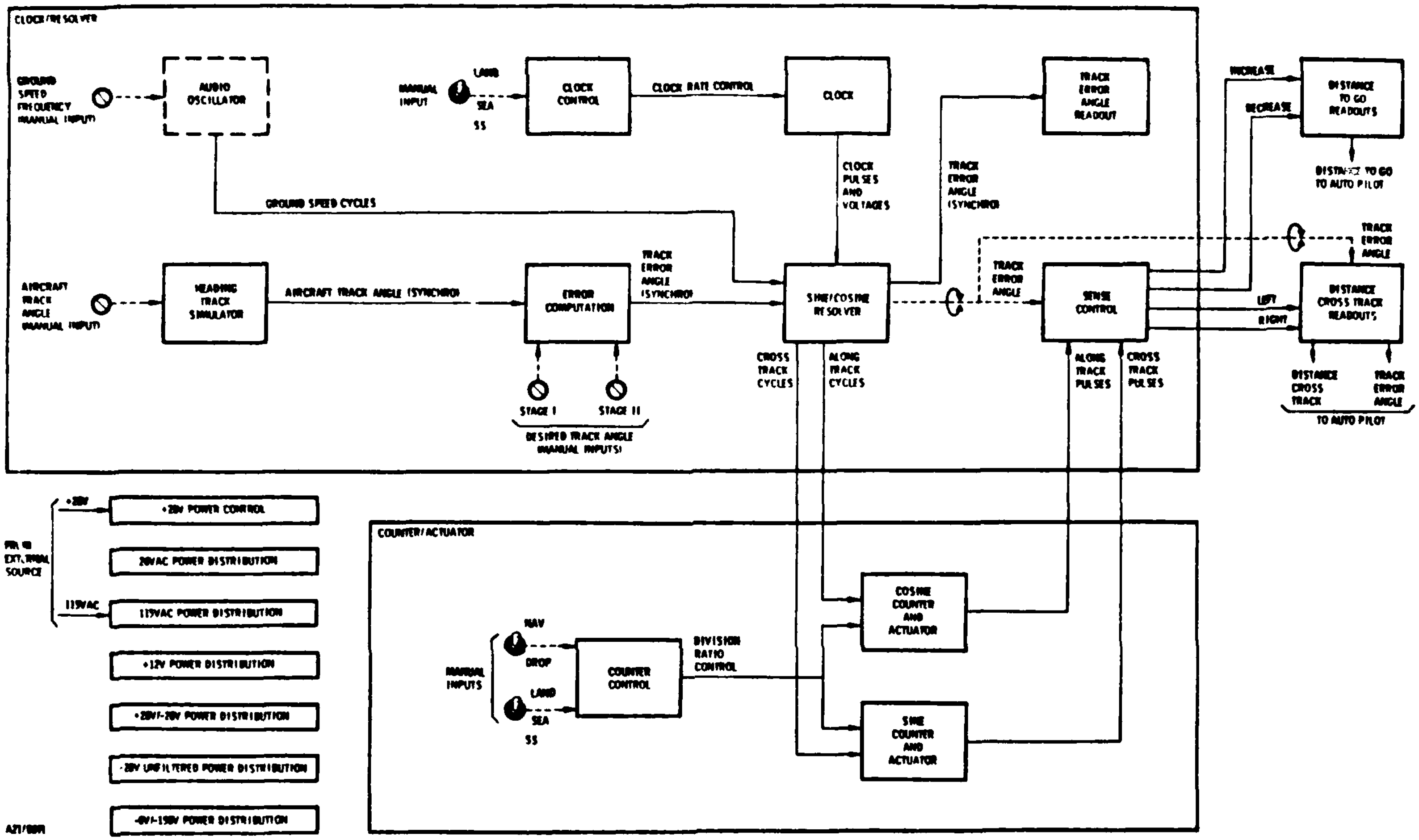


Figure 8-5. Navigational Computer Set AN/ASN-35 Block Diagram

8-11/8-12

Figure 2-19. Example of function diagram (block diagram).

Sample formats and preparation guidelines for some anticipated types of automated function diagrams are contained in Section 6.0.

2.4.4 Other Procedural Support Pool Data

In addition to the IPBs and function diagrams, a variety of other formatted data may be required to support maintenance and troubleshooting procedures. Specific features will depend on the particular system/equipment data to be presented, and the manner in which the data support the procedure. Some, such as waveform guides which are related to and needed for a specific procedural step, should be presented in the same frame presentation as the step to which they apply (Figure 2-20), as well as in pool. If the support data are applicable to a number of different steps, to a series of tasks, or to a group of equipment, the data should be included in pool. Some examples are access and locator diagrams, test specification tables, and test setup diagrams. Examples of some of these other supporting formats are illustrated in Figures 2-21 through 2-23. In general, the specification requirements which apply will be, in order of preference, MIL-M-38800A, MIL-STD-863A, and MIL-M-38784A.

Sample formats and preparation guidelines for various types of automated data in this category are contained in Section 6.0.

2.4.5 Reference Pool Data

This category of pool data includes a broad spectrum of data and information, varying widely in purpose, content, and format. Some information may deal with non-procedural technical data about the equipment or system (e.g., Theory of Operation), while other data deal with the status of the technical manual itself (e.g., List of Effective Pages). Guidelines for preparation of this type of information are generally straightforward and will

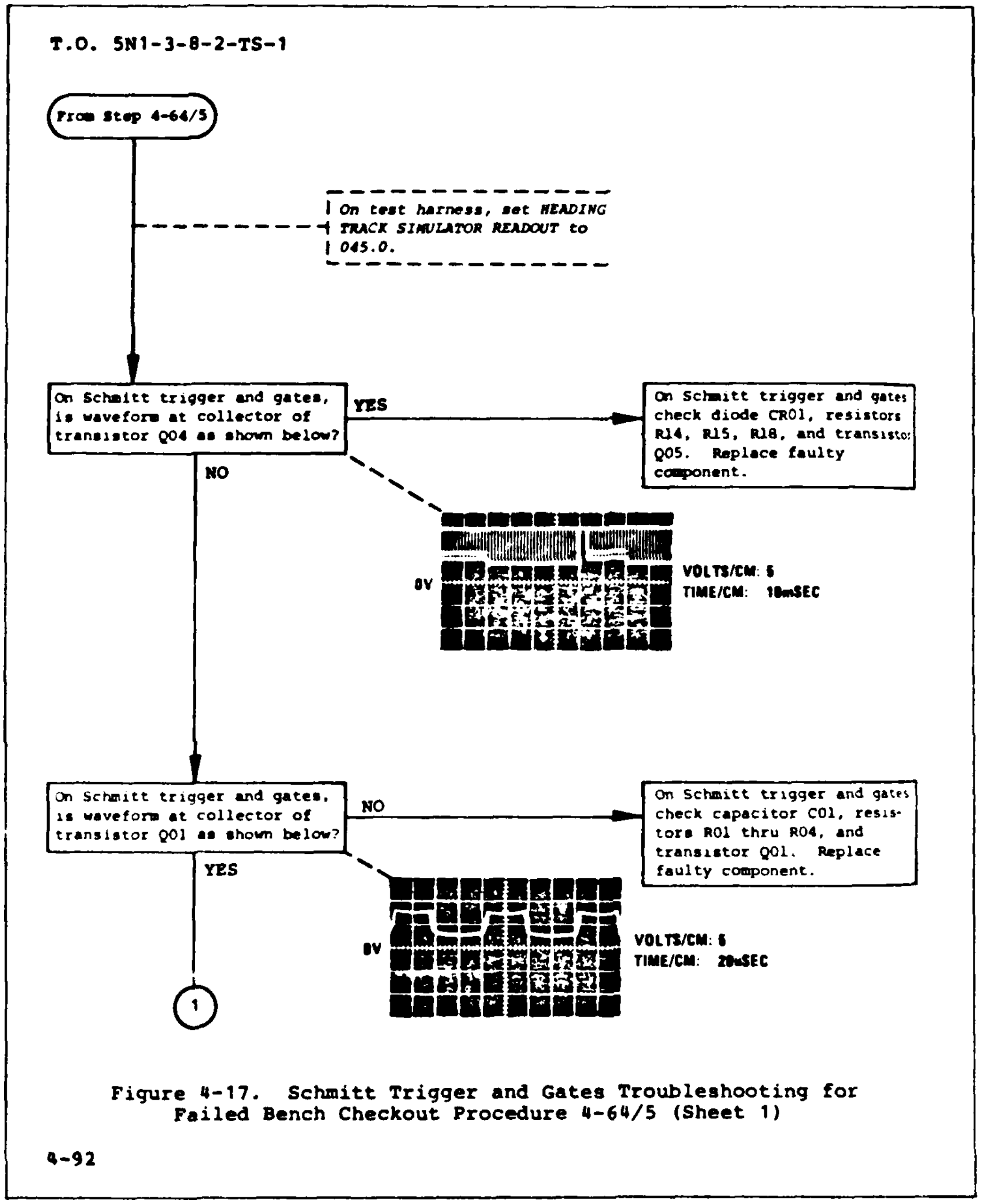


Figure 2-20. Example of procedural support data (waveform guide) included in procedural text instead of in pool data.

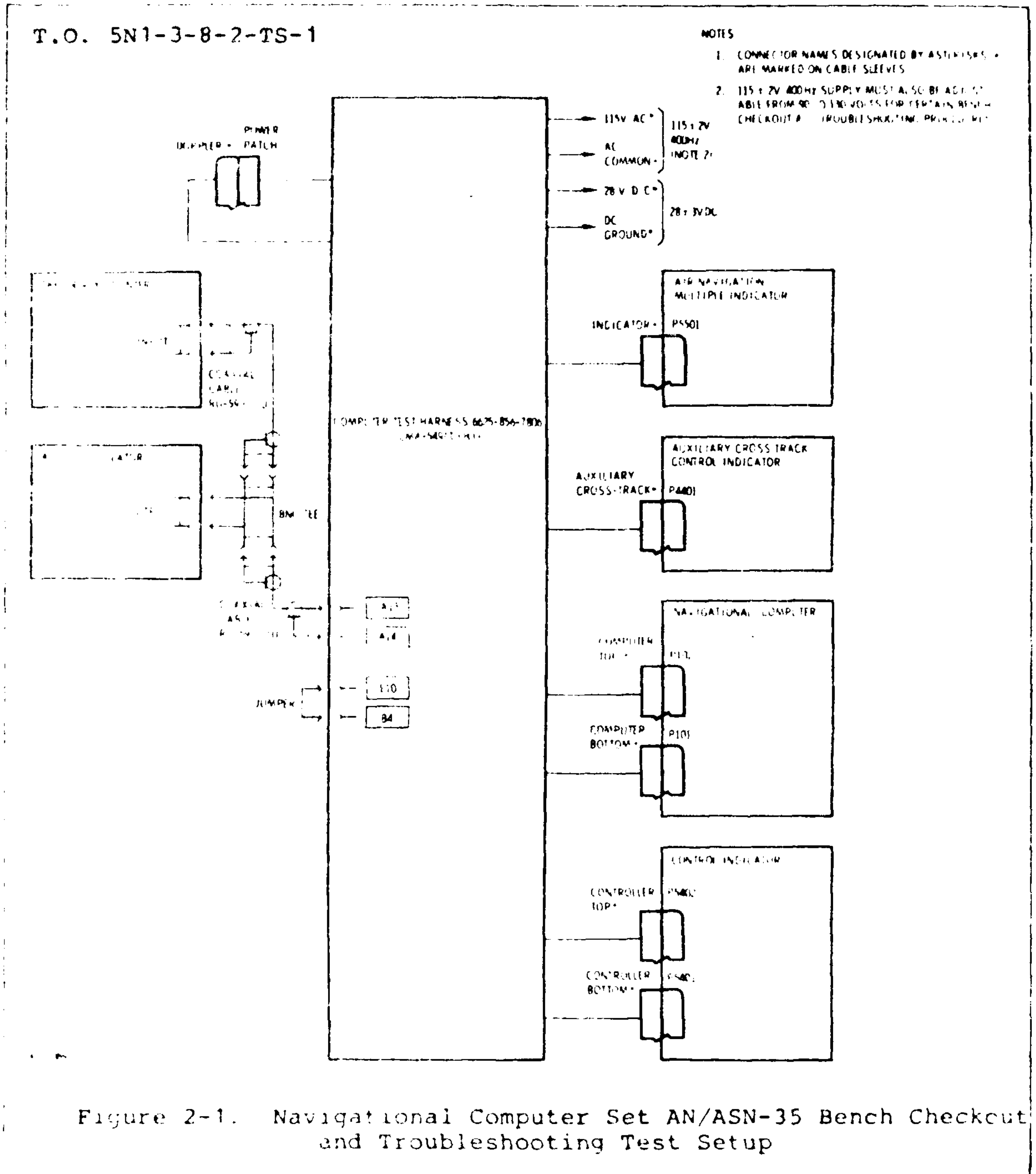
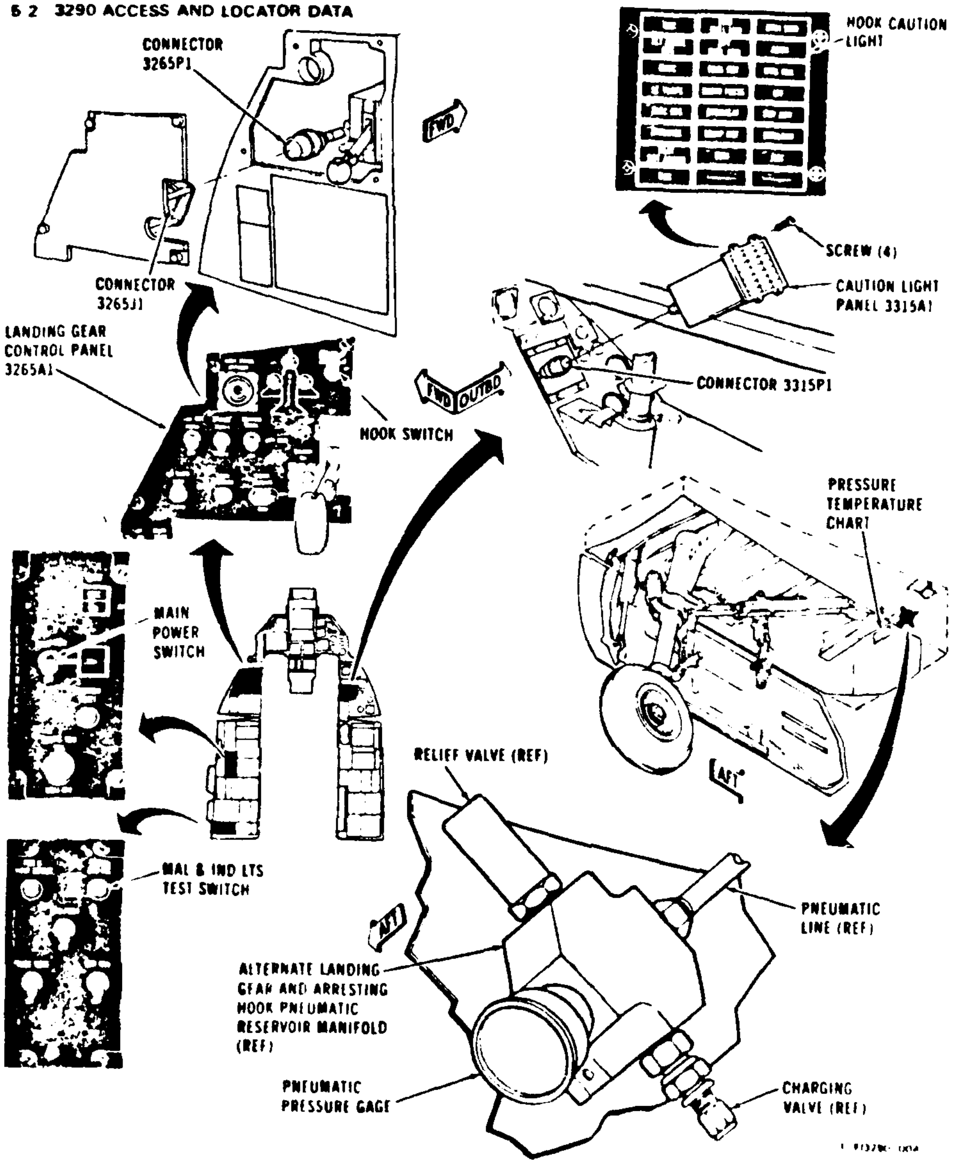


Figure 2-1. Navigational Computer Set AN/ASN-35 Bench Checkout and Troubleshooting Test Setup

Figure 2-21. Example of procedural support pool data (test setup).

T.O 1F-16A-2-32FI-00-1

5 2 3290 ACCESS AND LOCATOR DATA



32-90-00

Figure 5 1. Arresting Hook Locator Data (Sheet 1)

5-2

Figure 2-22. Example of procedural support pool data (access and locator data).

TEST SPECIFICATIONS		
TEST POINT	SIGNAL	VALUE
1A3P3-M	+28V TEST	>+22V
1A3P3-U	SIGNAL SELECT 6	<+1V
1A3P3-5	SIGNAL SELECT 3	>+22V
1A3P3-e	SIGNAL SELECT 2	<+1V
1A3P3-j	API B+ SWITCH	<+1V
2A4K8-3	BIT ANTENNA NO. 1	+8 TO +12V
2A4P1-V	LATCH	<+1V
2A4P1-i	SIGNAL SELECT 2	<+1V
2A4P2-N	SIGNAL SELECT 6	<+1V
2A4P2-P	SIGNAL SELECT 7	>+22V
2A4P2-R	SIGNAL SELECT 5	>+22V
2A4P2-S	SIGNAL SELECT 3	>+22V
2A4P2-T	SIGNAL SELECT 4	<+1V
2A4P2-a	SIGNAL SELECT 8	<+1V
5A1P6-b	PULL LOCK	<+1V
5A2J7-18 vs 30 (NOTE 1)	AZ VALVE DRIVE AZ VALVE RETURN	DVM REQUIRED TEST PASSES IF ANY OF THE FOLLOWING IS MET 1. J7-18 IS 4.0 TO 8.0 VDC 2. J7-30 IS >8 VDC IF J7-18 <4 VDC 3. J7-30 <8.8 VDC IF J7-18 >4.8 VDC
5A2J7-36	800 CPS REFERENCE	DVM REQUIRED 8.8 TO 10.2 VAC
5A2J7-38	SERVO TRACK	<+1V
5A2J7-35 vs 40 (NOTE 2)	EL VALVE DRIVE EL VALVE RETURN	DVM REQUIRED TEST PASSES IF ANY OF THE FOLLOWING IS MET 1. J7-35 IS 2.1 TO 3.3 VDC 2. J7-40 >4.8 VDC IF J7-35 <2.1 VDC 3. J7-40 <5.8 VDC IF J7-35 >3.2 VDC
5A2J7-37	EL ERROR NOTE PIN ANTENNA AT 30 DEG EL AND 40 DEG AZ	DVM REQUIRED 1.57 TO 1.91 VAC
5A2J8-38	AZ SEARCH ERROR NOTE PIN ANTENNA AT 30 DEG EL AND 40 DEG AZ	DVM REQUIRED 1.57 TO 1.91 VAC
6A8J8-4	13V, 400 CPS EX	DVM REQUIRED 13.3 TO 13.7 VAC
6A1A8-C	EL $E_1$4 (C1)	DVM REQUIRED 8.4 TO 9.0 VAC
6A1A8-C vs J (NOTE 3)	EL $E_1$4 (C1) vs (S1)	DVM REQUIRED EITHER OF THE FOLLOWING: 1. J >8.4 VAC IF C <8.4 VAC 2. J <9.0 VAC IF C >9.0 VAC
6A1A8-D	AZ A_D4	DVM REQUIRED 8.3 TO 9.2 VAC
6A1A8-J (DC)	EL $E_1$4 (S1)	>+50V
6A1A8-M	EL $E_1$4 (C4)	DVM REQUIRED 4.9 TO 5.5 VAC

TEST POINT	SIGNAL	VALUE
6A1A8-N vs P (NOTE 3)	EL $E_1$4 (C4) vs (S4)	DVM REQUIRED EITHER OF THE FOLLOWING 1. P >4.9 VAC IF N <4.9 VAC 2. P <5.5 VAC IF N >5.5 VAC
6A1A8-P (DC)	EL $E_1$4 (S4)	>+50V
6A1A8-T	L1 (R4)	DVM REQUIRED 4.1 TO 4.5 VAC
6A1A8-U	AZ A_D4	DVM REQUIRED 4.0 TO 4.4 VAC
6A1A8-Y vs a (NOTE 3)	AZ A_D4 (S4) vs (C4)	DVM REQUIRED EITHER OF THE FOLLOWING 1. Y >7.2 VAC IF A <7.2 VAC 2. Y <7.8 VAC IF A >7.8 VAC
6A1A8-Y (DC)	AZ A_D4 (S4)	>+50V
6A1A8-Z	P1 (R3)	DVM REQUIRED 7.5 TO 7.7 VAC
6A1A8-a	AZ A_D4	DVM REQUIRED 7.1 TO 7.8 VAC
6A1A10-C	COS 30 DEG F_B SIN 30 DEG A_B	DVM REQUIRED 8.4 TO 9.0 VAC
6A1A10-D	L1 (C1)	DVM REQUIRED 4.1 TO 4.7 VAC
6A1A10-D vs J (NOTE 3)	L1 (C1) vs (S1)	DVM REQUIRED EITHER OF THE FOLLOWING 1. J >4.1 VAC IF D <4.1 VAC 2. J <4.7 VAC IF D >4.7 VAC
6A1A10-J (DC)	L1 (S1)	>+50V
6A1A10-N	P1 (C4)	DVM REQUIRED 7.2 TO 7.8 VAC
6A1A10-N vs P (NOTE 3)	P1 (C4) vs (S4)	DVM REQUIRED EITHER OF THE FOLLOWING 1. P >7.2 VAC IF N <7.2 VAC 2. P <7.8 VAC IF N >7.8 VAC
6A1A10-P (DC)	P1 (S4)	>+50V
6A1A10-U	P1 (C1)	DVM REQUIRED 4.7 TO 5.3 VAC
6A1A10-U vs V (NOTE 3)	P1 (C1) vs (S1)	DVM REQUIRED EITHER OF THE FOLLOWING. 1. V >4.7 VAC IF U <4.7 VAC 2. V <5.3 VAC IF U >5.3 VAC
6A1A10-V (DC)	P1 (S1)	>+50V
6A1A10-Y (DC)	L1 (S4)	>+50V
6A1A10-Y vs a (NOTE 3)	L1 (S4) vs (C4)	DVM REQUIRED EITHER OF THE FOLLOWING: 1. Y >4.7 VAC IF A <4.7 VAC 2. Y <5.3 VAC IF A >5.3 VAC
6A1A10-a	L1 (C4)	DVM REQUIRED 4.7 TO 5.3 VAC
6A1P1-r	ANT 30 UP/30 RT (A8)	>+22V

TEST POINT	SIGNAL	VALUE
6A1P1-d	ANT 30 UP/30 AZ (A8)	<+1V
6A1P1-m	1.3 CPS LPD (B14)	<+1V
6A1P1-n	ANT SERVO LPD (B12)	<+1V
6A1P2-L	BIT AND A-G	<+1V
6A1P2-b	BIT SET (B11)	<+1V
11J2	PITCH COMPENSATION	DVM REQUIRED <0.5 VAC
13P1-X	COS L/X	DVM REQUIRED 12 TO 14 VAC
14J7-8	BIT RDP READOUT 1	+8 TO +12V
15P1-e	L/P CMD 3 (B1)	<+1V
15P1-f	L/P CMD 4 (A14)	<+1V
18P1-6	L/P CMD 2 (A13)	<+1V
18P3-T	CMPS 30 DEG NW (A10)	<+1V
18P3-R	P1 (R3)	DVM REQUIRED 7.1 TO 7.9 VAC
18P3-S	L1 (R3)	DVM REQUIRED 4.8 TO 5.5 VAC
18P3-CC	L1 (R4)	DVM REQUIRED 3.9 TO 4.7 VAC
AZ SCALE	AZ POSITION	28 TO 32 DEG RT
EL SCALE	EL POSITION	28 TO 32 DEG UP

NOTES

1. PIN ANTENNA ELEVATION AT BORESIGHT. POSITION ANTENNA IN AZIMUTH TO OBTAIN 350 MV AC AT 5A2J8-38.
2. PIN ANTENNA AZIMUTH AT BORESIGHT. POSITION ANTENNA IN ELEVATION TO OBTAIN 350 MV AC AT 5A2J7-37.
3. USE THIS TEST ONLY WHEN (DC) READING FOR STATOR (S) WINDING IS GOOD AND COMPENSATOR (C) READING IS BAD.
4. EXTENDER REQUIRED FOR 6A1A8 AND 6A1A10 TEST POINTS.

Figure 1. BIT 14 Troubleshooting Block Diagram (Sheet 2)

Figure 2-23. Example of procedural support pool data (test specifications tables).

not be detailed further here. Order of precedence for this program will be MIL-M-38784A, MIL-M-38800A, and the content specification for the particular system. Note that this type of information must be provided, as part of an Air Force Technical Order, and is no less subject to specification requirements than are the procedures themselves.

Some of the types of data and formats that are, for purposes of the automated delivery system, part of the reference pool data, but not described here, include, but are not limited to:

- List of Effective Pages
- Promulgation Page
- Change Record
- Table of Contents
- List of Illustrations
- List of Tables
- Alphabetical Index
- List of Time Compliance Technical Orders (TCTO)
- Principles/Theory of Operation
- List of Test Equipment
- List of Special Tools
- Special manufacturing/repair instructions
- System description data
- Description of system tie-in of equipment and accessories.

Samples of formats and operation guidelines for automated reference data that are comparable to paper-based TO front matter and other reference data are contained in Sections 4.0 and 5.0.

2.4.6 User Instructions

There is one kind of information that will be needed in the automated delivery system that often is not found in hard-copy TOs: instructions for use. Conventional technical manuals rarely include any guidance to the technician on how to use the manual, although an access flow diagram may be included for using the IPB if it is provided (see Figure 2-11). Some newer job aids, e.g., Job Guides, LTTAs, and Functionally Oriented Maintenance Manuals (FOMMs), do provide brief explanations of the most effective ways to use the manuals, generally as part of the front matter. Examples of these instructions are included in Figures 2-24, 2-25, and 2-26.

Instructions to the ATO system user will, of necessity, need to be more complete since the technician will need to know how to operate a hardware system as well as the conventions and approaches used in presenting the technical data. Automated delivery system instructions will be provided in three ways:

a. Through the use of prompts, advisories, and feedback messages associated with each frame.

b. Through the use of options lists associated with each identifiable portion of the data base.

c. Through a complete explanation of the system and its use, contained in the system users' guide.

Sample formats and preparation guidelines for the third approach are contained in Section 9.0.

T.O. 1F-16A-2-23JG-20-1

INTRODUCTION

1. PURPOSE OF THIS MANUAL.

2. Provides organizational level maintenance for the F-16 communications system.

3. SCOPE OF THIS MANUAL.

4. Provides start-to-finish, step-by-step maintenance actions for the F-16 communications system components. The procedures in this job guide are presented in a function/task arrangement with text supported by illustrations keyed to text procedural steps. Normally, text and illustrations will be on facing pages.

5. Illustrations in this job guide include a location view of the equipment on which the task is being performed and key numbers that are numerically identical to the task steps (figure 1). When a part/component within an illustration is referenced in more than one step in the procedure, the illustration will be keyed to each of the steps (figure 1, key numbers 4 and 5).

6. When multisheet illustrations are required, the task step number sequence will not be broken when proceeding from one sheet to the next.

7. The input conditions and follow-on maintenance entries for multitask functions will be coded to the applicable task(s). This code uses the last digit(s) of the paragraph number for the affected task and is displayed, in parenthesis, with each entry. An input condition or follow-on maintenance entry coded with a (1,10) signifies that this entry is applicable only to tasks with last digits of the paragraph numbers, X-X-1 and X-X-10. When personnel recommended exceeds one, each task step is coded with a letter(s) in parenthesis after the step number to indicate the person(s) recommended to accomplish the task.

ii

T.O. 1F-16A-2-23JG-20-1

1. (A) Remove nut, bolt and pin.
2. (A) Remove cotter pin and nut.
3. (A,B) Support door and actuator and remove bolt.
4. (A,B) Support beam and remove two nuts, two bolts, and two spacers.
5. (A,B) Remove beam.

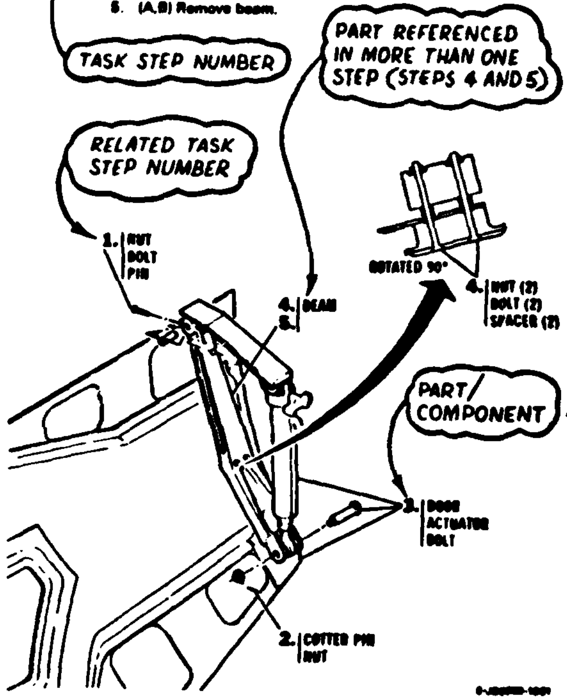


Figure 1.

iii

Figure 2-24. Example of user instructions in a Job Guide Manual.

T.O. 5N1-3-8-2-TS-1

malfunctions in the assemblies of the navigational computer and to determine the faulty component.

- *Section V, Bench Checkout and Troubleshooting Procedures for Control Indicator C-3819A/ASN-35.* - This section provides bench checkout and troubleshooting procedures for the control indicator. The purpose of this section is to detect malfunctions within the control indicator and to isolate the malfunction to the faulty component.

- *Section VI, Bench Checkout and Troubleshooting Procedures for Auxiliary Cross Track Control Indicator C-3820A/ASN-35.* - This section provides bench checkout and troubleshooting procedures for the auxiliary cross track control indicator. The purpose of this section is to detect malfunctions within the auxiliary cross track control indicator and to isolate the malfunction to the faulty component.

- *Section VII, Bench Checkout Procedure for Air Navigation Multiple Indicator ID-939A/ASN-35.* - This section provides a bench checkout procedure for the air navigation multiple indicator. The purpose of this section is to detect malfunctions within the air navigation multiple indicator. The air navigation multiple indicator is not repairable at the field (intermediate) maintenance level, therefore, no troubleshooting procedure is provided for this major unit of the computer set.

- *Section VIII, Reference Drawings.* - This section provides component location diagrams for the major units and subassemblies of the computer set. Also included in this section are functional diagrams of the computer set which can be used during checkout and troubleshooting.

1-7. USE OF MANUAL

1-8. The maintenance procedures in this manual are complemented by the data contained in the following technical orders:

T.O. 5N1-3-8-2 - Field Maintenance Instructions for Computer Set AN/ASN-35.

T.O. 5N5-12-2-3 - Overhaul Instructions for Navigational Computer CP-622/ASN-35.

T.O. 5N5-12-2-4 - Illustrated Parts Breakdown for Navigational Computer CP-622/ASN-35.

T.O. 5N6-4-8-3 - Overhaul Instructions for Control Indicator C-3819A/ASN-35.

T.O. 5N6-4-8-4 - Illustrated Parts Breakdown for Control Indicator C-3819A/ASN-35.

1-2

T.O. 5N1-3-8-2-TS-1

T.O. 5N6-4-9-3 - Overhaul Instructions for Auxiliary Cross Track Control Indicator C-3820A/ASN-35.

T.O. 5N6-4-9-4 - Illustrated Parts Breakdown for Auxiliary Cross Track Control Indicator C-3820A/ASN-35.

T.O. 5N8-4-6-3 - Overhaul Instructions for Air Navigation Multiple Indicator ID-939A/ASN-35.

T.O. 5N8-4-6-4 - Illustrated Parts Breakdown for Air Navigation Multiple Indicator ID-939A/ASN-35.

1-9. The bench checkout and troubleshooting procedures presented in this manual are based on the hot mockup approach to maintenance. The hot mockup approach assumes that a complete computer set, in good working order, is available to check out and troubleshoot faulty units and assemblies of the computer set. The overall computer set bench checkout procedures provide a means of verifying satisfactory operation of the hot mockup. In the event a malfunction occurs during computer set bench checkout, troubleshooting procedures are provided to isolate the fault to the faulty major unit (and in some instances the faulty assembly or component). Subsequent sections of the manual provide bench checkout and troubleshooting procedures for the computer set major units and their repairable assemblies. The faulty major unit or assembly is inserted into the hot mockup and the checkout procedure for that major unit or assembly is performed. When a step fails during bench checkout of an, major unit or assembly except the air navigation multiple indicator, a troubleshooting procedure is provided (cross-reference index) which either pin-points the fault or references a troubleshooting tree for further fault isolation.

1-10. The troubleshooting trees begin at the step in the checkout procedure where the fault occurred. They give procedures to be performed and ask questions about results obtained while monitoring voltages, waveforms, and/or resistances at specific points in the suspect circuits. The answers to the questions determine the paths to be taken within the troubleshooting trees. Each path ends by identifying the faulty major unit, assembly, functional circuit, or component. Some of the troubleshooting trees are multi-sheet illustrations. Continuity from sheet to sheet is provided by ballooned numbers. When a path leaves a sheet a number appears in a balloon. The path continues on the sheet that starts with this same number in a balloon.

1-3/(1-4 blank)

Figure 2-25. Example of user instructions in a Logic Tree Troubleshooting Aid (LTTA) manual.

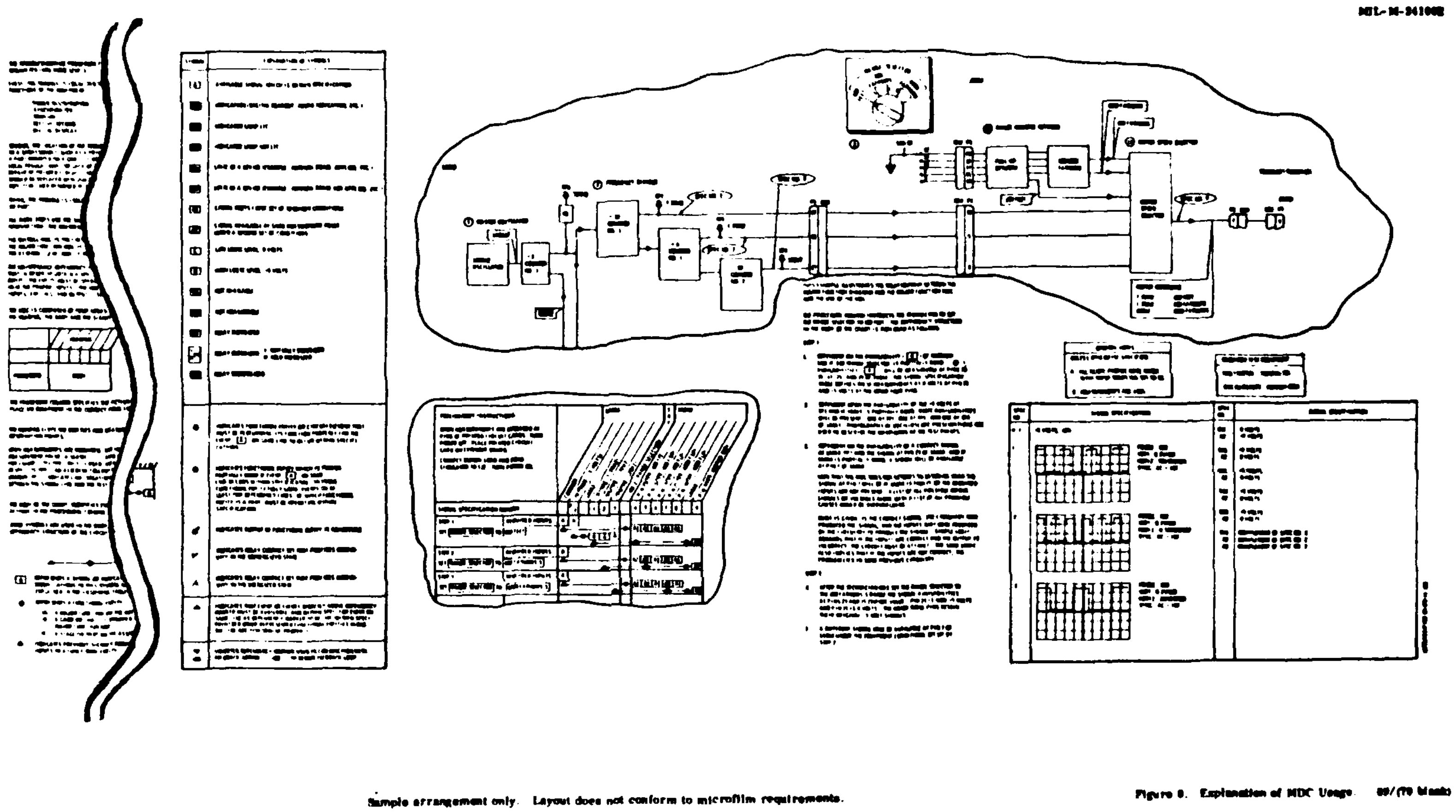


Figure 2-26. Example of user instructions in a Functionally Oriented Maintenance Manual (FOMM).

SECTION 3.0

GENERAL GUIDELINES AFFECTING FORMAT SELECTION AND DEVELOPMENT

3.1 INTRODUCTION

The materials in this section apply to the automated system data base as a whole. Factors discussed are the defined baseline delivery system, format characteristics based on that system, data organization and access requirements, and standardized coding and conventions used.

3.2 THE VAMIS SYSTEM CONCEPT

The concept of the system in its simplest form is to replace the shelves and/or file cabinets filled with paper copies of Technical Orders with a computer-based system that will have all of the advantages of a paper-based TO system and few, if any, of the disadvantages. Further, the system should eliminate, to the extent feasible, the deficiencies that are commonly associated with computer-based systems with which people interact. These general, and optimistic, goals have led to the definition of a prototype automated delivery system as a baseline. This conceptual system has been given the descriptive name of VAMIS, for Versatile Automated Maintenance Information System.

A principal objective of the system prototype definition program was to provide for effective and efficient interaction between the user (technician) and the system. This has resulted in defining three different modes of interaction, each with certain constraints and certain useful characteristics: the standard mode, the user request mode, and the review mode. These modes of interaction are described in Subsection 3.6.

As noted in subparagraph 1.3.1.f, early program development activities resulted in definition of a baseline hardware system for preparation, management, and presentation of data. The three principal elements of the hardware system are the computer subsystem, display subsystem, and control subsystem. Characteristics of these three subsystems that relate to format selection and development are discussed in Subsections 3.3, 3.4, and 3.5, respectively.

3.3 COMPUTER SUBSYSTEM

The computer selected as the baseline for this program was the Digital Equipment Co. VAX computer. This selection was based on the computing power available for data preparation and management, software availability, and compatibility with peripherals. A detailed description of the computer system is beyond the scope of this document. The formats that have been designed and the modes of use that have been established are completely compatible with the VAX computer programming and memory requirements.

3.4 DISPLAY SUBSYSTEM

3.4.1 Presentation Device

The baseline video display for this program is the Megatek 7000. Although it is not required that only this unit be used for system data presentation, the characteristics and capabilities of the display device do impose certain constraints on the characteristics of the formats used and the manner of their presentation. If other display devices are used, appropriate adjustments to the formats and guidelines described in this document will be required. In addition, this program was constrained by the requirement to use a single display device.

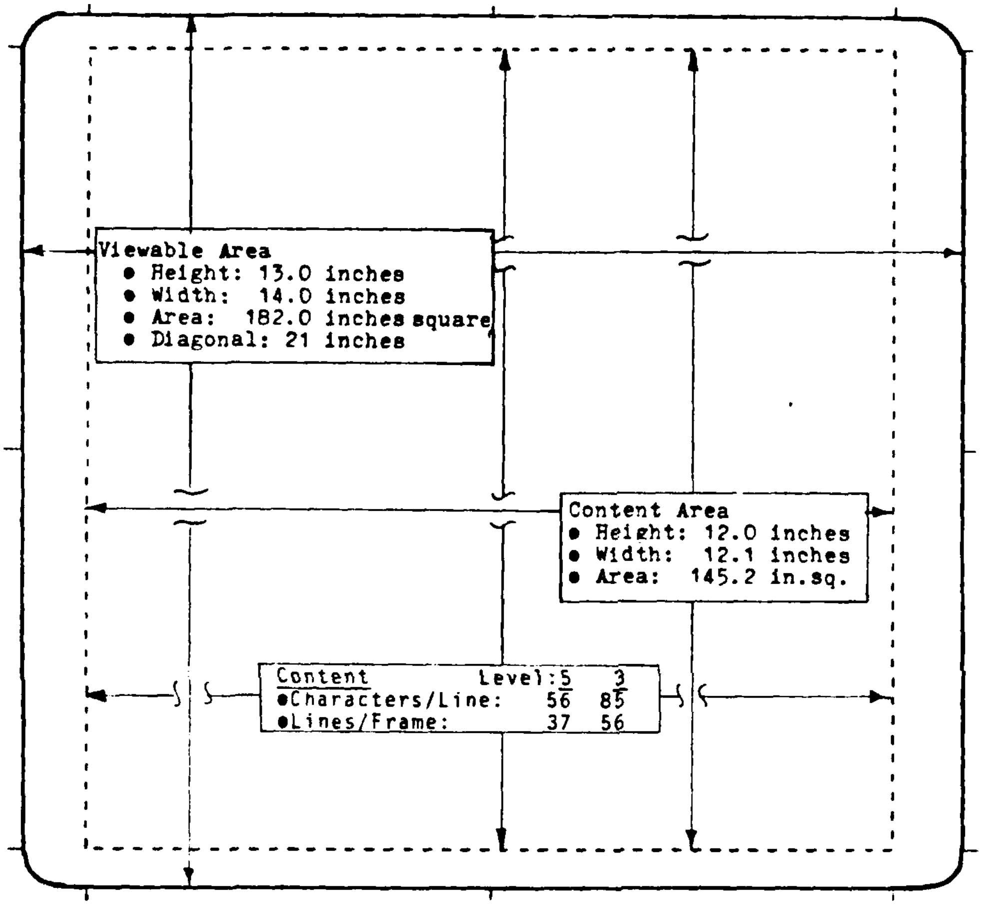
Use of a dual display can have some significant advantages and may permit (or require) some different format and content characteristics, and will probably require modification of the control unit design (see Subsection 3.5).

3.4.2 Screen Parameters

Figure 3-1 illustrates the principal factors related to the baseline display that influence format development and data preparation. Foremost are the screen size, the portion of the screen that can be effectively utilized, and the amount of information that can be displayed under the conditions specified for the program. Also of concern, but not discussed in detail here, are the capabilities of the display for presentation of complex graphics and for the use of color.

The Megatek 7000 is a high-resolution (4096 x 4096 addressable and viewable) display using stroke display technology and vector storage format. The screen size is 21 inches diagonal measure. Other characteristics are 4:1 contrast ratio, unlimited windowing, zoom (1-16), and capabilities for scrolling, panning, blinking, and rotation. Guidelines for use of color in formats are provided in Subsection 3.9, but are independent of the Megatek display capabilities.

Specifications for CRT devices will generally make a distinction between the viewable area (the total dimensions of the screen) and the content area (the portion of the screen that can be effectively used for presentation of information). The difference between the two (the margin) comprises screen space that either cannot be used because characters cannot be displayed there, or should not be used because of factors such as character distortion. Even when these factors do not exist, planning for usable content area should provide for a margin so that when the technician is viewing the screen from an angle, content is not obscured by the screen flanges. For the Megatek display, the margins are approximately 1 inch on each side and 1/2 inch on the top and bottom, permitting an approximately square content area.



NOTE: Screen size in this example is approximately 39% of the actual screen size of the Megatek 7000 display.

Figure 3-1. Characteristics of Megatek display screen affecting format organization and layout.

Displayable content, in terms of numbers of characters and lines, is a function of the required viewing distance, the character size required for legibility at that distance, and the character sizes that can be displayed. Viewing distance requirements for this program are 6 feet for procedural data and 3 feet for pool data. These requirements should be satisfied when the frame first appears on the screen, without subsequent magnification (or "zoom"), in all cases except some complex illustrations contained in pool.

3.4.3 Character Size

Research on CRT character and symbol legibility has provided a range of from 5 minutes of arc (for optimum viewing conditions) to more than 20 minutes of arc for the visual angle which should subtend at the eye at the required viewing distance. Most researchers agree that from 10 to 15 minutes of arc is adequate except for complex symbols and graphic details, or for degraded viewing conditions (Ref. 9; Ref. 10; Ref. 11; Ref. 12; MIL-STD-1472C). While most reports treat this relationship between character height and viewing distance as linear, some evidence suggests that the visual angle required is non-linear, decreasing slightly as viewing distance increases. For the automated delivery system, the visual angle (and resultant character sizes) shown in Table 3-1 was selected.

Table 3-1
Character and Simple Symbol Height Requirements

Data Type	Minimum Viewing Distance	Visual Angle (min. of arc)	Character Height Inches	Character Height mm.
Procedures	6 feet	10	0.209	5.32
Pool	3 feet	12	0.126	3.20

The Megatek display has a standard character set that can be displayed at eight size levels, as shown in Table 3-2.

Level 5 and level 2 characters were selected for presentation of procedural data and pool data, respectively, providing the content capabilities shown in Figure 3-1.

Table 3-2

Character Sizes Available from Megatek Standard Character Set

Level	Character Width (Res. Elements)	Character Width (Inches)	Character Height (Res. Elements)	Character Height (Inches)
0	8	.024	12	.306
1	16	.048	24	.072
2	24	.072	36	.108
3	32	.096	48	.144
4	40	.120	60	.180
5	48	.144	72	.216
6	56	.168	84	.252
7	64	.192	96	.288

3.5 CONTROL SUBSYSTEM

3.5.1 Requirements Definition

The preliminary definition of the automated delivery system included a determination of the type of control device to be used by the technician to interact with the system and the interactive capabilities that should be present on the control device.

As is the case with practically all commercial video display terminal (VDT) keyboards, the standard keyboard which accompanied the Megatek display, while useful for programming and for supervisory interaction with the system, was inappropriate as the control interface for system users. Accordingly, analyses were performed to optimize the control interface among the technician, the system capabilities, the modes of use, the contents of the data base, and the characteristics of the formatted technical information. The system characteristics and the modes of user interface with the system resulted in requirements for an alphanumeric keypad and a function keypad, integrated into a single control unit.

The capability for viewing the display from distances up to six feet imposed a secondary requirement that the control unit be capable of positioning a similar distance from the display, with repositioning as needed independently of the display. This will permit the technician to keep the control unit at the worksite while viewing the display. Design characteristics needed are small size and weight, ease of handling, damage resistance, and ease of interconnection with the computer/display subsystems.

Control unit design was based on interfacing with a single display screen. Use of a dual display would probably dictate several additional function keys, and possibly a rearrangement of the functional groups.

3.5.2 Configuration

A prototype control unit was defined and designed to achieve compatibility among the computer subsystem, the display subsystem, and the user. The configuration of the control unit attempts to optimize the user/control interface, especially in the allocation of function keys, which are directly associated with system instructions and standard frame content items. This integration is especially relevant in the content of prompts and feedback messages and in the user request mode of interaction.

The general configuration of the control unit is depicted in Figure 3-2. The unit packaging is based on requirements for portability, ruggedness, and user access in a shop/workbench type of environment. Interconnection with the computer/display subsystems is assumed to be through workbench busses to avoid

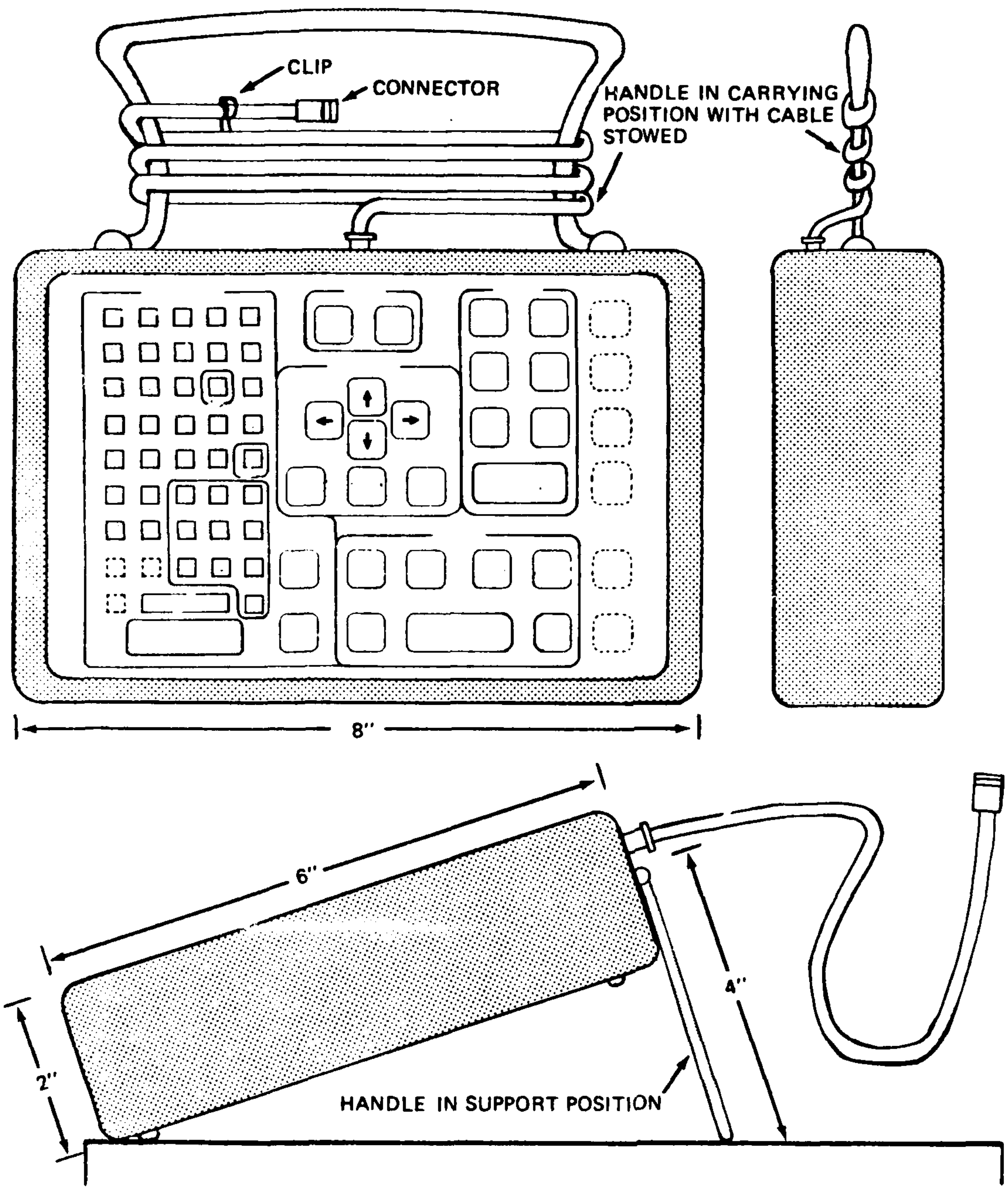


Figure 3-2. Packaging configuration of control unit.

lengthy cabling. The unit features a carrying handle which, when locked in position, serves as the "back legs" to improve user access and viewing angle. In the upright position (carrying and stowage), the handle provides for stowage of the interconnection cable. Individual keys are flush-mounted, under a sealed transparent overlay, using a flat-panel keyboard. The control unit is thus sealed against entry of shop pollution and/or atmospheric conditions. Raised keys would improve the tactile interface but, with currently available technology, would sacrifice the sealed control unit. User feedback at the control unit is limited to the tactile feedback when a key is depressed; all visual feedback is on the display screen. Figure 3-3 illustrates the panel configuration and key assignment for the control unit.

3.5.3 Control Functions

As can be seen in Figure 3-3, the keyboard functions are arranged in five control groups, as follows:

1. Display: This group is used to activate and deactivate the display. None of the other keys on the control unit are functional unless the display has been activated.

2. Control: This group contains the keys which are used to tell the computer where the user wants to go in the data base.

3. Screen: This group is used to control the size and position on the screen of illustrations which are being displayed. Text is not affected by these controls.

4. Memory: This group is used to retain specific frames of information selected by the user and show them again later when needed.

5. Input: This group contains the keys used for making a choice from the alternatives which may be offered and to give the computer specific instructions about what is wanted.

The functions of each of the keys comprising these groups are described in Table [illegible], including their application to each of the three modes of system use.

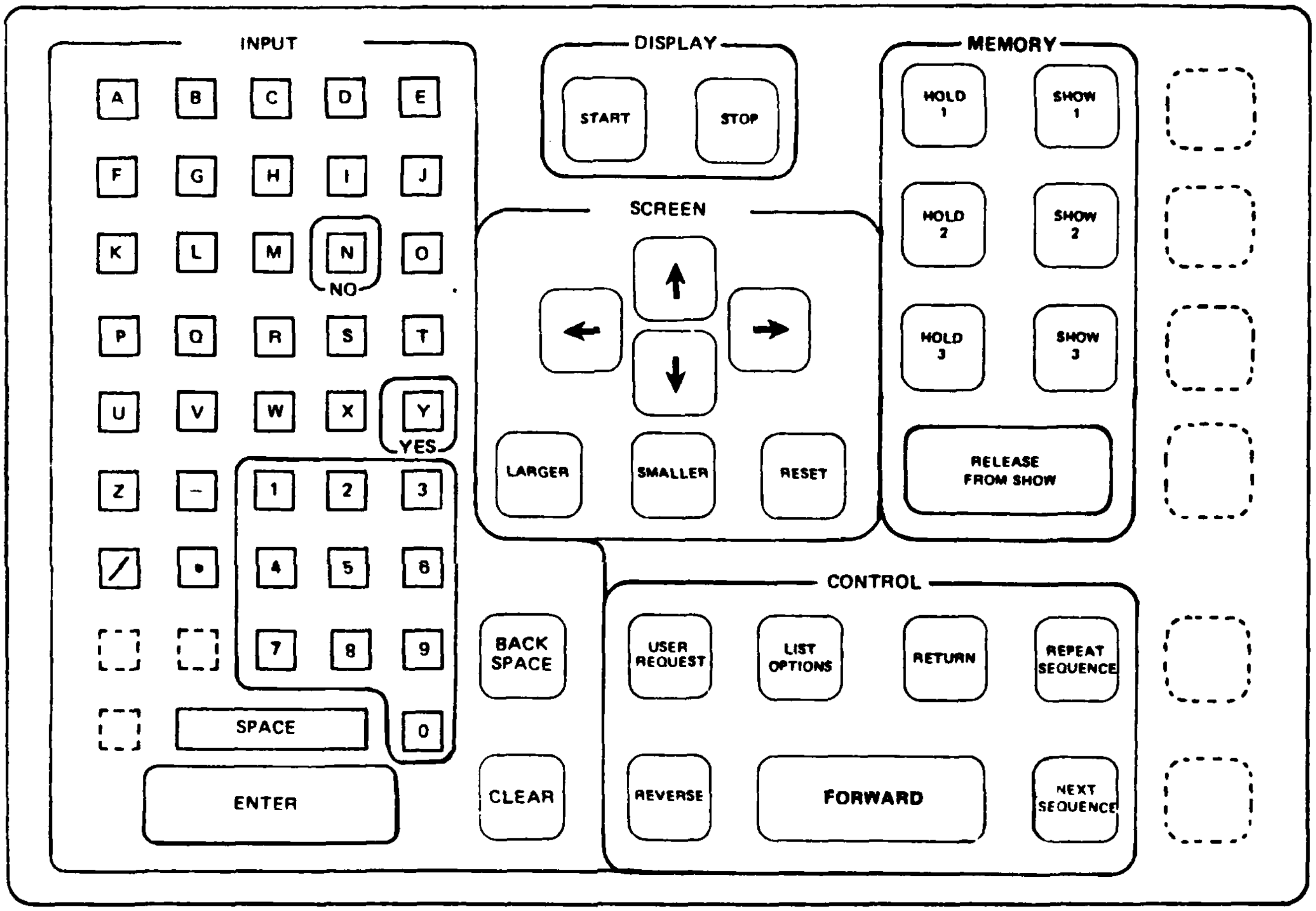


Figure 3-3. Identification of user controls on control unit.

Table 3-3

Description of Control Unit Key Functions and Applications

Control Group	Key	Function	Mode of Use: Standard	Mode of Use: User Request	Mode of Use: Review
DISPLAY	START	Activates the display and control unit. Indicates to the system that a new user wants to log on.	✓		
	STOP	Logs out the present user and deactivates the display and the control unit.	✓	✓	✓
CONTROL	FORWARD	Instructs the system to provide the next frame in an ordered sequence of frames.	✓		✓
	REVERSE	Instructs the system to provide the last previous frame wit: in a pre-established, ordered sequence. (User will not necessarily see, in reverse order, what was previously displayed.) System will not reverse past the first frame of a procedure or major section of pool data.	✓		✓
	NEXT SEQUENCE	Instructs the system to "jump forward" to the next major node in the pre-established sequence, skipping any intermediate frames. If in procedures, operates only from major node-to-node. If in pool, operates from any frame to the next node.	✓		✓
	REPEAT SEQUENCE	Instructs the system to "jump back" to the last major node in the ordered sequence (e.g., a decision point or beginning of a procedure). Repeated use will get back to the beginning of a procedure but no further.	✓		✓

Table 3-3 (Continued)

Control Group	Key	Function	Mode of Use: Standard	Mode of Use: User Request	Mode of Use: Review
CONTROL (con't.)	RETURN	Instructs the system to display the last previous track (non-pool) frame from an associated pool item.	✓		
		Instructs the system to display the last previous track or pool frame from:			
		a. Options list	✓		
		b. Users' guide	✓		
		c. Review mode			✓
	LIST OPTIONS	Instructs the system to display the menu of alternative data (track and pool) associated with the frame being displayed, including changing tracks. User may choose from the menu or RETURN.	✓		
	USER REQUEST	Instructs the system to go to the user request mode in preparation for a user request. System goes back to standard mode after the request is processed, or CLEAR is pressed.	✓		✓
SCREEN	LARGER	Increases the size of a displayed graphic one step with each key press. Only affects contents of an illustration window.	✓	✓	✓
	SMALLER	Decreases the size of a displayed graphic one step with each key press. Only affects contents of an illustration window.	✓	✓	✓

Table 3-3 (Continued)

Control Group	Key	Function	Mode of Use: Standard	Mode of Use: User Request	Mode of Use: Review
SCREEN (con't.)	↑ UP ↓ DOWN ← LEFT → RIGHT	Moves a displayed graphic in the direction of the arrow. Each key press moves the graphic a programmed increment. Only affects contents of an illustration window.	√	√	√
	RESET	Returns the displayed graphic to the size and/or position in which it was initially displayed.	√	√	√
MEMORY	HOLD 1 HOLD 2 HOLD 3	Stores a copy of the frame presently being displayed in a memory file (1, 2, or 3). If the selected memory file is already filled, the new copy will replace the old copy.	√		
	SHOW 1 SHOW 2 SHOW 3	Displays the frame copy that was previously stored in the selected memory file. All functions in the SCREEN group above are usable with respect to the frame, but no others, since the system is not actually at that place in the data base.	√	√	√
	RELEASE FROM SHOW	Displays the last non-memory frame from which a SHOW command was initiated.	√	√	√
INPUT	A - Z	Inputs alphabetic characters A through Z. Accepted by system when followed by ENTER.	√	√	
		Characters Y and N input YES and NO, respectively, in response to displayed prompts only. Accepted by system when followed by ENTER.	√		

Table 3-3 (Continued)

Control Group	Key	Function	Mode of Use: Standard	Mode of Use: User Request	Mode of Use: Review
INPUT (con't.)	0 - 9	Inputs numerals 0 (zero) through 9. Accepted by system when followed by ENTER.	✓	✓	
	- DASH / SLASH . PERIOD, DECIMAL	Inputs special symbols and punctuation needed for forming alphanumeric strings. Accepted by system when followed by ENTER.	✓	✓	
	SPACE	Inputs one character space needed in forming alphanumeric character strings. Accepted by system when followed by ENTER.	✓	✓	
	BACK SPACE	Backs the input cursor one character space and erases any input in that space. Used for making corrections to alphanumeric strings which have been input. Repeated presses will erase the entire string but will not change mode.	✓	✓	
	CLEAR	Erases all presently displayed input characters.	✓	✓	
		Deletes USER REQUEST instruction and returns user to the standard mode.		✓	
	ENTER	Finalizes the alphanumeric input, allowing the system to respond to the information keyed in. Required for all INPUT group key actions except BACK SPACE and CLEAR.	✓	✓	
Spare Keys		Provisions have been made for six spare function keys and three spare input keys.			

3.6 FUNCTIONAL INTERACTION MODES

The automated delivery system, and the control unit, has three modes of interaction: standard, user request, and review. All three modes are controlled from the control unit. The standard mode uses all portions of the control panel. The user request mode uses only the INPUT portion of the panel. The review mode does not use the INPUT portion.

3.6.1 Standard Mode

This functional mode uses the TOC/PROC model to define the commands available to the user at any particular time. Many commands are initiated via single-press function keys located in the control group.

The standard mode of interaction is also referred to as the TOC-PROC mode since the primary method of accessing a particular portion of the data base is through selection from hierarchical tables of content (TOC) to reach the procedure (PROC) or other information that is wanted. User interactions with the control unit are fairly simple, and are in response to the prompts that appear on each frame. Choices are principally to advance to the next frame in a linear sequence, binary (yes-no) decisions, and selection from limited menus and options lists.

The limited use of the alphanumeric keypad is to respond to system-initiated questions. These include: (a) indicating a selection from a TOC, an options list, or a pool menu; (b) choosing a path in the text as required by the displayed frame (e.g., Yes/No); and (c) entering a user identification name or number. The standard mode is the primary mode of use for technicians, especially when they are new to the system, and will prevail unless user actions put the system in one of the other two modes.

The descriptions of the REVERSE and REPEAT SEQUENCE functions contained in Table 3-3 require further explanation. If the user has passed through a particular portion of the data base, e.g., a procedure, in the standard mode, use of these keys will permit retracing the sequence in reverse order. If, however, the user has entered that portion of the data base somewhere in the middle via the user request mode, there is no path to retrace. In such a case, the use of REVERSE and REPEAT SEQUENCE will trace in reverse order the sequence established by the page sequence numbering scheme described in paragraph 3.8.6.

3.6.2 User Request Mode

This functional mode increases the flexibility a technician has to move about in the automated data base. It is secondary to the standard mode and should only be used by technicians who are thoroughly familiar with both the automated delivery system and the technical information in the data base. It is highly interactive and imposes a significant requirement on the memory of the user (even though the risk of getting lost or confused is reduced through system design and prompting). It permits the knowledgeable user to "shortcut" the TOC-PROC access procedure. The system will operate in the user request mode only when so instructed by the using technician. When the specific request has been satisfied, the system reverts to the standard mode of interaction. The user request mode requires heavy use of the alphanumeric keypad since commands are initiated through alphanumeric character strings. Capabilities include:

a. "Jumping" directly to any part of the data base via a frame index code or a task number.

b. Entering allowable codes/numbers and requesting specific associated information.

c. Entering allowable codes/numbers and obtaining a menu of information items associated with the code/number.

The allowable codes/numbers referred to above include data such as part numbers, reference designators, and MIDAS codes. These are termed input qualifiers, output qualifiers, and content identifiers, as described in paragraph 3.6.4. All user request mode functions are accomplished in a similar manner. The sequence of events is:

a. Press USER REQUEST function key (in either standard or review mode).

b. CRT displays user request mode prompt.

c. Key in an alphanumeric character string.

d. Press ENTER.

e. System returns to standard mode when requested data are displayed.

3.6.3 Review Mode

This functional mode provides a basis for technician review of the technical data base for purposes of familiarization or training.

In this mode, the system becomes a page turner and the frames are presented in a predetermined order. The technician, or other user, can select this mode of interaction from (and only from) any options list. The system will remain in the review mode until instructed to return to the point in the data base where the originating options list was selected by the technician. Frames presented in the review mode will carry a prominent feedback message instead of the normal prompt. Theoretically, a technician could page through all of the frames in a TO in the review mode. Practically, it is expected that the review mode will be used mostly for reviewing a selected sequence of procedures before beginning maintenance. This mode may also be helpful for training, both classroom and OJT.

In the review mode frames are presented in a predetermined sequence by use of the FORWARD key. The user may interact with all function keys except START, LIST OPTIONS, and HOLD. All keys in the INPUT group are inactive. Exit from the review mode can be accomplished by pressing the RETURN or USER REQUEST key, to enter the standard or user request mode, respectively; or by pressing STOP to log off the system.

3.6.4 User Request Mode Interactions

All user request mode interactions require the input of an alphanumeric character string to convey to the computer the intended instruction. Part of this character string consists of a two-letter mnemonic that identifies the type of input being entered. In most cases, a two-letter mnemonic at the end of the string is also required, to identify the type of information wanted by the user. Some mnemonics are both input and output qualifers, as shown in Table 3-4. The relationship between mnemonics used as user request mode qualifiers and those used for other, related purposes is depicted in Table 3-7, later in this section.

The alphanumeric character string is composed as follows:

$$\underbrace{XX}_{1\ 2}\quad \underbrace{XXXX....X}_{3}\quad \underbrace{XX}_{4\ 5}$$

1. The input qualifer: A two-letter mnemonic code to qualify the input string.
2. A space to delimit parts 1 and 3.
3. The content identifier: An alphanumeric code, e.g., part number.
4. A space to delimit parts 3 and 5.
5. The output qualifier: A two-letter mnemonic to qualify the output desired.

Table 3-4

Identification of User Request Mode Qualifiers

Mnemonic	Name	Input	Output
AA	Automated Assistance	√	√
CT	Checkout Tape or Card		√
FC	Fault Code	√	√
FI	Fault Isolation Procedure		√
FN	Frame Number	√	√
FR	Fault Reporting Procedure		√
GD	General Description		√
GS	General Systems Manual		√
GT	General Theory of Operation		√
GV	General Vehicle Manual		√
JG	Job Guide (Maintenance)		√
MC	MIDAS Code	√	√
OS	Operational Supplement		√
PB	Parts Breakdown, Illustrated	√	√
PN	Part Number	√	√
RD	Reference Designator	√	√
SD	Schematic Diagram		√
SR	Structural Repair Manual		√
SS	Safety Supplement		√
TN	Task Number	√	
TO	Technical Order	√	√
WD	Wiring Diagram		√

Table 3-5 shows the combinations of input and output qualifiers that the automated delivery system will accept, and the result of each legitimate combination. User requests that involve other combinations will generate an error message on the display screen. Likewise, if the content identifier character string that follows the input qualifier is not recognized by the computer as a valid combination, an error message will be presented. It is important to note that, except for input qualifier AA and sometimes TO, the input/output combinations are valid only for data within a specific TO in the data base within which the technician is working prior to initiating a user request. The system will not produce data from other TOs in the data base, nor types of data not contained in the TO. However, while a user is working with a particular TO, information from some other TO can be accessed in the user request mode by keying "AA ### AA" to obtain the list of TOs in the data base (see note 5 in Table 3-5), or the initial frame of another TO can be obtained by keying "TO ###," if the technician is authorized to use it.

3.7 ORGANIZATION OF DISPLAY FRAME CONTENTS

3.7.1 Standardization

One of the objectives of the automated delivery system program is to optimize the interface between the using technician and the presentation system. Among the factors to be considered in the satisfaction of this objective is the way in which data to be presented are organized. To the extent feasible, a standardized organization should be used. This will reduce search time when the technician is looking for a particular type of data or information, and decrease the likelihood of essential information being overlooked. In addition, the principles of standard placement of designated information which apply to paper TOs are maintained.

Table 3-5

System Response to Combinations of Input Qualifers, Content Identifiers, and Output Qualifiers in the User Request Mode

Input Qual	Content Ident.(2)	AA	CT	FC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	GT	GV	JG	MC	OS	PB	PN	RD	SD	SR	SS	TO	WD	Other	None
AA	φφ	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		⊛
AA	###	5																						⊛
FC	###				✓																			⊛
FN	###																							⊛
MC	###				✓					✓		✓			6			✓				✓		⊛
PB	φφ	5													8									⊛
PN	###				✓			✓				✓			9		9	✓				✓		⊛
RD	###									✓		✓			9	9		✓				✓		⊛
TN	###																							X
TO	φφ	17	✓	10	✓	11	✓		✓	✓	✓	✓	12	✓	✓	13	14	✓	✓	✓	15	✓		16
TO	###																							X
Any Above	Other																							
None	Any																							
Other	Any																							

LEGEND & NOTES

1. When the symbol or number is contained in [illegible] e.g. (X), the [illegible] frame is displayed. Otherwise, [illegible] of the applicable series is displayed.
2. The alphanumeric character string must be associated with the input qualifier to be accepted as valid.
3. Instructions for system use.*
4. Definition and [illegible] represented by [illegible] user's TO.*
5. List of [illegible]
6. IPB [illegible]
7. How to use IPB
8. IPB Manual [illegible]
9. IPB [illegible]
10. List of [illegible]
11. List of Effective Frames [illegible]
12. MTBAF [illegible]
13. IPB Part Number Index.
14. IPB Reference Designator Index.
15. Glossary of Terms
16. TO Table of Contents.
17. User request mode instructions.

▨ : Error; input qualifier not valid.

▧ : Error; output qualifier not valid.

☐ : Error; content identifier not valid.

* Not restricted to authorized users.

\### Valid alphanumeric string for input qualifier

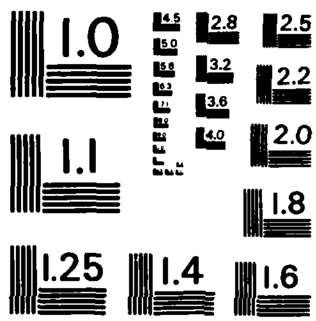
⊛ Menu of options for the input qualifier and content identifier in user request mode

X Frame corresponding to input qualifier and content identifier.

✓ Frame corresponding to input qualifier and content identifier which is in the part of the data base represented by the output qualifier.

AD-A162 711 MAINTENANCE TECHNICAL MANUALS: FORMAT DESCRIPTIONS AND GUIDELINES FOR AUT..(U) BIOTECHNOLOGY INC FALLS CHURCH VA R G HATTERICK DEC 85 AFHRL-TP-85-46 2/4

UNCLASSIFIED F33615-82-C-0006 F/G 1/3 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

To meet the standard organization objectives, all frames of information, regardless of character size, have three defined areas in which certain types of information are always placed. These are the header, body, and prompt, as shown in Figures 3-4 and 3-5 for level 5 and level 3 character sizes, respectively. (Note: Throughout the remainder of this report, examples of data being presented on the display subsystem are illustrated on simulated display "frames." These frames are scaled at approximately 38.5% of actual Megatek screen size for both level 5 and level 3 characters.)

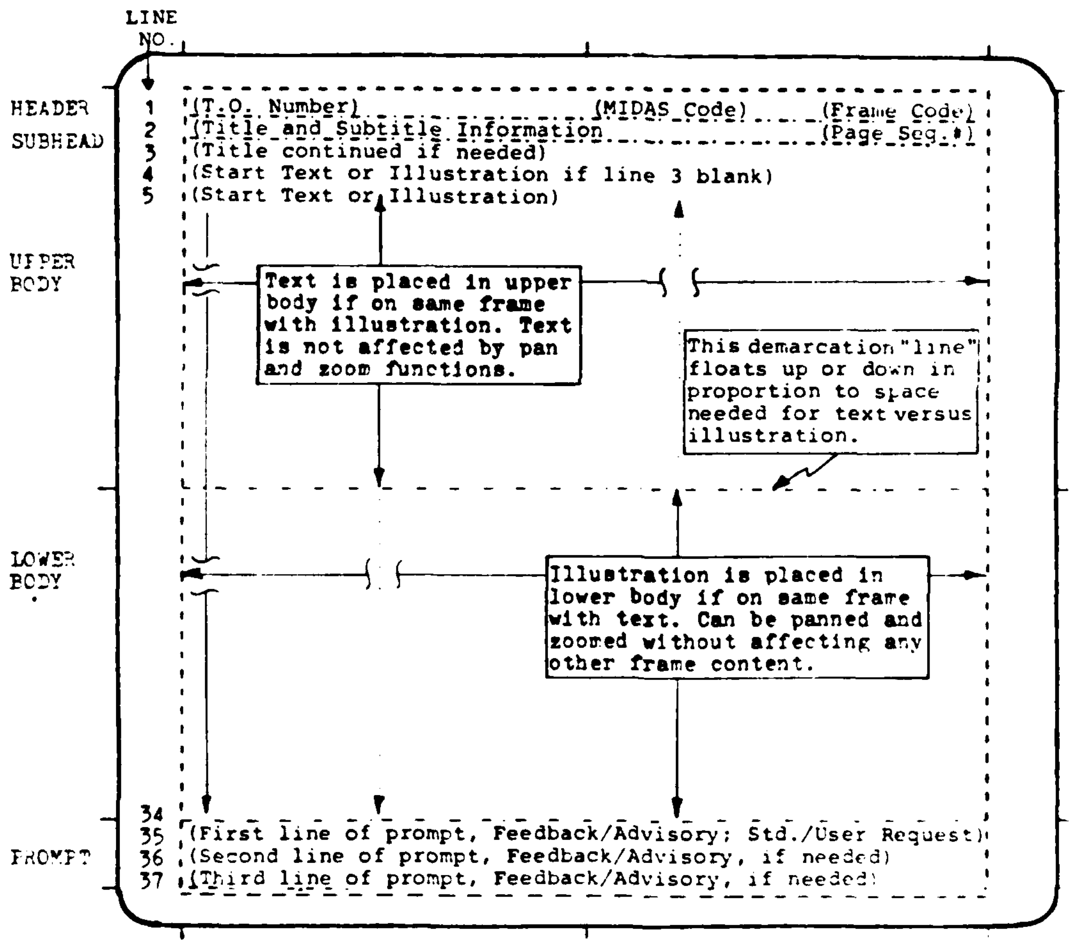


Figure 3-4. Organization of display frame contents (level 5 Megatek).

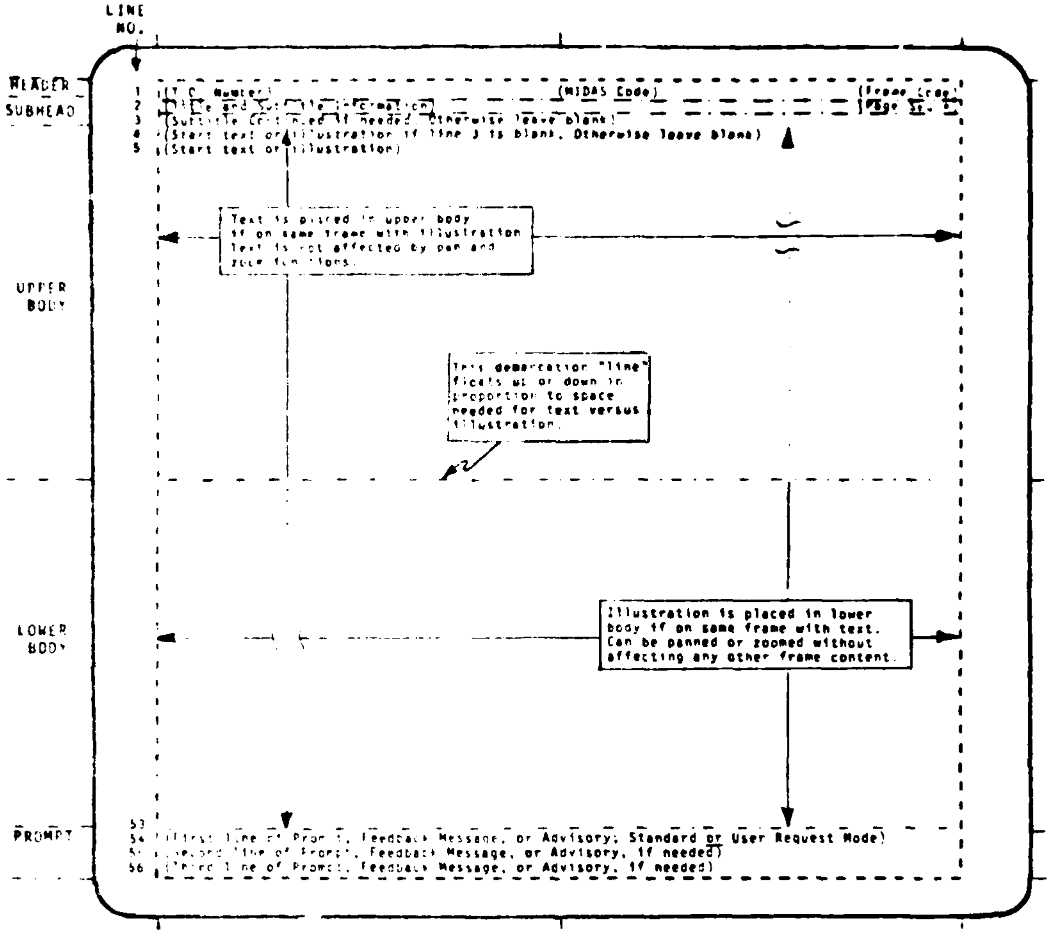


Figure 3-5. Organization of display frame contents (level 3 Megatek).

3.7.2 Header

The first two lines of each frame comprise the header section. The primary header is placed on the first line. If the information on the frame is part of a TO, the primary header consists of the TO number, the applicable MIDAS Code (if the MIDAS Code is in use and applies to the information of the frame), and the frame code. The next line of the header section is used for title and subtitle information, and a page sequence number, if applicable. If the information on the frame is not part of a

TO, the header lines are used to present equivalent identifying information. Note that the portions of lines 1 and 2 that are at the right margin, while technically part of the header, will change with each frame, although the remainder of the header may remain constant through a series of frames. Figures 3-6 and 3-7 illustrate several examples of header content. Guidelines for preparation and placement of header contents are described in Subsection 3.8.

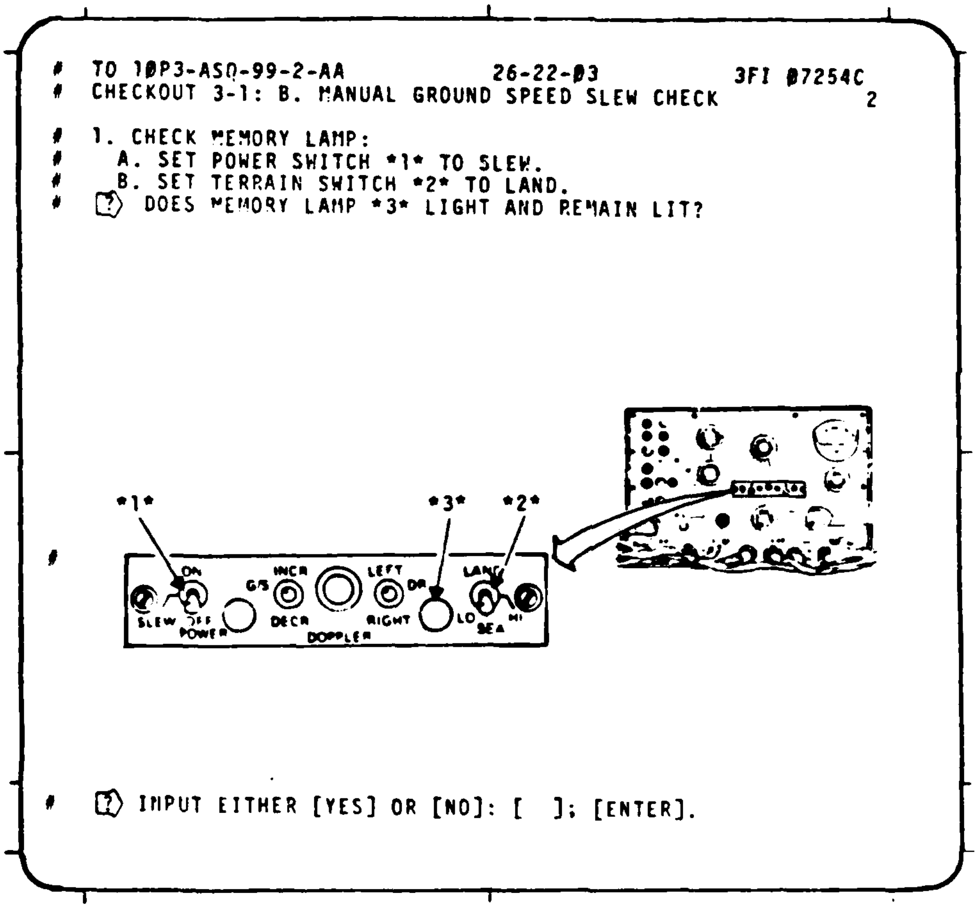


Figure 3-6. Example of typical procedural data (level 5) frame.

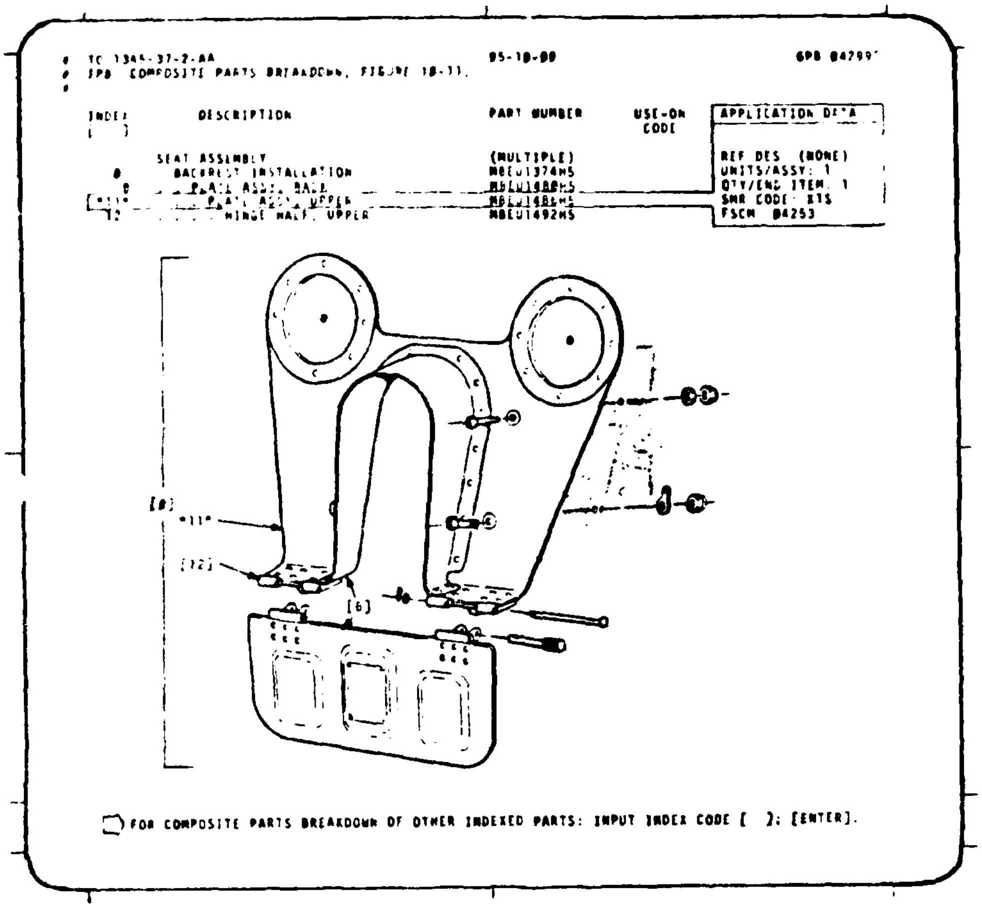


Figure 3-7. Example of typical pool data (level 3) frame.

3.7.3 Body

This portion of the frame begins on the third line and extends to the last line preceding the prompt area. The first line of the body (third frame line) will normally be left blank to provide separation from the header. The number of lines included in the body will vary according to the character size in use for the frame, as shown in Figures 3-4 and 3-5. The body of the frame is considered to have an upper portion and a lower portion only with respect to frames containing both text and illustrations.

When this occurs, text is always placed in the upper body, and illustrations are always placed in the lower body. The decision on the amount of space to be allocated to text versus illustration should be based on the needs of the user, and should consider (when appropriate) that the illustration can be panned and zoomed independently of other frame contents. When the body will contain only text or only illustration, the complete body area should be used, as needed. Figures 3-6 and 3-7 provide representative examples of placement of information in the body area.

3.7.4 Prompt

The prompt area comprises the last three lines of the frame, as identified in Figures 3-4 and 3-5, although in many cases only the first of these three lines will be used (see Figures 3-6 and 3-7). This convention deviates from the principle that user instructions should be presented before the information on which a decision will be based. Since the prompt information normally deals only with interaction with the system, standardized placement is believed to be more effective for the user, as well as to reduce programming complexity and data presentation requirements.

3.8 CODES AND CONVENTIONS

3.8.1 Overview

Paper-based Technical Orders and Technical Manuals use many techniques for coding and highlighting technical information. Some techniques are associated with particular format types, and some are standardized, e.g., for a particular branch of the military. Their purpose is to eliminate, or alleviate, the need for user searching to find particular kinds of information, to preclude overlooking especially important information, and to provide redundant means of identifying certain data through easily understood and learned "systems" of coding. The automated delivery system attempts to accomplish the objectives, to the extent feasible, through use of the Air Force TO standardized codes and conventions, especially those that are associated with the formats adapted for use in the system. In addition, advantage is taken of the capabilities for computer-generation and CRT-presentation of such codes and conventions. This subsection describes the techniques recommended for achromatic presentation. Recommended techniques for the use of color are described in Subsection 3.9.

3.8.2 TO Numbering

Air Force TOs are numbered according to an identification system specified in TO 0-1-01. An automated delivery system must be compatible with this numbering and identification system if it is to be accepted for use as part of the Air Force Technical Order (AFTO) System.

3.8.2.1 TOs. Every Technical Order in the AFTO System is identified by a unique TO number. The system of number identification has been developed so that the series of numbers:

- Identifies the general subject and/or content of the TO;
- Establishes the relationship among TOs for a particular system;
- Provides sequences for filing; and
- Indicates distribution requirements.

3.8.2.2 Numbering of TOs. Each TO number is divided into three or more parts. Each part is separated from the others by a dash; e.g., "00-25-113-F15" and "1F-16A-2-32FI-00-1."

a. The first one- or two-digit number in the sequence identifies the TO category. Table 3-6 identifies the categories of TOs encompassed by the AFTO System. Numbers are assigned according to equipment or commodity type whenever possible. Technical Orders containing instructions or procedures applicable to more than one major group are numbered in general series for the particular category.

b. The second and subsequent parts of the TO number identify specific series, types, subcategories, etc. of TOs within the category. Meanings may be different from one category to the next. Figure 3-8 illustrates two examples of TO numbering, for a general TO and for a specific system TO.

A detailed explanation of TO numbering is contained in the preface of TO 0-1-01. An explanation of the numbering pattern used within a category is given in the preface of the basic Numerical Index and Requirement Table (NI&RT) for each category of TOs listed in Table 3-6.

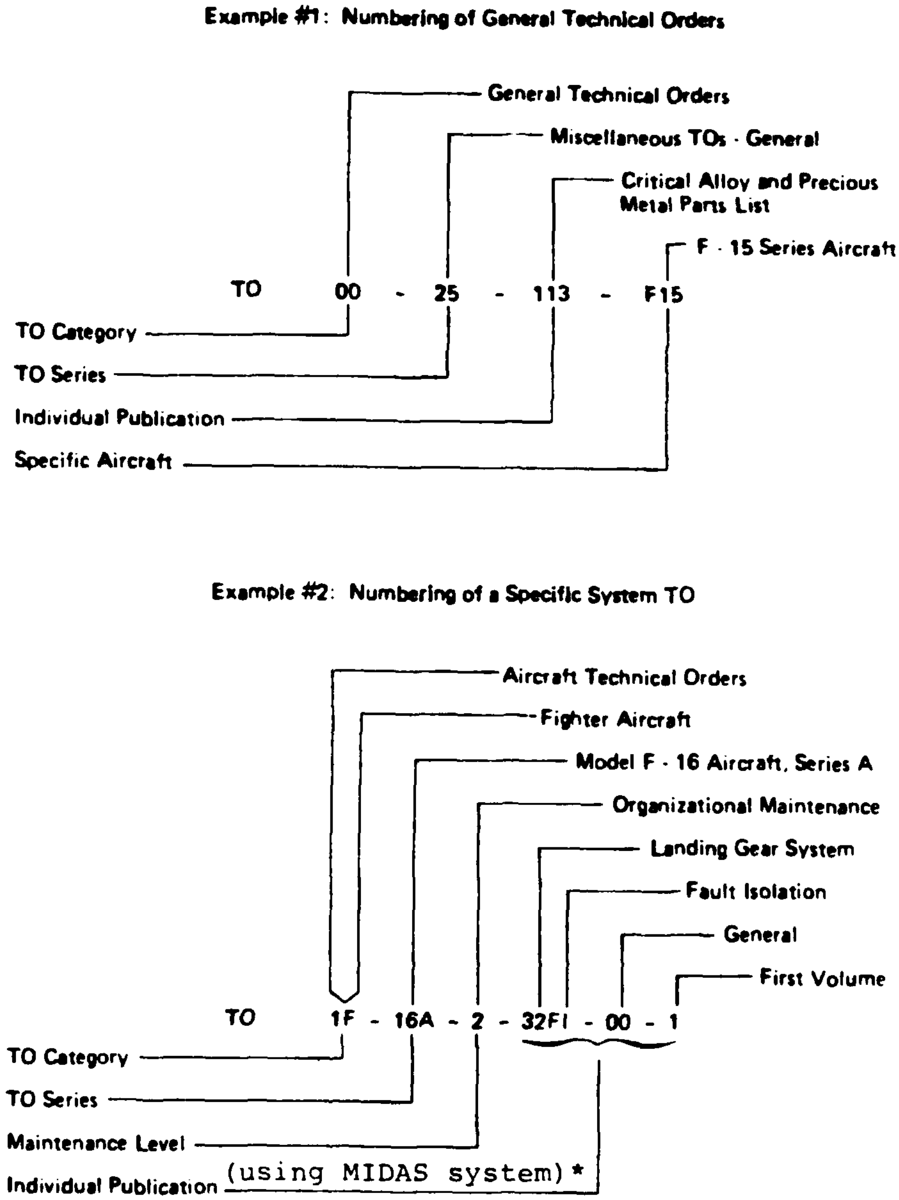
Certain TOs, especially multi-section Technical Manuals (TMs), are identified by letters within the "individual publication" portion of the TO number. Two different lettering systems are used that, while different, are fully compatible. One method is given in TO 0-1-01; the other is called "MIDAS," for Maintenance Integrated Data Access System. In each case where the same letter combinations are used by the two systems, the meaning is the same. Example 2 of Figure 3-8 shows an illustration of letter code placement. Table 3-7 identifies the letter codes used in hard-copy TOs, as well as intended automated delivery system applications.

Table 3-6

Technical Order (TO) Categories

TO Category	Title
0	Numerical Index and Requirements Tables, Numerical Index, Alphabetical Indexes, and Cross-Reference Table Technical Orders
00	General Technical Orders
1	Aircraft Technical Orders
2	Airborne Engine Technical Orders
3	Aircraft Propellers and Associated Equipment Technical Orders
4	Aircraft Landing Gear Components and Associated Equipment Technical Orders
5	Airborne Instrument Technical Orders
6	Aircraft and Missile Fuel Systems and Equipment Technical Orders
7	Airborne Engine Lubricating Systems and Associated Equipment Technical Orders
8	Airborne Electrical Systems Technical Orders
9	Airborne Hydraulic, Pneumatics and Vacuum Systems Technical Orders
10	Photographic Equipment, Supplies, and Sensitized Materials Technical Orders
11	Armament Technical Orders
12	Airborne Electronic Equipment Technical Orders
13	Aircraft Furnishing, Cargo Loading and Aerial Delivery, and Firefighting Equipment Technical Orders
14	Deceleration Devices, Personal and Survival Equipment Technical Orders
15	Aircraft and Missile Temperature Control, Pressurizing, Air Conditioning, Heating, Ice Eliminating, and Oxygen Equipment Technical Orders
16	Airborne Mechanical Equipment Technical Orders
21	Guided Missile Technical Orders
22	Aerospace Technical Orders
31	Ground Communications-Electronics-Meteorological (CEM) Technical Orders
32	Standard and Special Tools Technical Orders
33	General Purpose Test and Associated Equipment Technical Orders
34	Shop Machinery and Associated Equipment Technical Orders
35	Ground Handling, Support and Base Operating Equipment Technical Orders
36	Vehicles, Construction and Materials Handling Equipment and Equipment and Components Technical Orders
37	Fuel, Oil, Propellant Handling and Associated Equipment Technical Orders
38	Non Aeronautical Engines and Components Technical Orders
39	Watercraft and Associated Equipment Technical Orders
40	Commercial Air Conditioning, Heating, Plumbing, Refrigerating, Ventilating, and Water Treating Equipment Technical Orders
41	Subsistence and Food Service Equipment Technical Orders
42	Chemical, Oxygen, Metal, Textile, Fuels, Cordage, Lumber, and Rubber Materials (Dopes, Cleaning Compounds, Glues, Gases, Lubricants, Paints, Plastics, and so forth) Technical Orders
43	Simulators, Training Devices, and Associated Equipment Technical Orders
44	Common Hardware Equipment Technical Orders
45	Railroad and Associated Equipment Technical Orders
46	Office, Duplicating, Printing and Binding Equipment Technical Orders
47	Agricultural Equipment Technical Orders
49	Optical, Instruments, Timekeeping, and Navigation Equipment Technical Orders
50	Special Service Equipment Technical Orders
51	General Purpose Automatic Test Systems (GPATS) and Versatile Automatic Test Systems (VATES) Technical Orders
60	Explosive Ordnance Disposal Technical Orders

Source: AFHRL-TR-80-50, Table 2-1



Adapted from: AFHRL-TR-80-50, Figure 2-2

*See paragraph 3.8.3

Figure 3-8. Examples of meaning of TO numbers.

3.8.2.3 Identification of Model Changes. The assignment of a new series designator (e.g., F16; F16A) to a model of system or equipment indicates a significant change in configuration. When this occurs, a set of separate TOs for the series is usually procured. Even though these publications may repeat information contained in the manuals for the previous series, presenting the information in separate manuals makes it easier to understand and use, and simplifies the control of classified/restricted information. It also facilitates the inclusion of the changes that apply to one series but not the other.

In those cases where the configuration change is not significant enough to justify issuance of a separate TO, the technical information is issued as changes/additions to the existing TO. These changes may range from new TO sections for the new configuration to footnotes noting differences. When differences are plentiful, the TO may include "Difference Data Sheets" which identify the variations that exist between different configurations.

3.8.2.4 Numbering. In order to maintain compatibility with the AFTO identification system described above, and still reflect the unique characteristics of technical information presented via an automated delivery system, certain modifications have been made to the TO numbering and identification convention. The principal modifications are:

- Treat each specific system TO in the data base as a single, unsectionalized TO. This permits elimination from the TO identification number of all data that follow the maintenance level code. General TOs that are sectionalized by type of aircraft, etc. should probably retain that convention.

- Add "AA" (for "automated assistance") to the TO number to effectively identify it in indices as a computer-based TO. In general TOs, this would be added at the end of the full TO number; e.g., TO 00-25-113-F15-AA. In TOs for a specific system, "AA" is added after the maintenance level code, replacing the individual publication code; e.g., TO 1F-16A-2-AA.

While it would appear that substantial information value is lost by deleting the individual publication part of the TO number, it is irrelevant as part of the complete, unsectionalized TO, and the same information is provided on the appropriate frames of data through the use of MIDAS codes (see paragraph 3.8.3) and frame codes (see paragraph 3.8.4). The numbering system will retain the model/series designation convention described in subparagraph 3.8.2.3 for top-level model changes. Changes in equipment model/series below the top level will not be reflected in the TO number, but will be presented as "mini-TOs" through an access pre-selection method described in Section 4.0.

3.8.3 MIDAS Code

MIDAS is an acronym for Maintenance Integrated Data Access System, an approach to organization of aircraft system TOs that was developed in conjunction with the F-16 aircraft program. MIDAS is best known for the system of alphabetic and numeric indexing and identification that is applied to all portions of the TO. The alphabetic identification system has been discussed briefly in subparagraph 3.8.2.2 and is itemized in Table 3-7. The numeric portion of the MIDAS identification system is documented in MIL-M-83495, Appendix A, where it is called the system/subsystem/subject (S/S/S) numbering system. In MIDAS, both the alphabetic and system-level numeric identifiers are

Table 3-7

Standardized Mnemonic Codes

Mnemonic Code	Name	Applications: Hard-Copy: MIDAS	TO-0-1-01	Automated: Frame Codes[1]	Qualifiers[2]
AA	Automated Assistance	–	–	AA	AA
CL	Checklist	CL	CL	–	–
CT	Checkout Tape or Card	–	CT	–	CT
FC	Fault Code	–	–	–	FC
FI	Fault Isolation Procedure	FI	FI	FI	FI
FN	Frame Number	–	–	–	FN
FP	Film Pack	–	FP	–	–
FR	Fault Reporting Procedure	FR	–	–	FR
GD	General Description	–	–	GD	GD
GS	General Systems Manual	GS	–	–	GS
GT	General Theory of Operation	–	–	GT	GT
GV	General Vehicle Manual	GV	–	GV	–
JG	Job Guide Manual (NTS)	JG	JG	JG	JG
LC	Lubrication Chart	–	LC	–	–
MC	MIDAS Code	–	–	–	MC
OS	Operational Supplement	–	S	–	OS
PB	Parts Breakdown, Illustrated	IPB	–	PB	PB
PN	Part Number	–	–	–	PN
RD	Reference Designator	–	–	–	RD
SC	Sequence Chart	–	SC	–	–
SD	Schematic Diagram	SD	–	SD	SD
SR	Structural Repair Manual	SR	–	–	SR
SS	Safety Supplement	–	SS	SS	SS
TN	Task Number	–	–	–	TN
TO	Technical Order	–	TO	–	TO
WC	Work Card	–	WC	–	–
WD	Wiring Diagrams	WD	–	WD	WD
WS	Work Sheets	–	WS	–	–

Notes:

[1] Type of material code used in frame number

[2] See paragraph 3.6.4 for input and output qualifier discussion.

incorporated in the TO identification number, as shown in Example #2 of Figure 3-8. The S/S/S numbering system is used throughout each TO to identify the chapter, section, and subject (or function) to which the data on each page apply, and is incorporated in a coding system for fault reporting and fault isolation. Within each sectionalized TO, pages dealing with a particular subject (or function) have the same S/S/S number and are located together.

The MIDAS S/S/S numbering scheme is composed of three elements of two digits each separated by dashes: ##-##-##. The digits in the first element are used in both the MIDAS approach to TO numbering and in the six-digit indexing scheme. The first two digits identify the aircraft system, the second two digits identify the subsystem within a particular system type, and the third set of two digits identifies the subject, or function, within the subsystem. Figure 3-9 provides an example of the derivation of the three elements for particular systems, subsystems, and subjects. It is this three-element, six-digit number that is referred to as the MIDAS code in this document. Table 3-8 provides the standard system assignments for the first two digits of the MIDAS code. Use of these for data preparation, and definitions for the second and third elements of the code, should be developed from the instructions in MIL-M-83495.

When the MIDAS code is used in VAMIS applications, it is placed on the first line of the header (see Figures 3-4 and 3-5) of every frame starting at the frame center line. As presently constructed, eight (8) character spaces on the line are reserved for the MIDAS code (six numerals and two dashes). The MIDAS code S/S/S numbering system may be expanded to eight digits in the future. The expansion may add characters at the beginning of the series, so that equipment other than aircraft can use the

FIRST ELEMENT	SECOND ELEMENT	THIRD ELEMENT	COVERAGE
CHAPTER (Manual) (SYSTEM)	SECTION (SUBSYSTEM)	SUBJECT (FUNCTION)	
26 — (SYSTEM) "Fire Protection"	**00** —	**00**	Material which is applicable to the system as a whole.
26 —	**20** — (SUBSYSTEM) "Extinguishing"	**00**	Material which is applicable to the subsystem as a whole.
26 —	**22** — (SUB-SUBSYSTEM) "Engine Fire Extinguishing"	**00**	Material which is applicable to the sub-subsystem as a whole. This number (digit) is assigned by the manufacturer.
26 —	**22** —	**03** (Function) "Bottles"	Material which is applicable to a specific function of the sub-subsystem. Both digits are assigned by the manufacturer. If they are not specified herein.

NOTE: In covering material which is applicable to a system as a whole, the three element number shall be used. These shall be the system number followed by "-00-00."

Example: 21-00-00 would be used for description and operation, troubleshooting and maintenance practices for the complete Air Conditioning System.

Figure 3-3. Example of S/S/S numbering in MIDAS.

Table 3-8

System Level MIDAS Code Definitions

GROUP CODE	DEFINITION/TITLE
Aircraft	The complete operational unit.
01	(Reserved)
02	"
03	"
04	"
05	"
06	Dimensions & Areas
07	Lifting, Jacking, & Shoring
08	Leveling & Weighing
09	Towing & Taxing
10	Parking & Mooring & Aircraft Safety
11	Placards & Markings
12	Servicing
Airframe Systems - All except Power Plant	
20	(Reserved)
21	Air Conditioning
22	Auto Flight
23	Communication
24	Electrical Power
25	Equipment/Furnishings
26	Fire Protection
27	Flight Controls
28	Fuel
29	Hydraulic Power
30	Ice & Rain Protection
31	Indicating & Recording Systems
32	Landing Gear
33	Lights
34	Navigation
35	Oxygen
36	Pneumatic
37	Vacuum
38	Water/Waste
39	Electrical/Electronic Panels & Multipurpose Components
43	Communications - Staff
49	Auxilliary Airborne Power

GROUP CODE	DEFINITION/TITLE
Structure	Airframe structure minus systems
51	Structures
52	Doors
53	Fuselage
54	Nacelles/Pylons
55	Stabilizers
56	Windows
57	Wings
Propeller/Rotor	Complete systems minus anti-icing system
60	Standard Practices
61	Propellers
65	Rotors
Power Plant	Complete power unit.
70	Standard Practices
71	Power Plant
72	Engine
73	Engine Fuel & Control
74	Ignition
75	Air
76	Engine Controls
77	Engine Indicating
78	Exhaust
79	Oil
80	Starting
81	Turbines
82	Water Injection
83	Accessory Gear Boxes
84	Take Off Assist
General	
91	Charts
93	Electronic Warfare
94	Weapons System
95	Crew Escape & Safety
96	Missiles, Drones, & Telemetry
97	Photographic
98	Meteorological & Atmosphere Research
99	Surveillance

codes; or at the end of the series, to provide even more specific subject (function) identification. If this happens, additional character spaces will be required but the code should still be centered.

Placement of the MIDAS code in this location of the header will assist "at-a-glance" checking by users. To avoid having the MIDAS code become less detectable, it should be separated from other information on the primary header line by at least three character spaces. If a particular TO has a lengthy TO number that imposes on this separation, shift the MIDAS code to the right.

3.8.4 Frame Code Numbering System

The frame code numbering system is based on the requirement for the user to be able to identify the specific "page" within the TO for the purpose of reporting errors, need for improvement, and similar types of feedback from the user to the preparers of the data. Likewise, the data preparers must have some identification method (although it need not be visible to the data user) to distinguish one frame of data from any other. Ideally, a single coding system should be able to satisfy both of the above needs without compromising or degrading the solution to either. Finally, given that some space on the frame must be allocated to the frame "code," it should be used to impart useful information to the technician, if feasible, about the frame contents.

The frame code will always be located in the upper right-hand corner of the frame, on the first line, as shown in Figures 3-4 and 3-5. Frame codes are included in the example frames in Figures 3-6 and 3-7. The frame code will utilize a field of 10 character spaces. The code consists of a series of alphanumeric characters that:

- Provides a unique identification code for each frame within a TO;
- Identifies the change or revision status of the technical content of that frame;
- Identifies the level of detail (i.e., "track" applicability) to which the content should be/has been prepared; and
- Identifies the type of technical data comprising the content.

The sequence and definition of each character space are as follows:

Space #1: A numeral from 1 through 6 designating the level of detail of the content of the frame, as defined in Table 3-9. Numerals 7, 8, 9, and 0 are reserved for future use if this factor is changed or expanded.

Table 3-9

Level of Detail Codes (Character Space #1) for Frame Code

CODE		DESCRIPTION
1	=	Text & illustration applicable to Track #1 only.
2	=	Text & illustration applicable to Track #2 only.
3	=	Text & illustration applicable to Track #3 only.
4	=	Text & illustration applicable to Tracks #1 & #2.
5	=	Text & illustration applicable to Tracks #2 & #3.
6	=	Text & illustration applicable to Tracks #1, #2, & #3.
7	=	(Reserved)
8	=	(Reserved)
9	=	(Reserved)
0	=	(Reserved)

Spaces #2 and #3: A two-letter mnemonic that identifies the type of technical data comprising the content. The mnemonics will be the same as those used for data access and coding (see Table 3-7) and are based on the MIDAS code mnemonics, as modified for this program.

Space #4: A blank space to separate the level of detail/type of material code from the basic frame code. This space could be used for other purposes that are not visible to the user or reserved for expansion of the number of frames.

Spaces #5 through #9: A five-digit numerical code that provides a unique identification of the frame within the TO; i.e., the frame number. This will provide a capacity of 99,999 frames for each TO in the data base. A block of these codes should be allocated to any material that is common to the TOs included in the data base, e.g., the instructions on the use of the TO. In this program, frame numbers 99,001 through 99,999 have been reserved for materials which are independent of a specific TO.

Space #10: An alphabetic character (letter) to indicate the change, or revision status, of the frame content. The original issue of the frame will be blank; the first change to the frame will be coded "A," the next "B," and so forth through the alphabet. This will permit 26 changes to the frame before a new frame number must be assigned, or the TO is "reissued." Note, however, that authorized hard-copy TOs use numerals to show the change identification, so this is a non-conforming method. In addition, see the discussion of the change code symbol in subparagraph 3.8.7.3.

Figure 3-10 provides examples of various frame code possibilities.

Frame Code	Definition
• 3JG 12345	Track #3 non-troubleshooting maintenance procedure, frame #12345, original issue.
• 6PB Ø5678B	Applicable to Tracks #1, #2, and #3, Illustrated Parts Breakdown, frame #5678, Change B.
• 2FI 34567H	Track #2 troubleshooting procedure, frame #34567, Change H.
• 6AA 99ØØ2C	Applicable to Tracks #1, #2, and #3, User Instructions, frame #99002, Change C.
• 6SD 12456	Applicable to Tracks #1, #2, and #3, Schematic Diagrams, Frame #12456, original issue.

Figure 3-10. Example of frame codes.

Assignment of code entries will be primarily the responsibility of the senior technical writer for the TO. The codes for level of detail (Space #1) and type of material (Spaces #2 and #3) should be determined during task analysis but will be applied by the technical writer. The serial frame number that uniquely identifies the frame (Spaces #5 through #9) can be assigned as the frame content is completed, from a sequential list controlled by the senior technical writer, or blocks of numbers can be allocated to each individual technical writer. In either case, accurate records must be maintained so that frame codes are not used more than once in a TO.

3.8.5 Frame Titles and Subtitles

Every frame in the data base will contain title information, at some level, to provide to the user a description in words of the information to follow. Titles are necessary on each frame because of the absence of a physical "package," such as exists in paper-based TOs, and the resulting ease with which a user can obtain a frame of information that may be unrelated to the immediately preceding frame. Consequently, each frame must carry a narrative subject identification.

Titles and, if appropriate, subtitles are applied at three levels. The first level is the title frame, wherein all or most of the frame is used for title information. Title frames, discussed in Section 4.0, are used to precede a whole body of data and describe to the user the content of subsequent frames of the package. Title frames are equivalent to the title pages in both sectionalized and unsectionalized paper-based TOs.

The second level includes placement of primary titles in the header, on the second line, and more detailed subtitles and subject descriptions on subsequent lines. While second-level titles will usually require use of some portion of the frame body, as depicted in Figure 3-11, the depth of description will enable use of third-level titles in all frames of a series of information which follow. Second-level titles should include the overall system name and, if feasible, the subsystem which is the subject of the series of frames. Subtitles or descriptive statements should explain the specific nature of the frames which are to follow; e.g., Bench Checkout of System XYZ, Checkout No. 123. Frames containing second-level titles should be the first frame of a series of frames which all deal with the same subject, task, or function. The remainder of the frame should be used to begin the presentation of that information; e.g., the input conditions for a particular maintenance procedure.

a. Second-level frame title example.

```
# TO 1C-141A-2-AA              73-1Ø-ØØ             6JG Ø3592C
# C-141A ENGINE FUEL SYSTEM MAINTENANCE
  TASK 4-3: FUEL PUMP FILTER ELEMENT REMOVAL & INSTALLATION. 1
           NDITIONS:
```

b. Third-level frame title example.

```
# TO 1C-141A-2-AA              73-1Ø-ØØ             5JG Ø3598D
# 4-3: INPUT CONDITIONS, CONTINUED.                           3

  • EQUIPMENT CONDITIONS:

  +++++++++++++++++++++++ WARNING ++++++++++++++++++++++++
   THE FOLLOWING EQUIPMENT CONDITIONS MUST BE MET BEFORE
   DOING THE TASK YOU HAVE SELECTED.
```

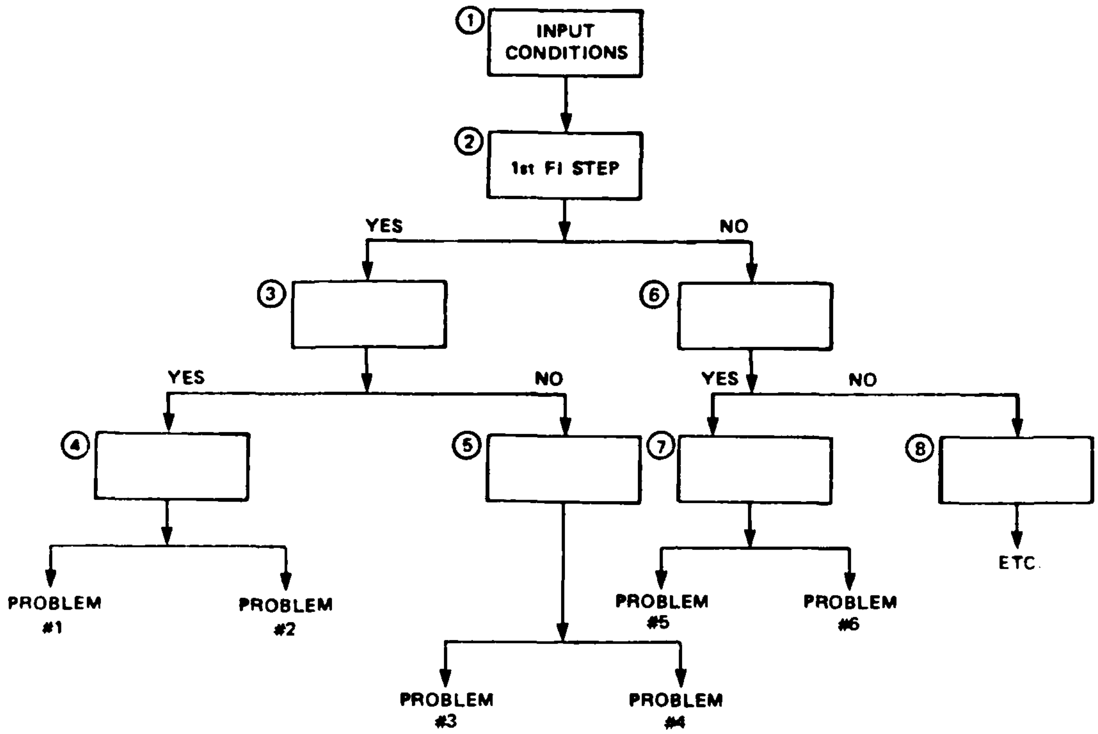
Figure 3-11. Examples of second-level and third-level frame titles.

Most of the frames in the data base will use third-level titles. A third-level title will normally consist of a brief title or statement which deals specifically with the frame contents; e.g., C/O 3-1: B. Manual Ground Speed Slew Check. This title is placed on the second line of the header, and should be complete in one line, leaving sufficient space for a "page" sequence number, if applicable (see paragraph 3.8.6). If additional explanation is necessary, it should be incorporated in the body of the frame (leaving the third line blank whenever possible). Figures 3-6 and 3-7 illustrated examples of third-level frame titles.

3.8.6 "Page" Sequence Number

"Page" sequence numbering is used for identification of frames of data which are normally presented in a certain sequence in the standard mode. A maintenance task, for example, might consist of 10 frames of information, numbered 1 through 10, beginning with the input conditions frame. Task information of this kind will always be presented in consecutive order in the standard mode. Similarly, the Index to Reference Designations in an IPB could include several hundred consecutively numbered frames which could, if the user prefers, be "paged" through in sequential order using the FORWARD key. Troubleshooting procedures are similarly numbered for each task since each frame is part of a discrete, identifiable set of information, even though choices at the decision points in the logic tree may result in skipping frames.

As shown in Figures 3-4 and 3-5, and further illustrated in Figures 3-6 and 3-11, the page sequence number is right-hand justified on the second line of the header. The first frame of the series is always numbered "1," and will normally have a second-level title (see paragraph 3.8.5). In series of frames which do not have a natural sequence (e.g., fault isolation procedures), a logical numbering scheme should be applied. For example, each frame in an LTTA sequence would be numbered sequentially following a path of acceptable responses. The numbering sequence would continue with the first in that branch resulting from a non-acceptable response, and so forth. This type of numbering is illustrated in Figure 3-12.



NOTE: Numbers in circles are page sequence numbers.

Figure 3-12. Page sequence numbering for branching path sequences in LTTAs.

3.8.7 Symbol Codes

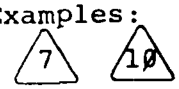
3.8.7.1 General Approach. Formats developed for the automated delivery system use symbol codes, as in paper-based systems, as a shorthand method of informing the user of some characteristic of the information being presented. Some of the codes are also found in some paper-based systems, and some are unique to the computer-based system. It may not be necessary to use all of these codes in a particular system, but it is important that use of codes be consistent; i.e., the meaning is equivalent from one TO to the next in the data base, and from one automated TO to another. In addition, the use of symbol codes should be a redundant method of information transfer. The operation of the system should never be dependent on the technical writer entering the correct symbol, or on the user seeing, or understanding, that symbol. For example, the system must be programmed to respond, or not respond, to a particular valid keyboard input whether or not the coding of the displayed data indicates that it is, or is not, a selectable entry.

Table 3-10 identifies the symbol codes which have been defined for use in the baseline automated delivery system formats. The following paragraphs briefly describe details of their use. If additional symbol codes are found to be needed for a particular system, or type of technical information, every effort should be made to ensure that the meaning is clear, there is no conflict with the standard codes, and the system is capable of presenting the symbol code so that it is easily recognized by the user.

3.8.7.2 <u>Selectable Function, Callout, or Menu Item</u>. Brackets ([ ]) are used to designate that some information in the body of the frame or in a prompt can, or should, be selected or input at the keyboard. In addition, it visibly sets off the reference or callout from other screen data. This symbol is the most extensively used of the symbol codes, appearing at least once in every frame of data. Since it is unique to an interactive system, it has no counterpart in paper-based TOs. Use of brackets varies with the type of data with which it is associated and the response which is expected of the user. In prompts and advisories, the name of a keyboard function key may be contained within the brackets, e.g., [ENTER] or [FORWARD]. In-text and illustration callouts may show the appropriate selectable number or letter

Table 3-10

Symbol Codes Used in Interactive Formats

Symbol	Definition	Reference
[ ]	Selectable function callout, or menu item (key codes and index codes) Examples: [A] Index key "A" [23] Index keys "2" & "3", e.g., "23" [ENTER] Function key "ENTER"	Figures 3-5, 3-6, 3-15
* *	Non-selectable callout Examples: *2* *A* *125* *F*	Figure 3-15
#	Change in text or illustration	Figure 3-6
	Question must be answered before proceeding	Figure 3-6
	Prompt or advisory on this line	Figure 3-7
Ø	Numeral "zero," when not otherwise distinguishable from letter "O" Example: T.O. 1ØP3-ASQ-99	
	Notes and footnotes in illustrations Examples: 	Figure 3-14
———→	Leader line for illustration callouts	Figure 3-15
++++++++	Delineates WARNING message	Figure 3-16
''''''''	Delineates CAUTION message	Figure 3-16
--------	Delineates in-text NOTE	Figure 3-16

within the brackets, e.g., [B] or [23]. In certain cases the brackets may be empty. This may occur in prompts to show the need for input of a selection; e.g.,

> FOR BREAKDOWN ILLUSTRATION: INPUT FIGURE NUMBER [ ]; [ENTER].

When the user makes a selection on the keyboard, the number will appear within the brackets of the prompt to permit the user to verify its accuracy before entering the request. Similarly, on menus and lists empty brackets are placed at the top of a column of item designators to show that all designators, unless otherwise coded, are selectable on the keyboard. This eliminates the necessity for placing each menu designator within brackets. Figures 3-6 and 3-7 showed many of the uses of the bracket symbol. For other examples, see the format samples in this and subsequent sections.

a. Key codes and index codes. Letters, numbers, and words appearing on the screen which are selectable using the control unit keyboard will be denoted by brackets ([ ]). When these appear in the text or in prompts, or as callouts in illustrations, the brackets will enclose the code; e.g., [2], [A], [3B], [FORWARD]. The right-hand bracket will always be followed by either a blank space or normal punctuation. When codes are used in column format, as in menus and lists, the brackets will be placed at the top of each column of selectable codes to denote that all codes in the column are selectable unless otherwise coded. Preferred practice is to place the brackets immediately beneath the column title; e.g., INDEX or KEY.
[ ] [ ]

In instances where space is a problem and the placement of brackets would require use of a line which will be blank otherwise, the brackets may enclose the column title; e.g., [INDEX] or [KEY]. This usage should be avoided to the extent possible since there are no keys on the control unit with these names.

b. <u>Key code and index code content</u>. Codes may consist of one or more number or letter characters, separately or in combination. Whenever possible, use an already available code; e.g., in IPBs use the index number as the index code. When there are no constraints based on other frame contents, follow these preferential usage rules:

- When a column will contain fewer than ten (10) codes, use single-digit numbers.
- When a column will contain from ten (10) to twenty-six (26) codes, use single-digit letters.
- When a column, or multiple columns in the same frame, will exceed twenty-six (26) codes, use multi-digit numbers.
- When two (2) different columns are needed on the same frame (to select different kinds of data from the same line description), title one column "INDEX" and use number-based codes. Title the other "KEY" and use letter-based codes.

When a number-based code requires further definition, e.g., if there are three options for the same index number, use letter suffixes and/or prefixes: 7A, 7B, 7C or AP3, AP4, AP5. Suffixes should be used in preference to prefixes. In a column of letter-based codes, suffix and/or prefix numbers may also be used.

c. <u>Non-selectable codes</u>. When it is necessary for text or lists to include codes that are <u>not</u> selectable, but which may be confused with those that are selectable, the code should be preceded and followed by asterisks rather than brackets (see subparagraph 3.8.7.3).

d. Columns of codes. The width of columns of index codes and key codes will depend on content. The minimum width in all cases will be two (2) character spaces, one for a code character followed by at least one blank space. The maximum width will normally not exceed six (6) spaces, comprising five (5) alphanumeric characters and one (1) blank space.

e. Column justification. When a column of codes is either all numeric or all alphabetic, the column should be right-hand justified. When a column of codes contains both numerics and alphabetics, whether as basic codes or as suffixes, the column should be justified on the "units" of the numeric codes. Alphabetic codes and letter suffixes to numeric codes will be in the column which follows the justification column. In the event that alpha codes in a mixed column require more than one character, e.g., AA, AB, the last letter of the alpha code will be placed in the space following the justification column, with the code extending to the left. Example:

```
 98
 99A
 99B
100
   Z
101
  AA
  BB
```

3.8.7.3 Non-Selectable Callout. Double asterisks (* *) are used to designate that a particular callout or reference which appears in the text or illustration is not selectable on the keyboard. As with the brackets used for indicating that the callout is selectable, the symbols help to designate, or set off, the reference or callout, e.g., *123*, to assist in distinguishing between the callout and other letters or numbers which may appear on the frame, e.g., values. Asterisk symbols are shown in Figures 3-6 and 3-7. The code should always be used when space permits, and is especially important if the user could be confused about which callouts are selectable and which are not. On some complex diagrams and illustrations, where adding the codes to the callouts would significantly degrade the quality of the illustration, other methods of clarifying the issue will be needed.

Two notes are in order regarding the use of asterisks as a symbol code. The first is that asterisks are sometimes used in both text and illustrations of paper-based systems to reference a note or footnote. Since this practice is not intended, or necessary, in an automated delivery system, and footnote asterisks are not "paired" with a callout, the use of these codes should not represent a conflict with other uses. The second consideration is the style, and size, of the symbol. The asterisks used in the examples in this document are 5-pointed, e.g., *. This choice was partly one of convenience, and partly because a 5-pointed asterisk is more easily resolvable by the eye than is the 6-pointed asterisk, e.g., ✱ , of the same size. Some displays, however, may use a 6-pointed asterisk as a standard character, and some may more economically use 6-pointed asterisks. In a vector-type display, for instance, a 5-pointed asterisk requires five vectors to "draw" it, while a 6-pointed asterisk requires only three vectors. If it appears that a 6-pointed asterisk should be used, the size of the symbol may need to be increased in order to enhance discrimination.

3.8.7.4 <u>Change in Text or Illustration</u>. The symbol "#" is used for a marginal indication that some portion of the data on that line has been changed, including additions and deletions. The symbol is placed in the left marginal space, outside of the defined area or (in multi-column formats) in the space between columns to the left of the affected entry. Specifications for preparation of paper-based TOs generally require some indication (vertical bars, etc.) of the location of the changes on revision pages, and this symbol serves the same purpose. (Also see discussion at paragraph 3.8.4 regarding the use of the frame code for indicating revision status of the frame.)

Change coding requirements have sometimes been challenged on the grounds that the fact of a change is irrelevant, since USAF technicians are required to perform maintenance, etc. in accordance with the TO, and not from memory. A technician who has never performed maintenance with a procedure showing that a particular passage has been changed will derive little benefit from the information, whether in hard copy or on a video screen. On the other hand, technicians who have performed a task repeatedly over a period of time may continue to perform it that way without realizing that it has been changed if some method of emphasizing the change is not used. Change marking also facilitates a review of differences when new "change pages" are being placed in paper TOs.

The value of change marking in an interactive system of the baseline configuration may be both more and less significant than in a paper-based system. Systems which provide for automatic (as far as the user is concerned) update and correction of the data base make it difficult for the user to know of, much less compare, the changes from the earlier data unless some emphasis is marked. Conversely, automatic update of technical data may (and should) result in much more frequent and timely correction of data, but only the last change will be noted on the frame. In addition, while paper-based TOs have marginal space to spare, video screens have very little, and some systems may have none in which characters or symbols can be displayed. This would require use of valuable content area, and further degrade the presentation of useful and necessary information.

As long as change marking of TOs is required, the method presented here is recommended as being the simplest and contributing the least amount of distracting clutter on the screen. Alternate methods such as highlighting changes only on demand through a keyboard input may be feasible in the future.

3.8.7.5 Prompt and Question Markers. These two codes are discussed together since the same basic symbol is used for both: . The marker is placed at the left margin of the content area and points to a prompt to the user, or a question which must be answered before the user can obtain the appropriate next frame. A question mark is placed in the symbol, e.g., ?, to denote such a question. The symbol preceding the related prompt at the bottom of the frame will also include the question mark. If a user attempts to bypass making a choice (e.g., YES or NO), the system should either:

- Default to a neutral frame, such as an options list, or
- Present an advisory error message with instructions for making a choice.

The question symbol is used only for questions where a choice must be made, either to instruct the system on which next frame is needed based on results found during performance of a task (see Figure 3-6), or to prevent the technician from continuing a maintenance procedure without at least acknowledging the potential existence of a hazardous condition (see Figure 3-13). Both of these possibilities are further illustrated in the format samples and guidelines in later sections. In addition, specialized variations on the use of the prompt/question symbol are described and illustrated in Section 8.0 in connection with the discussion of Track 2 LTTAs. When the nature of the prompt is routine, the question mark is omitted from the prompt symbol, as shown in Figure 3-7.

```
#  TO 1C-141A-2-AA              73-1Ø-ØØ            5JG Ø3598D
#  4-3: INPUT CONDITIONS, CONTINUED.                          3

   • EQUIPMENT CONDITIONS:

   +++++++++++++++++++++++ WARNING ++++++++++++++++++++++++
    THE FOLLOWING EQUIPMENT CONDITIONS MUST BE MET BEFORE
    DOING THE TASK YOU HAVE SELECTED.
   ++++++++++++++++++++++++++++++++++++++++++++++++++++++++

   - HAS FUEL FROM TANKS BEEN SHUT OFF FOR APPLICABLE ENGINE
     AS SHOWN BY:
       - FIRE EMERGENCY HANDLE *1* PULLED AND TAGGED?
#      - ENGINE FIRE EXTINGUISHER CIRCUIT BREAKER *2* OPEN AND
#          TAGGED?
```

```
#      ARE BOTH CONDITIONS VERIFIED? INPUT [YES] OR [NO] [   ];
#      [ENTER].
```

Figure 3-13. Example of use of question marker symbols for hazardous condition verification.

3.8.7.6 Numeral Zero. The characters representing the letter "O" and the number "0" (zero) are frequently so similar, if not identical, that readers cannot tell the difference. Ordinarily, when the character is in context, there is no problem. Often, however, the context is not apparent or does not help. Because of this it is necessary to be able to discriminate between the two characters. For purposes of standardization, the method for providing discriminability should be applied throughout the data base, not just when the writer believes that confusion might result. The preferred solution, obviously, is to use characters with different characteristics that are easily recognizable as the letter or number they represent. The character sets which are standard for many displays have zeros and Os which are different and, with use, become recognized as the number or letter without confusion. However, when such discrimination is not readily available, one of the characters should be altered. The practice followed in these guidelines is to place a slash mark through the number zero (Ø). This is the recommended approach.

3.8.7.7 Notes and Footnotes in Illustrations. The graphics and legends which make up an illustration cannot always provide a completely clear representation of configuration or other characteristics. Common practice is to provide a note, usually referenced by a number or letter placed in a circle, box, or triangle. The standard approach used in these samples is the number and triangle: △7 . Care should be exercised in the use of notes. In hard-copy illustrations such notes are often used to reference differences in configuration between various series or models of equipment. In a computer-based system each configuration should be represented independently, with appropriate identification, as part of the mini-TO concept. Notes should be reserved for circumstances which cannot be shown graphically, or to provide a reference to related configuration illustrations, etc. Figure 3-14 provides an example of the use of notes in drawings and illustrations.

3.8.7.8 Leader Lines for Illustrations. Many variations of leader lines to connect a callout to a particular component or characteristic are used in TO drawings and illustrations. The preferred practice for automated applications is a single, straight line with a filled arrowhead: ───▶ . The use of the arrowhead to point to the component is recommended to aid in determining where the leader line ends, since this is often a problem in detailed drawings and may be particularly so in computer-generated video displays. Leader lines should never cross, and should consist of a single straight line whenever possible. Figure 3-15 depicts several examples of the use of this symbol.

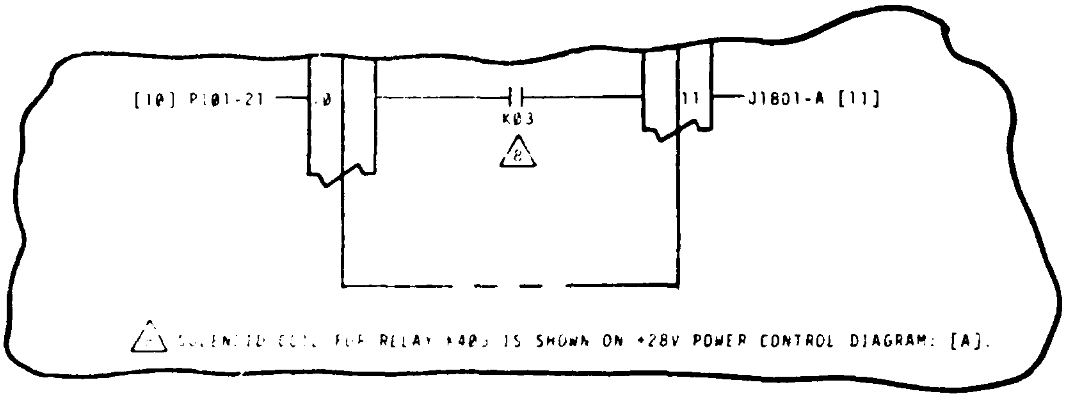


Figure 3-14. Example of the use of the note symbol in illustrations.

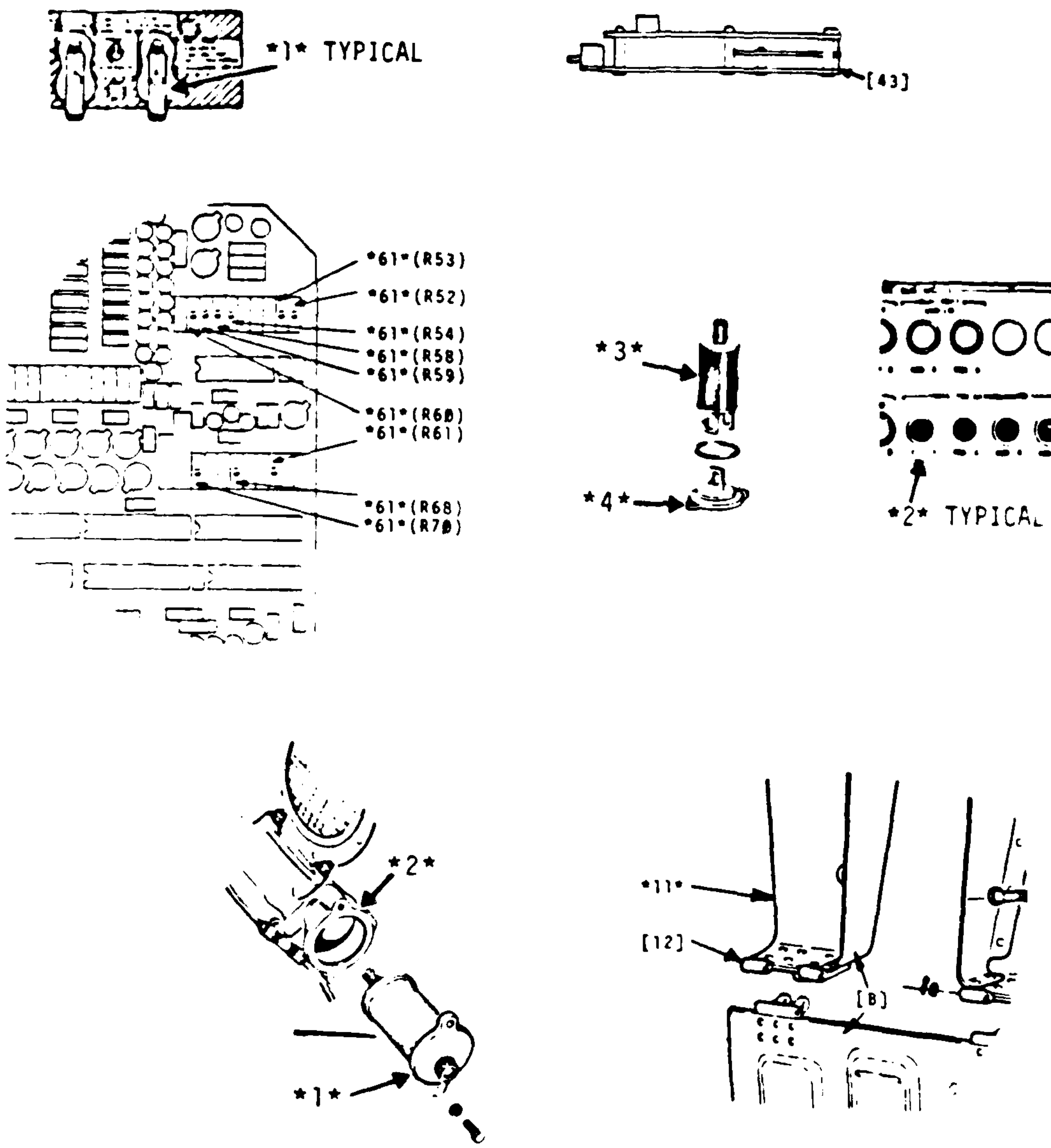


Figure 3-15. Examples of the use of leader lines in illustration callouts.

3.8.8 Warnings, Cautions, and Notes

AFTO specifications are fairly consistent in requiring special attention to the manner in which warnings, cautions, and notes are displayed on the pages of paper-based TOs. Military Specification MIL-M-38784 provides the basic requirements to the extent that technical content specifications do not provide specific requirements. MIL-M-38784A defines these three types of data as follows:

- Warning: An operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in injury to or death of personnel.
- Caution: An operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.
- Note: An essential operating or maintenance procedure, condition, or statement, which must be highlighted.

The specification provides several acceptable methods for presenting warnings, cautions, and notes, all of which are intended to draw attention to the statement through highlighting, character size, page layout, etc.

The approach followed in this baseline program is generally consistent with the requirements of MIL-M-38784, but increases the use of symbolic highlighting and decreases the use of page layout factors which take up added frame content space. The recommended coding and layout of warning, caution, and note statements are illustrated in Figure 3-16. The symbols selected for the "borders" for each statement type are based on their perceived relative value in attracting attention to the statement, but at relatively little cost to the graphic capability and memory of the system.

++++++++++++++++++++++++++ WARNING ++++++++++++++++++++++++++++++
MAKE CERTAIN THAT ELECTRIC AND HYDRAULIC POWER IS OFF. A POWERED FAN THAT BREAKS LOOSE WILL CUT OR REMOVE FINGERS.
+++

'''''''''''''''''''''''''' CAUTION ''''''''''''''''''''''''''''''
CONNECT A 6 dB PAD (EDISON 800-P3) AND AN INLINE RF FUSE TO THE RF OUTPUT OF THE SIGNAL GENERATOR. ON LOW LEVEL RF INPUT RECEIVER TESTS, THE INLINE FUSE MAY HAVE TO BE REMOVED TO ELIMINATE INSERTION LOSS EFFECTS.
'''

--------------------------- NOTE -------------------------------
UNLESS OTHERWISE SPECIFIED, ALL TESTS ARE TO BE CONDUCTED WITH THE BW (BANDWIDTH) SWITCH IN THE WB (WIDEBAND) POSITION.

- Center the title in the frame, with one blank space before and after.
- Symbols are to extend from the left-hand margin to the right-hand margin.
- Indent text one space from the left-hand margin on all lines.
- Single line text which is less than one full line should be centered.
- Skip one line before the top symbol line and after the bottom symbol line which delineate a warning, caution, or note.

Figure 3-16. Conventions for warnings, cautions, and notes.

Warning and caution statements should always precede the procedural text to which they apply, but follow the header information. Notes can either precede or follow the text, but should generally precede it. In all cases, the border and the statement text should use the full width of the frame content area. Figure 3-13 illustrated placement of a warning statement on a typical frame of information. Additional approaches to highlighting warning and caution statements are discussed in paragraph 3.8.9 and, for color-capable display systems, in Subsection 3.9. Note, however, that these alternates are in addition to, not instead of, the guidance provided here.

3.8.9 Highlighting and Other Coding

3.8.9.1 General. Many other methods of coding are available for use, depending on system capability and coding needs. These include inverse video, brightness coding, and flashing. These methods are not only more easily accomplished with a computer-based video display than in paper-based systems, but some are not possible in a paper-based manual. As is true with the use of color, however, these capabilities can be easily misused, or serve no useful purpose, if they are not based on a specific need or are not applied in a consistent manner. For this program the following specific guidance applies.

3.8.9.2 Brightness Coding. In order for this method of coding to be effective, the contrast between two brightness levels must be great enough to ensure detectability by the user. Not more than three (and preferably not more than two) different brightness levels should be used for coding. The higher brightness level should always be used for the element to which the user's attention is to be drawn. Although brightness coding is not used in this program, it can sometimes be used effectively for applications such as:

- Highlighting a particular line of text or in a complex table when a cursor is used, to assist the user in locating and holding his place on a specific item of information.
- Highlighting a key code or index code and its related data in response to a keyboard input, to assist the user in verifying the selection accuracy prior to entering the request.
- Highlighting a feedback message, particularly an error message, to draw the user's attention to it.
- Highlighting warnings, cautions, and notes to further promote user detection and response.

When brightness coding is used, it should always be accomplished by increasing the brightness of the coded item rather than by decreasing the brightness of the remaining data, causing the latter to become less legible.

3.8.9.3 Flashing. Display coding by means of causing some portion of the display to flash on and off, or "blink," with different brightness levels is not recommended for presentations of the type being considered here with one exception (see paragraph 3.8.10). Best use of flash coding is for emergency types of conditions, where the user must take some response action rapidly in order to avoid or remedy a hazardous condition. This type of use could be appropriate for some types of operational procedures presentations, or in some kinds of test procedures where automated test equipment (ATE) is linked with the automated display system, considerations not present with the baseline system. Flashing should not be used in circumstances where the flashing message could remain on the screen for a period of time, such as while a particular procedural step or task is performed, since it then becomes distracting rather than helpful. The only application for this type of coding in the computer-based system is a blinking advisory message as described in paragraph 3.8.10. If flash coding is otherwise used, it should be reserved for only the most urgent warnings and the system must have the capability for canceling the flashing, either in response to an elapsed period of time or by providing the user with the capability of acknowledging the message through the control unit.

3.8.9.4 Inverse Video. Coding by the inverse video technique (i.e., by reversing the normal background-to-content relationship, e.g., from light on dark to dark on light) is one of the most effective video coding techniques when used consistently. It is effective in both achromatic and color presentations, although the "best" uses may be different in the two types of display. The guidelines for this program are to use inverse video only for the standard prompt message, to draw attention to the prompt while at the same time providing separation between the prompt and the rest of the displayed information. In so doing, if a feedback or advisory message is displayed after the prompt, it too will be more detectable than if it appears in the same manner as the prompt. Because of the costs involved in preparing paper-based materials, the samples which are used to illustrate format characteristics throughout this document do not show the prompt in inverse video. Figures 3-17 and 3-18 depict the use of this coding technique for the frame prompt, for dark-on-light and light-on-dark normal presentations, respectively.

3.8.10 Prompts and Feedback/Advisory Messages

The last three lines of each frame of data are reserved for prompts, feedback messages, and advisory messages. A particular frame of data will always have at least one prompt, describing to the user what needs to be done with respect to the data displayed, or to suggest probable alternative courses of action. The convention is to display the prompt in inverse video as shown in Figures 3-17 and 3-18, with each prompt preceded by a pointer. Prompts should be concise statements that begin with what is to be done (or what can be obtained), followed by the means of accomplishment. A single prompt should, if possible, be complete on one line. Only one prompt will be needed for most frames. As a general rule, frames should not exceed two prompts, leaving the remaining space for feedback and advisory messages.

Feedback and advisory messages will only appear on the screen in response to some action by the user. Feedback messages are a result of normal interaction with the system, such as providing the technician with the meaning of a particular choice he has made in a logic tree troubleshooting procedure (see Section 8.0) or reminding the user that the system is in the review mode. Feedback messages are also the basis for structuring user interface with the system when the technician selects the user request mode of operation (see Subsection 3.6). In this case the feedback message becomes a special prompt for inputting the user request and disappears from the screen when the request has been satisfied or canceled. As shown in Figures 3-17 and 3-18, feedback messages will normally be displayed on the next available line of the prompt area.

Advisory messages are different from feedback messages only in meaning. If a user makes an error that is recognizable by the system (e.g., selecting a key code that is not among the displayed, available choices), requests information that is not in the data base, or performs similar incorrect interactions, an

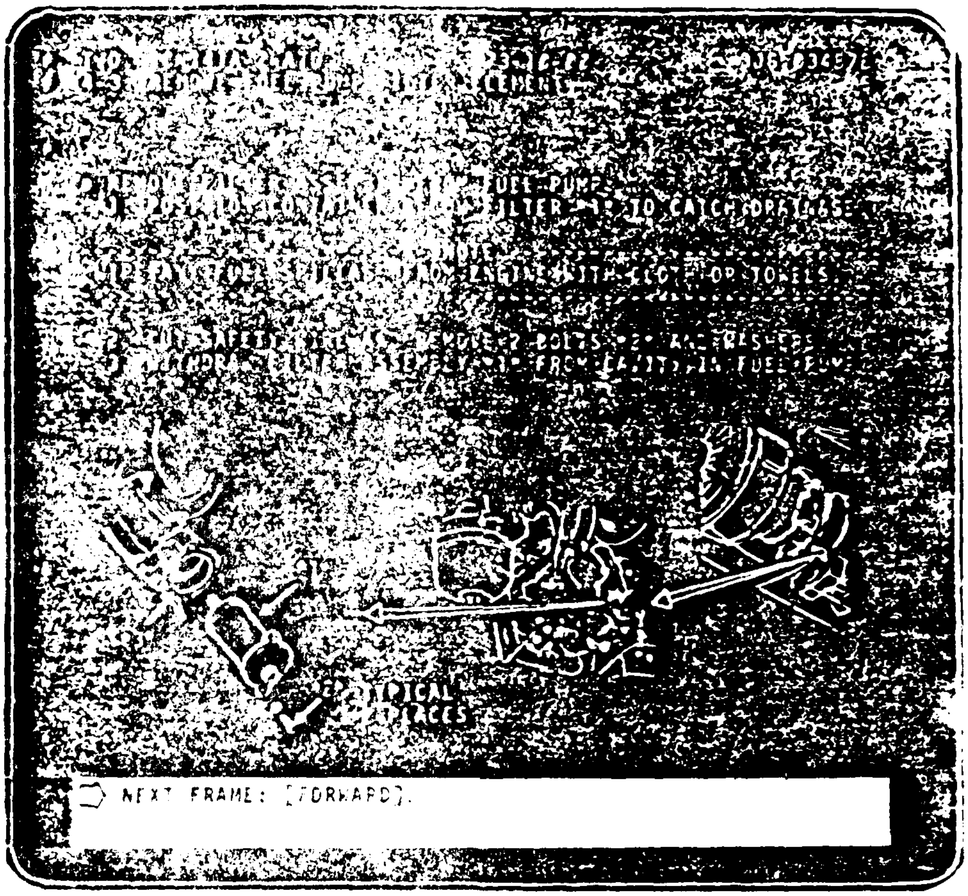


Figure 3-17. Example of inverse video coding of prompt and feedback messages (normal light on dark background).

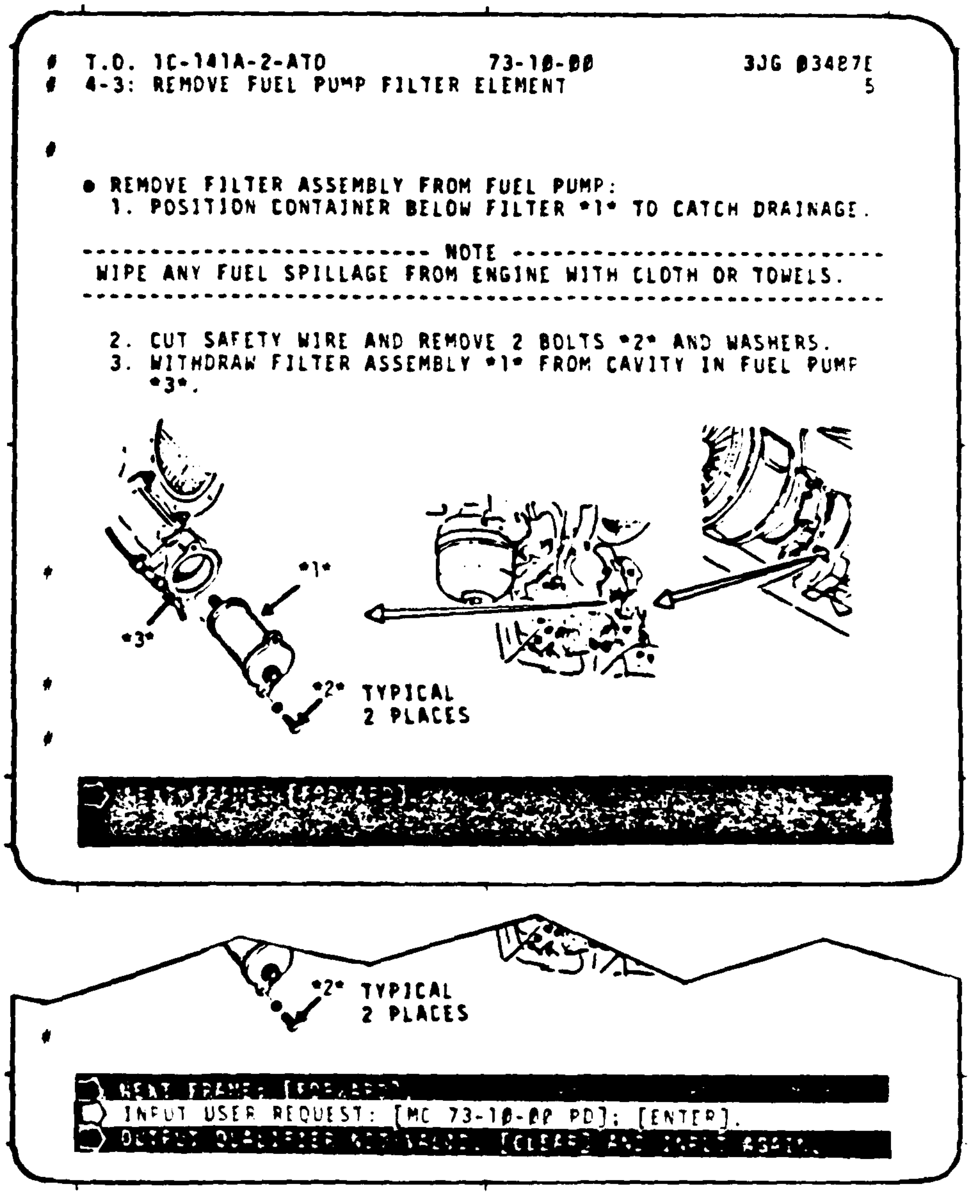


Figure 3-18. Example of inverse video coding of prompt, feedback, and advisory messages (normal dark on light background).

appropriate advisory message is displayed on the last line of the prompt area. The advisory message should state what was done incorrectly and provide a prompt to assist in correction of the problem. Examples of possible advisory messages include:

INCORRECT CODE INPUT. [CLEAR] AND INPUT AGAIN.

DATA NOT AVAILABLE. NEED HELP? [LIST OPTIONS].

[FORWARD] KEY NOT AVAILABLE. [CLEAR] AND MAKE A SELECTION.

Advisory messages will replace any standard prompt or feedback message that may already be on the last line of the prompt area, and will disappear when the user presses the [CLEAR] key or takes the suggested corrective action. Advisory messages should be highlighted to obtain maximum contrast with the prompt and feedback messages which may also be displayed. If the prompt is in inverse video and a feedback message is present in normal video, the advisory message should be in inverse video and should be a blinking message to attract attention. Figure 3-18 included an example of an advisory message along with a standard prompt and a feedback message.

3.8.11 Callouts Between Text and Illustration

Many frames of data will include text references to equipment and components. When appropriate to the type of data being presented and the needs of the user, the referenced equipment and components should be illustrated on the same frame. The text (or table) should include a callout number, or letter in some cases, which is keyed to the component or equipment shown in the illustration. Callouts are preferred to the use of component names in the illustration. Names, which are sometimes lengthy, require increased display space, add clutter to the displayed information, and require more visual search if more than one component is referenced. In text the callout will immediately follow the name of the item. In tables the callout will usually be in a column which precedes the item name, but may be in a column which follows the name. The same callout number or letter will be shown associated with the illustrated component or equipment.

In both text (or tables) and illustrations the callout will be symbol-coded according to the convention described in subparagraphs 3.8.7.2 and 3.8.7.3 to show whether or not it is selectable (see Figures 3-6 and 3-7). In the illustration the callout preferably will be at the end of a leader line, as described in subparagraph 3.8.7.8, or in some cases placed directly on the illustrated component.

The sequence of callout numbering will normally be the same as the order of mention in the text, especially for single-frame presentations. For data that is presented in a series of frames, e.g., a Track 3 maintenance procedure, the sequence of numbering is determined by the order of first mention in the series of frames and maintained throughout the series. If the series of frames includes branching paths, the page sequence numbering convention described in paragraph 3.8.6 is used to determine the order of first mention.

To the extent feasible without violating these and other conventions, placement of callouts in the illustration should be in left-to-right and top-to-bottom order, or in clockwise order. In the latter case, if space permits and a full surround of callouts is used, the lowest number should be at the top-left, increasing in a clockwise direction. In most half-frame illustrations, where a full surround is not available, clockwise numbering should begin in the lower-left corner.

Although not planned in the baseline system, other methods for associating text references to illustrated equipment are available and should be considered. One potentially effective technique is the use of highlighting, either active or passive, which can reduce clutter by eliminating callouts in the illustration. With active highlighting, if the technician needs prompting as to the location of a component referenced in the text, he could press a function key (e.g., [BLINK]) and the referenced callout and associated component in the illustration would blink. In passive highlighting, if a line cursor is in use which causes each line of text to be highlighted (as a placeholder), the associated components of the illustration can be highlighted at the same time. Each of these methods has some advantages for skills improvement through OJT, but they both have the disadvantage of requiring additional user inputs through the control unit.

3.9 COLOR CODING

3.9.1 Introduction and Background

The use of color in conjunction with presentation of information has the potential for greatly enhancing the effectiveness of the presentation, regardless of the media by which the information is presented. Even though the baseline presentation system designated for the automated delivery system program is not color-capable, the increasing availability and comparatively more reasonable costs for color video systems make it almost inevitable that automated presentation of Air Force technical data will soon be accomplished "in color." The purpose of this subsection is to provide some guidance on such use of color so that the presentation will improve performance, not merely be more colorful. Unfortunately, this elusive goal is made more difficult since color illustrations cannot be used as examples in this report.

Although the use of color in information presentation is not new, there is a surprising lack of criteria based on research in color and its influence on performance. Military specifications and standards contain requirements for color coding of such things as equipment types and labels, placards, etc., but there is practically no information relative to the use of color in military procedures, and none that specifically applies to the presentation of such procedures via an interactive system. In general, military manuals do not use color at all, the exceptions being the use of shades of blue in the FOMM manuals, and the use of red for highlighting in some of the Army's SPA manuals. Neither system requires the use of color. A review (Ref. 8) of the literature for identification of research-based color-coding principles for CRT displays was only partly successful, since most of the limited research was performed using other media (i.e., CRT presentation was not a consideration). Nevertheless, some guidance can be provided based on the findings of the limited CRT color-coding research and by extension of the paper-based findings until more complete research-based criteria become available.

The findings of the limited literature review (Ref. 8) provide a basis for defining some guidelines for CRT color presentations, but they should be recognized as preliminary pending performance of directly applicable studies. The review and the findings dealt with the use of color for coding purposes; the aesthetic aspects of color were not specifically treated.

The literature review identified three color-coding uses which have strong support: (1) color coding can speed search tasks, (2) color coding can speed count tasks, and (3) highlighting can be an effective color-coding technique. The use of color also has some drawbacks: (1) increases in symbol size required to maintain legibility, (2) additional cost of color monitors, (3) increased computer and software requirements, and (4) additional format considerations so that color-weak or color-blind individuals can use the system.

One other significant conclusion is that color seems to impart qualities that other codes do not, and researchers have not yet determined what that unique color quality is. The reason for the strong user preference, attention-getting, and memory properties of color are not well understood.

3.9.2 Color Selection and Coding Principles

The use of color as a coding medium offers a valuable means of providing unambiguous, easily discriminable information to the viewer. Among other applications, color coding can aid in the perception of warning signals, the identification of functional relationships, and the association of displays with related controls. When used in a coding system, color should always be redundant with some other cue. The information provided by a particular color should also be indicated in some other form; e.g., location, orientation, alpha-numerics, scale indications. Color can be particularly useful as a means for organizing information and is especially effective as a means for coding low probability or very important events.

The benefits of color coding can be realized only if color is not used indiscriminately. Excessive use may, in fact, provide interference to effective performance. The same qualities which make color useful for coding can, if overused or inconsistently applied, result in unintended confusion and distraction. As colors are used more frequently and as the number of different colors used for coding increases, the attention-getting value of each color diminishes. Similarly, when a particular color has multiple meanings, it both loses its attention-getting quality and may lead to confusion or error.

All coding schemes must be learned. Learning of a color code can be facilitated by keeping the code simple and by taking advantage of common usage in everyday life. Complex or poorly designed coding systems will detract from, rather than enhance, performance. The following specific guidelines should be considered.

3.9.2.1 Redundancy. In all applications of color coding, color should provide redundant information. That is, the pertinent information should be available from some other cue in addition to color.

3.9.2.2 Number of Colors. The number of colors used for coding should be kept to the minimum needed for providing sufficient information and should not exceed 11. When used in close association, a lower number is preferred.

3.9.2.3 Meaning of Colors. The meaning, if any, attached to a particular color should be narrowly defined. When appropriate to context, red, green, and amber (yellow) should be reserved for the following uses:

- Red: Unsafe, danger, immediate action required.
- Green: Safe, no action required.
- Amber (yellow): Hazard (potentially unsafe); caution, attention required.

3.9.2.4 Consistency of Meaning. The meaning, if any, assigned to particular colors should be consistent across all applications.

3.9.2.5 Principles of Color Selection. The primary principle that should be applied in selecting colors for coding purposes which do not have the immediate safety implications of red, green, and amber is to ensure that each color is recognized as different from any other. Table 3-11 lists 22 colors of maximum contrast. Each successive color has been selected so that it will contrast maximally with the color just preceding it and satisfactorily with earlier colors in the list. The first 9 colors have been selected so as to yield satisfactory contrast for red-green-deficient as well as color-normal viewers. The remaining 13 colors are useful only for color-normal viewers.

Table 3-11

Twenty-Two Colors of Maximum Contrast
(Ref. 13)

Color Serial or selection number	General color name	ISCC-NBS centroid number	ISCC-NBS color-name (abbreviation)	Munsell renotation of ISCC-NBS Centroid Color
1	white	263	white	2.5PB 9.5/0.2
2	black	267	black	N 0.8/
3	yellow	82	v.Y	3.3Y 8.0/14.3
4	purple	218	s.P	6.5P 4.3/9.2
5	orange	48	v.O	4.1YR 6.5/15.0
6	light blue	180	v.l.B	2.7PB 7.9/6.0
7	red	11	v.R	5.0R 3.9/15.4
8	buff	90	gy.Y	4.4Y 7.2/3.8
9	gray	265	med. Gy	3.3GY 5.4/0.1
10	green	139	v.G	3.2G 4.9/11.1
11	purplish pink	247	s.pPk	5.6RP 6.8/9.0
12	blue	178	s.B	2.9PB 4.1/10.4
13	yellowish pink	26	s.yPk	8.4R 7.0/9.5
14	violet	207	s.V	0.2P 3.7/10.1
15	orange yellow	66	v.OY	8.6YR 7.3/15.2
16	purplish red	255	s.pR	7.3RP 4.4/11.4
17	greenish yellow	97	v.gY	9.1Y 8.2/12.0
18	reddish brown	40	s.rBr	0.3YR 3.1/9.9
19	yellow green	115	v.YG	5.4GY 6.8/11.2
20	yellowish brown	75	deep yBr	8.8YR 3.1/5.0
21	reddish orange	34	v.rO	9.8R 5.4/14.5
22	olive green	126	d.OlG	8.0GY 2.2/3.6

In addition, colors selected for coding should contrast well with the background on which they appear. Ambient lighting and method of generation of color coding will influence the apparent color of the coded element. Each color selected for coding should be evaluated on the type of CRT on which it will be used, not from hard-copy or surface colors.

3.9.2.6 Use of Color. The many hues (colors) and saturations (lightness and darkness) available in CRT displays are virtually limitless. Care must be taken to select the best colors and to specify their use such that they will be consistent with each other. Table 3-12 provides general guidelines for color selection.

Table 3-12
General Characteristics of Colors
Used in CRT Displays (Ref. 13)

Red—Good attention-getting color. Associated with danger.

Yellow (amber)—Good attention getting color. Associated with caution.

Green—A non-attention-getting color; easy on the eyes. Associated with satisfactory conditions.

Black—Normally used as the background color, i.e., the color of blank character spaces. Also used as the action character when reverse field coding is employed.

White—A non-attention-getting color. It should be used for standard alphanumeric text or tables where the information is contained in the characters and not the color. Might also be used for labels, coordinate axes, dividing lines, demarcation brackets, etc.

Cyan (light blue)—(Same as white)—Might be used in conjunction with white to provide some amount of noncritical discrimination (e.g., use cyan for tabular column headings and demarcation lines, use white for alphanumeric data).

Blue (dark)—Poor contrast with dark background. Not recommended for attention-getting purposes or for information-bearing data. Use for labels and other advisory type messages.

Magenta—A harsh color to the eye. Should be used sparingly, and for attention-getting purposes.

Orange—Good attention-getting color. Care must be taken that hue is selected to be readily differentiable from red, yellow, and white

3.9.2.7 Red-Green Combinations. Whenever possible, red and green colors should not be used in combination. Use of red symbols/characters on a green background should especially be avoided.

3.9.3 Application of Color-Coding Principles

This section applies some, if not all, of the color-coding principles and guidelines discussed above to the formats developed for the baseline automated system. The intent here is not to dictate which specific colors should be used for which purposes, but merely to focus on some acceptable methods for making effective use of color for presentation of maintenance information on CRTs.

3.9.3.1 Assumptions. Development of the guidance which follows is based on the following assumptions:

a. The CRT screen will have a dark (gray) background if background color is not introduced.

b. The control device may have the capability for controlling line-by-line "place-holding" through cursor movement, a capability which is not now planned.

c. Military specification requirements directing the use of red for warnings, hazardous situations, and similar emergency type messages will apply.

3.9.3.2 Principles Applied. The color-coding principles that have been applied in the guidance and examples which follow include:

a. Use high-contrast colors (including white on a dark background) to draw attention to the elements of the instruction.

b. Use relatively low-contrast colors for relatively non-important content.

c. Use color consistently in a series of presentations.

d. Use color to provide association between related elements of the frame contents.

e. Use as few different colors as possible in a single presentation, with seven as a maximum.

3.9.3.3 Guidance and Examples. Figure 3-19 illustrates, at much reduced scale, an example of a troubleshooting frame with light characters on a dark background. What this subparagraph will attempt to show, in black and white, is how up to seven colors can be used effectively for enhancement of the presentation and, it it hoped, of performance.

The colors which are used are light blue (cyan), white, red, orange, yellow, light green, and purple. With the screen background used, each gives fair contrast although some are obviously better in this regard than others. Cyan is used as the standard color of non-coded frame contents since it has relatively low contrast and little or no attention-getting value. Figure 3-20 illustrates, by masking the cyan-colored contents, the data on the frame which are color coded. The arrows between number callouts and illustration are in the non-coded color cyan to avoid color-coding elements of the illustration which have no equivalent element in the text. In trials where arrows carried the color code, there was some sense of it being a distraction rather than an aid to detection.

Using the same masking technique, Figure 3-21 highlights the use of the color red for the warning message and the associated step of the procedure. When shown as white on dark, the warning message and the procedural step stand out clearly. However, the color red has relatively low contrast against a dark background. To compensate, the warning message and the associated procedural step are color coded (red) in inverse video as is highlighted in the example.

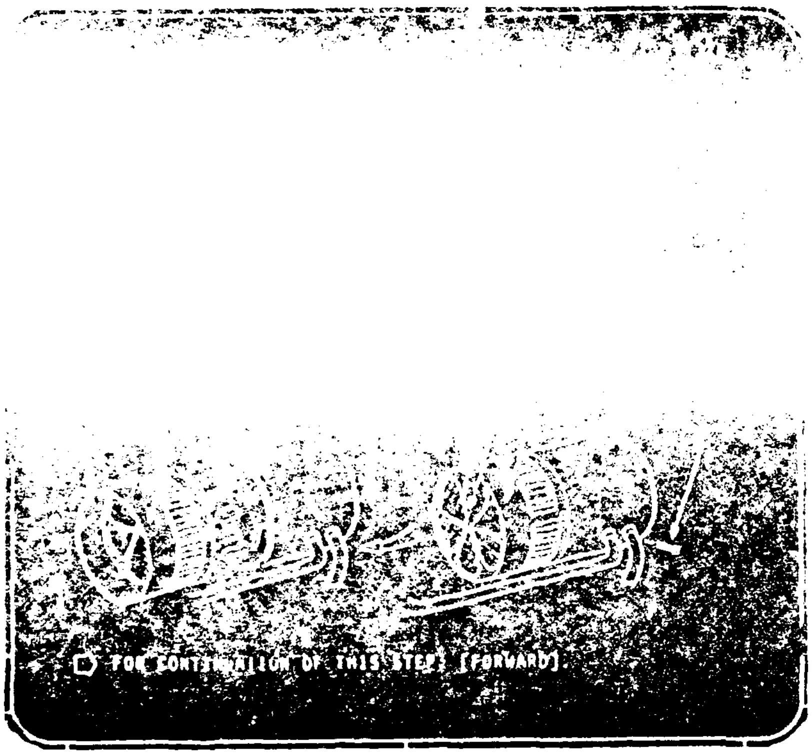


Figure 3-19. Example of troubleshooting frame for application of color coding principles--no coding highlighted.

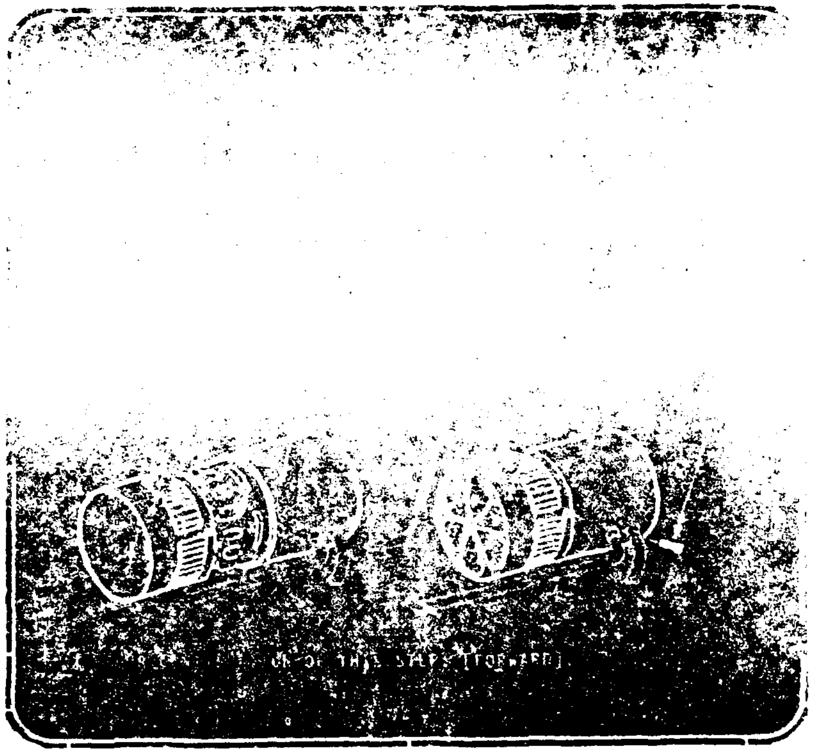


Figure 3-20. Example of troubleshooting frame for application of color coding principles--active (color-coded) information highlighted.

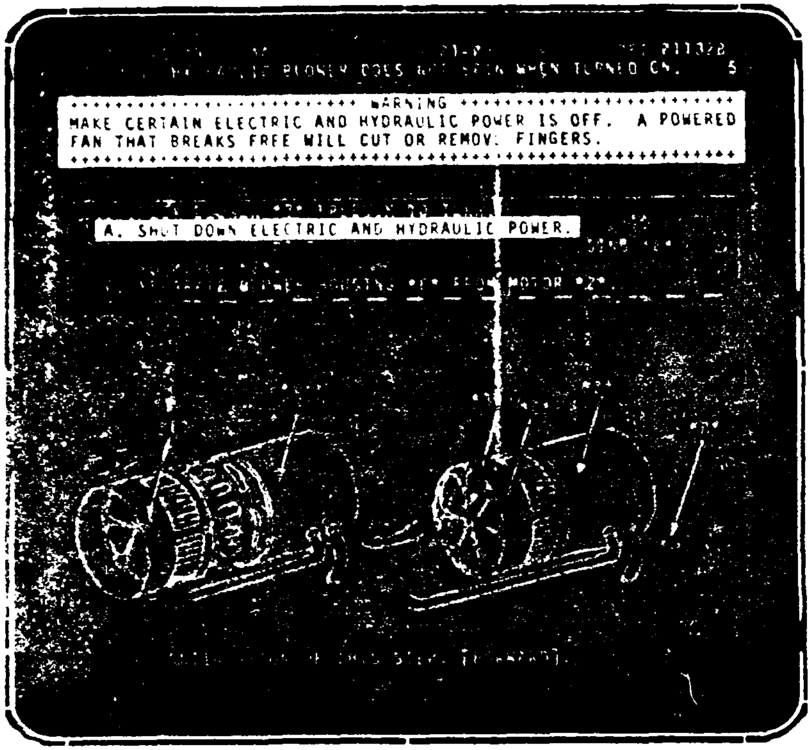


Figure 3-21. Example of troubleshooting frame for application of color coding principles--warning and associated procedural step in inverse video highlighted.

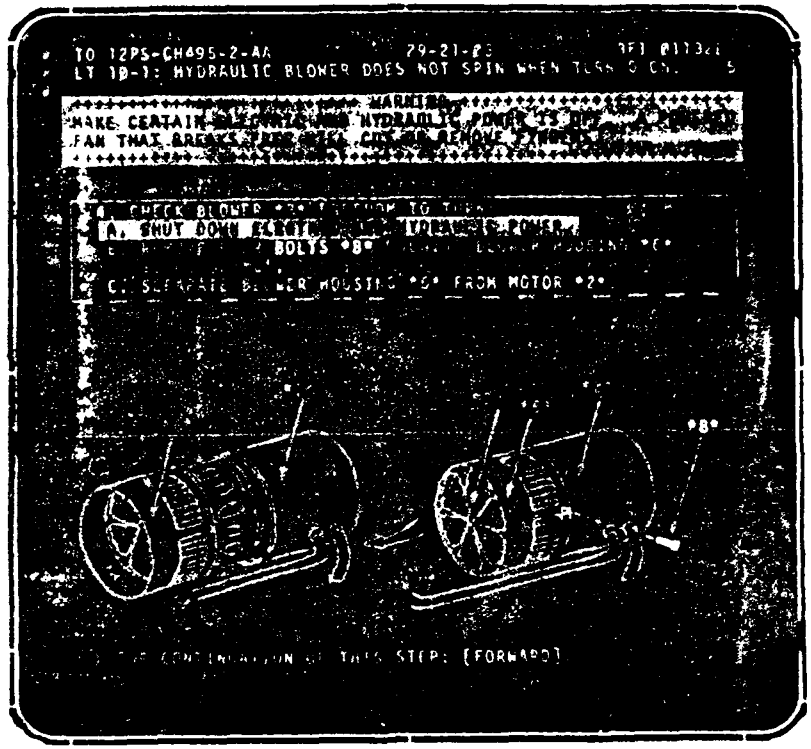


Figure 3-22. Example of troubleshooting frame for application of color coding principles--highlighting associated text and illustration elements (Example 1).

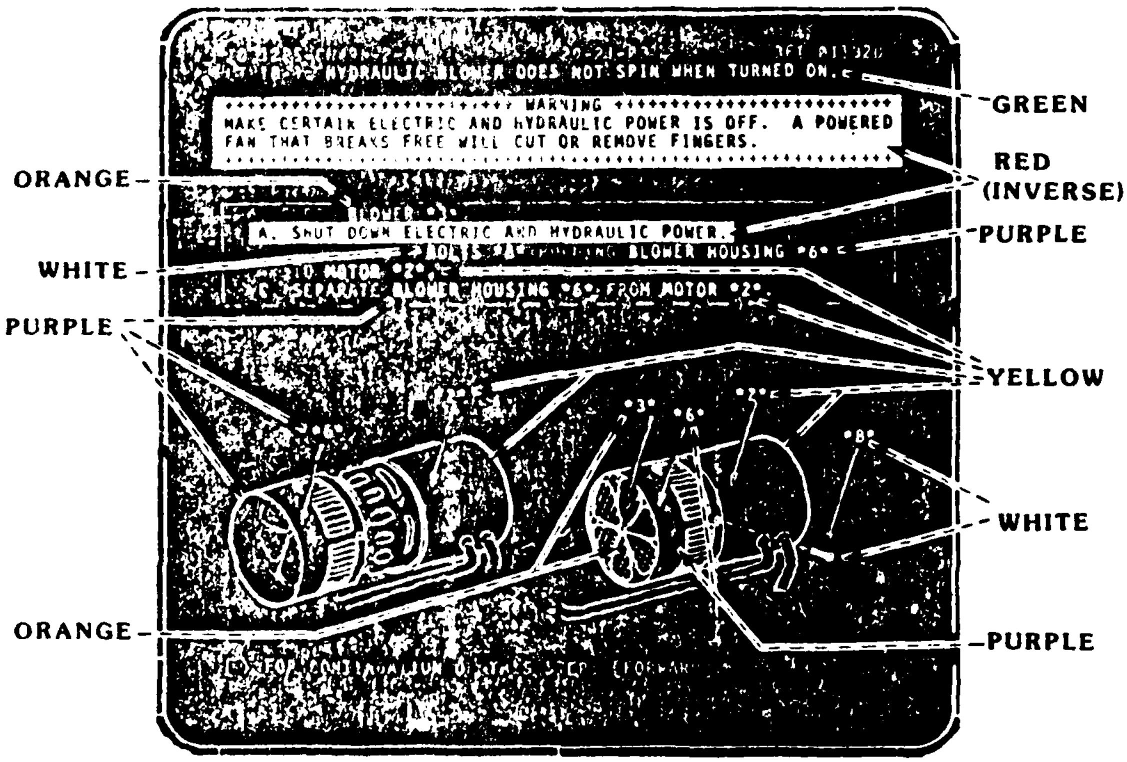


Figure 3-23. Example of troubleshooting frame for application of color coding principles-- highlighting associated text and illustration elements (Example 2).

Color can be used equally effectively to associate key elements of the procedural text with the appropriate portion of an illustration. In the following examples, each of the remaining colors was used to associate a term in the text with one of the components in the illustration.

To aid detection, the colors with highest background contrast were used for the smallest illustrated components. The color white was used for coding of the "bolts," as shown in Figure 3-22.

Assignment of the remaining colors is depicted in Figure 3-23. Note that in those instances where a particular component is named in more than one step the same color code is used. Similarly, in a series of frames on the same subject every effort should be made to use the same color for a particular component that is coded in each frame of the series of presentations. This will not always be possible in procedures which include many different components, but every effort should be made to preclude the color code for a particular component from changing in sequential frames of data unless there is a reason for it.

Even though color coding is used, numbered callouts are still used in the text and illustration to provide a means of association even if the color generator(s) should fail or if the user is color blind or color weak. To provided added search redundancy, the numbered callout is color coded the same as the component with which it is associated.

On systems which have the capability for toggling a cursor up and down the frame to "mark" the particular step in which the user is involved, the same approach as already described can be used with some modifications. Cursor movement could be used to activate the color codes on each line (and the associated components in the illustration) with all other data in the passive (cyan) color. This method can also be used with inverse color coding if appropriate.

The preceding discussion, guidance, and examples have been based on an assumed dark (gray) background. The same principles apply if the background is light, although specific applications and color selections may vary. In addition, and quite commonly on color CRTs, the background itself may be colored, either because it is the normal background for the display or because someone decides that a colored background is more impressive or attractive. Two cautions are in order:

a. Background color can have significant influence on the choice and application of colors used for coding purposes. Red and green, for example, should not be superimposed since this sometimes results in perceived color reversals.

b. Background colors should not be changed indiscriminately, as is often done in briefing types of presentations. If background color changes, it should signify an important difference in the nature of the information being displayed (e.g., procedural data versus pool data; or maintenance procedures versus troubleshooting procedures).

3.10 PRINT CAPABILITIES

The baseline system has very limited provisions for allowing the user to obtain paper copy of data displayed by the system. In fact, it was an initial system requirement that the automated delivery system obviate the need for <u>any</u> paper-based TO or related materials. Although this requirement was deleted during the course of the project, the system concept (including format characteristics) has continued to place little dependence on the availability of supporting printed material, or on the capability for obtaining a display printout.

It was recognized, however, that some information in the data base will have increased value to a technician if it is transportable, that is, if it can be used when the technician is out of view of the display device. For example, input conditions frames will list equipment, materials, and supplies that may be needed for performing a maintenance task. If the technician must go elsewhere to obtain such items, having a printout of the list will remove the need to make a handwritten copy or rely on memory.

Whether, and how extensive, a print capability should be provided is a decision that should be based on the anticipated needs of the user. In general, printout capabilities should be strictly limited. Otherwise, because of resistance to change factors, some technicians may print everything in order to have their own paper-based TO. In addition to defeating the purpose of the system, this would remove TO data from AFTO system controls. It would also increase the likelihood of erroneous or obsolete procedures being followed since corrections and changes would not be incorporated automatically.

If only certain data are to be made available in printout form, such data should not be on the same frame with data which should not be printed, and the prompt should provide appropriate instructions; e.g.,

FOR PRINT OF THIS LIST: INPUT KEY CODE [A]; [ENTER].

For more complete illustrations, see the input conditions examples in Sections 7.0 and 8.0.

If certain task sequences are to be made available in printout form, instructions for obtaining print copy should be included in the input conditions frame for the task. This might be appropriate in cases where equipment cannot be introduced to the site where maintenance is to be performed.

If printouts are to be generally unconstrained, the control unit keyboard should have a [PRINT] function key.

SECTION 4.0

DATA BASE ACCESS, FRONT MATTER, AND COMMON FORMATS

4.1 SCOPE

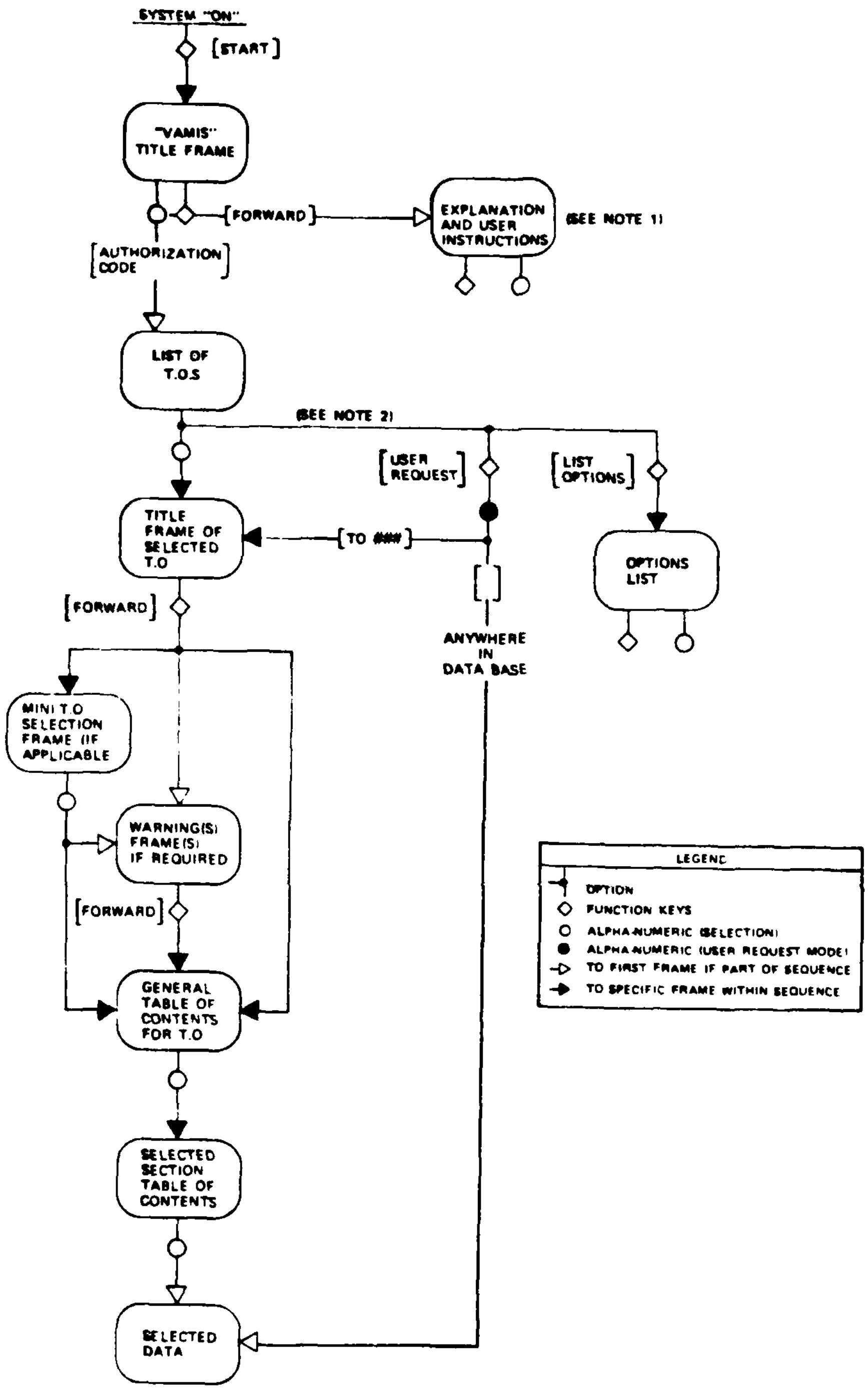
This section discusses the logic inherent in the system to aid users to gain initial access to particular data, the introductory frames which are accessed in the standard mode of operation, and the formats which are relatively common in all parts of the data base.

4.2 ACCESS PATHS

As with any TO, the user must first locate the correct "manual" before the data inside are of any use. Access to the data base is based on a specified logic which first ensures that the technician understands the automated delivery system and that he/she has been authorized to perform maintenance using the system, or otherwise has need to enter the data base. The standard access path then follows a process of assisting the user in defining needs, progressively narrowing the choices until the desired information is obtained. After gaining initial system access, experienced users can, if desired, bypass any portion of this "front matter" by going directly to the data they want in the user request mode. The essential steps in the access path are depicted in Figure 4-1.

4.2.1 Start-Up

There are two phases involved in system activation. The first step, not shown in Figure 4-1, is to power-up the system as a whole. This step will normally be accomplished by the shift supervisor, senior NCO, or other responsible authority, and is



NOTE 1 FULL ACCESS TO THIS PART OF THE DATA BASE IS AVAILABLE WITHOUT INPUTTING USER AUTHORIZATION CODE. SEE SECTION 9.0.

NOTE 2 USER REQUEST MODE AND OPTIONS LISTS ARE ALWAYS AVAILABLE AFTER USER SIGNS ON WITH VALID AUTHORIZATION CODE

Figure 4-1. Access paths for entering the VAMIS data base.

performed at the computer. It does not involve use of the control unit except as may be appropriate for testing. The second phase is to activate the control/display interface. This is accomplished by pressing the [START] key on the control unit. (If the interactive system in use is a portable, self-contained system, both activation steps are included in the START function.) The initial presentation on the display, an example of which is shown in Figure 4-2, identifies the system, a necessary step for first-time users, and provides guidance for entering the data base. (The name "VAMIS" which is shown in Figure 4-2 is for illustrative purposes only; i.e., that a name should be given to the system with which users can identify.) The brief explanation provided on this frame, dealing with the experimental nature of the system, will change when the automated system achieves operational status.

The initial frame provides instructions, in the expanded prompt area, for both authorized users and other personnel. Users who follow the first prompt are "signing on" the system, as discussed in paragraph 4.2.2. The prompt for other personnel is somewhat more detailed since such personnel may be totally unfamiliar with the system. Compliance with the prompt, pressing [FORWARD], takes the user to the non-TO portion of the data base where an explanation of the system and user guidance is provided. This aspect of the system is described in more detail in Section 9.0.

4.2.2 Signing On

Users who follow the first prompt on the system title frame (Figure 4-2) will use the Input portion of the control unit to enter their assigned authorization, or access, code. For a particular system the authorization code can be a simple password or a complex string of alphanumeric characters known only to the individual user, the responsible authority for the facility, and the computer. The baseline approach used here is to use the individual's service number/social security number (SSN) as the content of the authorization code. The response of the prompt to the user's input then would be:

AUTHORIZED USERS: INPUT AUTHORIZATION CODE [### ## ####]; [ENTER].

The computer compares the entered code with the list of codes for authorized users and, if acceptable, logs the individual onto the system. If the code is not valid, an appropriate advisory message is displayed and the individual is denied access to the data base.

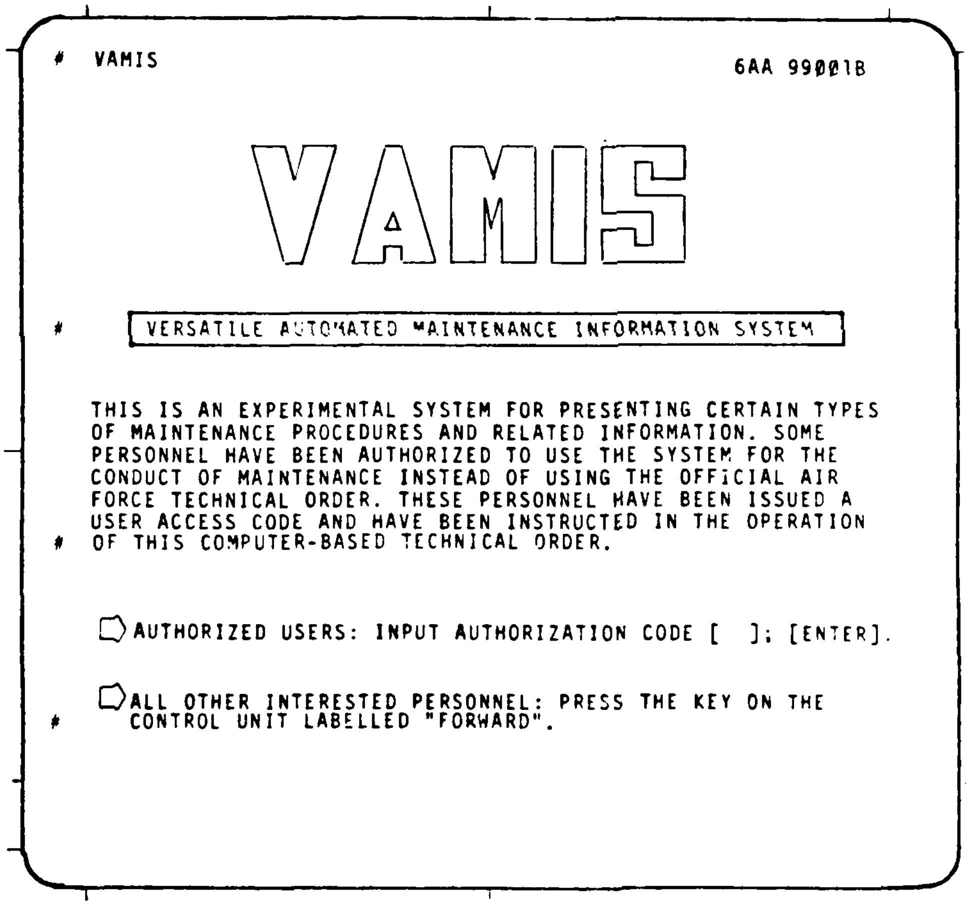


Figure 4-2. Example of VAMIS title frame and access instructions.

The signing-on process also accomplishes several other actions handled by the computer based on its programming. If any limitations on data base access have been placed on the particular user, e.g., only authorized to perform maintenance on certain systems, or not allowed access to specified levels of classified information, the computer will scale the available data base accordingly. The computer is instructed to provide the data at the level of detail specified for the individual user by a supervisor, or according to some other criterion such as AFSC/skill level. Users who automatically are presented technical information at less than the most detailed level (Track 3) will be able to obtain a more detailed presentation through use of the options list (see Figure 4-9). They will not, however, be able to obtain less detailed presentations than they are authorized until the computer has been so instructed by the responsible individual. This will normally occur when the user has demonstrated sufficient proficiency in performance at the assigned level of detail. It may also be appropriate to authorize different levels of detail for different TOs, and to authorize temporary presentations at less detailed levels for purposes of supervised OJT.

Note that once a user has signed on, the system will assume that the same individual is the user until he/she signs off (by pressing [STOP] on the control unit). In order to prevent unauthorized use of an unattended system that was left running, as well as inappropriate use by an authorized user, it is recommended that several other security provisions be programmed into the system:

- A clock that will shut down the system automatically if no control inputs have been made during a specified period of time, e.g., 30 minutes.

- A system-generated request to confirm the user's authorization code if data not directly related to that which has been in use are requested, in either the standard mode or user request mode of operation. Decision criteria such as the user's AFSC can be applied for this purpose.

4.2.3 Entering the Data Base

When an authorized user has correctly entered his/her code, and the system accepts it, the user is presented with the initial frame of information to assist entering the data base. As mentioned above, and illustrated in Figure 4-1, the user can access the information in either the standard mode or, if sufficiently knowledgeable of both the system and the data needed, in the user request mode of operation. Obtaining data in the user request mode, regardless of where the user is in the data base, is described in paragraph 3.6.4. Initial data base access in the user request mode is also discussed in Subsection 4.4.

4.3 STANDARD MODE ACCESS

Access to contents in the standard mode is based on selection from a series of menu-like tables of contents and specialized selection frames that progressively narrow the choices until the technician reaches the particular data needed. As in paper-based TOs, some required "front matter" frames are included in the sequence to ensure that the user is made aware of important information. With such frames the user acknowledges the presentation of the information by use of the [FORWARD] key (rather than by menu selection) to obtain the next frame. Since these menus and other front matter frames contain no procedural data for performing maintenance, they are, technically, pool data.

However, since they are necessary for gaining access to procedural data as well as pool data, they are formatted in accordance with the viewing distance criteria of procedural data.

4.3.1 TO Selection Frame(s)

Assuming that the system contains more than one TO in the data base, the first task of the technician is to select the particular TO needed. If the system is dedicated to a single TO, this frame is not needed. Conversely, if the system is part of a large, central shop system, there may be many individual TOs in the data base, requiring multiple frames for making the selection. (It is in these instances where the user request mode of access, as shown in the access path of Figure 4-1, may be quicker than menu selection.) Figure 4-3 illustrates an example of a typical TO selection menu, complete in one frame. Listed TOs should be in numerical sequence by TO number. If listings will be lengthy, e.g., for central systems, the user should have the alternative of selecting from a topical menu or index which presents the TOs alphabetically by equipment name, etc. Whichever method is used, selection of the key code associated with a listed TO obtains the title frame for that TO.

4.3.2 TO Title Frame

The TO title frame, an example of which is shown in Figure 4-4, has the same purpose and use as in paper-based manuals. It provides full identification of the TO which follows, including the currency of the contents, allowing the user to confirm that this is the TO wanted. Assuming that it is, the user presses [FORWARD] to obtain the next frame, the nature of which depends on the TO content. If it is not the desired TO, the user can return to the (first) selection menu frame by pressing [REPEAT SEQUENCE], or by pressing [LIST OPTIONS] and selecting the TO selection frame from the options list.

```
# VAMIS                                                 6AA 99002D
  TECHNICAL ORDERS AVAILABLE FROM VAMIS:

   KEY         T.O. NUMBER          TITLE
   [ ]
#   A    11B29-3-25-2-AA     AIRCRAFT BOMB EJECTOR RACK ASSEMBLY
                             MAU-12 FIELD MAINTENANCE AND
                             ILLUSTRATED PARTS BREAKDOWN.
#   B    12R2-2ARC164-2-AA   RADIO SET AN/ARC-164(V) INTERMEDIATE
                             MAINTENANCE INSTRUCTIONS WITH
                             ILLUSTRATED PARTS BREAKDOWN.




# FOR T.O. NEEDED: INPUT KEY CODE [  ]; [ENTER].
```

Figure 4-3. Example of list of Technical Orders in the VAMIS data base.

4.3.3 Other Front Matter

The next type of material to be presented in the accessing process depends primarily on TO content, as is illustrated in Figure 4-1. Possibilities discussed here, in the order of their presentation if used, are the model/series ("mini-TO") selection menu, warning frames, and general table of contents. Examples of some other formats that are typically included as front matter in paper TOs are presented in Section 5.0.

```
*  TO 12R2-2ARC164-2-AA            23-20-00            6GD 00001E


                         TECHNICAL MANUAL

                INTERMEDIATE MAINTENANCE INSTRUCTIONS


                     RADIO SET AN/ARC-164(V)


                     BIOTECHNOLOGY, INC.
                     CONTRACT F33615-82-C-0006


   THIS TO CONTAINS TOPS C101 DATED 23 MAY 1977,
                    TOPS C102 DATED 23 JANUARY 1978,
                    TOPS C103 DATED 25 MAY 1978, AND
                    TOPS C104 DATED 16 FEBRUARY 1979.


   PREPARED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

   30 JUNE 1981
   LAST CHANGE DATE: 30 NOVEMBER 1981


     WHEN YOU ARE READY FOR THE NEXT FRAME:[FORWARD].
     IF YOU NEED HELP:[LIST OPTIONS].
```

Figure 4-4. Example of VAMIS Technical Order title frame.

4.3.3.1 Model/Series Selection Menu. This format, an example of which is depicted in Figure 4-5, represents one of the more significant contributions which can be made by an automated delivery system. One of the serious problems that occurs in paper-based TOs is that after a hardware system has been fielded, the modification and improvement cycle generally begins. The result is that after a few years more than one version of the system exists, each of which must be accurately reflected in the TO. If the differences are extensive, separate TOs may be prepared for each model or series. Less extensive differences are likely to be reflected in a single TO with separate descriptions, procedures, and/or illustrations provided where differences exist for each of the models or series of equipment.

```
# TO 11B29-3-25-2-AA              94-10-00              6GD 000058
  MAU-12 MODEL/SERIES SELECTION MENU

# THIS T.O. HAS INFORMATION FOR MORE THAN ONE TYPE OF MAU-12
  EQUIPMENT. SELECTION OF THE TYPE OF SPECIFIC INTEREST IS
  NECESSARY AND WILL SIMPLIFY YOUR TASK.

  KEY    USAF TYPE       PART NUMBER              NSN
  [ ]
   1     MAU-12A/A        63J14360          1095-00-017-8902
   2     MAU-12B/A        64J13210          1095-00-758-8774
   3     MAU-12C/A        69J13060-1        1095-00-401-2664
   4     MAU-12C/A        69J13060-3        1095-00-025-5657
   5     MAU-12C/A        69J13060-5        1095-00-166-4286




  INPUT APPROPRIATE KEY CODE: [   ]; [ENTER].
```

Figure 4-5. Example of VAMIS model/series selection menu frame.

The philosophy is to provide a front-end method of selecting the particular model or series of equipment which is of interest, and letting the computer assemble a "mini-TO" which contains the applicable information. Some data in the mini-TO will be common to all models/series, some will be common to several but not all, and some will be specific to a particular model. In some instances it may be more appropriate for the model/series selection menu to come after the general TOC in the access path; e.g., when differences are at a level low enough that neither the warning frames nor TOC is affected.

Use of this approach has both significant advantages and important costs. During data preparation it will be necessary for the preparing activity to designate the model/series applicability of all of the data which is prepared, whether unique to a series or common to more than one series, and the applicability to each new frame, or revised frame, of data. Computer programming must be such that every applicable frame is assembled in the correct sequence, with no omissions and no inappropriate inclusions. The advantages are both to the user and to the data preparers. Once a mini-TO is assembled, there will be many fewer requirements for making a selection of the applicable model/series during the performance of a maintenance action, although this will still occur for parts differences below the model/series level.

4.3.3.2 Warning(s) Frames. These frames contain the general warning that applies to the system as a whole, or to the model/series selected. Requirements for such warnings and the content to be included are the same as for paper-based TOs. Construction of the warnings (and cautions, if applicable) should follow the same guidelines specified for in-text warnings and caution messages in paragraph 3.8.8.

4.3.3.3 Table of Contents (TOC). The standard mode of access and use depends heavily on the selection of the specific data of interest from table of contents menus. Figure 4-6 provides an example of a general table of contents frame from which the user will select the type of data he/she wants to access from the overall TO (or mini-TO). Figure 4-7 illustrates an example of a more specific table of contents, covering one particular part of the data base. Selection from a TOC at this level of specificity will normally yield the initial frame of the data wanted by the user.

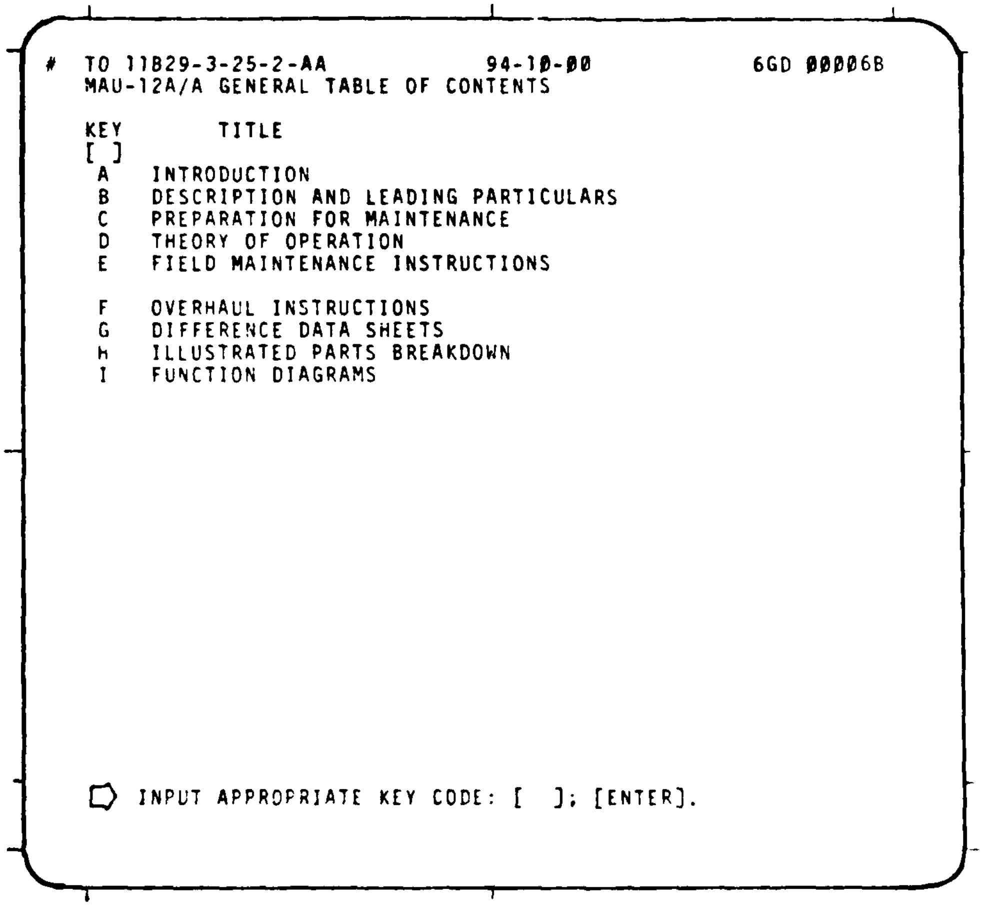


Figure 4-6. Example of VAMIS general table of contents (TOC) frame.

```
#  TO 1C-141A-2-AA                    73-ØØ-ØØ            6JG Ø7896D
   C-141A POWER PLANT: 4. ENGINE FUEL SYSTEM MAINTENANCE
   TABLE OF CONTENTS

   TASK                DESCRIPTION
   [  ]
    1  FUEL SHUTOFF DURING MAINTENANCE.
    2  FUEL PUMP - REMOVE & INSTALL.
    3  FUEL PUMP FILTER ELEMENT - REMOVE & INSTALL.
    4  FUEL CONTROL UNIT - REMOVE & INSTALL.
    5  FUEL CONTROL FILTER ELEMENT - REMOVE & INSTALL.

    6  FUEL DEICER FILTER AIR VALVE & ACTUATOR - REMOVE & INST.
    7  FUEL PUMP DIFFERENTIAL PRESSURE SWITCH - REMOVE & INST.
    8  FUEL FLOW TRANSMITTER - REMOVE & INSTALL.
    9  FUEL INLET PRESSURE SWITCH - REMOVE & INSTALL.
   1Ø  FUEL DEICER FILTER ELEMENT - REMOVE & INSTALL.

   11  FUEL SHUTOFF ACTUATOR - REMOVE & INSTALL.



   FOR DATA NEEDED: INPUT TASK NUMBER[  ];[ENTER].
```

Figure 4-7. Example of VAMIS procedures table of contents (TOC) frame.

The number of frames in between the general TOC and the specific TOC represented by these two examples depends primarily on the overall size of the TO and the type of information sought by the user. There may be several sectional title frames for specific parts of the data base, such as the Illustrated Parts Breakdown (IPB) and some intermediate-level TOCs. Each title frame and TOC should be prepared to the viewing distance criteria for the data encompassed by it.

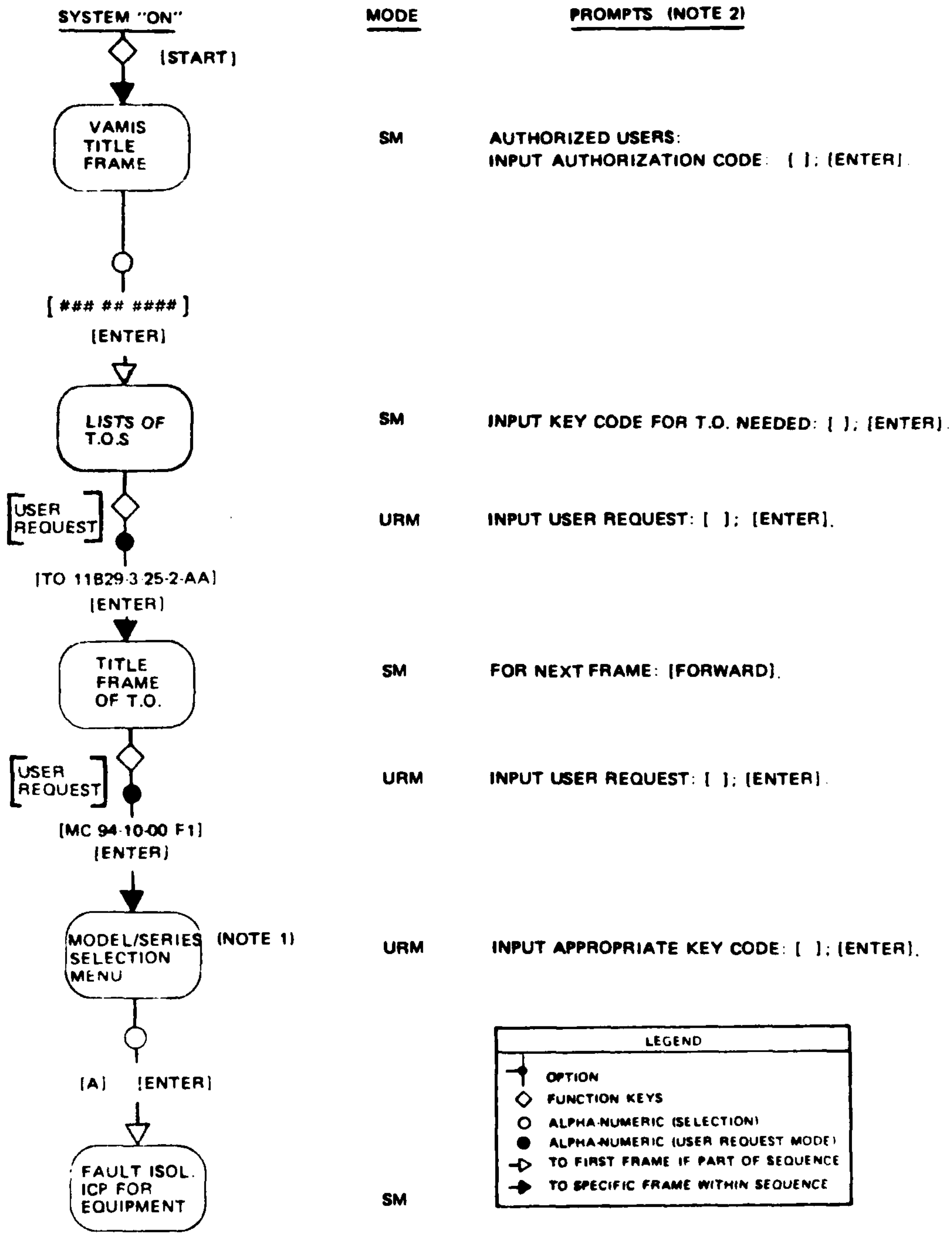
Construction of TOCs for greatest user efficiency is discussed in paragraph 4.5.1.

4.4 USER REQUEST MODE ACCESS

As was depicted in Figure 4-1, once the user has signed on the system, any part of the data base to which the user is authorized access can be entered in the user request mode. For the knowledgeable technician this can be a much more efficient path than entering via the standard mode. It is not necessary that the technician know the exact frame of data needed and what code combination is necessary to obtain it. Just knowing certain identifiers and how to interact with the system in the user request mode can produce significant shortcuts.

Figure 4-8 illustrates one way that a technician might access information in the user request mode, starting with the initial sign-on to the system. Definitions of the input/output qualifiers were presented in Table 3-7. Combinations of acceptable qualifiers and content identifiers were presented in Table 3-5.

The rule of thumb for the user request mode is that the system will provide the data requested (assuming they are available) even if they are not what the user expected or wanted. Thus, the burden is on the user to know what to request and how to request it. A second condition of user request mode interaction is that pressing [USER REQUEST] is necessary before <u>each</u> request since the system reverts to the standard mode as soon as the frame of data resulting from the request is displayed. One exception to both of these norms is apparent in Figure 4-8: If the data requested by the user must first be identified according to model/series, the applicable model/series selection menu (see Figure 4-5) is inserted in the sequence by the system. When



NOTES

1 THIS FRAME IS INSERTED IN SEQUENCE ONLY IF A MODEL/SERIES SELECTION MUST BE MADE IN ORDER TO PROVIDE THE CORRECT PROCEDURE.

2 THE SM OR URM PROMPT ON THE ASSOCIATED FRAME OF DATA.

Figure 4-8. Representative data access path in user request mode.

the technician makes a selection from the menu, the interrupted user request is then completed without re-input of the request.

4.5 COMMON FORMATS

Formats in the automated delivery system have many common characteristics. At the sub-format level, the codes and conventions discussed in Subsection 3.8 are used in all types of data. In procedural data, i.e., maintenance procedures and troubleshooting procedures, the logic (and to some extent the format) is the same for all three tracks, differing mostly in level of detail. Menus are used throughout the data base. The purpose of the menu is to permit the user to quickly and efficiently make a choice of types of information available. The two primary examples of menus are the table of contents, discussed above, and the options list.

4.5.1 Menus

Most menus will consist of two columns of information: listing of information within some category, and listing of associated codes, selection of which will access the information. In menus of this type, the selection codes should be in a column at the left margin of the frame. The listing of available information should be in a column to the right of the selection codes, with not more than five character spaces separation. If no natural hierarchy exists in the information listing, a line should be skipped at intervals in order to provide visual groupings of information. The maximum for interval spacing should be after every ten lines, with a preferred interval after every five lines. Selection codes should, if practical, consist of not more than two characters. When possible, the normal means of identification, e.g., task number, should comprise the selection code. When the information included in the menu has a "normal" order or sequence, it should be listed in that order. If there is no "normal" order, the information should be presented in some logical sequence or groups; e.g., by types of information. Where it can be determined, the sequence of presentation should be based on the likelihood of the information being needed by the user, if it does not disrupt a normal or logical sequence.

The simple menu can be presented in multiple columns if space permits and the type of data lends itself to this kind of presentation. Examples of multiple-column menus are included in the pool data examples in Sections 5.0 and 6.0. When multiple-column menus are used, a vertical line should separate the major columns.

In some cases it is appropriate to have more than one choice for a particular topical listing. For example, in the IPB the user can choose either a breakdown illustration or maintenance parts list from a single listing of major assemblies (see Figure 6-12 in Section 6.0). The selection code columns should be side-by-side at the left of the frame. The codes used should be distinctly different in each column; e.g., all numbers in the first column and all alphabetic characters in the second column.

4.5.2 Options List

The options list is a special purpose menu which is specifically oriented to the philosophy of data availability and presentation. While it is part of the standard mode of operation, it represents a compromise between the TOC accessing methods of the standard mode and the free accessing methods of the user request mode. The concept of the options list is that for every frame of data in the data base there are a relatively predictable, limited number of logical choices of related information which the user might need or want. Some of these choices will be specifically associated with the "reference" frame; others will be predictable choices even if they contain no technical information related to the reference frame. Figure 4-9 illustrates a typical options list such as might be associated with a frame of troubleshooting procedures.

```
*  TO 12PS-CH495-2-AA              29-21-03            2FI 01488C
   LOGIC TREE 10-1 OPTIONS LIST

   KEY                  OPTIONS
   [ ]
    A     MORE PROCEDURAL DETAIL
    B     LESS PROCEDURAL DETAIL
    C     ACCESS & LOCATOR DIAGRAM, HYDRAULIC BLOWER
    D     ILLUSTRATED PARTS BREAKDOWN, HYDRAULIC BLOWER
    E     SCHEMATIC DIAGRAM, HYDRAULIC BLOWER (SD 247890)

    F     WIRING DIAGRAM, HYDRAULIC BLOWER (WD 2375-34)
    G     CHECKOUT 10-2, HYDRAULIC BLOWER UNIT
    H     THEORY OF OPERATION, HYDRAULIC BLOWER UNIT
    I     TEST EQUIPMENT SETUP, HYDRAULIC BLOWER TESTS
*   J     TABLE OF CONTENTS, TO 12PS-CH495-2-AA

*   K     INDEX, TO 12PS-CH495-2-AA
    L     GLOSSARY
*   M     VAMIS USERS' GUIDE
    N     GENERAL OPTIONS LIST
    O     REVIEW MODE

*   P     USER RECORD



*  FOR INFORMATION WANTED: INPUT KEY CODE[  ]; [ENTER].
```

Figure 4-9. Example of VAMIS options list frame.

The reference frame for the options list in this example is a Track 2 logic tree frame for fault isolation (see Figure 8-5 in Section 8.0). The options list would be accessed by the user by pressing [LIST OPTIONS] on the control unit. The reasons for wanting the options list could vary from simple curiosity, to needing specific supplementary information, to needing help. The options list should always include the option for change in level of detail (either more or less, if available).

Track 2 and 3 options list should always show less detail as an option; Track 1 and 2 options list should always show more detail as an option. If a user who is not authorized to use a less detailed track selects that option, an advisory message should be displayed which states why less detailed data are not available. This approach will still provide a means by which the more experienced tecnician who has selected more detailed data can get back to the original, less detailed track. It should not include choices that the user could have made, either directly or indirectly, while viewing the reference frame. For example, troubleshooting with the logic tree requires the user to answer yes or no to a series of questions regarding the conditions found. Inputting those answers accesses other parts of the logic tree or other logic trees or maintenance procedures which would be needed to continue. If the same data were made available via an options list, the user could bypass answering the logic tree questions, casting doubt on the thoroughness of the fault isolation activity. If none of the options listed are of interest to the user, the reference frame (from which the user accessed the options list) can be obtained by pressing [RETURN] on the control unit.

SECTION 5.0
POOL REFERENCE DATA

5.1 INTRODUCTION

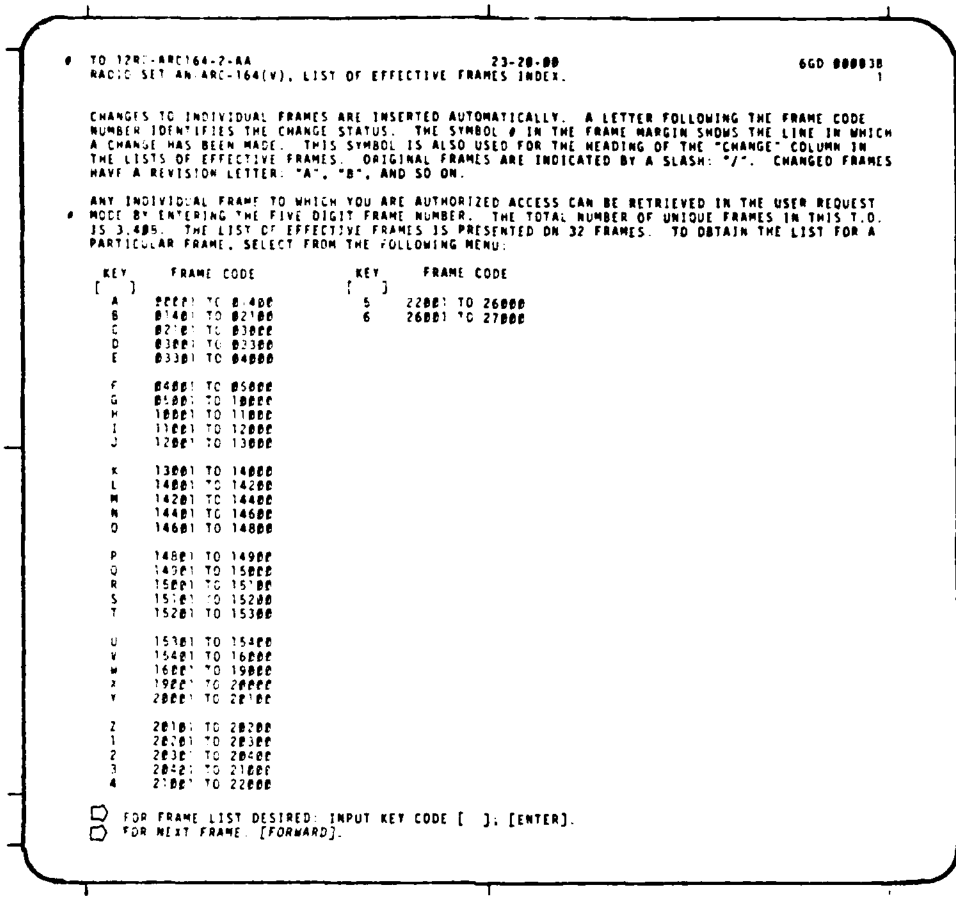
Reference data in pool include all TO information which is not specifically designated as procedural ("track") data, procedural support pool data, or front matter. This category encompasses information about the TO itself and information which may be helpful to a technician in understanding the system on which maintenance is to be performed. Reference data are always prepared at the Level 3 legibility criterion, although some illustrations may be smaller if they can be increased in size with the zoom control. The level of detail applicable to text is that equivalent to Track 3. Only one level of detail is used for reference pool data.

Technicians will generally not use reference pool data in the normal course of performing maintenance, and only will see it if they specifically request some portion of it, either intentionally or by mistake, or if they are scanning the TO in the review mode. Requests for reference data can be made via the user request mode or, in the standard mode, via the general table of contents or (for some data) an options list. The guidelines which have been described for other types of data in the data base are generally applicable to pool reference data for equivalent formats. The remainder of this section illustrates some of the more common types of pool reference data and discusses features which may be unique.

5.2 LIST OF EFFECTIVE FRAMES (LOEF)

This format is equivalent to the List of Effective Pages (LOEP) which is required in all TOs. While the LOEP has some utility to a technician who is inserting change pages in a TO, the LOEF will have very limited use and may be one of the types of information which can be eliminated by a VAMIS-type system insofar as display to the users is concerned. The data will still be needed by TO preparers, and until a contrary decision is made by the AFTO System authorities, it should be planned for inclusion in the pool reference data. While the LOEP of a paper-based TO is a simple itemization of the current pages in a TO with the applicable revision date noted, an LOEF should be in two parts to aid locating the portion of the list which is of interest. The first part should be an index, as illustrated in the example in Figure 5-1, which provides a means for going to the LOEF frame containing the frame numbers of concern. This is a simple, multi-column menu preceded by an explanation of the frame numbering and change convention, as well as instructions on how to obtain the particular LOEF frame or an individual data frame. The frame numbers encompassed by each line entry in the LOEF index should be broad enough to accommodate addition of new frames (as new data are added to the TO) without having to make changes to the index. It is not necessary that all frame numbers in the from/to entry be assigned. The length of the LOEF index will depend on the number of frames in the TO and how the frame numbers are grouped on individual LOEF frames. For large TOs, multiple index frames will be needed.

Individual LOEF frames, an example of which is illustrated in Figure 5-2, are multi-column lists of the assigned frame codes, in frame number order, with the last issue/revision date. They are not menus, since there is nothing appropriate to select, but the user can, if desired, step through the LOEF with the FORWARD (and REVERSE) key. It is not necessary for frame numbers to be continuous on each LOEF, but when they are non-continuous, sufficient space should be left in each LOEF for later additions without having to reorganize the entire LOEF.



\# TO 12R2-ARC164-2-AA 23-20-00 6GD 000038
RADIO SET AN/ARC-164(V), LIST OF EFFECTIVE FRAMES INDEX. 1

CHANGES TO INDIVIDUAL FRAMES ARE INSERTED AUTOMATICALLY. A LETTER FOLLOWING THE FRAME CODE NUMBER IDENTIFIES THE CHANGE STATUS. THE SYMBOL # IN THE FRAME MARGIN SHOWS THE LINE IN WHICH A CHANGE HAS BEEN MADE. THIS SYMBOL IS ALSO USED FOR THE HEADING OF THE "CHANGE" COLUMN IN THE LISTS OF EFFECTIVE FRAMES. ORIGINAL FRAMES ARE INDICATED BY A SLASH: "/". CHANGED FRAMES HAVE A REVISION LETTER: "A", "B", AND SO ON.

ANY INDIVIDUAL FRAME TO WHICH YOU ARE AUTHORIZED ACCESS CAN BE RETRIEVED IN THE USER REQUEST
\# MODE BY ENTERING THE FIVE DIGIT FRAME NUMBER. THE TOTAL NUMBER OF UNIQUE FRAMES IN THIS T.O. IS 3,405. THE LIST OF EFFECTIVE FRAMES IS PRESENTED ON 32 FRAMES. TO OBTAIN THE LIST FOR A PARTICULAR FRAME, SELECT FROM THE FOLLOWING MENU:

KEY [ ]	FRAME CODE	KEY [ ]	FRAME CODE
A	00001 TO 01400	5	22001 TO 26000
B	01401 TO 02100	6	26001 TO 27000
C	02101 TO 03000		
D	03001 TO 03300		
E	03301 TO 04000		
F	04001 TO 05000		
G	05001 TO 10000		
H	10001 TO 11000		
I	11001 TO 12000		
J	12001 TO 13000		
K	13001 TO 14000		
L	14001 TO 14200		
M	14201 TO 14400		
N	14401 TO 14600		
O	14601 TO 14800		
P	14801 TO 14900		
Q	14901 TO 15000		
R	15001 TO 15100		
S	15101 TO 15200		
T	15201 TO 15300		
U	15301 TO 15400		
V	15401 TO 16000		
W	16001 TO 19000		
X	19001 TO 20000		
Y	20001 TO 20100		
Z	20101 TO 20200		
1	20201 TO 20300		
2	20301 TO 20400		
3	20401 TO 21000		
4	21001 TO 22000		

FOR FRAME LIST DESIRED: INPUT KEY CODE [ ]; [ENTER].
FOR NEXT FRAME. *[FORWARD]*.

Figure 5-1. Example of VAMIS List of Effective Frames index frame.

5.3 RECORD OF APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS (TCTOs)

TCTOs are a special category of Technical Orders which provide instructions for accomplishing or making a record of "one time" changes to standard systems and equipment or for imparting precautionary instructions relating to safety, limitations, or inspections of systems/equipment or munitions. Compliance is required within specified time limits. TCTOs are numbered in

TO 12R2-2ARC164-2-AA 23-2Ø-ØØ 6GD ØØØØ45
LIST OF EFFECTIVE FRAMES: ØØØØ1 TO Ø14ØØ. 2

TYPE	NO #	DATE	TYPE	NO #	DATE	TYPE	NO #	DATE	TYPE	NO #	DATE
6GD	ØØØØ1A	12DEC8Ø	1F1	Ø12Ø1B	2ØOCT81						
6GD	ØØØØ2A	12NOV8Ø	1F1	Ø12Ø2A	2ØOCT81						
6GD	ØØØØ3/	16DEC8Ø	1F1	Ø12Ø3F	21OCT81						
6GD	ØØØØ4/	17DEC8Ø	1F1	Ø12Ø4/	15DEC8Ø						
6AA	ØØØØ5C	25APR81	2F1	Ø12Ø5M	29JAN82						
6GD	ØØØØ6E	13JUN81	2F1	Ø12Ø6H	23MAR81						
6AA	ØØØØ8B	24MAY81	2F1	Ø12Ø9I	23MAR81						
6GD	ØØ1ØØ/	16DEC8Ø	2F1	Ø1235A	18FEB81						
6AA	ØØ1Ø1A	25JAN81	2F1	Ø1236R	18FEB83						
6AA	ØØ1Ø2A	25JAN81	2F1	Ø1241D	28JUL81						
5JG	ØØ188B	28JAN81	6PB	Ø1245A	11AUG81						
5JG	ØØ189B	28JAN81	6PB	Ø1246B	11AUG81						
3JG	ØØ19ØC	28JAN81	3SS	Ø1247/	11AUG81						
4JG	ØØ191/	17DEC8Ø	2SS	Ø1248/	11AUG81						
2JG	ØØ192B	28DEC81	1SS	Ø1249/	11AUG81						
3F1	Ø1131B	9DEC8Ø	6GD	Ø125ØG	26FEB81						
3F1	Ø1132/	9DEC8Ø	6GD	Ø1251A	1SEP81						
3F1	Ø1133/	1ØDEC8Ø	6GD	Ø1252A	1SEP81						
3F1	Ø1141/	9DEC8Ø	6GD	Ø1253/	17DEC8Ø						
2F1	Ø115ØC	15DEC8Ø	6GT	012552	29SEP85						

NEXT FRAME: [FORWARD].

Figure 5-2. Example of VAMIS List of Effective Frames frame.

the same manner as basic TOs, with the last "dash number" generally being -501 or above. TCTOs may be included in the automated system or may be in hard copy only. If in VAMIS, they may be incorporated in the procedures section, the pool section, or both depending on the nature of the instruction and what is to be accomplished. Each TO which is affected by the issuance of a TCTO includes, as part of the front matter, a record of applicable TCTOs. For a VAMIS program, this will be included in pool reference data. Figure 5-3 illustrates an example of the applicable format. This format is equivalent to that used in paper-based TOs with the exception that a means of selecting and obtaining the applicable TCTO is provided if the TCTO is in the data base.

TO 13A5-37-3-AA 95-10-00 6GD 00015G
RECORD OF APPLICABLE TCTO'S

KEY [ ]	TCTO NUMBER	TCTO DATE	COMPLIANCE DATES FIRST	FINAL	TITLE
A	13A5-32-503	1JUN71	1JAN72	1FEB73	INSTALLATION OF EMERGENCY OXYGEN
	13A5-32-503C	REPLACED	------	------	SYSTEM ON MARTIN BAKER EJECTION SEAT
B	13A5-32-503D	20APR73	1JUL73	1APR76	F/RF/YRF-4C,D,E AIRCRAFT AND -107,
					AT-35, CT-34 AND ST-48 TRAINERS (ECP
					MDA-809451).
△	1F-4-989	11JAN74	1MAR74	1APR76	REPLACEMENT OF GAS-POWERED INERTIAL
△	1F-4-989C	29MAR74	1JUL74	1APR76	REEL, F/RF-4 AIRCRAFT AND TRAINERS.
△	1F-4-996	15DEC72	1AUG73	15JUN74	INSTALLATION OF AN/URT-33B PERSONNEL
△	1F-4-996C	27SEP73	1DEC73	15JUN74	LOCATOR BEACON IN SURVIVAL KIT, PART
△	1F-4-996D	15OCT74	15FEB75	1APR76	NO. 140000-100, F/RF/YRF-4C,D,E
					AIRCRAFT, MOBILE TRAINING EQUIPMENT.

△ AVAILABLE ONLY IN HARD COPY.

FOR TCTO NEEDED: INPUT KEY CODE[ ]; [ENTER].

Figure 5-3. Example of VAMIS record of applicable Time Compliance Technical Order (TCTO) format.

5.4 INTRODUCTORY MATERIALS

The scope of the introductory materials to be included in the pool reference data portion of the data base depends largely on the size and complexity of the TO. Introductory materials for sectionalized TOs are generally specific to the particular type of data found in that section, and may include cross-references to other sections of the TO. In unsectionalized TOs the introductory materials must provide an overview of the entire TO and cross-references to other TOs that may be related. A VAMIS TO is, effectively, an unsectionalized TO so the introductory materials should be scoped accordingly. The exception, as is illustrated in the example in Figure 5-4, is that the TO may be scaled based on the model/series selection menu, a factor which should be described in the introductory materials.

Other introductory materials may include descriptions of the types of maintenance procedures, e.g., job guides, and troubleshooting procedures, e.g., LTTAs, and how they are used. Content specifications frequently require that the introductory materials also include an explanation of the use, in AF TOs, of the terms "shall," "will," "should," and "may," as defined in MIL-M-38784. In addition, the introductory materials could include such data as a consumable materials list and a support equipment list. If extensive, data of this type could be placed in separate, identifiable "sections" of the TO.

5.5 GENERAL DESCRIPTION FORMATS

Data in this category are sometimes included with introductory materials but are more typically in an identifiable section of the TO. General description data explain, through the use of both text and illustrations, what the system and its major subsystems/assemblies consist of and how they relate to each

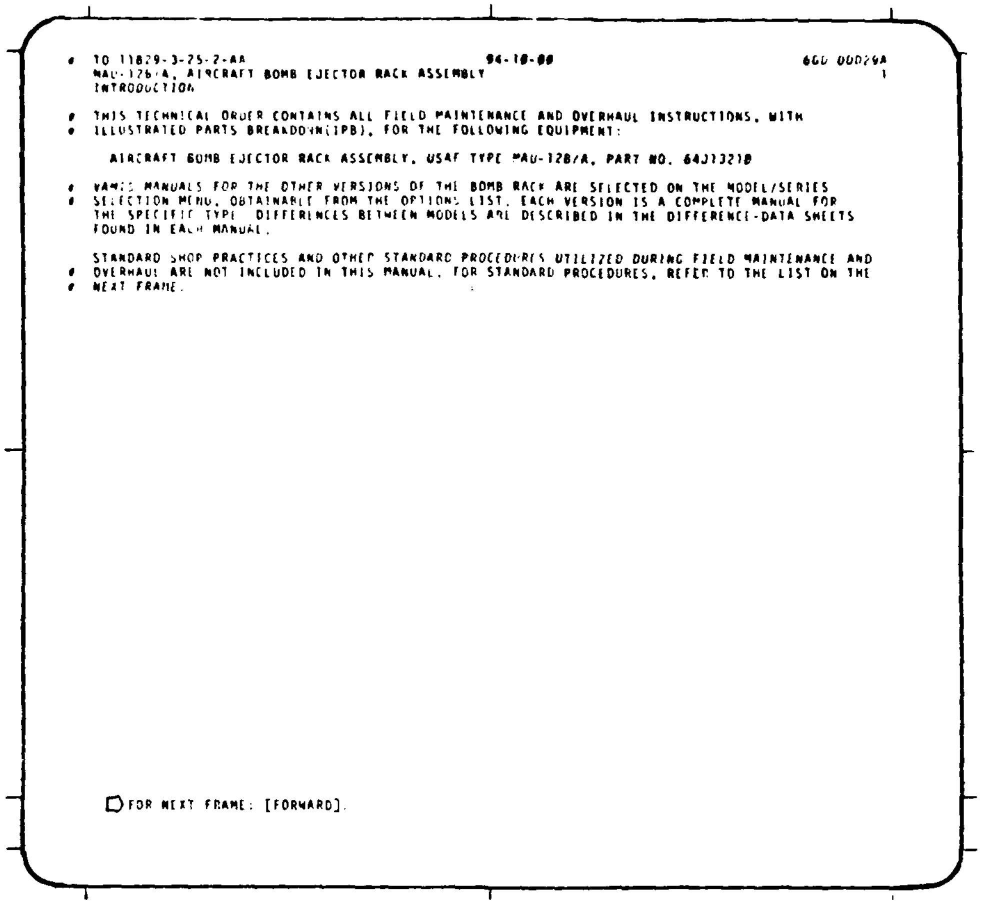
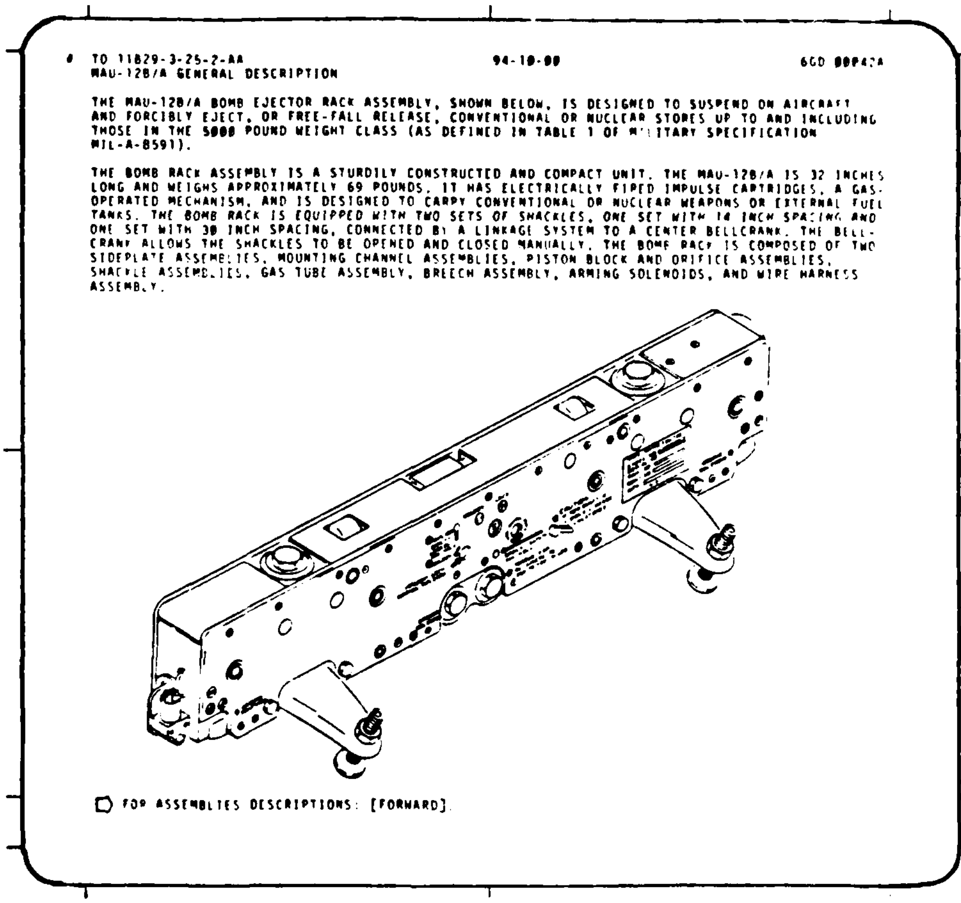


Figure 5-4. Example of VAMIS introductory materials format.

other. Figure 5-5 provides an illustration of the appropriate format for such information. Note that data in this category will rarely be different from one model/series to another. It can therefore be prepared once for all models/series and used throughout, with details changed as applicable. For large, complex systems it may be appropriate to have a TOC for this portion so that users can go directly to the description of interest to them. It should also be possible to "page" through the general description in an ordered sequence. The description at each level should always identify the major assemblies or components at the next lower level, as well as the higher assembly (if any) of which it is a part.


TO 11B29-3-25-2-AA 94-10-00 6CD 00P42A
MAU-12B/A GENERAL DESCRIPTION

THE MAU-12B/A BOMB EJECTOR RACK ASSEMBLY, SHOWN BELOW, IS DESIGNED TO SUSPEND ON AIRCRAFT AND FORCIBLY EJECT, OR FREE-FALL RELEASE, CONVENTIONAL OR NUCLEAR STORES UP TO AND INCLUDING THOSE IN THE 5000 POUND WEIGHT CLASS (AS DEFINED IN TABLE 1 OF MILITARY SPECIFICATION MIL-A-8591).

THE BOMB RACK ASSEMBLY IS A STURDILY CONSTRUCTED AND COMPACT UNIT. THE MAU-12B/A IS 32 INCHES LONG AND WEIGHS APPROXIMATELY 69 POUNDS. IT HAS ELECTRICALLY FIRED IMPULSE CARTRIDGES, A GAS-OPERATED MECHANISM, AND IS DESIGNED TO CARRY CONVENTIONAL OR NUCLEAR WEAPONS OR EXTERNAL FUEL TANKS. THE BOMB RACK IS EQUIPPED WITH TWO SETS OF SHACKLES, ONE SET WITH 14 INCH SPACING AND ONE SET WITH 30 INCH SPACING, CONNECTED BY A LINKAGE SYSTEM TO A CENTER BELLCRANK. THE BELL-CRANK ALLOWS THE SHACKLES TO BE OPENED AND CLOSED MANUALLY. THE BOMB RACK IS COMPOSED OF TWO SIDEPLATE ASSEMBLIES, MOUNTING CHANNEL ASSEMBLIES, PISTON BLOCK AND ORIFICE ASSEMBLIES, SHACKLE ASSEMBLIES, GAS TUBE ASSEMBLY, BREECH ASSEMBLY, ARMING SOLENOIDS, AND WIRE HARNESS ASSEMBLY.

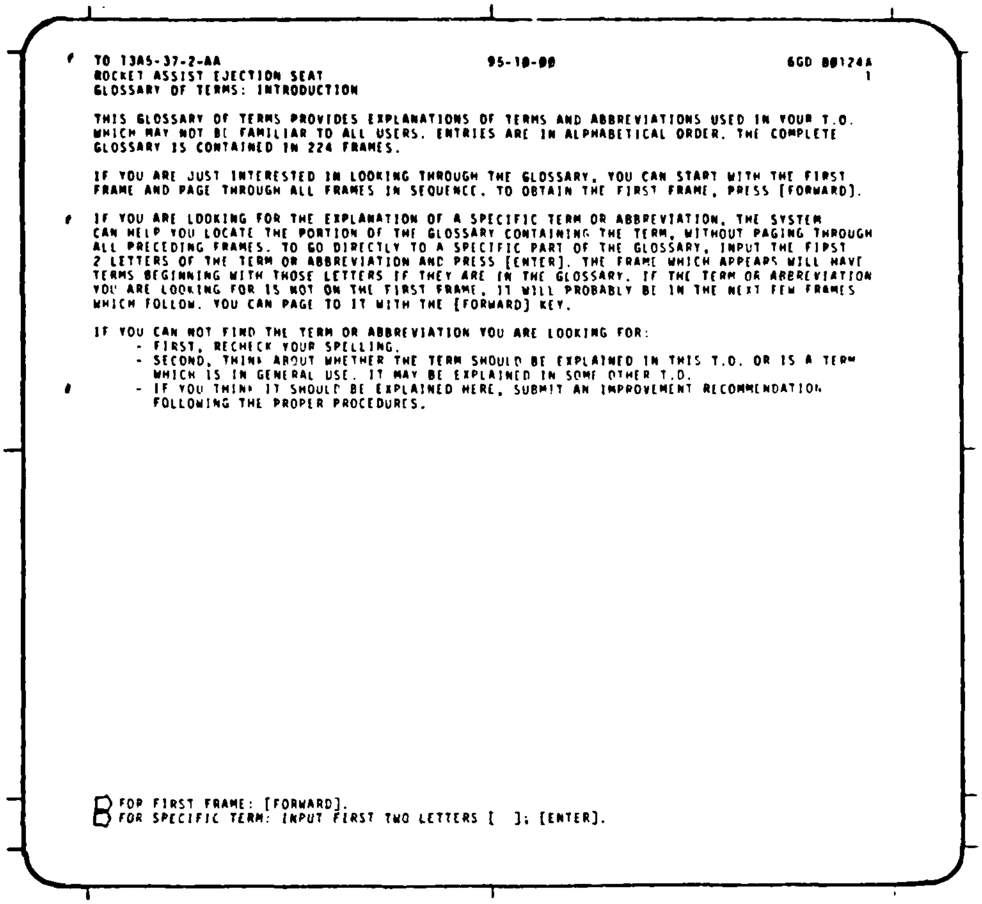
FOR ASSEMBLIES DESCRIPTIONS: [FORWARD]

Figure 5-5. Example of VAMIS general description materials format.

5.6 GLOSSARIES

A glossary is not normally found in AF Technical Orders, although it is quite common in technical reports and in some specifications. TOs do have a counterpart to a glossary, however, in the definition of terms (or explanation of terms) section, usually a part of the introductory materials. This section normally contains only unusual terms which the authors of the TO have reason to think may be unfamiliar to the user. The definition of terms section is usually quite brief and, in sectionalized TOs, applies only to the technical materials in that section. In a VAMIS TO, the glossary will often be quite comprehensive since it will apply to all of the technical materials in the entire TO, and the reference user will be the Track 3 technician.

Glossaries are accessed either from the general TCC or from any options list. In either case, when selected by the user, the first frame displayed should identify the type of material in that part of the data base, and provide guidance to the user for obtaining the specific data of interest. Figure 5-6 illustrates an example of a VAMIS glossary introductory frame. If the glossary is lengthy, as will often be true with TOs for complex systems, the user should be able to "jump" to a particular part of the glossary, in addition to "paging" through it. The example shown assumes a very lengthy glossary, and the input of two characters of the term should enable the user to "jump" to within a few frames of the terms desired. In glossaries of medium length, using the NEXT SEQUENCE key or inputting only the first character may be sufficient. Alternatively, it may be feasible for some limited glossaries to list the terms as a menu (in alphabetical order) on the glossary introduction frame and allow the user to select the specific term desired.



TO 13A5-37-2-AA 95-10-00 6GD 00124A
ROCKET ASSIST EJECTION SEAT 1
GLOSSARY OF TERMS: INTRODUCTION

THIS GLOSSARY OF TERMS PROVIDES EXPLANATIONS OF TERMS AND ABBREVIATIONS USED IN YOUR T.O. WHICH MAY NOT BE FAMILIAR TO ALL USERS. ENTRIES ARE IN ALPHABETICAL ORDER. THE COMPLETE GLOSSARY IS CONTAINED IN 224 FRAMES.

IF YOU ARE JUST INTERESTED IN LOOKING THROUGH THE GLOSSARY, YOU CAN START WITH THE FIRST FRAME AND PAGE THROUGH ALL FRAMES IN SEQUENCE. TO OBTAIN THE FIRST FRAME, PRESS [FORWARD].

IF YOU ARE LOOKING FOR THE EXPLANATION OF A SPECIFIC TERM OR ABBREVIATION, THE SYSTEM CAN HELP YOU LOCATE THE PORTION OF THE GLOSSARY CONTAINING THE TERM, WITHOUT PAGING THROUGH ALL PRECEDING FRAMES. TO GO DIRECTLY TO A SPECIFIC PART OF THE GLOSSARY, INPUT THE FIRST 2 LETTERS OF THE TERM OR ABBREVIATION AND PRESS [ENTER]. THE FRAME WHICH APPEARS WILL HAVE TERMS BEGINNING WITH THOSE LETTERS IF THEY ARE IN THE GLOSSARY. IF THE TERM OR ABBREVIATION YOU ARE LOOKING FOR IS NOT ON THE FIRST FRAME, IT WILL PROBABLY BE IN THE NEXT FEW FRAMES WHICH FOLLOW. YOU CAN PAGE TO IT WITH THE [FORWARD] KEY.

IF YOU CAN NOT FIND THE TERM OR ABBREVIATION YOU ARE LOOKING FOR:
- FIRST, RECHECK YOUR SPELLING.
- SECOND, THINK ABOUT WHETHER THE TERM SHOULD BE EXPLAINED IN THIS T.O. OR IS A TERM WHICH IS IN GENERAL USE. IT MAY BE EXPLAINED IN SOME OTHER T.O.
- IF YOU THINK IT SHOULD BE EXPLAINED HERE, SUBMIT AN IMPROVEMENT RECOMMENDATION FOLLOWING THE PROPER PROCEDURES.

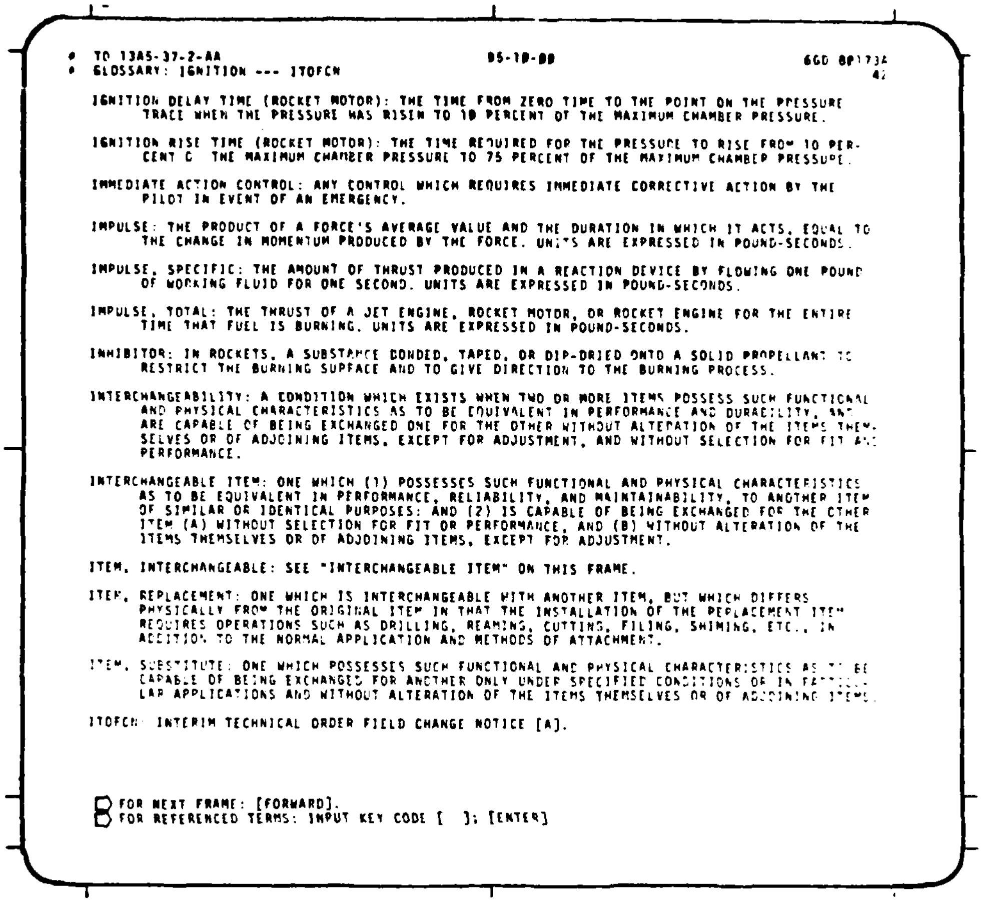
B FOR FIRST FRAME: [FORWARD].
FOR SPECIFIC TERM: INPUT FIRST TWO LETTERS [ ]; [ENTER].

Figure 5-6. Example of VAMIS glossary introduction frame.

The glossary frame itself has no unusual characteristics, as shown in the example in Figure 5-7. The term should stand out from the explanatory text, which should be indented. The text should briefly explain what the term means in the context of the TO and the maintenance activities encompassed. (Note: Entries in this example frame are intended to be illustrative of format only; they are not intended to establish guidelines for content or level of detail of the explanations.) A glossary frame can include more than one term, but the explanation for that term should be complete on the frame on which it starts. When more than one term is on a frame, the terms should be in alphabetical order. Similarly, when the user is paging through the glossary, the terms should appear in alphabetical order. Glossary frames will very rarely, if ever, include illustrations. If an illustration is needed, it should accompany the term's explanation, preceding any other term on the same frame. When the explanation of a term must include the use of another term which may be equally unfamiliar to the user, Key Codes can be incorporated in the text to provide a shortcut method of obtaining the explanation of the second term. However, this should generally be avoided.

5.7 INDEXES

Very few AF Technical Orders contain an index. In part this is because TOs are sectionalized if they are covering large, complex systems and the resulting TO would be very lengthy if everything was combined in one "package." Each sectional TO has its own TO number and TOC, easing the difficulty of locating a particular kind of data. The difficulty level increases rapidly, however, if data from more than one sectional TO are needed for the same job. This is a frequent cause of complaints and problems experienced by technicians. VAMIS will include an index for all but the simplest TOs. Although many "aids" have been factored into the baseline system design and format construction to assist users in finding a particular piece of information, there is still a risk of getting lost. Further, it should not always be necessary for a technician who has finished a task and wants some other unrelated data to go back to the general TOC and follow the normal accessing procedure. In fact, use of the index is a reasonable alternative to the normal accessing approach to entering the data base once the technician has selected a TO.



* TO 13A5-37-2-AA 05-10-00 6GD 0P173A
* GLOSSARY: IGNITION --- ITOFCN 42

IGNITION DELAY TIME (ROCKET MOTOR): THE TIME FROM ZERO TIME TO THE POINT ON THE PRESSURE TRACE WHEN THE PRESSURE HAS RISEN TO 10 PERCENT OF THE MAXIMUM CHAMBER PRESSURE.

IGNITION RISE TIME (ROCKET MOTOR): THE TIME REQUIRED FOR THE PRESSURE TO RISE FROM 10 PER-CENT O THE MAXIMUM CHAMBER PRESSURE TO 75 PERCENT OF THE MAXIMUM CHAMBER PRESSURE.

IMMEDIATE ACTION CONTROL: ANY CONTROL WHICH REQUIRES IMMEDIATE CORRECTIVE ACTION BY THE PILOT IN EVENT OF AN EMERGENCY.

IMPULSE: THE PRODUCT OF A FORCE'S AVERAGE VALUE AND THE DURATION IN WHICH IT ACTS, EQUAL TO THE CHANGE IN MOMENTUM PRODUCED BY THE FORCE. UNITS ARE EXPRESSED IN POUND-SECONDS.

IMPULSE, SPECIFIC: THE AMOUNT OF THRUST PRODUCED IN A REACTION DEVICE BY FLOWING ONE POUND OF WORKING FLUID FOR ONE SECOND. UNITS ARE EXPRESSED IN POUND-SECONDS.

IMPULSE, TOTAL: THE THRUST OF A JET ENGINE, ROCKET MOTOR, OR ROCKET ENGINE FOR THE ENTIRE TIME THAT FUEL IS BURNING. UNITS ARE EXPRESSED IN POUND-SECONDS.

INHIBITOR: IN ROCKETS, A SUBSTANCE BONDED, TAPED, OR DIP-DRIED ONTO A SOLID PROPELLANT TO RESTRICT THE BURNING SURFACE AND TO GIVE DIRECTION TO THE BURNING PROCESS.

INTERCHANGEABILITY: A CONDITION WHICH EXISTS WHEN TWO OR MORE ITEMS POSSESS SUCH FUNCTIONAL AND PHYSICAL CHARACTERISTICS AS TO BE EQUIVALENT IN PERFORMANCE AND DURABILITY, AND ARE CAPABLE OF BEING EXCHANGED ONE FOR THE OTHER WITHOUT ALTERATION OF THE ITEMS THEM-SELVES OR OF ADJOINING ITEMS, EXCEPT FOR ADJUSTMENT, AND WITHOUT SELECTION FOR FIT AND PERFORMANCE.

INTERCHANGEABLE ITEM: ONE WHICH (1) POSSESSES SUCH FUNCTIONAL AND PHYSICAL CHARACTERISTICS AS TO BE EQUIVALENT IN PERFORMANCE, RELIABILITY, AND MAINTAINABILITY, TO ANOTHER ITEM OF SIMILAR OR IDENTICAL PURPOSES: AND (2) IS CAPABLE OF BEING EXCHANGED FOR THE OTHER ITEM (A) WITHOUT SELECTION FOR FIT OR PERFORMANCE, AND (B) WITHOUT ALTERATION OF THE ITEMS THEMSELVES OR OF ADJOINING ITEMS, EXCEPT FOR ADJUSTMENT.

ITEM, INTERCHANGEABLE: SEE "INTERCHANGEABLE ITEM" ON THIS FRAME.

ITEM, REPLACEMENT: ONE WHICH IS INTERCHANGEABLE WITH ANOTHER ITEM, BUT WHICH DIFFERS PHYSICALLY FROM THE ORIGINAL ITEM IN THAT THE INSTALLATION OF THE REPLACEMENT ITEM REQUIRES OPERATIONS SUCH AS DRILLING, REAMING, CUTTING, FILING, SHIMING, ETC., IN ADDITION TO THE NORMAL APPLICATION AND METHODS OF ATTACHMENT.

ITEM, SUBSTITUTE: ONE WHICH POSSESSES SUCH FUNCTIONAL AND PHYSICAL CHARACTERISTICS AS TO BE CAPABLE OF BEING EXCHANGED FOR ANOTHER ONLY UNDER SPECIFIED CONDITIONS OR IN PARTICU-LAR APPLICATIONS AND WITHOUT ALTERATION OF THE ITEMS THEMSELVES OR OF ADJOINING ITEMS.

ITOFCN: INTERIM TECHNICAL ORDER FIELD CHANGE NOTICE [A].

FOR NEXT FRAME: [FORWARD].
FOR REFERENCED TERMS: INPUT KEY CODE [ ]; [ENTER]

Figure 5-7. Example of VAMIS glossary frame.

As with glossaries, indexes are accessed either from an options list or from a general TOC. The first frame of the index should be an introduction and guidance frame, the format of which is the same as the glossary introduction frame illustrated in Figure 5-6.

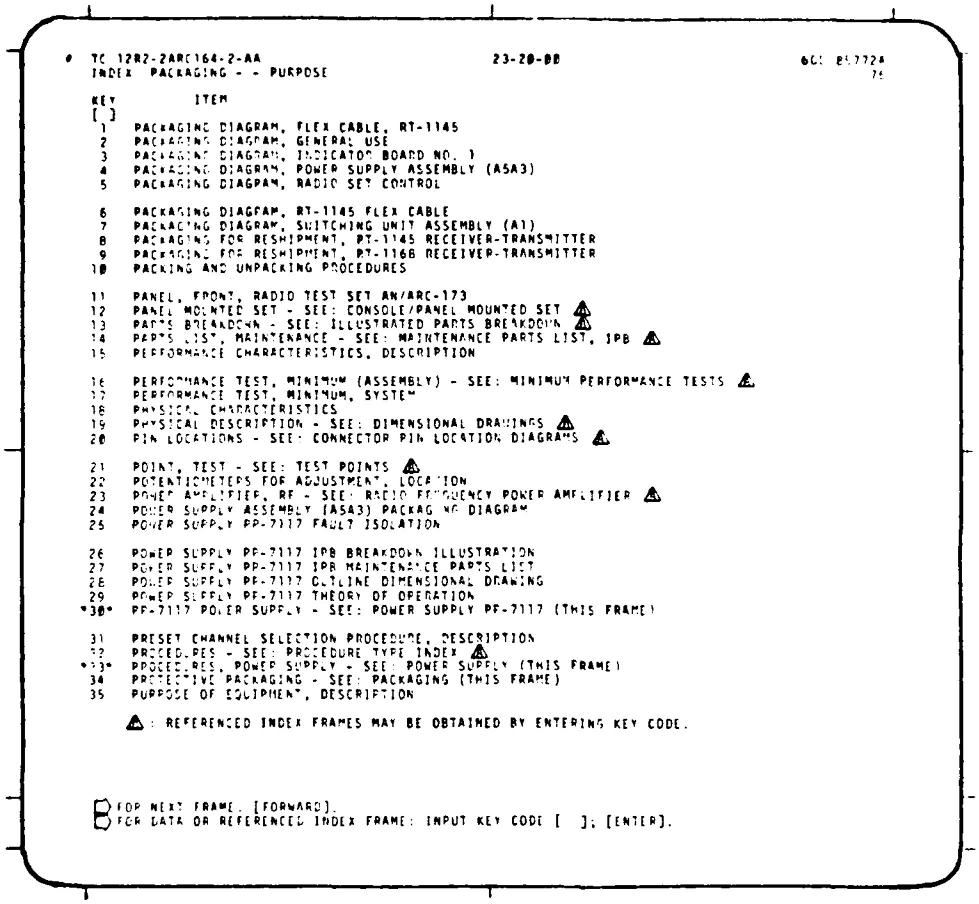
Index frames should be a type of menu, from which the user can select the particular type of information needed. As shown in the example in Figure 5-8, a VAMIS index will differ in several ways from an index such as might be found in a technical report or specification. First, it is not necessary to list an index reference for each utilization of a particular term or name. A particular component might be named in every frame of data for a procedural task. Providing an index reference to each such entry would not only be irrelevant, it would make use of the index so cumbersome that its purpose would be defeated. What is needed is to list the name of each such component in the appropriate context of its relationship to the data of which it is a part. When selection is made, the system accesses the first frame of the appropriate series of data.

Secondly, the index will not contain any page numbers, or other usual types of location references. Not only are page numbers (i.e., frame numbers) of no use to the technician in this application, but the actual data to be supplied will depend on the authorized Track level of the user. A Track 3 technician cannot use the index to request a frame of data which is only authorized for use by Track 1 technicians, for example.

In addition, the index entries must be sufficiently descriptive of the context so that the user can be reasonably certain when a selection is made that it represents the portion of data needed. Once a selection is made, and the data accessed, the user cannot easily return to the same index frame in order to make another selection (but see Subsection 5.8, below).

Index entries should be easily identifiable, and should consider each way in which a user might reasonably expect to find it. Thus official nomenclature such as "Auxiliary Cross Track Control Indicator" should also be entered in the index as "Cross Track Control Indicator, Auxiliary," "Control Indicator, Auxiliary Cross Track," and "Indicator, Control, Auxiliary Cross Track."

The "official" entry should contain all of the context references for accessing the data. All other alternate entries should, when selected, access the official entry frame if there are two or more different context listings. If there is only one item of data available, it is more efficient to provide the data than to cross-reference all the nomenclature variations.



TC 1282-2ARC164-2-AA 23-20-00 6C: 857724
INDEX PACKAGING - - PURPOSE 76

KEY [ ]	ITEM
1	PACKAGING DIAGRAM, FLEX CABLE, RT-1145
2	PACKAGING DIAGRAM, GENERAL USE
3	PACKAGING DIAGRAM, INDICATOR BOARD NO. 1
4	PACKAGING DIAGRAM, POWER SUPPLY ASSEMBLY (A5A3)
5	PACKAGING DIAGRAM, RADIO SET CONTROL
6	PACKAGING DIAGRAM, RT-1145 FLEX CABLE
7	PACKAGING DIAGRAM, SWITCHING UNIT ASSEMBLY (A1)
8	PACKAGING FOR RESHIPMENT, RT-1145 RECEIVER-TRANSMITTER
9	PACKAGING FOR RESHIPMENT, RT-1168 RECEIVER-TRANSMITTER
10	PACKING AND UNPACKING PROCEDURES
11	PANEL, FRONT, RADIO TEST SET AN/ARC-173
12	PANEL MOUNTED SET - SEE: CONSOLE/PANEL MOUNTED SET △
13	PARTS BREAKDOWN - SEE: ILLUSTRATED PARTS BREAKDOWN △
14	PARTS LIST, MAINTENANCE - SEE: MAINTENANCE PARTS LIST, IPB △
15	PERFORMANCE CHARACTERISTICS, DESCRIPTION
16	PERFORMANCE TEST, MINIMUM (ASSEMBLY) - SEE: MINIMUM PERFORMANCE TESTS △
17	PERFORMANCE TEST, MINIMUM, SYSTEM
18	PHYSICAL CHARACTERISTICS
19	PHYSICAL DESCRIPTION - SEE: DIMENSIONAL DRAWINGS △
20	PIN LOCATIONS - SEE: CONNECTOR PIN LOCATION DIAGRAMS △
21	POINT, TEST - SEE: TEST POINTS △
22	POTENTIOMETERS FOR ADJUSTMENT, LOCATION
23	POWER AMPLIFIER, RF - SEE: RADIO FREQUENCY POWER AMPLIFIER △
24	POWER SUPPLY ASSEMBLY (A5A3) PACKAGING DIAGRAM
25	POWER SUPPLY PP-7117 FAULT ISOLATION
26	POWER SUPPLY PP-7117 IPB BREAKDOWN ILLUSTRATION
27	POWER SUPPLY PP-7117 IPB MAINTENANCE PARTS LIST
28	POWER SUPPLY PP-7117 OUTLINE DIMENSIONAL DRAWING
29	POWER SUPPLY PP-7117 THEORY OF OPERATION
30	PP-7117 POWER SUPPLY - SEE: POWER SUPPLY PP-7117 (THIS FRAME)
31	PRESET CHANNEL SELECTION PROCEDURE, DESCRIPTION
32	PROCEDURES - SEE: PROCEDURE TYPE INDEX △
33	PROCEDURES, POWER SUPPLY - SEE: POWER SUPPLY (THIS FRAME)
34	PROTECTIVE PACKAGING - SEE: PACKAGING (THIS FRAME)
35	PURPOSE OF EQUIPMENT, DESCRIPTION

△ : REFERENCED INDEX FRAMES MAY BE OBTAINED BY ENTERING KEY CODE.

FOR NEXT FRAME, [FORWARD].
FOR DATA OR REFERENCED INDEX FRAME: INPUT KEY CODE [ ]; [ENTER].

Figure 5-8. Example of VAMIS index format.

If a particular entry, e.g., "Procedures" in the example in Figure 5-8, would require a lengthy list of data for that heading, a special index should be provided for users who want that heading. This will preclude other users from having to page through numerous frames in order to reach a term starting with the same characters; e.g., "Protective packaging."

5.8 USER RECORD

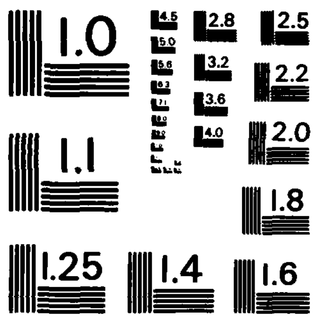
This type of information has no counterpart in paper-based TOs, unless one considers the individual methods used by technicians to identify the location of a particular drawing or schematic within the TO (e.g., attaching a paper clip to a page, turning down a corner, writing the page number on a piece of paper) or keeping track of progress (e.g., checking off in the margins). A VAMIS-type system has the unique capability for keeping track of the requests made, frames displayed, and other such factors during the period of use. Indeed, it must keep track of many of these factors in order that it can respond to control inputs such as RETURN, REPEAT SEQUENCE, and RELEASE FROM SHOW. This capability can be used to provide valuable information to both the individual user and the automated system managers. It may also be useful for upgrading technician skills through formal training and OJT.

5.8.1 Individual Use of User Record

The user record, an example of which is illustrated in Figure 5-9, presents a step-by-step record of a user's progress through the data base, identifying the frames of information that were presented and the control inputs that were made. Header information identifies the user (but not the user's authorization code), the time logged on the system, and the user record frame sequence number. If it is a second or subsequent user record

AD-A162 711 MAINTENANCE TECHNICAL MANUALS: FORMAT DESCRIPTIONS AND GUIDELINES FOR AUT..(U) BIOTECHNOLOGY INC FALLS CHURCH VA R G HATTERICK DEC 85 AFHRL-TP-85-46 3/4

UNCLASSIFIED F33615-82-C-0006 F/G 1/3 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

frame, it also shows the time that each new record frame was started. In this example, a frame code beginning with 9AA is assigned, since that series is not used for frame identification. While the frame code has no value to the user in this application, it may be useful for maintainance supervisors and training officers for reaccessing user records.

```
VAMIS USER RECORD                              START: 030526:1605:32        9AA 0002A
AFC JONES, JOHN J.                             FRAME: 030526:1712:24          2 OF  2
[SEQ]    T.O.             FRAME       DESCRIPTION                            ACTION
 51   13A5-37-2           3JG 03487 REMOVE UPPER PLATE ASSY (1)             FORWARD
 52   13A5-37-2           3JG 03488 REMOVE UPPER PLATE ASSY (2)             LIST OPT
 53   13A5-37-2           3JG 03490 OPT LIST FOR 3JG 0348R                  RETURN
 54   13A5-37-2           3JG 03498 REMOVE UPPER PLATE ASSY (2)             INCREASE
*55*                                                                        PAN
*56*                                                                        HOLD 2
*57*                                                                        SHOW 2
*58*                                SHOW 2                                  REL FM SHOW
 59   13A5-37-2           3JG 03488 REMOVE UPPER PLATE ASSY (2)             USER REC
*60*                                                                        PE 0P AA
 61   13A5-37-2           6PB 04005 HOW TO USE THIS IPB                     INCREASE
*62*  13A5-37-2           6PB 04005 HOW TO USE THIS IPB (ERR MSG)           REVERSE
 63   13A5-37-2           6PB 04004 IPB INTRO PURPOSE & SCOPE               REVERSE
 64   13A5-37-2           6PB 04221 IPB TABLE OF CONTENTS                   REVERSE
 65   13A5-37-2           6PB 04152 IPB TITLE FRAME                         B
 66   13A5-37-2           6PB 04005 HOW TO USE THIS IPB                     REPEAT SEQ
 67   13A5-37-2           6PB 04152 IPB TITLE FRAME                         P
 68   13A5-37-2           6PB 04221 IPB TABLE OF CONTENTS                   S
 69   13A5-37-2           6PB 04009 RECORD OF APP TCTO (1)                  FORWARD
 70   13A5-37-2           6PB 04955 RECORD OF APP TCTO (2)                  B
 71   13A5-32-503D        6GD 00001 TITLE FRAME                             FORWARD
 72   13A5-32-503D        6GD 00002 TABLE OF CONTENTS                       C
 73   13A5-32-503D        6GD 00245 RELATED PUBS                            6
 74   13A5-37-2           6GD 00001 TITLE FRAME                             FORWARD
 75   13A5-37-2           6GD 00006 TABLE OF CONTENTS                       H
 76   13A5-37-2           6PB 04152 IPB TABLE OF CONTENTS                   SHOW 1
*77*                                SHOW 1                                  SHOW 2
*78*                                SHOW 2                                  REL FM SHOW
 79   13A5-37-2           6PB 04152 IPB TABLE OF CONTENTS                   D
 80   13A5-37-2           6PB 04005 IPB ILLUS MAJ ASSY LIST                 J
 81   13A5-37-2           6PB 04064 IPB MPL BACKREST INST (1)               FORWARD
 82   13A5-37-2           6PB 04005 IPB MPL BACKREST INST (2)               LIST OPT
 83   13A5-37-2           6PB 04922 OPT LIST FOR 6PB 04085                  N
 84   13A5-37-2           6GD 05683 INDEX INTRO (1)                         PA
 85   13A5-37-2           6GD 05772 INDEX: PACKAGING--PURPOSE (76)          RETURN
 86   13A5-37-2           3JG 03466 REMOVE UPPER PLATE ASSY (2)             LIST OPT
 87   13A5-37-2           3JG 03489 OPT LIST FOR 3JG 0348B                  R
 88   VAMIS               9AA 00001 USER REC AFC JONES, JOHN J (1)          FORWARD
 89   VAMIS               9AA 00002 USER REC AFC JONES, JOHN J (2)          66
 90   13A5-37-2           6PB 04005 HOW TO USE THIS IPB                     C
 91   13A5-37-2           6PB 04006 IPB ILLUS MAJ ASSY LIST                 10
 92   13A5-37-2           6PB 05136 IPB BKDN ILLUS, BACKREST INST           11
 93   13A5-37-2           6PB 04299 IPB CPB, PLATE ASSY, UPPER              12
 94   13A5-37-2           6PB 04300 IPB CPB, HINGE HALF, UPPER              RETURN
 95   13A5-37-2           3JG 03488 REMOVE UPPER PLATE ASSY (2)             FORWARD
 96   13A5-37-2           3JG 03490 REMOVE UPPER PLATE ASSY (3) END         NO
 97   VAMIS               6** 90610 LOGOFF INST                             STOP
*98*  END USER RECORD FOR AFC JONES, JOHN J. TIME OFF: 030526:1822:19

TO OBTAIN A LISTED FRAME: INPUT SEQ NUMBER [  ]; [ENTER].
TO RETURN TO LAST PROCEDURE: [RETURN].
```

Figure 5-9. Example of VAMIS user record frame.

An individual user could access his own user record via the options list. It would show only the record of activity of that user from the point of signing on the system for the current period of use. If the user signs off the system, his or her user record is no longer available in this manner (but see paragraph 5.8.2, below). The example in Figure 5-9 illustrates a hypothetical record of a technician's movement through the data base, documenting each control action and the system response to that action. The record also provides clues of the points at which errors were made, or poor choices were exercised. (See sequence numbers 61, 62, 70, 80 (selected maintenance parts list when the breakdown illustrated was wanted), 84 (input PA instead of BA, for BAckrest), 85 (got impatient and ended up back in the Procedures).) It also shows how the technician used the user record to determine what should have been done (88, 89), reviewed how to use the IPB, and obtained the desired data to finish the task.

Users could request their user record if they simply wanted to review where they had been within the data base, but are more likely to access it as a way of identifying the point at which they "got lost," then using that information for getting back to where they want to be. It may also be useful to help identify where a mistake was made (e.g., responding with a YES when the correct troubleshooting response to a logic tree question was NO). It may, in addition, provide a shortcut for reaccessing a frame of pool data without going through a long menu selection process.

When the individual user logs off the system, the computer registers the log-off action and time, and the record is no longer available through normal accessing procedures.

5.8.2 Management Use of User Records

As stated above, when the individual logs off the system, the user record is no longer available through normal procedures. It is planned, however, that individual user records be retained in the system memory for a period of time for use by supervisory personnel and training staff, where applicable. While no firm plan exists in this program for such a capability, it is envisioned that being able to call up the user records for individual technicians could be a valuable capability. When performance problems are encountered, an individual's user record file could be reviewed, possibly with the individual, to try to determine sources of the problems and corrective measures which are needed. Similarly, supervisory or training staff could evaluate user records to assist in identifying areas where improvement through training would be appropriate, or when technicians have become proficient enough to warrant changing the authorized Track level. User record files could also be printed in hard copy for long-term storage, releasing the frame space for new user records.

SECTION 6.0
PROCEDURAL SUPPORT POOL DATA

6.1 INTRODUCTION

Procedural support pool data are defined as that data and information ". . . which are used primarily to amplify or clarify a specific maintenance or troubleshooting procedure, or otherwise assist in accomplishing a task" (see paragraph 2.4.1). This definition can include a broad spectrum of information found in TOs since almost any portion of a TO can be used for procedural support under some circumstances. Conversely, data that fit this definition may also have other uses which are unrelated to support of a maintenance procedure.

In VAMIS, procedural support pool data comprise the following:

a. Illustrated Parts Breakdown (IPB)

b. Function Diagrams

c. Other, e.g., Access and Locator Diagrams, Test Setup Instructions, and Test Specifications.

It is anticipated that, while these data types will be used for support of maintenance and troubleshooting, in some cases Track 1 technicians will access this type of information as the primary basis for task performance.

6.2 ILLUSTRATED PARTS BREAKDOWN (IPB)

6.2.1 General Format Considerations

In the AFTO System, the IPB for an equipment system may be a separate section, or chapter, of the basic maintenance TO or it may be a completely separate TO, with its own TO number. In the latter case, the TO containing the IPB would be numbered as "-4" for the basic TO, replacing the maintenance level designation. When packaged as a section of the basic TO, the IPB has the same maintenance level designation as the TO of which it is a part (e.g., -2 for organizational; -3 for intermediate). IPBs are not normally associated with organizational level TOs.

VAMIS IPBs will be considered as a section of the basic TO and carry the same maintenance level designation. This will permit the IPB to be accessed directly from the related maintenance level TO without calling up a different TO number. However, since the IPB for a -2 and a -3 maintenance TO for a system are likely to have identical contents, it is acceptable to designate the IPB as a -4 TO if the direct access (and return) requirements can be satisfied through software. The latter approach will permit preparation of a single IPB to support both levels of maintenance, even if they are not performed at the same site.

All portions of the IPB data will have the parts breakdown designation in the frame code. All parts breakdown frames are prepared according to Level 3 viewing criteria. Portions of any parts breakdown frame which are composed of illustrations are subject to the screen controls on the control unit.

Air Force IPBs are required to be prepared in accordance with specification MIL-M-38807 (USAF), which imposes both format and content requirements. In general, VAMIS IPBs comply with these requirements, but some variations in format are needed. The principal reason for the variance is that paper-based IPBs frequently require using data from two, or more, parts of the IPB at the same time. Since the baseline VAMIS does not have dual screens for side-by-side presentations of such related data, a new format called a Composite Parts Breakdown (CPB) has been devised to meet the same objectives. All other "parts" of the IPB are represented in the VAMIS IPB in formats similar to those in paper-based TOs.

6.2.2 Contents and Data Access

USAF IPBs consist of several "parts," each containing usable data and cross-references to another part. In this way a user can work to a particular page which may contain all of the information needed, or may use the cross-references to access individual pages in more than one part and use them together. The path followed by the user depends on the identifying information already in hand and the type(s) of information needed.

The VAMIS IBP concept is similar, but with several significant differences. The path followed by the user is still based on what is already known. However, the path will always lead to a Composite Parts Breakdown (CPB) for the item of interest, where all useful information is presented on one frame. The other parts have been converted to intermediate steps in the path. Figure 6-1 illustrates the principal types of data in a VAMIS IPB and the pathways available in both the standard and user request modes of use. The VAMIS IPB contains the same types of front matter and introductory materials, plus various lists, indexes, and illustrations configured to lead the user to the needed data in the correct CPB. In some instances the technician may stop short of the CPB (e.g., at a breakdown illustration) if the need for information has been satisfied. As can be seen, the knowledgeable user can eliminate many intermediate steps in the user request mode.

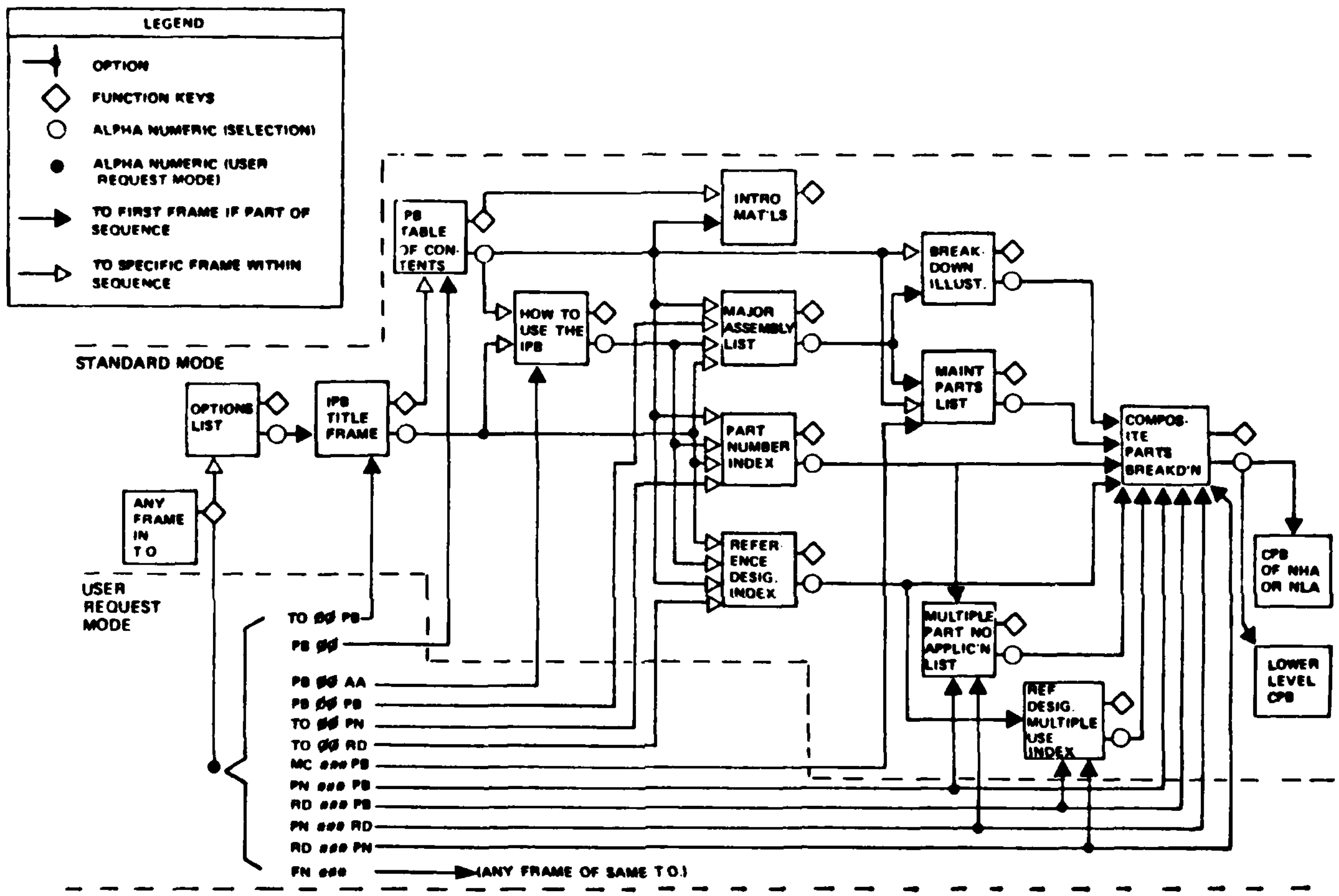


Figure 6-1. Data access pathways for VAMIS Illustrated Parts Breakdown.

6.2.3 Front Matter and Introductory Materials

VAMIS IPBs will contain all of the same front matter and introductory materials necessary for compliance with MIL-M-38807 (USAF). Although some of these materials will be necessary intermediate steps in the standard mode, most will have to be intentionally selected by the user in either the standard or user request mode.

6.2.3.1 Title Frame and Table of Contents. An IPB title frame, an example of which is illustrated in Figure 6-2, is the first frame which will be displayed to standard mode users, either from a TO general TOC or an options list. Guidelines for formatting of title frames are discussed in paragraph 4.3.2. In addition to its obvious function of identifying the discrete portion of the TO which the user has accessed, the title frame also includes a top-level IPB TOC for those who know what data they want and how to interact with a VAMIS IPB. Users who are less certain of what they want may select the IPB TOC. Those who are not sure how to obtain what they need should select the "How To Use This IPB" section.

An example of a VAMIS IPB TOC is illustrated in Figure 6-3. Guidelines for IPB TOC preparation are the same as for other TOCs except that the level of detail for the major, non-introductory, parts of the IPB is purposely limited. This is to ensure that the user who accesses any of these IPB parts begins at the appropriate first frame for that part. Consequently, the IPB TOC is most useful to individuals who want information about the IPB from the introductory materials.

6.2.3.2 How To Use a VAMIS IPB. Paper-based IPBs generally contain one or more pages of guidance, especially directed at new users, for obtaining a particular piece of IPB information

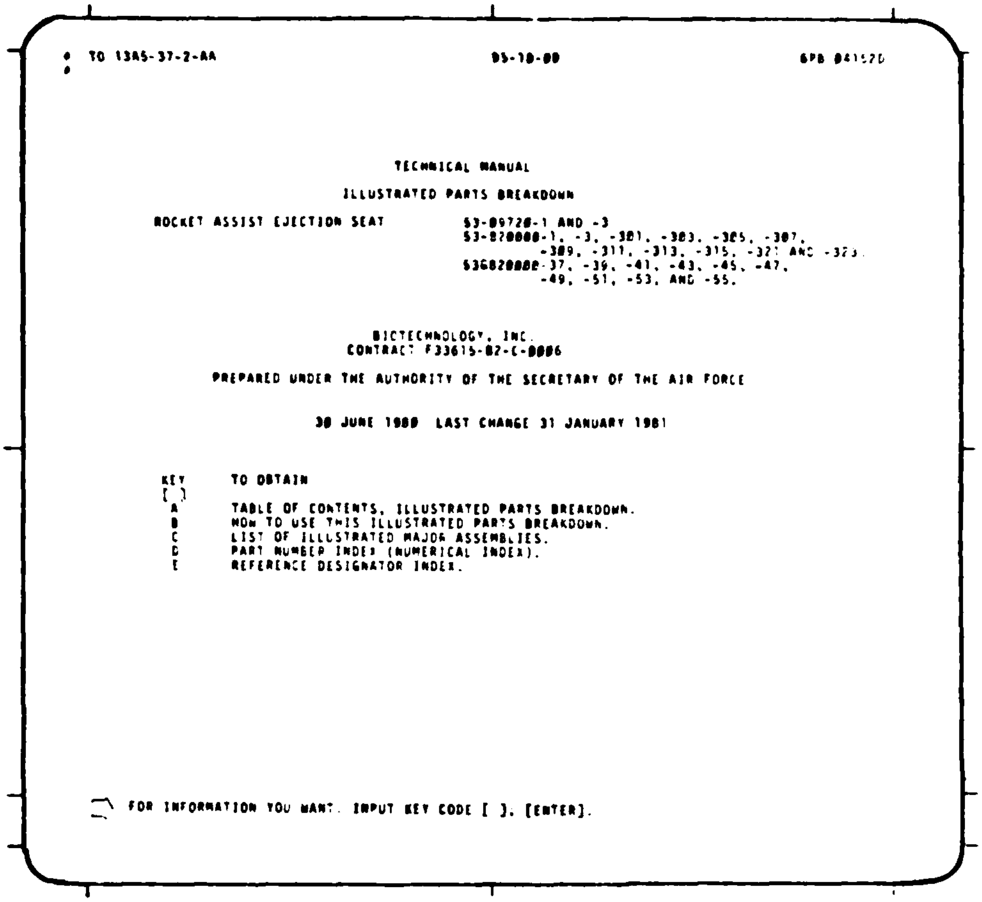


Figure 6-2. Example of VAMIS IPB title frame.

based on what is already known about a part or assembly. This often takes the form of a decision flow diagram (see Figure 2-11), some of which can be entered from either end, with the direction based on what is known to start with.

VAMIS IPBs will also use the flow diagram approach as is shown in the example in Figure 6-4. The direction is always the same, however, even though the path may be different, and the end result is always intended to be a CPB. Further, new technicians

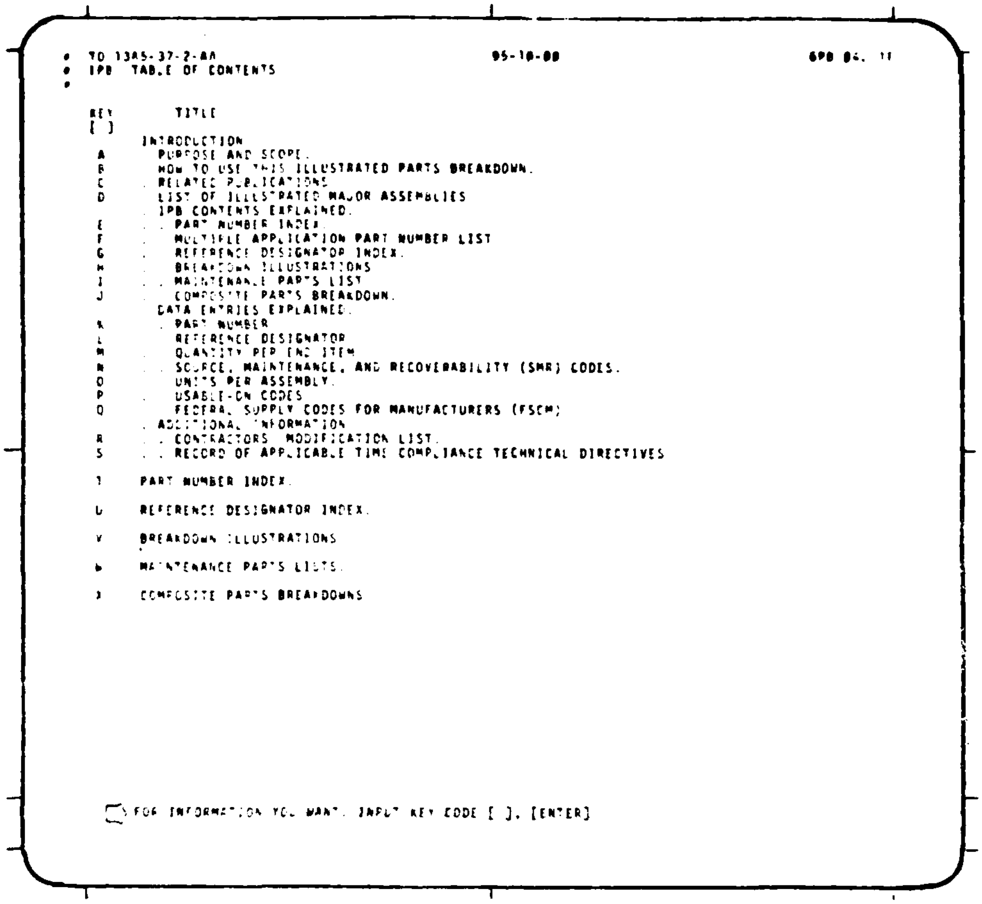


Figure 6-3. Example of VAMIS IPB TOC frame.

need only to refer to the diagram for purposes of selecting a path since the prompts on each frame will guide them to completion if they know what they want. The new user of a paper-based IPB may need to continually look back at the decision flow diagram to determine what the next step should be.

6.2.3.3 <u>Other Introductory Materials</u>. The remaining materials in the IPB are intended to explain IPB contents, terms, and

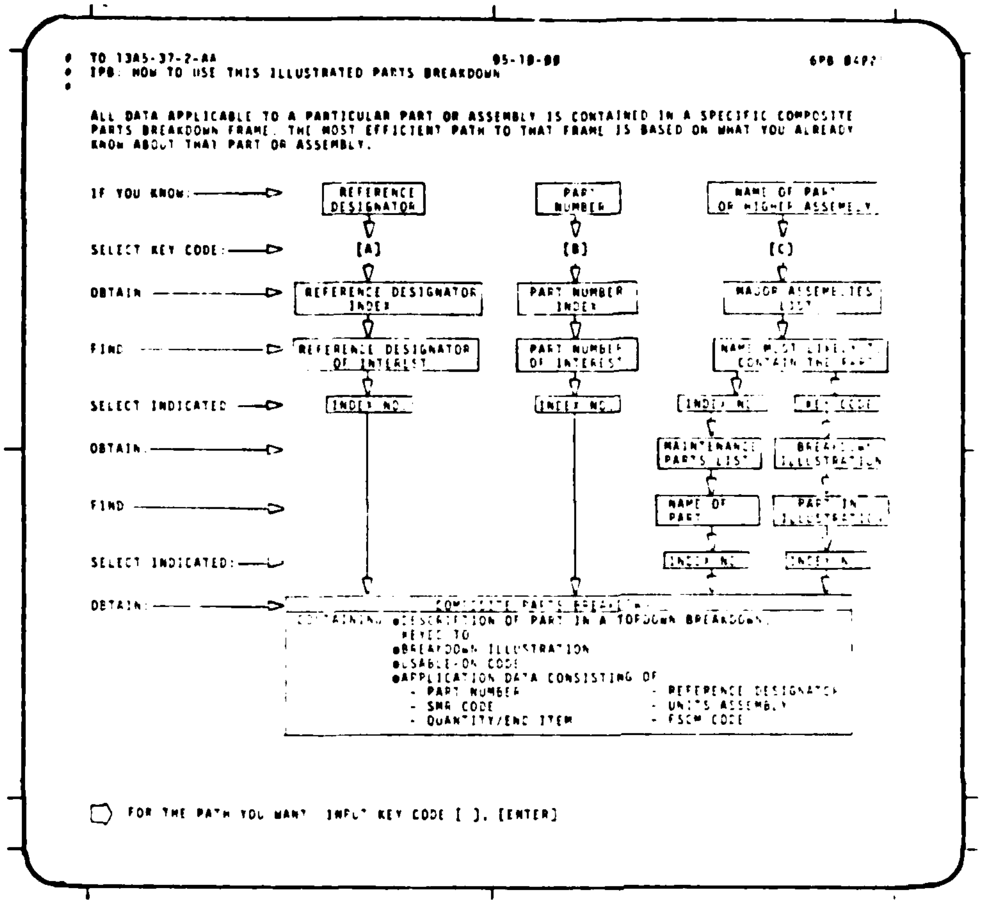
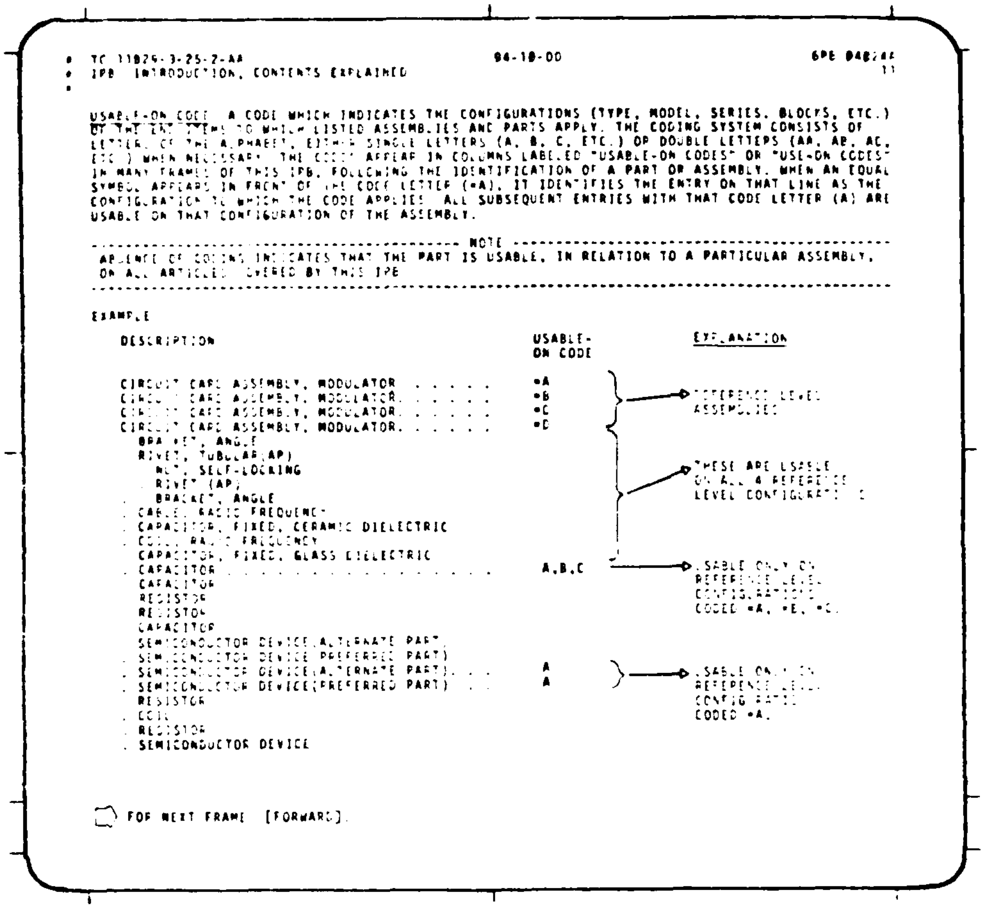


Figure 6-4. Example of VAMIS "How To Use This IPB" frame.

sources of data in the IPB. The TOC example in Figure 6-3 identifies the types of explanations to be included. Users may review these materials in sequence to gain an overall understanding of the IPB, or may select (from the TOC) a particular topic for review. An example of one such topic, explaining "usable-on codes," is illustrated in Figure 6-5. Note that, as explained in the example, VAMIS IPBs do not use a master list of usable-on codes as found in some paper-based IPBs, in order to avoid the necessity for referring back to the


TC 11829-3-25-2-AA 94-10-00 6PE 048244
IPB INTRODUCTION, CONTENTS EXPLAINED 11

USABLE-ON CODE. A CODE WHICH INDICATES THE CONFIGURATIONS (TYPE, MODEL, SERIES, BLOCKS, ETC.) OF THE END ITEMS TO WHICH LISTED ASSEMBLIES AND PARTS APPLY. THE CODING SYSTEM CONSISTS OF LETTERS OF THE ALPHABET, EITHER SINGLE LETTERS (A, B, C, ETC.) OR DOUBLE LETTERS (AA, AB, AC, ETC.) WHEN NECESSARY. THE CODES APPEAR IN COLUMNS LABELED "USABLE-ON CODES" OR "USE-ON CODES" IN MANY FRAMES OF THIS IPB, FOLLOWING THE IDENTIFICATION OF A PART OR ASSEMBLY. WHEN AN EQUAL SYMBOL APPEARS IN FRONT OF THE CODE LETTER (=A), IT IDENTIFIES THE ENTRY ON THAT LINE AS THE CONFIGURATION TO WHICH THE CODE APPLIES. ALL SUBSEQUENT ENTRIES WITH THAT CODE LETTER (A) ARE USABLE ON THAT CONFIGURATION OF THE ASSEMBLY.

NOTE

ABSENCE OF CODING INDICATES THAT THE PART IS USABLE, IN RELATION TO A PARTICULAR ASSEMBLY, ON ALL ARTICLES COVERED BY THIS IPB

EXAMPLE

DESCRIPTION	USABLE-ON CODE	EXPLANATION
CIRCUIT CARD ASSEMBLY, MODULATOR	=A	REFERENCE LEVEL ASSEMBLIES
CIRCUIT CARD ASSEMBLY, MODULATOR.	=B	
CIRCUIT CARD ASSEMBLY, MODULATOR.	=C	
CIRCUIT CARD ASSEMBLY, MODULATOR.	=D	
BRACKET, ANGLE		THESE ARE USABLE ON ALL 4 REFERENCE LEVEL CONFIGURATIONS
RIVET, TUBULAR(AP)		
NUT, SELF-LOCKING		
. RIVET (AP)		
. BRACKET, ANGLE		
. CABLE, RADIO FREQUENCY		
. CAPACITOR, FIXED, CERAMIC DIELECTRIC		
. COIL, RADIO FREQUENCY		
CAPACITOR, FIXED, GLASS DIELECTRIC		
. CAPACITOR	A,B,C	USABLE ONLY ON REFERENCE LEVEL CONFIGURATIONS CODED =A, =B, =C.
CAPACITOR		
RESISTOR		
RESISTOR		
CAPACITOR		
SEMICONDUCTOR DEVICE(ALTERNATE PART)		
. SEMICONDUCTOR DEVICE(PREFERRED PART)		
. SEMICONDUCTOR DEVICE(ALTERNATE PART). . .	A	USABLE ONLY ON REFERENCE LEVEL CONFIGURATION CODED =A.
. SEMICONDUCTOR DEVICE(PREFERRED PART) . . .	A	
RESISTOR		
. COIL		
. RESISTOR		
. SEMICONDUCTOR DEVICE		

FOR NEXT FRAME [FORWARD].

Figure 6-5. Example of VAMIS IPB introductory materials frame; IPB contents explained (usable-on codes).

master list. Instead, an embedded cross-reference is used on all frames as appropriate which identifies each higher assembly and the lower assemblies and parts which apply.

6.2.4 Lists, Indexes, and Breakdown Illustrations

The materials discussed in this paragraph are those that a technician will use to obtain the particular CPB containing the

the information needed. Paper-based counterparts somewhat serve the purpose, but also include some, but not all, of the useful data which may be sought. As explained in the bottom portion of the "How To Use" frame (Figure 6-4), this information is termed "application data" in a VAMIS IPB. There are five basic types of intermediate selection frames:

a. Reference designation index

b. Part number index

c. Major assemblies list

d. Maintenance parts list

e. Breakdown illustration.

The characteristics of each type, and its role in obtaining the applicable CPB, are discussed below.

6.2.4.1 Reference Designation (RD) Index. One of the most common ways of entering an IPB is with a reference designation as the "known information." The technician may want to obtain the equivalent part number, a breakdown illustration, some selected application data, or some combination. Several types of paper-based RD indexes were illustrated in Figure 2-14. VAMIS-type IPBs will normally have two types of RD index frames: an RD master index and an RD index.

When the number of individual RD index frames will exceed 10, the first frame of the sequence will be an RD master index as illustrated in Figure 6-6. An RD master index reduces the number of individual index frames which a technician will need to step through to find the correct one. Each line entry in the master index coincides with the first entry on an individual RD index frame. If feasible, the master index should be complete on one frame, and each major group of RDs should start on a new line, preferably with a blank line preceding it, or start a new column. Note that, in the example, RD 11 (at key code 21) is not out of sequence according to the IPB specification requirements for sequencing. Recognition by technicians would probably be enhanced if "eleven" was in conventional numerical sequence, but sequencing would then be different from paper-based IPBs.

TO 12R2-2ARC164-2-9A 23-20-00 GPB 04P12E
IPB REFERENCE DESIGNATIONS (MASTER INDEX) 1

KEY [ ]	BEGINNING WITH REFERENCE DESIGNATION	KEY [ ]	BEGINNING WITH REFERENCE DESIGNATION	KEY [ ]	BEGINNING WITH REFERENCE DESIGNATION
1	1	36	2	71	3
2	1A2	37	2A1A1A1Q00	72	3A1A1A1Q00
3	1A2A1U1	38	2A1A1A2	73	3A1A1A2
4	1A2A2Q1	39	2A1A1A2P1	74	3A1A1A2P1
5	1A2A3	40	2A1A1A3	75	3A1A1A3
6	1A3	41	2A1A2	76	3A1A2
7	1A3A1C7	42	2A2	77	3A2
8	1A3A1RT1	43	2A2A1U1		
9	1A3A1R6	44	2A2A2Q1	79	4
10	1A4	45	2A2A3	80	4A3
11	1A4A1C4	46	2A3	81	7
12	1A4A1L1	47	2A3A1C7	82	7A1A1A1Q00
13	1A4A1RT1	48	2A3A1RT1	83	7A1A1A2
14	1A4A1R7	49	2A3A1R6	84	7A1A1A2P1
15	1A5	50	2A4	85	7A1A1A3
16	1A5A1J1	51	2A4A1C4	86	7A1A2
17	1A5A1R5	52	2A4A1L1	87	7A2
18	1A5A2	53	2A4A1RT1		
19	1A5A2L2	54	2A4A1R7	89	9
		55	2A5	90	9A1A1A1Q00
21	11	56	2A5A1J1	91	9A1A1A2
		57	2A5A1R1	92	9A1A1A2P1
		58	2A5A2	93	9A1A1A3
		59	2A5A2L2	94	9A1A2
				95	9A2

FOR SPECIFIC REFERENCE DESIGNATION INDEX FRAME INPUT KEY CODE [ ], [ENTER].

Figure 6-6. Example of VAMIS IPB reference designation index, master index frame.

The technician who has chosen this path will select the key code opposite the appropriate RD on the master index to obtain a specific RD index frame. An example is shown in Figure 6-7. Each such frame lists all of the system RDs within the group in proper sequence. Selection of the key code adjacent to the known RD will in most cases access the appropriate CPB.

TO 12R2-2ARC164-2-AA 23-20-00 GPB 04[illegible]

IPB: REFERENCE DESIGNATIONS INDEX (2 TO 2A1A1A1E86) 21

KEY [ ]	REFERENCE DESIGNATION	KEY [ ]	REFERENCE DESIGNATION	KEY [ ]	REFERENCE DESIGNATION
1	2	36	2A1A1A1C26	71	2A1A1A1E20
2	2A1	37	2A1A1A1C27	72	2A1A1A1E21
3	2A1A1	38	2A1A1A1C28	73	2A1A1A1E3
4	2A1A1A1	39	2A1A1A1C29	74	2A1A1A1E4
5	2A1A1A1CR1	40	2A1A1A1C30	75	2A1A1A1E5
6	2A1A1A1CR2	41	2A1A1A1C31	76	2A1A1A1E6
7	2A1A1A1CR3	42	2A1A1A1C32	77	2A1A1A1E7
8	2A1A1A1CR4	43	2A1A1A1C33	78	2A1A1A1E70
9	2A1A1A1CR5	44	2A1A1A1C34	79	2A1A1A1E71
10	2A1A1A1CR6	45	2A1A1A1C35	80	2A1A1A1E72
11	2A1A1A1CR7	46	2A1A1A1C36	81	2A1A1A1E73
12	2A1A1A1CR8	47	2A1A1A1C37	82	2A1A1A1E74
13	2A1A1A1CR9	48	2A1A1A1C38	83	2A1A1A1E75
14	2A1A1A1C00	49	2A1A1A1C39	84	2A1A1A1E76
15	2A1A1A1C01	50	2A1A1A1C40	85	2A1A1A1E77
16	2A1A1A1C02	51	2A1A1A1C41	86	2A1A1A1E78
17	2A1A1A1C03	52	2A1A1A1C42	87	2A1A1A1E79
18	2A1A1A1C04	53	2A1A1A1C43	88	2A1A1A1E8
19	2A1A1A1C05	54	2A1A1A1C44	89	2A1A1A1E80
20	2A1A1A1C06	55	2A1A1A1C45	90	2A1A1A1E81
21	2A1A1A1C07	56	2A1A1A1C46	91	2A1A1A1E82
22	2A1A1A1C08	57	2A1A1A1E1	92	2A1A1A1E83
23	2A1A1A1C09	58	2A1A1A1E10	93	2A1A1A1E84
24	2A1A1A1C10	59	2A1A1A1E100	94	2A1A1A1E85
25	2A1A1A1C11	60	2A1A1A1E101	95	2A1A1A1E86
26	2A1A1A1C12	61	2A1A1A1E11		
27	2A1A1A1C13	62	2A1A1A1E12		
28	2A1A1A1C14	63	2A1A1A1E13		
29	2A1A1A1C15	64	2A1A1A1E14		
30	2A1A1A1C20	65	2A1A1A1E15		
31	2A1A1A1C21	66	2A1A1A1E16		
32	2A1A1A1C22	67	2A1A1A1E17		
33	2A1A1A1C23	68	2A1A1A1E18		
34	2A1A1A1C24	69	2A1A1A1E19		
35	2A1A1A1C25	70	2A1A1A1E2		

FOR COMPOSITE PARTS BREAKDOWN: INPUT KEY CODE [ ]; [ENTER].

Figure 6-7. Example of VAMIS IPB reference designation index frame.

In a relatively limited number of cases the system will be unable to provide the correct CPB because of multiple use of a single RD for different equipment configurations. For such cases an RD multiple use index frame is inserted in the sequence. An example is depicted in Figure 6-8. This example depicts a particularly complex case based on configurations in the reference IPB, so the format should satisfy all foreseeable applications. In less complex cases, the boxed area in the example could contain more than one target RD, as long as the list of next higher assemblies (NHAs) is compatible.

```
# TO 12R2-2ARC164-2-AA                          23-20-00                     6PB 04053E
# IPB  REFERENCE DESIGNATIONS (MULTIPLE USE INDEX) 3A1
#

  THE SELECTED REFERENCE DESIGNATION APPLIES TO MORE THAN ONE PART. CHECK THE LIST BELOW FOR
  USE OF YOUR REFERENCE DESIGNATION ON HIGHER ASSEMBLIES AND MAKE A CHOICE.

  REFERENCE    KEY   DESCRIPTION                                    PART NUMBER   USABLE-
# DESIGNATION                                                                     ON CODE

  3                  CONTROL, RADIO SET C-9533/ARC-164(V)           705908-001    *A
                                                                    705908-002    *B
                                                                    705908-003    *C
                                                                    705908-004    *D
                                                                    705908-005    *Q

  3                  CONTROL, RADIO SET C-9680/ARC-164(V)           706075-001    *E
                                                                    706075-002    *F
                                                                    706075-003    *G
                                                                    706075-004    *H
                                                                    706075-005    *R

  3                  CONTROL, RADIO SET C-9681/ARC-164(V)           706076-001    *I
                                                                    706076-002    *J
                                                                    706076-003    *K
                                                                    706076-004    *L
                                                                    706076-005    *S

  3                  CONTROL, RADIO SET C-9682/ARC-164(V)           706079-001    *M
                                                                    706079-002    *N
                                                                    706079-003    *O
                                                                    706079-004    *P
                                                                    706079-005    *T

( 3A1          [  ]  . SWITCHING UNIT, FREQUENCY CHANNEL
                 1       SA-2061/ARC-164(V) (ALTERNATE PART)        918848-001    A,E,I,M
                 2       SA-2061A/ARC-164(V) (PREFERRED PART)       912406-001    A,E,I,M

                 3       SA-2061/ARC-164(V) (ALTERNATE PART)        918848-002    B,F,J,N
                 4       SA-2061A/ARC-164(V) (PREFERRED PART)       912406-002    B,F,J,N

                 5       SA-2061/ARC-164(V) (ALTERNATE PART)        918848-003    C,G,K,O
                 6       SA-2061A/ARC-164(V) (PREFERRED PART)       912406-003    C,G,K,O

                 7       SA-2061/ARC-164(V) (ALTERNATE PART)        918848-004    D,H,L,P
                 8       SA-2061A/ARC-164(V) (PREFERRED PART)       912408-004    D,H,L,P

                 9       SA-2061/ARC-164(V) (ALTERNATE PART)        918846-005    Q,R,S,T
                10       SA-2061A/ARC-164(V) (PREFERRED PART)       912408-005    Q,R,S,T

  FOR SPECIFIC COMPOSITE PARTS BREAKDOWN  INPUT KEY CODE [  ]; [ENTER].
```

Figure 6-8. Example of VAMIS IPB reference designations multiple use index frame.

6.2.4.2 Part Number (PN) Index. An approach to obtaining IPB information which is as common as the RD index is through a PN index. An example of a paper-based PN index was illustrated in Figure 2-13. In an approach similar to that described for the RD index, when the number of individual PN index frames will exceed 10, a PN master index frame is used as illustrated in Figure 6-9. PN entries on each line coincide with the first PN

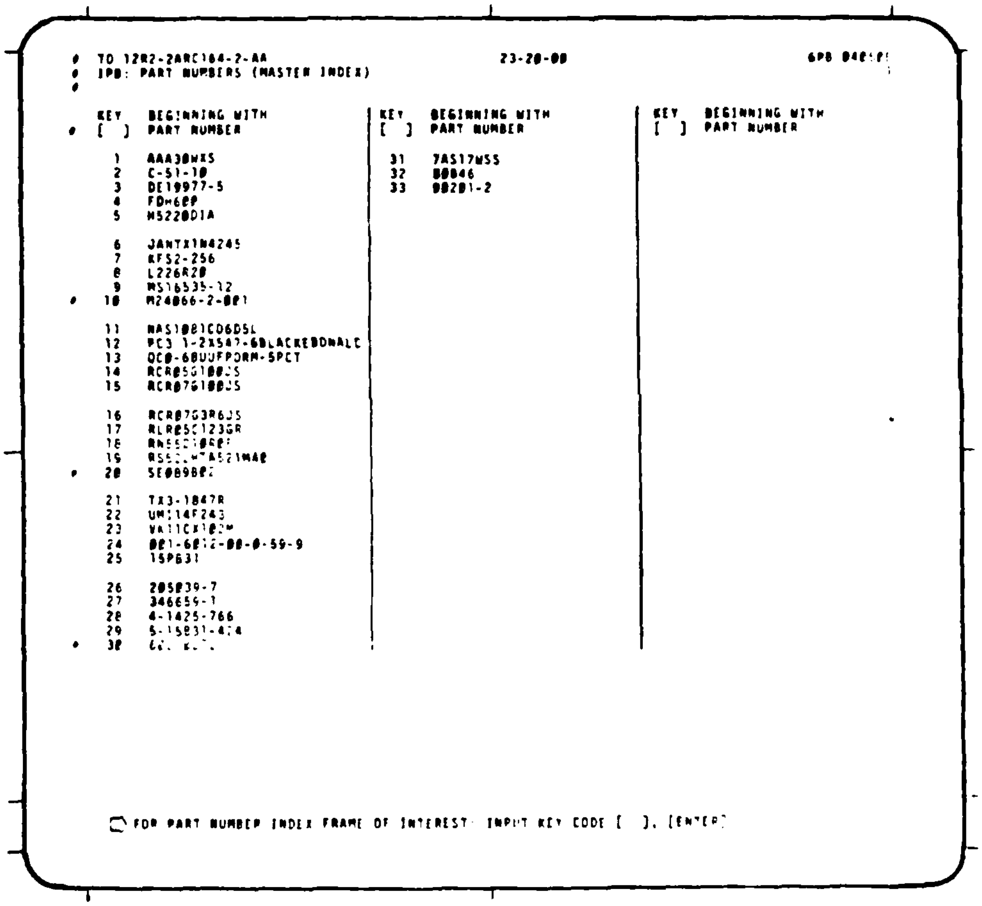


Figure 6-9. Example of VAMIS IPB part numbers master index frame.

index frame. PNs beginning with alphabetic characters precede those beginning with integers. Selection of the key code adjacent to the applicable beginning PN will yield the appropriate individual PN index frame, an example of which is presented in Figure 6-10.

TO 13A5-37-2-AA 95-10-00 6PB 04743E
IPB PART NUMBERS INDEX (MBEU1444H5 TO MBEU1753H5) 9

KEY [ ]	PART NUMBER	KEY [ ]	PART NUMBER	KEY [ ]	PART NUMBER
1	MBEU1444H5	36	MBEU1520-20H5	71	MBEU167H5
2	MBEU1445H5	37	MBEU1520H5	72	MBEU16720
3	MBEU1446H5	38	MBEU1521H5	73	MBEU16761
4	MBEU1447H5	39	MBEU1522-17H5	74	MBEU1679H5
5	MBEU1448H5	40	MBEU1522-20H5	75	MBEU16796
6	MBEU1449H5	41	MBEU1522H5	76	MBEU16797
7	MBEU145J5	42	MBEU1523H5	77	MBEU168H5
8	MBEU1450H5	43	MBEU1527H5	78	MBEU16804
9	MBEU1451H5	44	MBEU15290	79	MBEU16836
10	MBEU1453H5	45	MBEU15291	80	MBEU16842
11	MBEU1454H5	46	MBEU15292	81	MBEU16844
12	MBEU1455H5	47	MBEU15293	82	MBEU16860
13	MBEU1465	48	MBEU1530H5	83	MBEU1696H5
14	MBEU14650	49	MBEU1531H5	84	MBEU17H5
15	MBEU1466	50	MBEU15393	85	MBEU1700H5
16	MBEU1477H5	51	MBEU1542H5	86	MBEU17026
17	MBEU1478H5	52	MBEU1543H5	87	MBEU17199
18	MBEU148J5	53	MBEU155H5	88	MBEU1720H5
19	MBEU1480H5	54	MBEU1552H5	89	MBEU17202
20	MBEU14840	55	MBEU1553H5	90	MBEU17203
21	MBEU14841	56	MBEU1554H5	91	MBEU17206
22	MBEU14842	57	MBEU1556H5	92	MBEU17282
23	MBEU1486H5	58	MBEU16567	93	MBEU1729H5
		59	MBEU16568	94	MBEU174H5
25	MBEU1487H5	60	MBEU166H5	95	MBEU1752H5
26	MBEU1490H5	61	MBEU1664H5	96	MBEU1753H5
27	MBEU14904	62	MBEU16645		
28	MBEU1491H5	63	MBEU16647		
29	MBEU1492H5	64	MBEU16649		
30	MBEU1493H5	65	MBEU1665H5		
31	MBEU1494H5	66	MBEU16650		
32	MBEU14966	67	MBEU1667H5		
33	MBEU14967	68	MBEU1668H5		
34	MBEU15H5	69	MBEU1669		
35	MBEU1520-17H5	70	MBEU1669H5		

FOR COMPOSITE PARTS BREAKDOWN INPUT KEY CODE [ ]. [ENTER].

Figure 6-10. Example of VAMIS IPB part numbers index frame.

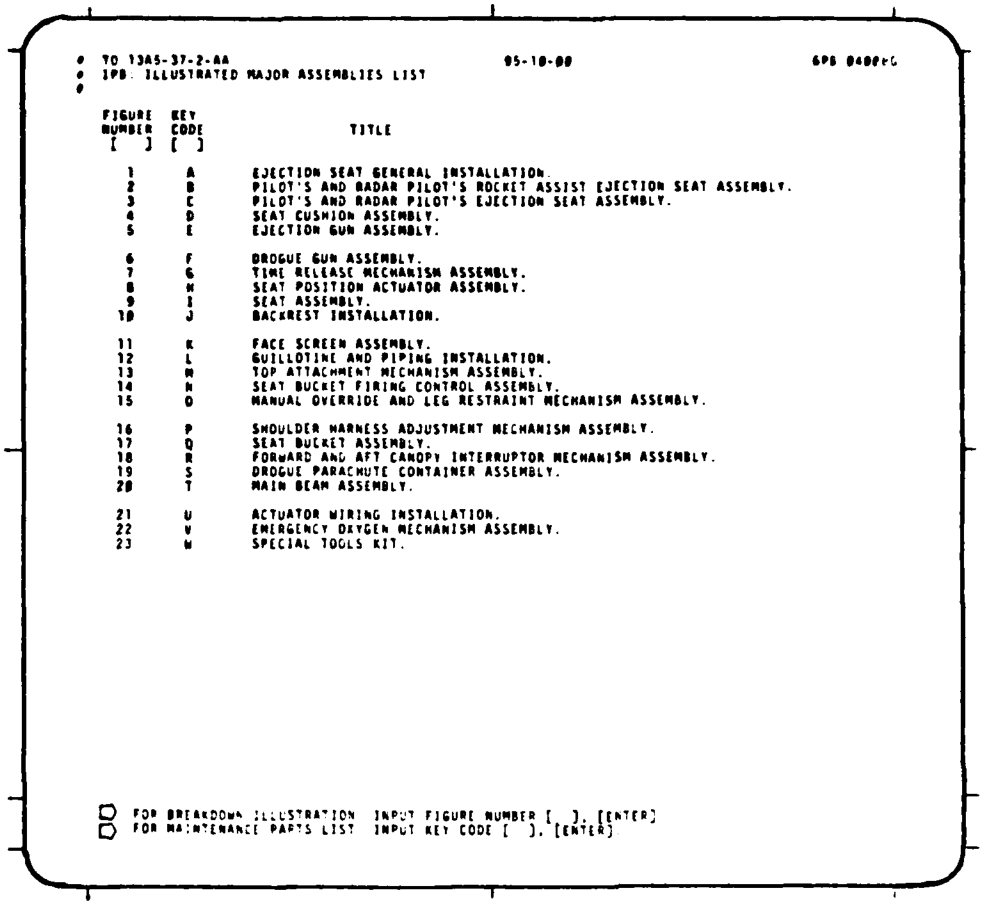
Selection of the applicable key code for the known part number will normally access the CPB for that PN, unless the particular part with that PN has more than one application or use within the system. In the latter case, a multiple application PN index (MAPNI) frame is inserted in the sequence. This format, an example of which is illustrated in Figure 6-11,

```
#  TO 12R2-2ARC164-2-AA                23-20-00                 GPB 04055E
#  IPB. MULTIPLE APPLICATION PART NUMBER INDEX (PN M475R)
#

   THE SELECTED PART IS:  M475R, CAPACITOR, FIXED, ELECTROLYTIC.
   THIS PART HAS MULTIPLE APPLICATIONS. SELECT THE APPLICATION OF INTEREST FROM THE LIST BELOW.

   KEY   M475R            HIGHER ASSEMBLIES USING THIS PART
   CODE  REFERENCE
   [ ]   DESIGNATIONS     PART NUMBER   DESCRIPTION

                          705907-001    RECEIVER-TRANSMITTER, RADIO RT-1145
                          919403-001    . RECEIVER, RADIO, GUARD R-1976
    A    1A3A1C101        (MULTIPLE)    . . CIRCUIT CARD ASSY, GUARD

                          (MULTIPLE)    RECEIVER-TRANSMITTER, RADIO RT-1168
                          919403-001    . RECEIVER, RADIO, GUARD R-1976
    B    2A3A1C101        (MULTIPLE)    . . CIRCUIT CARD ASSY, GUARD

                          (MULTIPLE)    INDICATOR, FREQUENCY CHANNEL ID-1961, ID-1961A
    C    4A1C1            918599-002    . CIRCUIT CARD ASSY, INDICATOR BOARD 1
    D    4A1C2            918599-002    . CIRCUIT CARD ASSY, INDICATOR BOARD 1
    E    4A1C2            918599-001    . CIRCUIT CARD ASSY, INDICATOR BOARD 1 (ID-1961 ONLY)

    F    4A2C1            918600-002    . CIRCUIT CARD ASSY, INDICATOR BOARD 2
    G    4A3C5            918656-002    . CIRCUIT CARD ASSY, INDICATOR BOARD 3
    H    4A4C5            916431-002    . CIRCUIT CARD ASSY, INDICATOR BOARD 4

#    FOR SPECIFIC COMPOSITE PARTS BREAKDOWN: INPUT KEY CODE [ ], [ENTER].
```

Figure 6-11. Example of VAMIS IPB multiple application part number index (MAPNI) frame.

is used whenever a selected PN has multiple applications that would result in more than one CPB. As will be shown later in this section, however, the CPB format has some flexibility for incorporating multiple application PNs; it will not always be necessary to insert a MAPNI. As a general rule, if the PN has more than one equivalent RD and more than one figure/index number in the same NHA, plan on separate CPBs selected via a MAPNI. If the PN has multiple RDs with the same figure/index number, they can usually be combined in a single CPB.

6.2.4.3 Major Assemblies List (MAL). This format is primarily for individuals who do not know either the RD or the PN of the part, but are familiar with the names. As is depicted in Figure 6-1, it may also be the preferred route for users who want to obtain a breakdown illustration but do not need the data on a CPB. An example of the major assemblies list format is shown in Figure 6-12. It is actually a simple menu of the major assemblies which make up the system or equipment, and for which maintenance parts lists (MPL) and breakdown illustrations (BI) are provided in the IPB. It is this relationship to MPLs and BIs which gives the MAL its only unusual feature: Two selection columns are provided, giving the user a choice of path to the CPB. Technicians who are more familiar with the nomenclature would select the MPL; those who are more familiar with configuration, or simply want an illustrated breakdown would select BI. Although many MALs will be complete on one frame, it will not be unusual for complex system MALs to continue on second and subsequent frames. When this occurs, the numbers in the figure number column should be consecutive through the series of frames, coinciding with the actual figure numbers of the applicable BI. Key codes, on the other hand, are arbitrary codes and should start over on each new frame.



TO 13A5-37-2-AA 05-10-00 GPB 0400FG
IPB: ILLUSTRATED MAJOR ASSEMBLIES LIST

FIGURE NUMBER [ ]	KEY CODE [ ]	TITLE
1	A	EJECTION SEAT GENERAL INSTALLATION.
2	B	PILOT'S AND RADAR PILOT'S ROCKET ASSIST EJECTION SEAT ASSEMBLY.
3	C	PILOT'S AND RADAR PILOT'S EJECTION SEAT ASSEMBLY.
4	D	SEAT CUSHION ASSEMBLY.
5	E	EJECTION GUN ASSEMBLY.
6	F	DROGUE GUN ASSEMBLY.
7	G	TIME RELEASE MECHANISM ASSEMBLY.
8	H	SEAT POSITION ACTUATOR ASSEMBLY.
9	I	SEAT ASSEMBLY.
10	J	BACKREST INSTALLATION.
11	K	FACE SCREEN ASSEMBLY.
12	L	GUILLOTINE AND PIPING INSTALLATION.
13	M	TOP ATTACHMENT MECHANISM ASSEMBLY.
14	N	SEAT BUCKET FIRING CONTROL ASSEMBLY.
15	O	MANUAL OVERRIDE AND LEG RESTRAINT MECHANISM ASSEMBLY.
16	P	SHOULDER HARNESS ADJUSTMENT MECHANISM ASSEMBLY.
17	Q	SEAT BUCKET ASSEMBLY.
18	R	FORWARD AND AFT CANOPY INTERRUPTOR MECHANISM ASSEMBLY.
19	S	DROGUE PARACHUTE CONTAINER ASSEMBLY.
20	T	MAIN BEAM ASSEMBLY.
21	U	ACTUATOR WIRING INSTALLATION.
22	V	EMERGENCY OXYGEN MECHANISM ASSEMBLY.
23	W	SPECIAL TOOLS KIT.

FOR BREAKDOWN ILLUSTRATION INPUT FIGURE NUMBER [ ]. [ENTER]
FOR MAINTENANCE PARTS LIST INPUT KEY CODE [ ]. [ENTER]

Figure 6-12. Example of VAMIS IPB major assemblies list frame.

6.2.4.4 Maintenance Parts List (MPL). In paper-based IPBs the MPL (formerly the group assembly parts list) is both a source of applications data as well as an index or cross-reference to the associated breakdown illustration. In VAMIS-type IPBs the MPL is primarily a selection menu, as shown in Figure 6-13, for obtaining the correct CPB. Index codes, descriptive nomenclature,

TO 12R2-2ARC164-2-AA 23-20-ØP GPB Ø4P-4
IPB MAINTENANCE PARTS LIST; FIGURE 12, MODULATOR CIRCUIT CARD ASSY.

INDEX [ ]	PART NUMBER	DESCRIPTION	USABLE-ON CODE
ØA	918819-8Ø1	CIRCUIT CARD ASSEMBLY, MODULATOR	*A
ØB	918819-8Ø2	CIRCUIT CARD ASSEMBLY, MODULATOR	*B
ØC	918819-8Ø3	CIRCUIT CARD ASSEMBLY, MODULATOR	*C
ØD	918819-8Ø6	CIRCUIT CARD ASSEMBLY, MODULATOR	*D
1	932952-8Ø1	. BRACKET, ANGLE	
A	TC7361-3Ø65	. RIVET, TUBULAR(AP)	
2	RS52LHTA521M4Ø	. . NUT, SELF-LOCKING	
B	MS2Ø426AD2-2	. . RIVET (AP).	
3	932952-1	. . BRACKET, ANGLE	
4	46660Ø-1	. CABLE, RADIO FREQUENCY.	
5	CC2-2UUFPORMSPCT	. CAPACITOR, FIXED, CERAMIC DIELECTRIC	
6	368766-847	. COIL, RADIO FREQUENCY	
7	ATC1ØØE15ØJP5ØØSP	. CAPACITOR, FIXED, GLASS DIELECTRIC	
8	CK05BX1Ø2K	. CAPACITOR	A,B,C
9	CK05BX471K	. CAPACITOR	
1Ø	RWR81S182ØFM	. RESISTOR	
11	RCR07G5R1JS	. RESISTOR	
12	CK05BX47ØK	. CAPACITOR	
13	RCR07G161JS	. RESISTOR	
14	MS75Ø83-Ø1	. COIL	
15	368766-846	. COIL, RADIO FREQUENCY	
16	MS75Ø83-Ø7	. COIL	
17	OC6-8UUFPORMSPCT	. CAPACITOR, FIXED, COMPOSITION	
18	368766-844	. COIL, RADIO FREQUENCY	
19	615467-9Ø1	. TRANSISTOR	
C	NAS671C8	. NUT (AP)	
2Ø	ATC1ØØB24ØJP5ØØSP	. CAPACITOR, FIXED, GLASS DIELECTRIC	
21	368766-837	. COIL, RADIO FREQUENCY	
22	RCR07G18ØJS	. RESISTOR	
23	JANTX1N645	. SEMICONDUCTOR DEVICE	
24	RCR07G151JS	. RESISTOR	
25	RCR07G51ØJS	. RESISTOR	
26A	JANTX1N4454	. SEMICONDUCTOR DEVICE(ALTERNATE PART)	
26B	JANTX1N4454-1	. SEMICONDUCTOR DEVICE(PREFERRED PART)	
27A	JANTX1N4454	. SEMICONDUCTOR DEVICE(ALTERNATE PART)	A
27B	JANTX1N4454-1	. SEMICONDUCTOR DEVICE(PREFERRED PART)	A
28	RCR07G562JS	. RESISTOR	
29	MS75Ø83-Ø9	. COIL	
3Ø	RCR07G331JS	. RESISTOR	
31	JANTX1N746A	. SEMICONDUCTOR DEVICE	
32	M39ØØ3-Ø1-23Ø4	. CAPACITOR	
33	CK05BX473K	. CAPACITOR	
34A	CK05BX473K	. CAPACITOR	A
34B	CK06BX1Ø5K	. CAPACITOR	B,C,D
35	CK05BX1Ø4K	. CAPACITOR	

FOR CONTINUATION [FORWARD].
FOR COMPOSITE PARTS BREAKDOWN INPUT INDEX CODE [ ]; [ENTER].

Figure 6-13. Example of VAMIS IPB maintenance parts list (MPL) frame.

indenture, and usable-on codes used in the MPL establish the baseline for related breakdown illustrations and CPBs. Part numbers and usable-on codes are included to assist the user in selecting the correct part. The description column, which is primarily what technicians will use in identifying the part of interest, is in the normal top-down breakdown, indentured organization. On a continuation frame, such as would follow this example frame, all top (Ø) level entries must be repeated, as well as any lower indentures against which usable-on codes apply.

6.2.4.5 Breakdown Illustration (BI). Breakdown illustrations in VAMIS will normally not differ greatly from those in paper-based IPBs, as can be seen in the examples in Figures 6-14 and 6-15 (for a mechanical assembly and an electronic assembly, respectively). However, some large illustrations, which may be on foldout pages in a paper TO, will need to be divided into subassemblies, or on some other basis, in order to be comprehensible on a video screen. All parts which can be illustrated should be shown and should have an index number which is the same as on the MPL and CPB. Parts which are not illustrated will normally have no index number, but should, if possible, be listed with a code for selection of the applicable CPB. If the selection of a particular index code could result in more than one Composite Parts Breakdown, because of multiple part numbers and/or different usable-on configurations, divert to the appropriate reference designator multiple use index (index numbers, like reference designators, normally apply to the part in a specific location). In systems where RDs have not been assigned (as in many mechanical assemblies), a special multiple use index may have to be compiled. Alternatively, the Composite Parts Breakdown could list all the alternative part numbers for that use of the index number. On plan view breakdown illustrations such as the example in Figure 6-15, it is not feasible to have the index numbers meet the character size requirements normally imposed, or to show the code "brackets" indicating selectability, without degrading the illustration's comprehensibility. The user will need to use the zoom feature to increase character size. The note at the top of the frame should clarify the availability of index numbers for selection.

6.2.5 Composite Parts Breakdown (CPB)

This format is the working part of a VAMIS-type IPB, and is the end result of the selection methods, formats, and pathways described above. Figure 6-16 illustrates an example of a relatively simple CPB, the result of selecting index code 11 on the breakdown illustration (Figure 6-14) or on the maintenance parts list. The same CPB would result from selection of PN MBEU1486H5 on the PN index (key code 23 on Figure 6-10). Since reference designations are not used in this system (normal for mechanical assemblies), this CPB would have no related RD index.

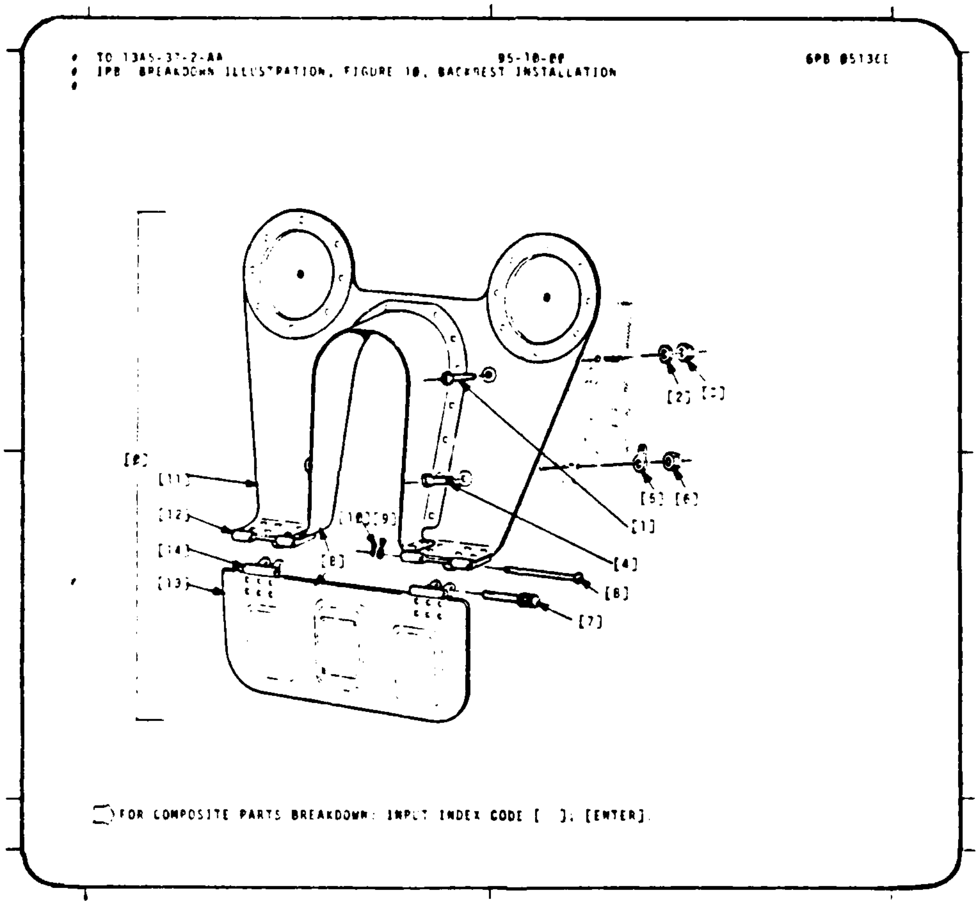


Figure 6-14. Example of VAMIS IPB breakdown illustration frame (exploded view of simple mechanical assembly).

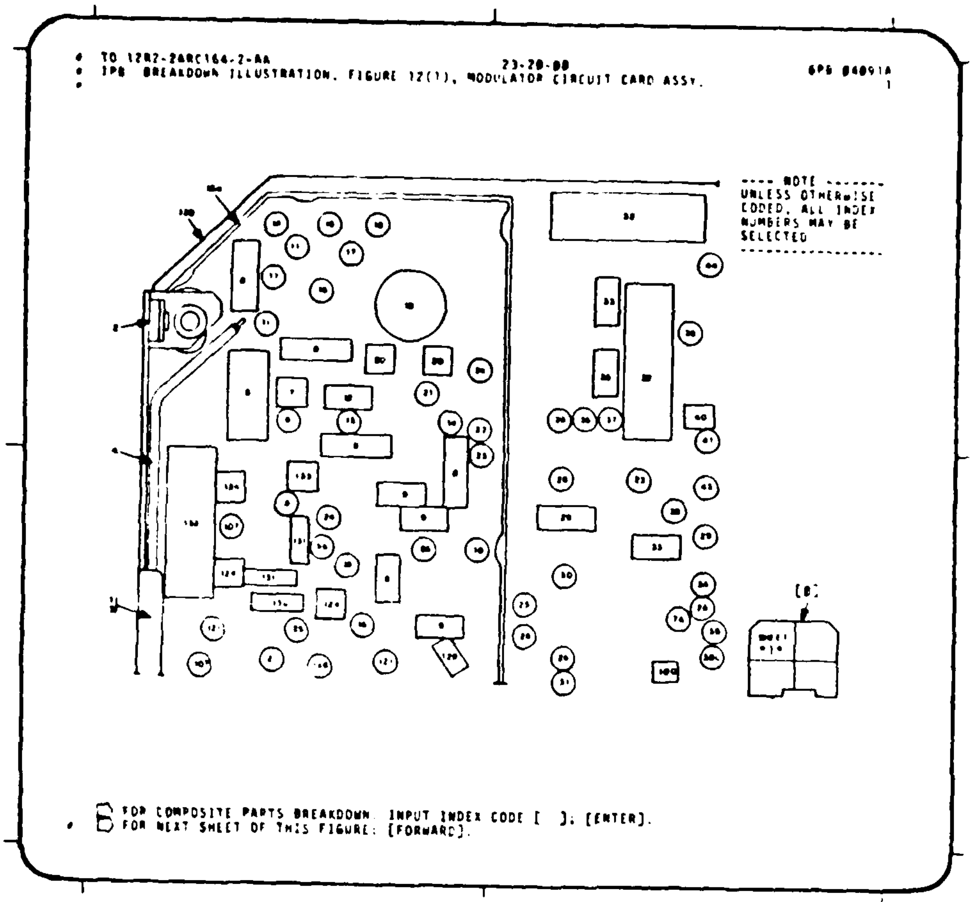


Figure 6-15. Example of VAMIS IPB breakdown illustration (plan view of electronic assembly).

The basic elements of a CPB are the applicable BI (or necessary portion thereof), the applicable portion of the MPL (including the selected indexed part, and higher and lower assemblies/parts), the applicable part numbers and usable-on codes, and the application data for the indexed part. The listing for the selected part is highlighted by boxing in this example. Since no further breakdown of the selected part is available, the index number is coded as not selectable. If a further breakdown was available, the * * would not be shown.

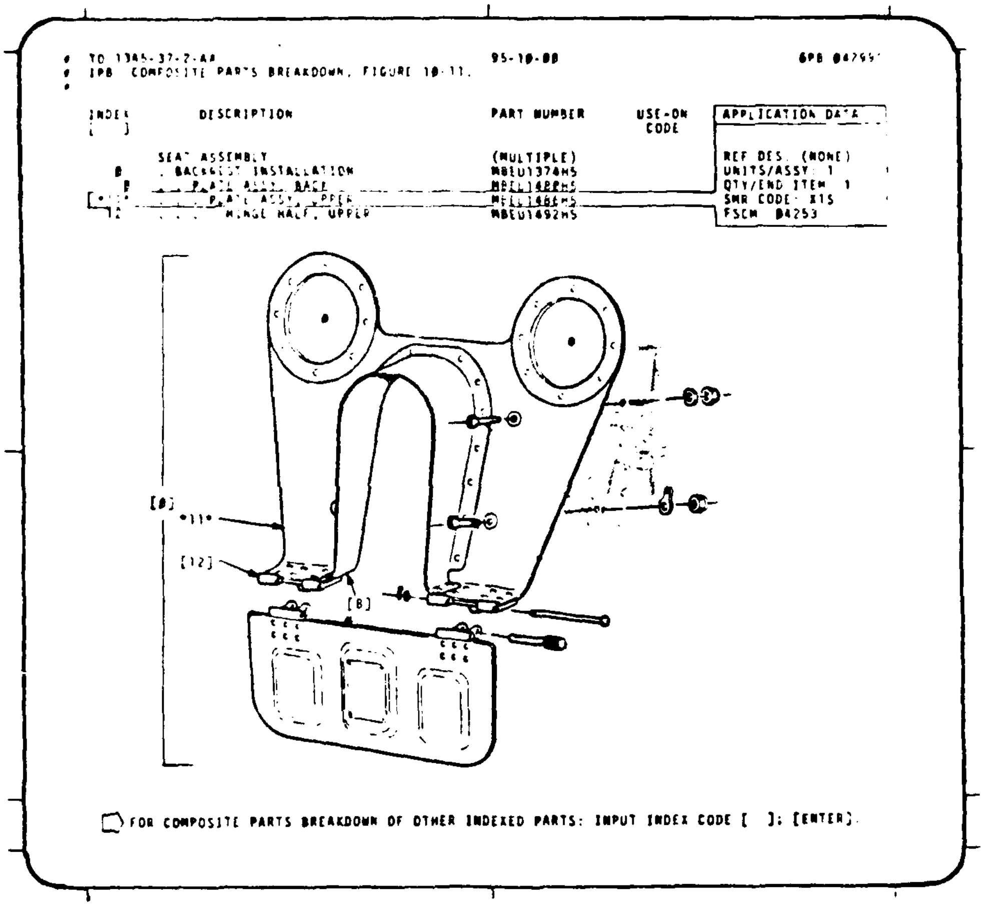


Figure 6-16. Example of VAMIS IPB Composite Parts Breakdown (CPB) frame (simple mechanical assembly with exploded view).

When the list of next lower assemblies (NLAs) is short, they should be included in the CPB. When the list is lengthy, provide an index code for next lower assemblies. Selection of the code would go to a new frame containing the full list of NLAs indentured under the part of interest with an indexed breakdown illustration, but without the topdown breakdown or application data. Selection of the index code for one of these NLAs would yield a typical CPB.

The topdown breakdown used in a CPB should start no higher than one level above the reference (Ø) level, unless higher level usable-on codes are involved and they are necessary information. Attempting to construct a complete topdown breakdown consumes valuable display space and has limited information value.

Many CPBs may not be as simple as in the preceding example. To illustrate, the example in Figure 6-17 requires the inclusion of

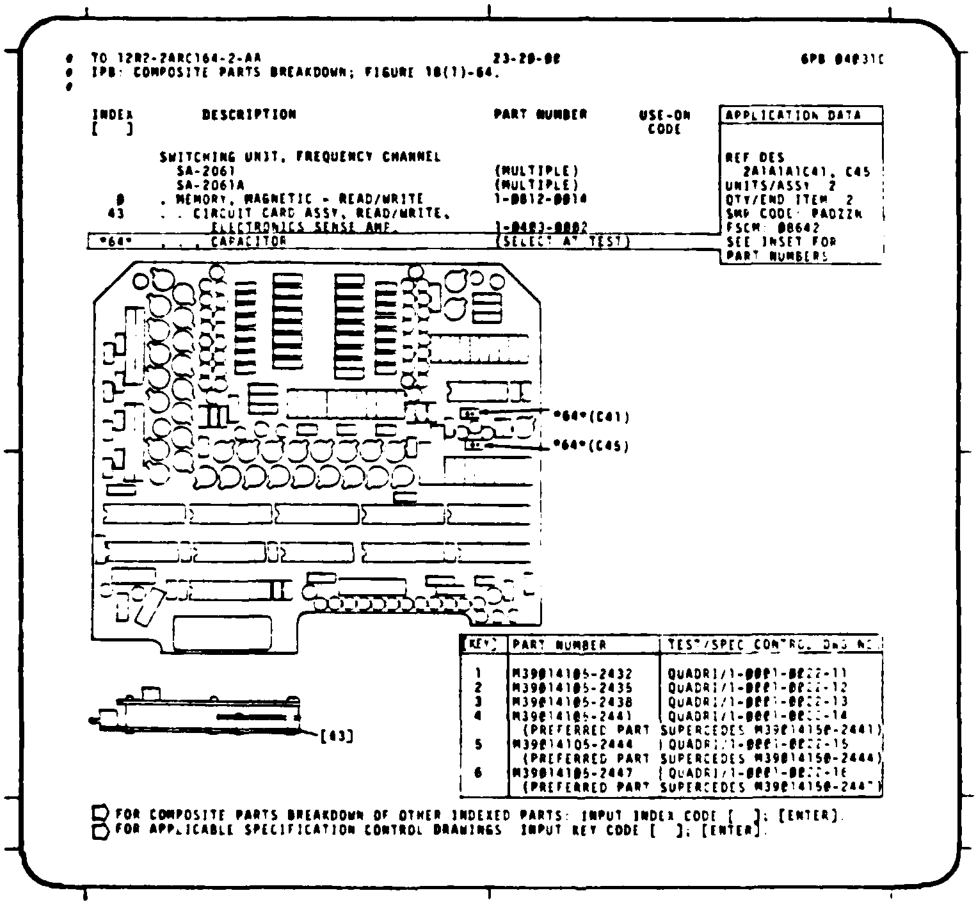


Figure 6-17. Example of VAMIS IPB Composite Parts Breakdown (CPB) frame (electronic assembly) with referenced data on same frame.

some "select-at-test" data to determine the correct PN. Since space on the frame is available, the reference data are included on the same frame, as shown. When this approach is used, e.g., for coding select-at-test part numbers, care must be taken that the key codes do not duplicate index codes.

When the need for provision of such additional information requires more space than is conveniently available on a single CPB frame, the referenced data are placed on a supplementary frame which can be directly accessed from the CPB. This approach is illustrated in the examples in Figures 6-18 and 6-19.

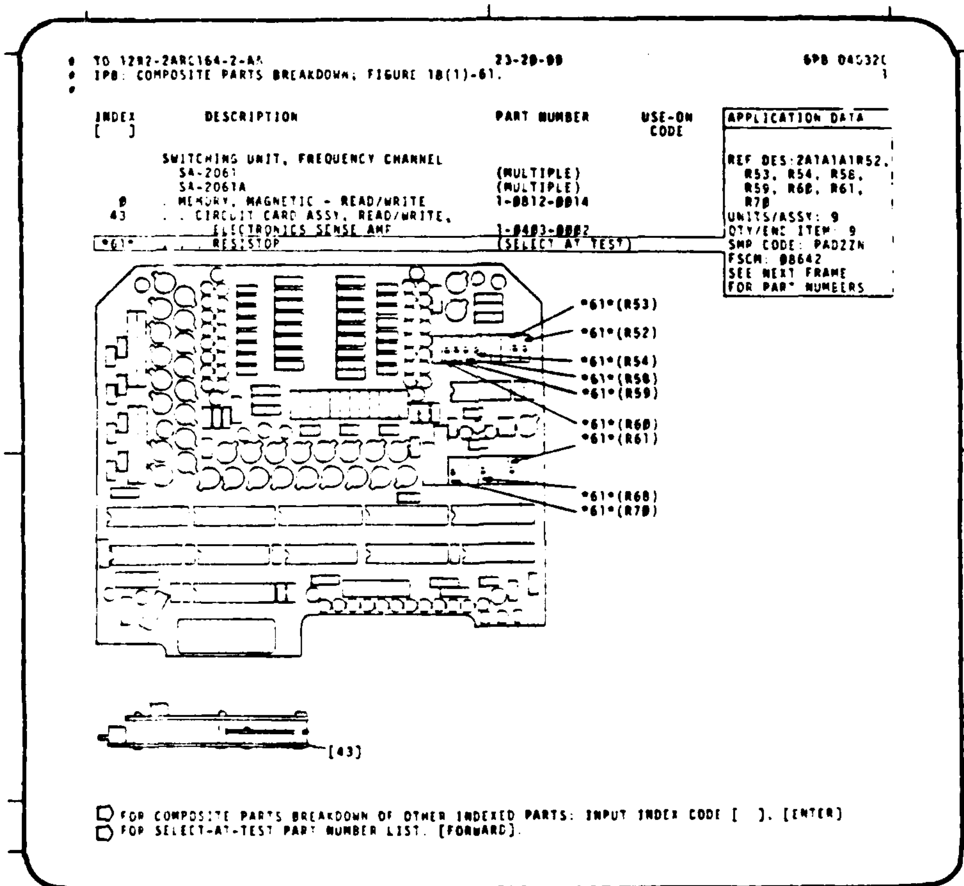


Figure 6-18. Example of VAMIS IPB Composite Parts Breakdown (CPB) frame (electronic assembly) with referenced data on next frame.

TO 12R2-2ARC164-2-AA 23-20-00 GPB 04P33 2
IPB: COMPOSITE PARTS BREAKDOWN; FIGURE 10(1)-61.
10(1)-61 RESISTOR, SELECT-AT-TEST PART NUMBER LIST

THE CORRECT PART NUMBER IS SELECTED AT TEST ACCORDING TO THE FOLLOWING TABLE:

KEY [ ]	PART NO	TEST/SPEC CONTROL DWG	KEY [ ]	PART NO.	TEST/SPEC CONTROL DWG
1	RN55D14R0F	QUADRI/1-0003-0017-14	36	RN55D1301F	QUADRI/1-0003-0019-11
2	RN55D16R9F	QUADRI/1-0003-0017-22	37	RN55D1401F	QUADRI/1-0003-0019-14
3	RN55D20R0F	QUADRI/1-0003-0017-29	38	RN55D1501F	QUADRI/1-0003-0019-17
4	RN55D23R2F	QUADRI/1-0003-0017-35	39	RN55D1621F	QUADRI/1-0003-0019-20
5	RN55D27R4F	QUADRI/1-0003-0017-42	40	RN55D1741F	QUADRI/1-0003-0019-23
6	RN55D30R1F	QUADRI/1-0003-0017-46	41	RN55D1821F	QUADRI/1-0003-0019-25
7	RN55D33R2F	QUADRI/1-0003-0017-50	42	RN55D1911F	QUADRI/1-0003-0019-27
8	RN55D35R7F	QUADRI/1-0003-0017-53	43	RN55D3011F	QUADRI/1-0003-0019-46
9	RN55D39R2F	QUADRI/1-0003-0017-57	44	RN55D3091F	QUADRI/1-0003-0019-47
10	RN55D53R6F	QUADRI/1-0003-0017-70	45	RN55D3241F	QUADRI/1-0003-0019-49
11	RN55D59R0F	QUADRI/1-0003-0017-74	46	RN55D3321F	QUADRI/1-0003-0019-50
12	RN55D60R4F	QUADRI/1-0003-0017-75	47	RN55D3401F	QUADRI/1-0003-0019-51
13	RN55D64R9F	QUADRI/1-0003-0017-78	48	RN55D3481F	QUADRI/1-0003-0019-52
14	RN55D69R8F	QUADRI/1-0003-0017-81	49	RN55D3571F	QUADRI/1-0003-0019-53
15	RN55D73R2F	QUADRI/1-0003-0017-83	50	RN55D3741F	QUADRI/1-0003-0019-55
16	RN55D78R7F	QUADRI/1-0003-0017-86	51	RN55D3831F	QUADRI/1-0003-0019-56
17	RN55D80R6F	QUADRI/1-0003-0017-87	52	RN55D3921F	QUADRI/1-0003-0019-57
18	RN55D84R5F	QUADRI/1-0003-0017-89	53	RN55D4021F	QUADRI/1-0003-0019-58
19	RN55D3010F	QUADRI/1-0003-0018-46	54	RN55D4221F	QUADRI/1-0003-0019-60
20	RN55D3480F	QUADRI/1-0003-0018-52	55	RN55D4421F	QUADRI/1-0003-0019-62
21	RN55D4020F	QUADRI/1-0003-0018-58	56	RN55D4641F	QUADRI/1-0003-0019-64
22	RN55D4530F	QUADRI/1-0003-0018-63	57	RN55D4871F	QUADRI/1-0003-0019-66
23	RN55D5110F	QUADRI/1-0003-0018-68	58	RN55D4991F	QUADRI/1-0003-0019-67
24	RN55D5490F	QUADRI/1-0003-0018-71	59	RN55D5111F	QUADRI/1-0003-0019-68
25	RN55D6040F	QUADRI/1-0003-0018-75	60	RN55D5231F	QUADRI/1-0003-0019-69
26	RN55D6490F	QUADRI/1-0003-0018-78	61	RN55D5491F	QUADRI/1-0003-0019-71
27	RN55D6980F	QUADRI/1-0003-0018-81	62	RN55D5621F	QUADRI/1-0003-0019-72
28	RN55D7500F	QUADRI/1-0003-0018-84	63	RN55D5761F	QUADRI/1-0003-0019-73
29	RN55D8060F	QUADRI/1-0003-0018-87	64	RN55D5901F	QUADRI/1-0003-0019-74
30	RN55D8450F	QUADRI/1-0003-0018-89	65	RN55D6041F	QUADRI/1-0003-0019-75
31	RN55D9090F	QUADRI/1-0003-0018-92	66	RN55D6191F	QUADRI/1-0003-0019-76
32	RN55D9530F	QUADRI/1-0003-0018-94	67	RN55D6491F	QUADRI/1-0003-0019-78
33	RN55D1001F	QUADRI/1-0003-0018-00	68	RN55D6651F	QUADRI/1-0003-0019-79
34	RN55D1101F	QUADRI/1-0003-0019-04	69	RN55D6811F	QUADRI/1-0003-0019-80
35	RN55D1211F	QUADRI/1-0003-0019-08	70	RN55D6981F	QUADRI/1-0003-0019-81

FOR APPLICABLE SPECIFICATION CONTROL DRAWING INPUT KEY CODE [ ]; [ENTER].
RETURN TO COMPOSITE PARTS BREAKDOWN [REVERSE].

Figure 6-19. Example of VAMIS IPB Composite Parts Breakdown (CPB) supplementary data list frame.

Additional variations of the basic CPB format are illustrated in Figures 6-20 and 6-21. Both examples are single-frame CPBs which illustrate solutions to problem areas. Figure 6-20 shows the value of the usable-on codes and the ability to quickly obtain related CPBs. Figure 6-21 shows an acceptable approach to providing a CPB for a part which is not illustrated or indexed. When new IPB data are being prepared, however, consideration should be given to indexing all parts, even if they are not illustrated.

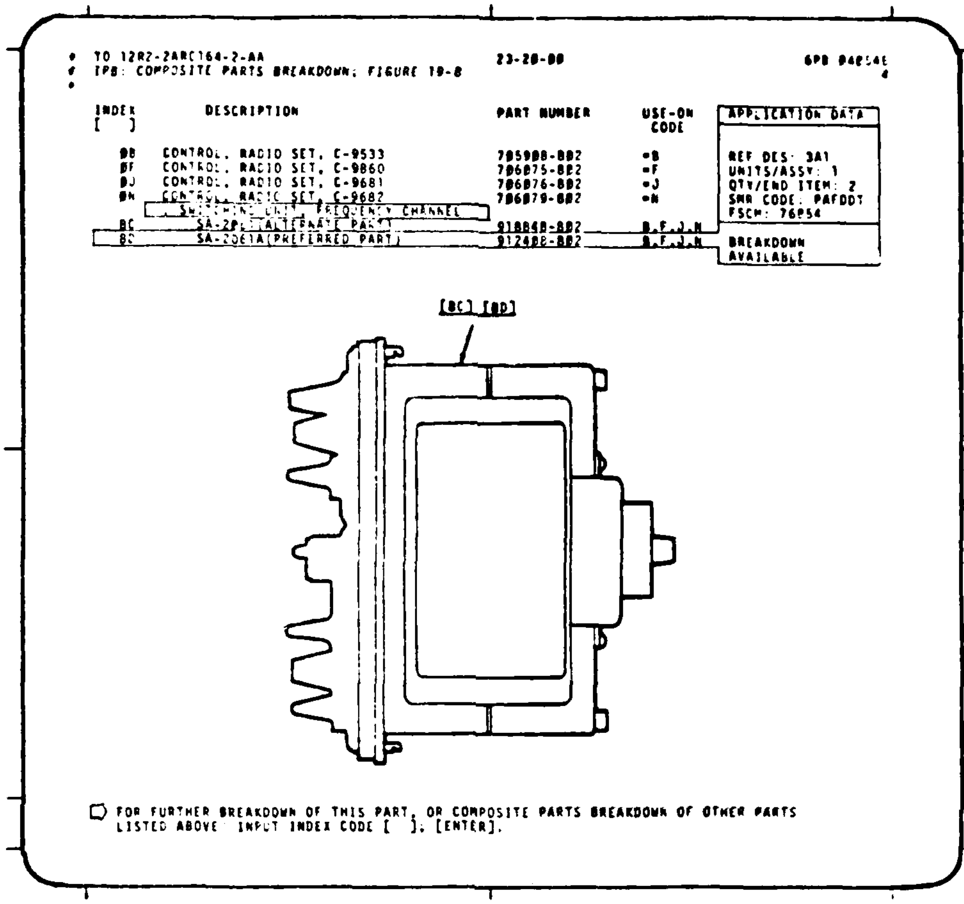


Figure 6-20. Example of VAMIS IPB Composite Parts Breakdown (CPB) frame with multiple higher assemblies and parts of interest.

6.3 FUNCTION DIAGRAMS

6.3.1 Introduction

A general discussion of function diagrams is presented in paragraph 2.4.3, including the scope intended by the use of the term and the specification requirements which are applicable. For purposes of VAMIS-type systems, all function diagrams are classified either as schematic diagrams (SD) or wiring diagrams (WD). All of the samples illustrated herein are in the SD category, but the principles and guidelines apply equally to the WD category.

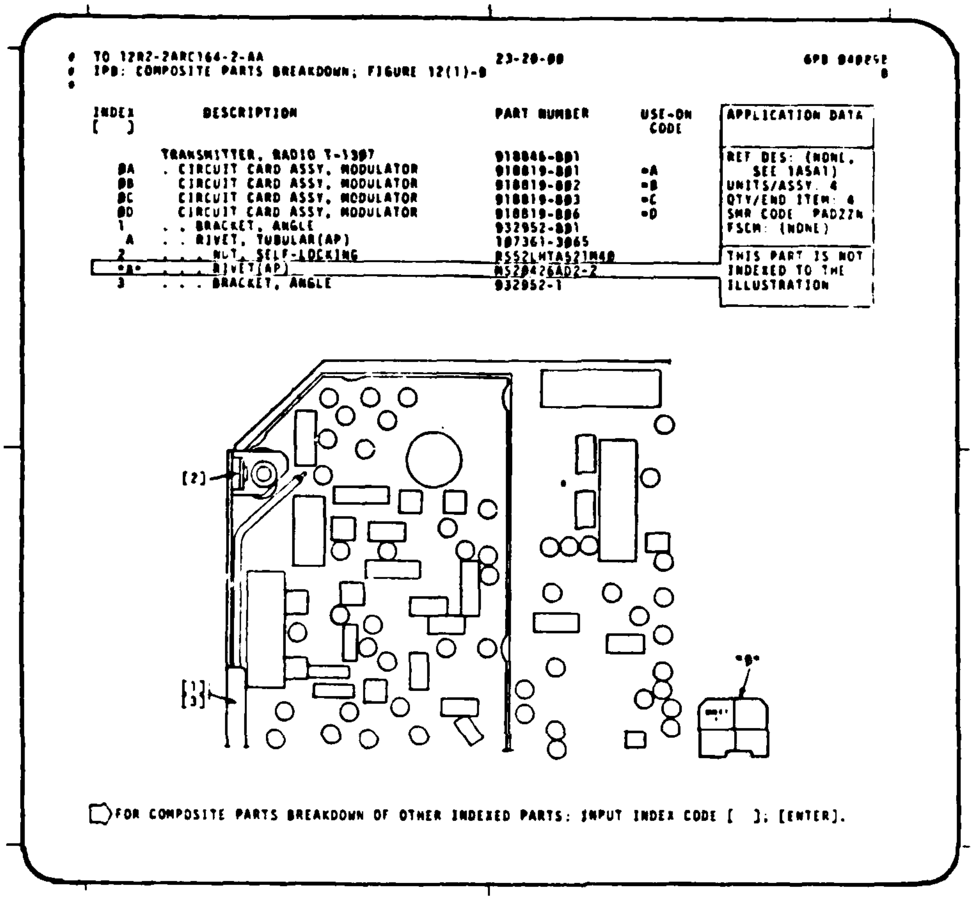


Figure 6-21. Example of VAMIS IPB Composite Parts Breakdown (CPB) frame for non-indexed/illustrated attaching parts (AP).

6.3.2 General Considerations

Function diagrams, probably more than any other type of information found in technical manuals, have characteristics which are closely related to the type of equipment or system which is to be represented. As a result, mechanical system function diagrams will be different from electronic system diagrams. In addition, the range of complexity and size may vary from a diagram containing only a few simple entries to one that (if paper-based) may contain thousands of entries with as many interrelationships, and extend over many foldout pages. In the latter case it becomes necessary to provide referents when a line of flow must be interrupted, on both the "from" page and the "to" page, so that the user can make the connection. Although unwieldy, a user can refer to multiple pages of function diagrams in paper-based systems when items of interest are on separate pages. In a computer-based system with a single screen, however, it will be difficult to jump back and forth between two function diagram frames that are supposed to be continuous without losing one's place. Screen size increases the burden since only a small portion of a large and complex diagram can be displayed legibly at any one moment.

An additional consideration for formatting of function diagrams is the use to which they may be put. The same diagram may be examined to try to understand the system interrelationships, to try to trace a particular path, or to try to identify interfaces with a particular point. It may be used for testing, for troubleshooting, or simply for general reference. VAMIS function diagrams should be able to support all such uses.

The development of these function diagram format concepts and guidelines was based on the following premises:

- The user should have maximum flexibility in moving between one portion of the function diagram pool and any other related portion.
- Extra care should be taken to prevent the user from getting lost.
- The computer system should have the task of making interconnections between "interrupted" points in the same flow.

- The diagram should be legible and useful at the time of initial presentation on the screen. Since function diagrams are part of pool information, Level 3 legibility criteria apply.

6.3.3 <u>Approach</u>

6.3.3.1 <u>Function Diagram Access Paths</u>. Methods defined to enable users to access particular function diagrams of interest are depicted in Figure 6-22. This methodology has much in common with the logic used for accessing IPBs and is based upon the anticipated use of both the standard mode and the user request mode of operation. Although not specifically shown in the figure, the method assumes that the function diagram portion of pool, like the IPB portion, will be treated as a discrete portion of the data base, allowing the user to move about within it with more flexibility than in other portions of pool. Once the user has accessed the function diagram portion of pool, all control unit keys are operable in the same manner as if the user was in the text portion. The exception is the RETURN function, which normally always takes the user back to the last frame of procedural text, or other non-pool data, which was displayed prior to accessing the function diagrams. In certain circumstances, to be explained later, use of the RETURN key in the function diagram pool will take the user back to a higher-level function diagram. In the standard mode, the number of steps required to reach a usable function diagram will depend on the specificity of the reference in the options list (or other in-text reference) and the complexity of the diagram. In the ideal case, the technician may be able to go directly from an options list to a usable simple function diagram. In the worst case, the technician may have to go through a series of lists and higher level diagrams to obtain the specific usable diagram wanted.

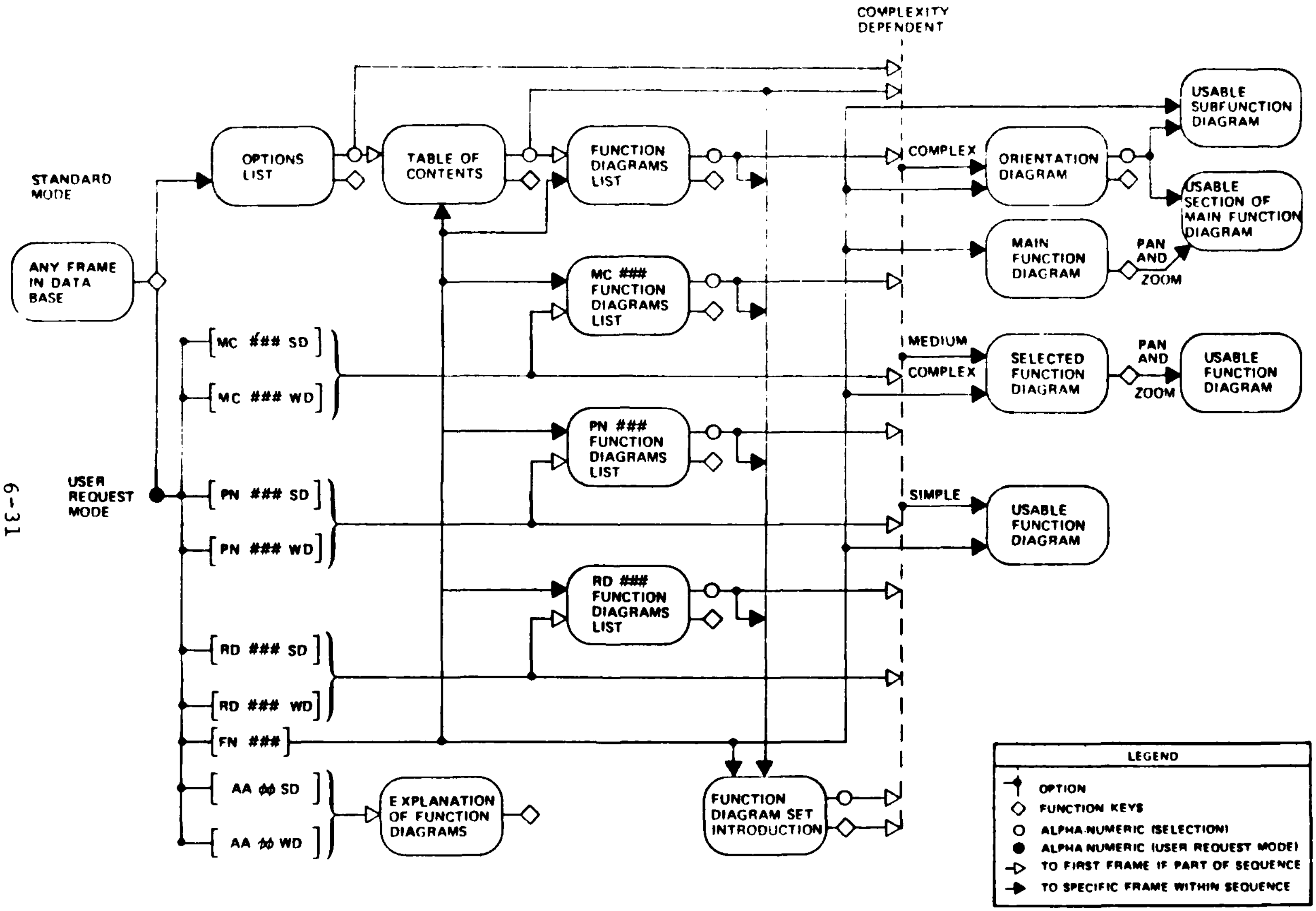


Figure 6-22. Data access pathways for VAMIS function diagrams (schematic diagrams and wiring diagrams).

The same access constraints apply to the user request mode, with the added constraint that the shortest access path is heavily dependent on what the technician already knows about what is needed, and how many other function diagrams satisfy the same function diagram identification criteria. For example, if a technician in the user request mode calls for a diagram with a MIDAS code input, there may be a sizable number of schematics (or wiring diagrams) with the same MIDAS code, making it impossible for the system to go directly to the specific diagram needed by the technician. In such cases the system goes to a menu frame which lists all of the schematics available with the MIDAS code which was input. The technician would then select the specific diagram needed, in the standard mode.

Figure 6-23 illustrates an example of a function diagrams list that might be accessed in the standard mode. Similar menus should be provided for accessing via the user request mode, as applicable. If lengthy lists will require more than one frame, they should be split according to some logical method of organization. Note that, within groups, unless there is a logical order of presentation, listings should be in alphabetic or numeric sequence to assist in scanning the list. If the TO data base will also contain wiring diagrams (WD), a short list could be included as a group here, or a selectable cross-reference to the wiring diagrams list could be shown.

6.3.3.2 Complexity Factors. As was mentioned above and illustrated in Figure 6-22, the actual path to be taken to obtain a usable function diagram will depend heavily on the size and complexity of the diagram. The access logic and format samples

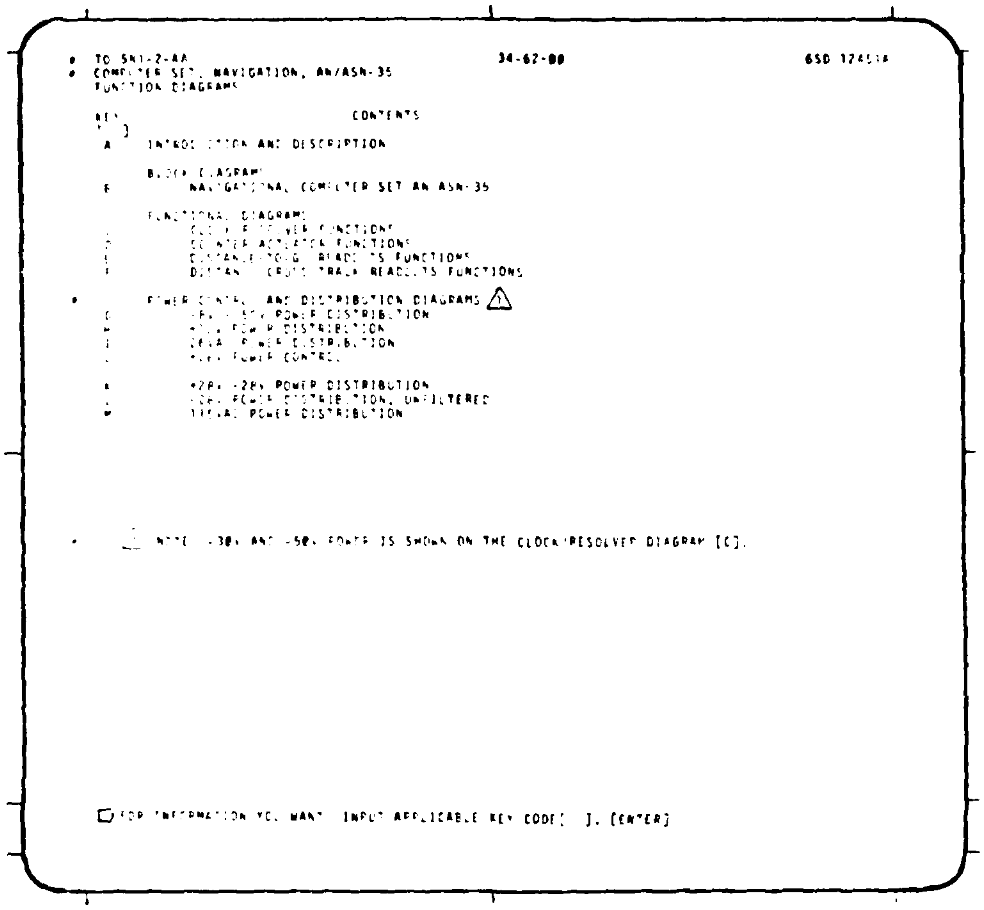


Figure 6-23. Example of VAMIS function diagrams list.

discussed later in this section are based on definition of three types of diagrams, where size and complexity are the differentiating factors. The three types are:

a. Simple Diagram (Type 1). The diagram is sufficiently simple that all elements of the diagram, both text and graphics, will satisfy the Level 3 legibility criteria at the time of initial display of the complete diagram.

b. Medium Complexity Diagram (Type 2). The diagram can be presented complete in one frame with all graphics and identification labels for major elements satisfying the Level 3 legibility criteria. Graphic and text details, however, will not be sufficiently legible without increasing the size of the diagram through use of the zoom feature.

c. High Complexity Diagram (Type 3). The diagram is either so large or so complex that none of it would meet the legibility criteria if it was presented complete in one frame.

As is shown in Figure 6-22, the simple case (Type 1) diagram can be accessed directly when the specific diagram selection is made and is fully usable. The Type 2 diagram is equally available but will require manipulation of SCREEN controls before it is fully usable. The Type 3 diagram will require an intervening selection step before a usable diagram can be obtained. The format-related characteristics of each diagram type are discussed and illustrated later in this section.

6.3.3.3 Location Feedback. One of the anticipated problems of technicians entering the function diagram pool is that of getting lost, or losing the point of reference within the diagram. This will be particularly risky if diagrams are increased in size with the zoom feature and/or moved with the pan feature so that the complete diagram is not visible. To counter this anticipated problem, the following guidance should be observed:

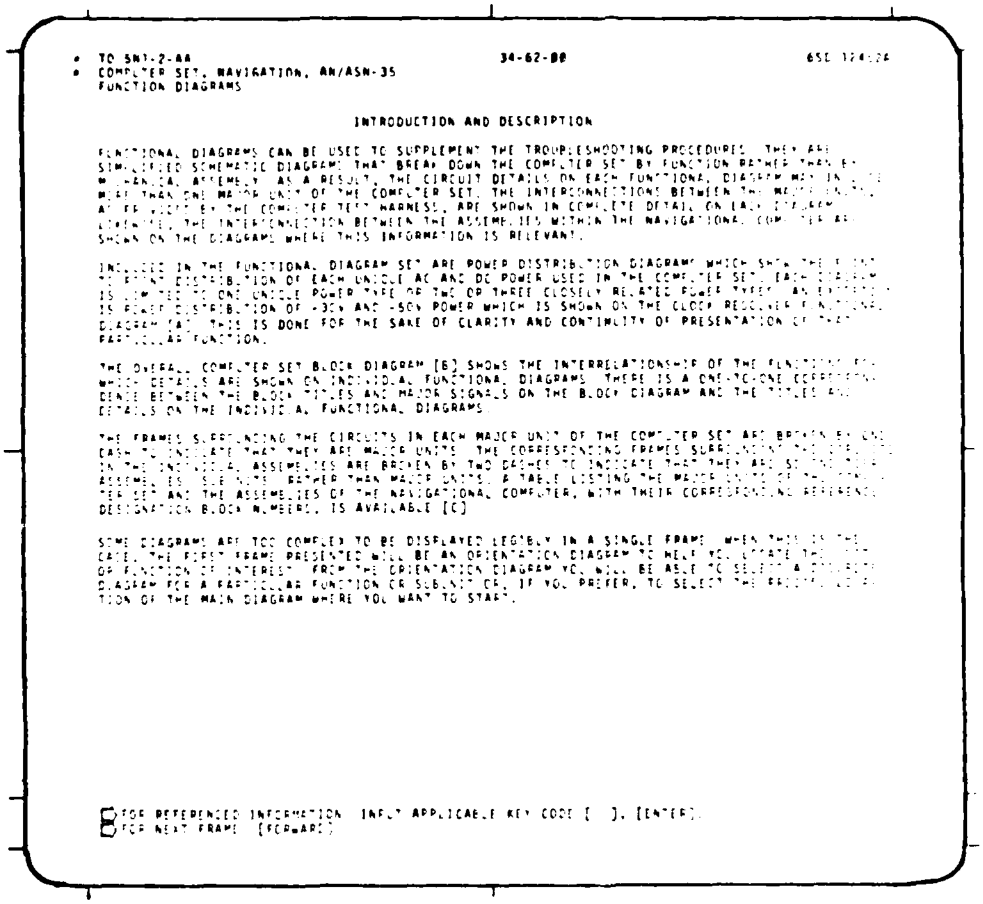
a. The header portion of the frame, as in other portions of the data base, should contain all appropriate identifying information and should remain in the field of view at all times. It should not be considered as part of the illustration so that it becomes subject to being panned or zoomed out of the viewable area. With illustration space severely limited, there will be a temptation to make use of this display area for the diagram itself. However, many diagrams are so similar in content that, without identifying information, they could easily be confused with each other. For example, if magnified portions of two similar diagrams were placed in memory without the identifying information, when SHOW 1 and SHOW 2 were pressed it would be extremely difficult to recognize which diagram was which.

b. All diagrams should contain location coordinates to assist the technician in determining location within the diagram. The top margin and the left margin of the diagram are recommended for this purpose. A slave windowing approach should be used so that, if the diagram is panned or zoomed, the portions of the location coordinates that are associated with the visible portion of the diagram contents will remain in the viewable area in the correct relationship. This approach is described and illustrated in some of the examples which follow.

6.3.3.4 Use of Prompts and Advisories. The guidance which applies to other types of VAMIS formats is equally applicable to the data in the function diagrams pool. In addition, the data preparer should anticipate the desirability of using some of the routine system functions, such as memory and screen control, and provide prompts to that effect when prompt space is available.

6.3.4 Introductory Materials

As a discrete portion of the computer-based TO, the function diagrams pool has its own set of front matter and introductory materials. This could include a sectional title frame, as was used in the IPB (Figure 6-2), a table of contents and list of diagrams (Figure 6-23), as well as a description and explanation of the characteristics and use of the schematics and wiring diagrams. An example of the latter type of information is illustrated in Figure 6-24. As shown in this example, unique



TO 5N1-2-AA 34-62-00 65E 124:2A
COMPUTER SET, NAVIGATION, AN/ASN-35
FUNCTION DIAGRAMS

INTRODUCTION AND DESCRIPTION

FUNCTIONAL DIAGRAMS CAN BE USED TO SUPPLEMENT THE TROUBLESHOOTING PROCEDURES. THEY ARE SIMPLIFIED SCHEMATIC DIAGRAMS THAT BREAK DOWN THE COMPUTER SET BY FUNCTION RATHER THAN BY MECHANICAL ASSEMBLY. AS A RESULT, THE CIRCUIT DETAILS ON EACH FUNCTIONAL DIAGRAM MAY IN[illegible] MORE THAN ONE MAJOR UNIT OF THE COMPUTER SET. THE INTERCONNECTIONS BETWEEN THE MAJOR UNITS, A[illegible] BY THE COMPUTER TEST HARNESS, ARE SHOWN IN COMPLETE DETAIL ON EACH DIAGRAM. [illegible], THE INTERCONNECTION BETWEEN THE ASSEMBLIES WITHIN THE NAVIGATIONAL COMPUTER ARE SHOWN ON THE DIAGRAMS WHERE THIS INFORMATION IS RELEVANT.

INCLUDED IN THE FUNCTIONAL DIAGRAM SET ARE POWER DISTRIBUTION DIAGRAMS WHICH SHOW THE [illegible] DISTRIBUTION OF EACH UNIQUE AC AND DC POWER USED IN THE COMPUTER SET. EACH DIAGRAM IS LIMITED TO ONE UNIQUE POWER TYPE OR TWO OR THREE CLOSELY RELATED POWER TYPES. AN [illegible] IS POWER DISTRIBUTION OF +30V AND -50V POWER WHICH IS SHOWN ON THE CLOCK RESOLVER FUNCTIONAL DIAGRAM [A]. THIS IS DONE FOR THE SAKE OF CLARITY AND CONTINUITY OF PRESENTATION OF THAT PARTICULAR FUNCTION.

THE OVERALL COMPUTER SET BLOCK DIAGRAM [B] SHOWS THE INTERRELATIONSHIP OF THE FUNCTIONS FOR WHICH DETAILS ARE SHOWN ON INDIVIDUAL FUNCTIONAL DIAGRAMS. THERE IS A ONE-TO-ONE CORRESPONDENCE BETWEEN THE BLOCK TITLES AND MAJOR SIGNALS ON THE BLOCK DIAGRAM AND THE TITLES AND DETAILS ON THE INDIVIDUAL FUNCTIONAL DIAGRAMS.

THE FRAMES SURROUNDING THE CIRCUITS IN EACH MAJOR UNIT OF THE COMPUTER SET ARE BROKEN BY ONE DASH TO INDICATE THAT THEY ARE MAJOR UNITS. THE CORRESPONDING FRAMES SURROUNDING THE [illegible] IN THE INDIVIDUAL ASSEMBLIES ARE BROKEN BY TWO DASHES TO INDICATE THAT THEY ARE [illegible] ASSEMBLIES (SUBUNITS) RATHER THAN MAJOR UNITS. A TABLE LISTING THE MAJOR UNITS OF THE COMPUTER SET AND THE ASSEMBLIES OF THE NAVIGATIONAL COMPUTER, WITH THEIR CORRESPONDING REFERENCE DESIGNATION BLOCK NUMBERS, IS AVAILABLE [C].

SOME DIAGRAMS ARE TOO COMPLEX TO BE DISPLAYED LEGIBLY IN A SINGLE FRAME. WHEN THIS IS THE CASE, THE FIRST FRAME PRESENTED WILL BE AN ORIENTATION DIAGRAM TO HELP YOU LOCATE THE [illegible] OF FUNCTION OF INTEREST. FROM THE ORIENTATION DIAGRAM YOU WILL BE ABLE TO SELECT A [illegible] DIAGRAM FOR A PARTICULAR FUNCTION OR SUBUNIT OR, IF YOU PREFER, TO SELECT THE [illegible] TION OF THE MAIN DIAGRAM WHERE YOU WANT TO START.

FOR REFERENCED INFORMATION INPUT APPLICABLE KEY CODE [ ], [ENTER].
FOR NEXT FRAME [FORWARD]

Figure 6-24. Example of VAMIS function diagrams introductory materials.

and unexpected characteristics of the diagrams should be explained for the user. The use of key codes within the text enables the user to efficiently access a particular frame as an example to clarify the text discussions. The description makes no mention of the placement or use of key codes or other standard VAMIS attributes since they are not unique to the function diagrams. Mention is made, however, of the two different types of presentation of highly complex schematics since this is not routinely available in the VAMIS approach to technical information presentation.

6.3.5 Simple Function Diagrams (Type 1)

Type 1 function diagrams are those which can be structured and prepared to be completely visible and meet all Level 3 legibility criteria upon initial screen display. An example of a Type 1 diagram is depicted in Figure 6-25. The user can, if desired, further increase magnification with the zoom feature and move the diagram around on the screen for use at a more distant work location. In addition, the example shows how directly related diagrams are noted and key-coded for direct access rather than requiring use of an options list or other menu approach.

6.3.6 Medium Complexity Function Diagrams (Type 2)

Type 2 function diagrams are those which are too lengthy or complex to qualify as Type 1 diagrams, but which can be structured and prepared so that the total diagram is visible and the major elements meet Level 3 legibility criteria at the time of initial presentation. An example of a Type 2 diagram at the time of initial presentation is shown in Figure 6-26. Major function titles and locator legends are sized for initial legibility, and the technician is prompted to use the screen controls to further increase legibility of the details.

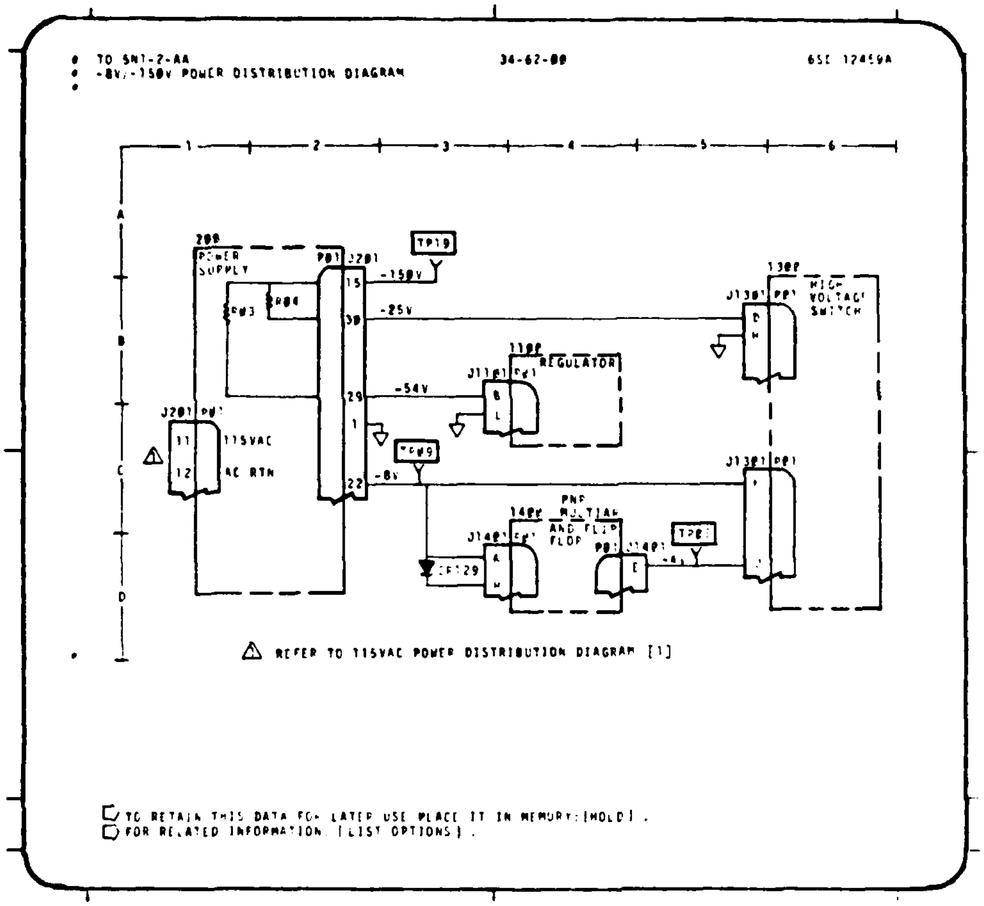


Figure 6-25. Example of VAMIS function diagram, Type 1 (simple schematic).

Figure 6-27 shows an example of use of the zoom and pan control functions to increase legibility of the diagram. Note that although portions of the diagram have disappeared from the illustration "window" as a result of such control actions, the portion of the locator grid which is associated with the remaining portion of the diagram stays in the viewable area. Independent windowing allows the grid to change size along with the diagram and keeps it aligned, but prevents the useful portion from going off-screen. Note also that this illustration contains some lower-case characters (a, b, and c on the Brake

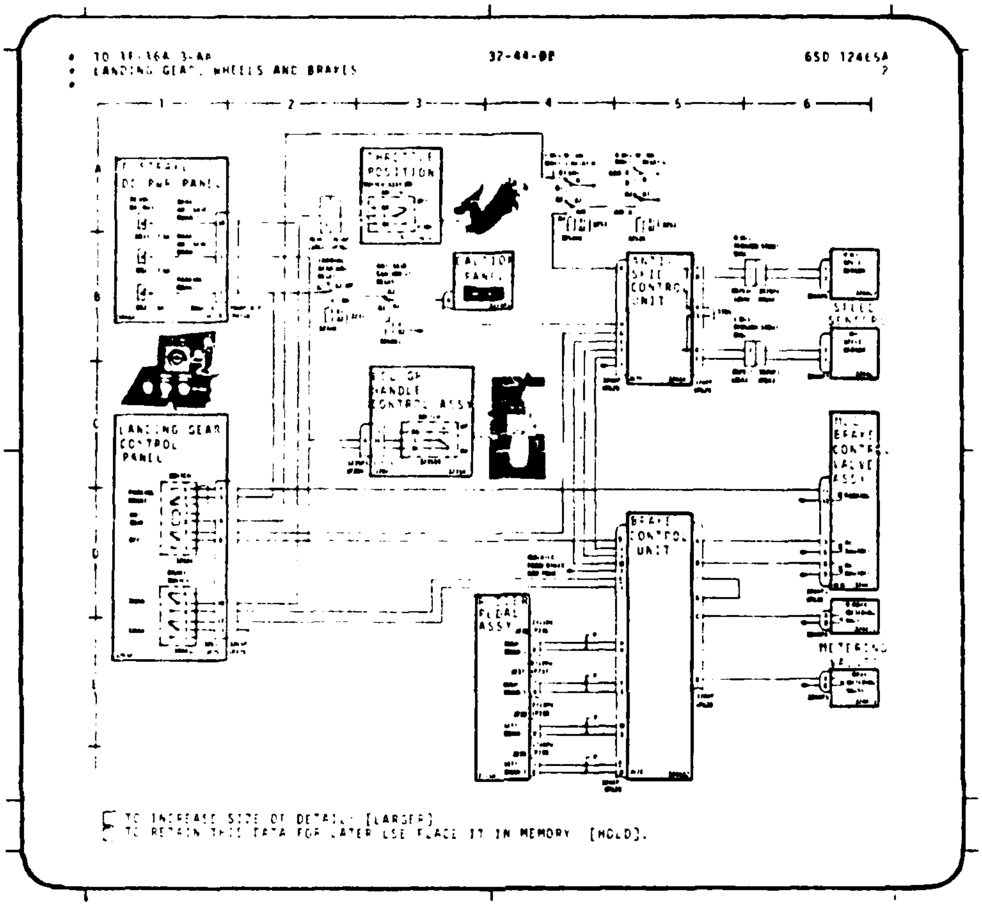


Figure 6-26. Example of VAMIS function diagram, Type 2 (moderately complex schematic, initial presentation).

Control Unit board). Since this represents the actual labeling on the board, and the diagram can be zoomed-up for legibility, the character style and Level 3 character size criteria can be deviated from.

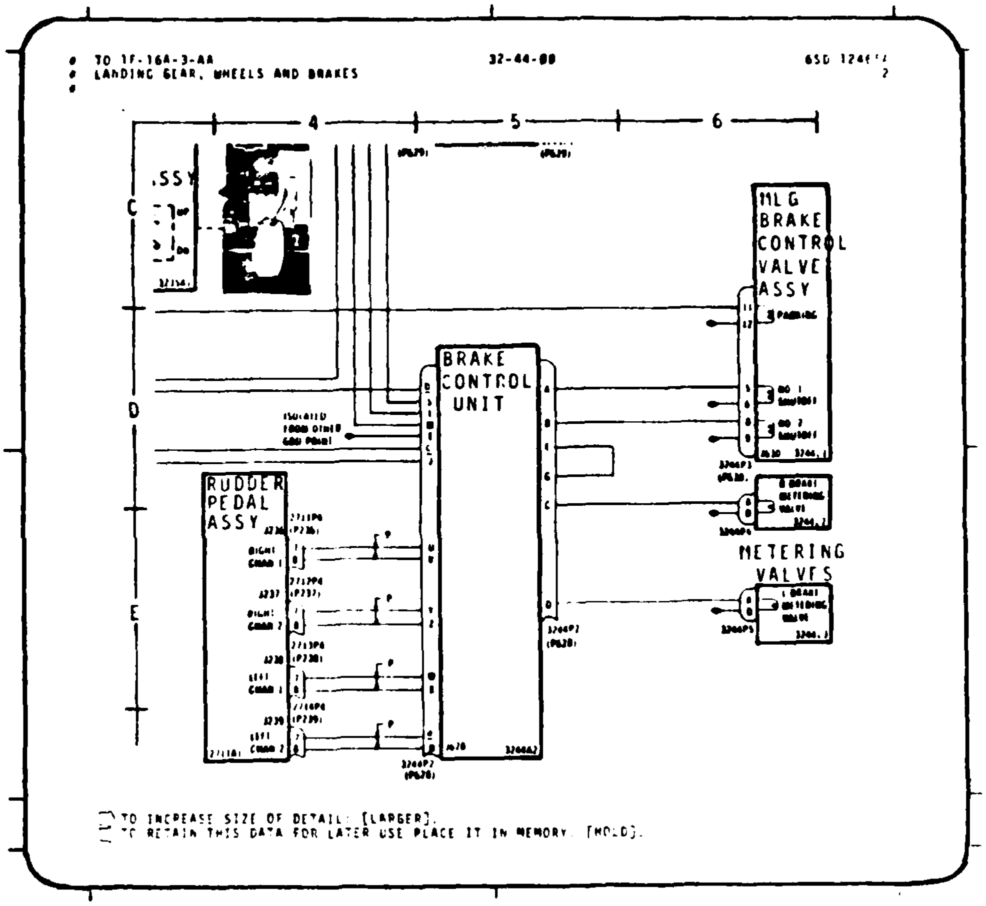


Figure 6-27. Example of VAMIS function diagram, Type 2 (moderately complex schematic, following user screen control actions).

A different approach is presented in Figure 6-28. In this example, the block diagram serves the dual purpose of providing a functional overview of the system (its primary role), as well as a means of selecting an individual functional diagram. In its primary role it is a Type 2 diagram. In its other role it serves as an orientation diagram (discussed in subparagraph 6.7.3.1, below), so that if the user needs more functional detail than is available on the block diagram, the individual functional diagram can be selected.

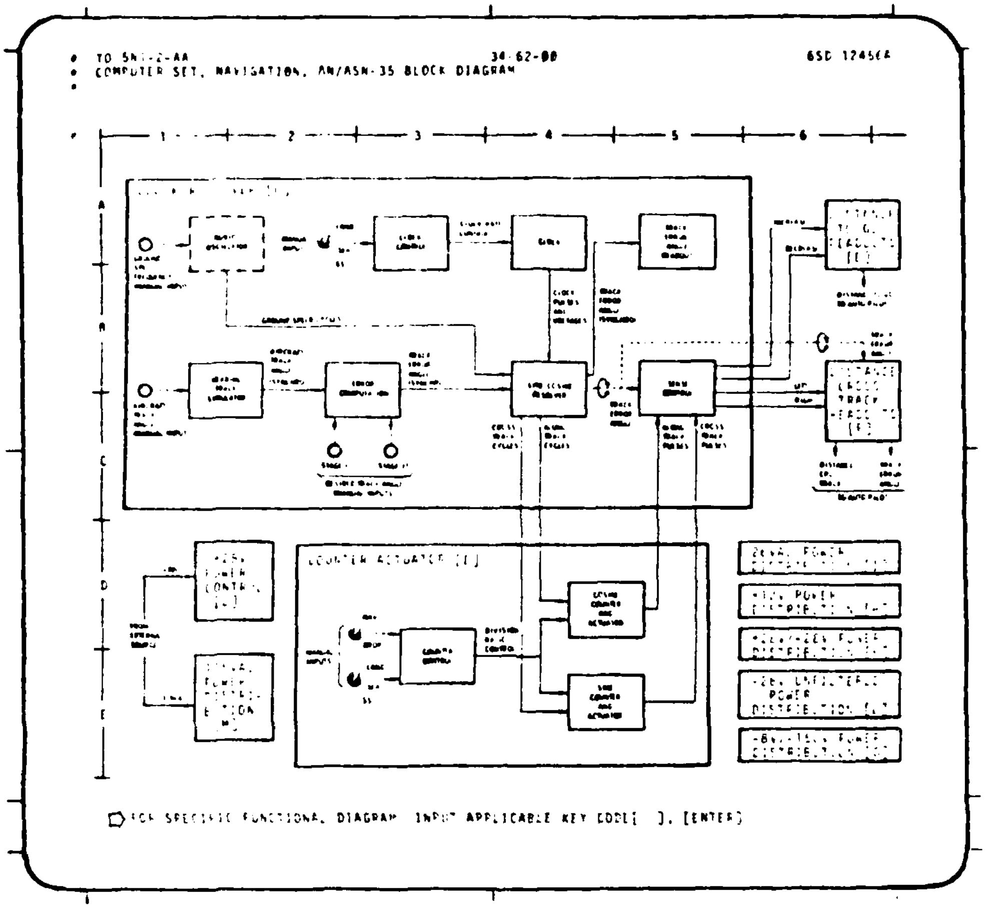


Figure 6-28. Example of VAMIS function diagram, Type 2 (block diagram).

6.3.7 High Complexity Function Diagrams (Type 3)

Type 3 function diagrams are those that are too lengthy or too complex to be prepared as either Type 1 or Type 2 diagrams. Type 3 function diagrams will require special efforts by the data preparer and special actions by the user to obtain usable schematic and wiring diagrams. Type 3 function diagrams for presentation on VAMIS will involve three diagram subtypes: orientation diagrams, subfunction diagrams, and main diagrams. Each subtype and its interrelationships are discussed below.

6.3.7.1 Orientation Diagrams. An orientation diagram is displayed as the initial presentation of a complex and lengthy schematic (or other function) diagram which cannot be handled as in the simple or medium complexity cases. Its purpose is to allow the user to become familiar with the contents of the schematic, and to select both the type of presentation and the starting point desired. Figure 6-29 shows an example of an

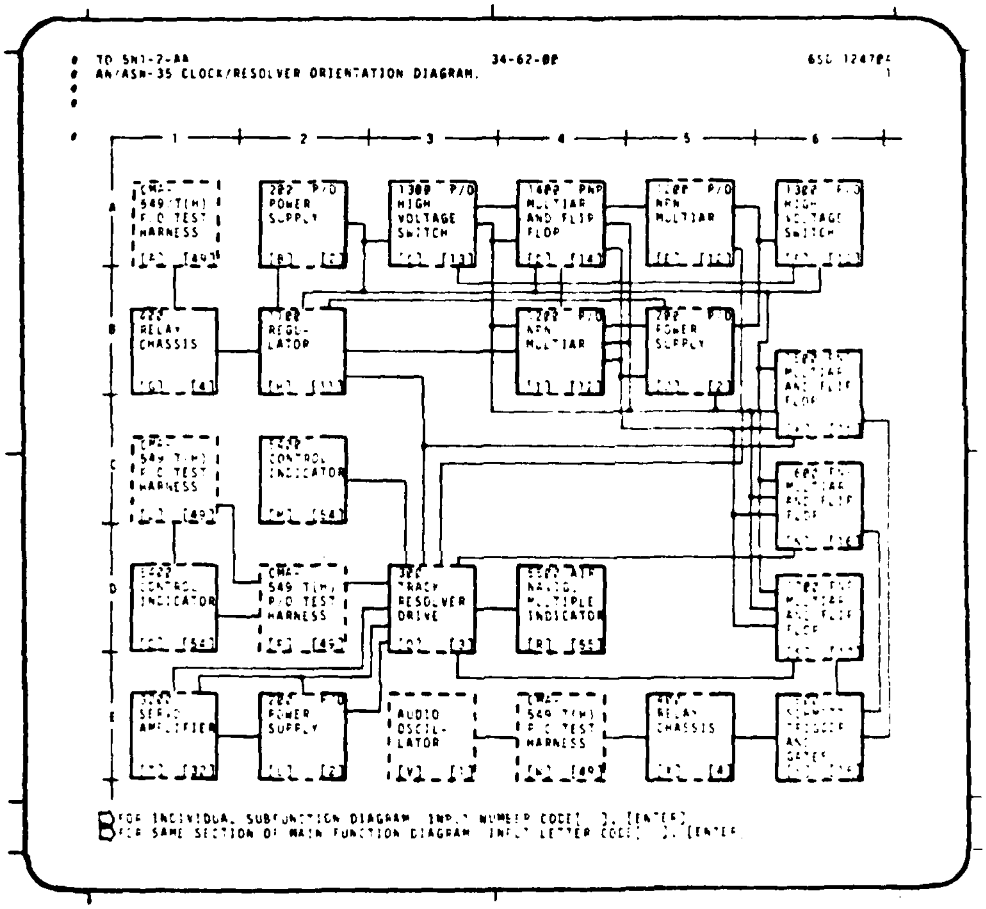


Figure 6-29. Example of VAMIS function diagram, Type 3 (orientation diagram for complex schematics; Example 1).

orientation diagram based on a hard copy schematic consisting of two foldout sheets, which if connected would measure approximately 11 by 44 inches. All detail is eliminated, but all functional entities are represented in the approximate same relationship as in the original diagram. The function blocks are graphically coded (by dashes) the same as the original diagram to indicate the level of the function. Number and letter codes are provided within the blocks as a means of selecting the detailed subfunction diagram of interest (see subparagraph 6.3.7.2) or the equivalent detailed section of the main diagram (see subparagraph 6.3.7.3). Since the orientation diagram is structurally complete and legible at initial display, it is technically a Type 1 diagram. However, since it has insufficient functional detail to be used as a function diagram, and is a necessary step in the process to obtain that detail, it is classified as a Type 3 diagram.

Figure 6-30 illustrates an alternate method of presenting an orientation diagram. This approach may be useful when the physical relationships of the equipment or components comprising the diagram are important to understanding, and the size of the diagram does not preclude single-frame presentation even if the complexity is too great. In this case, all textual detail and some graphic detail has been eliminated and key code callouts were used to identify the significant elements of the diagram. The user can input a key code to obtain a specific subfunction just as in the preceding example. Alternately, the user can specify a particular coordinate location to obtain a legible presentation of the equivalent portion of the main diagram, with all detail included. Input of coordinate locations for this purpose was not used in the first orientation diagram example since it did not have the same physical layout as the main diagram that it represented.

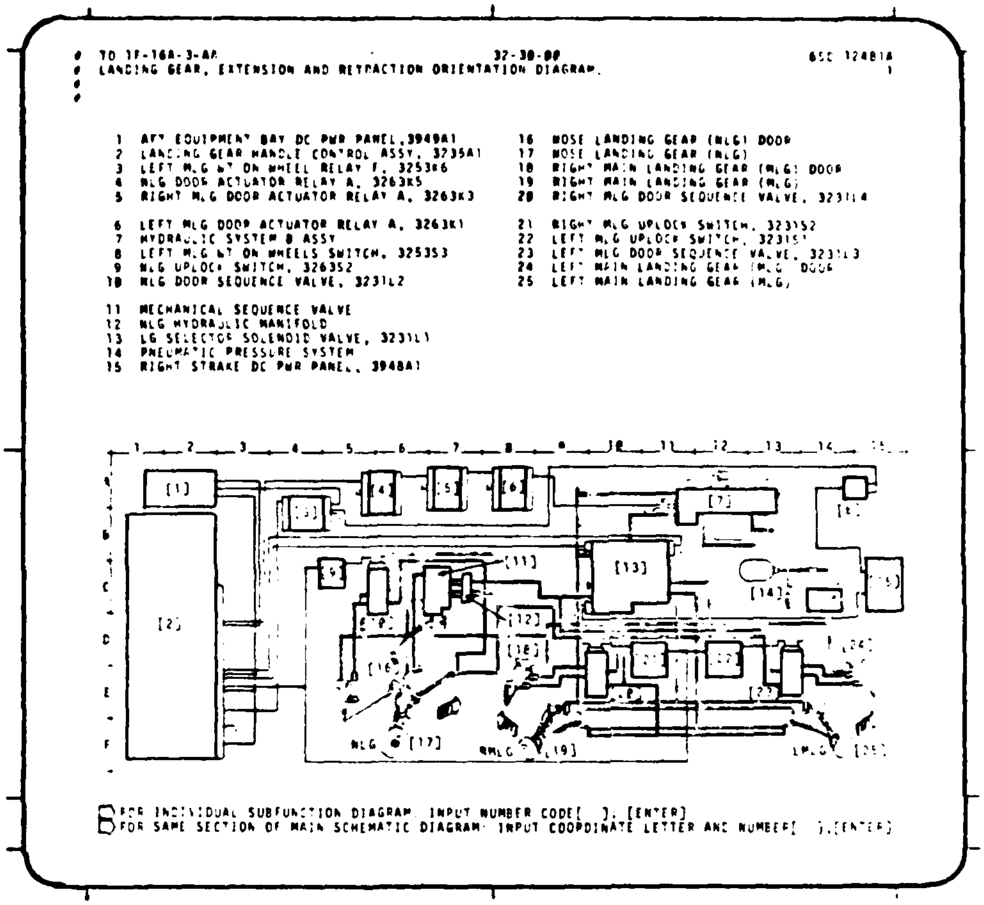


Figure 6-30. Example of VAMIS function diagram, Type 3 (orientation diagram for complex schematics; Example 2).

6.3.7.2 Subfunction Diagrams. This subtype of the Type 3 function diagram is intended to provide one means for technicians to obtain the functional detail needed for task performance. These diagrams are obtained by selecting a numeric code on the orientation diagram, and consist of two closely related parts: the subfunction and the subfunction interfaces. The basic subfunction diagram shows the detail of a specific functional entity. The subfunction interface diagram shows the detail between any two subfunctions that are functionally related.

Figure 6-31 shows an example of a basic subfunction diagram, a discrete portion of a complex functional diagram. This is the display that would result if the user selected key code [4] in

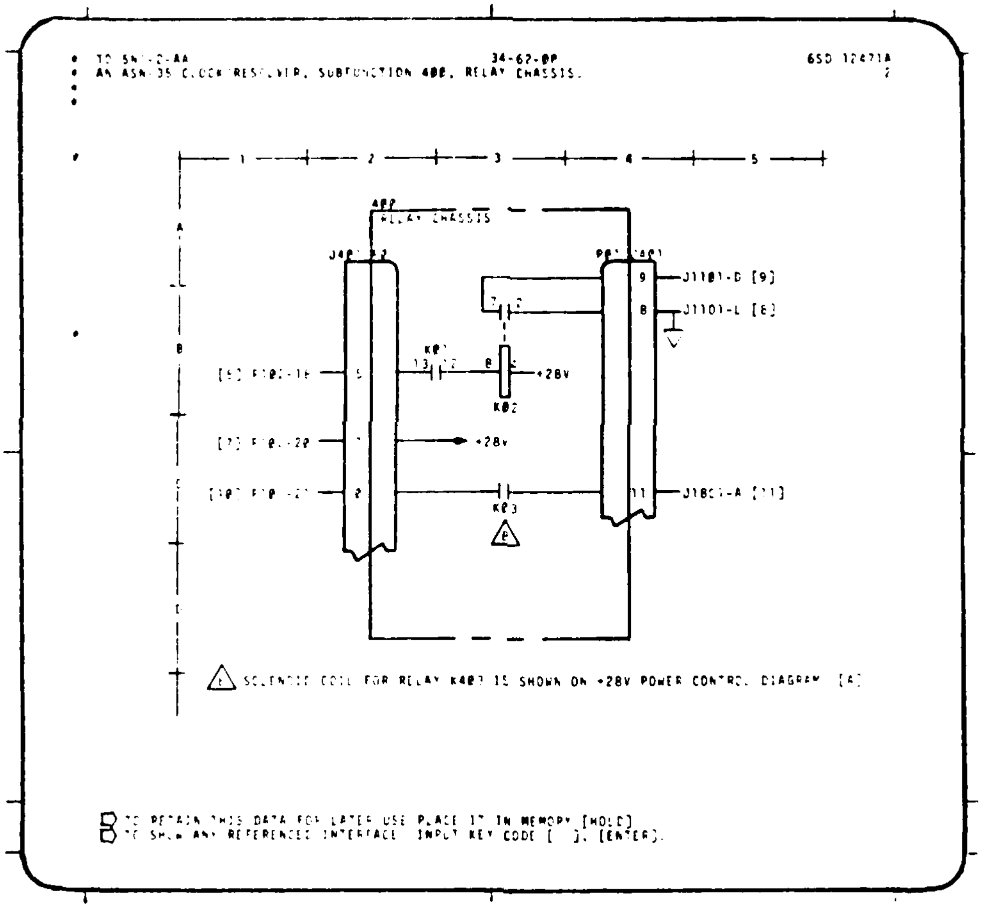


Figure 6-31. Example of VAMIS function diagram, Type 3 (subfunction diagram for high complexity schematic; Example 1).

the orientation diagram in Figure 6-29. The diagram shows all of the block 400, Relay Chassis functions, and identifies the functional interfaces that are relevant to the Clock/Resolver function. The user can show a diagram of any particular interface or go to a related functional diagram by inputting the appropriate key code. Note that the Relay Chassis subfunctions on the main Clock/Resolver function diagram are split into two parts, in two separate parts of the diagram, as shown in the orientation diagram (Figure 6-29).

An example of a subfunction interface diagram (SID) is shown in Figure 6-32, depicting the functional interface(s) between two

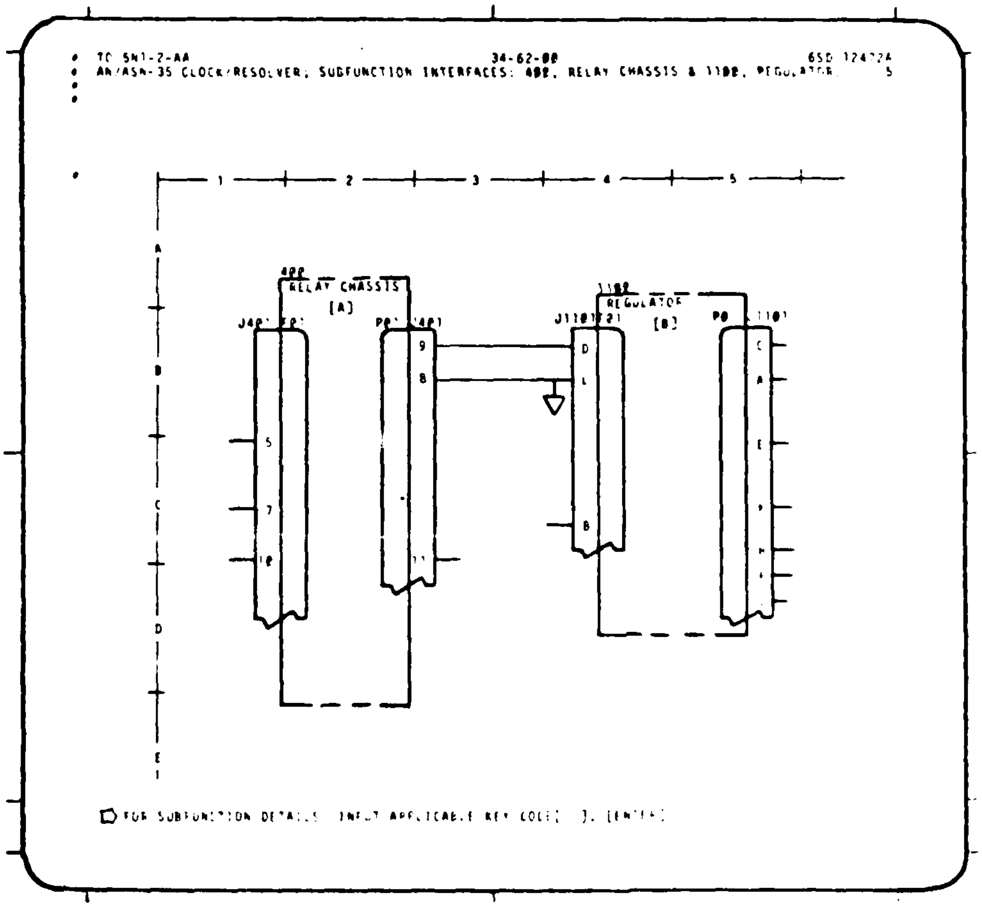


Figure 6-32. Example of VAMIS function diagram, Type 3 (high complexity; subfunction interface diagram).

Clock/Resolver subfunctions. This is the SID that would result from selection of key codes [8] or [4] in the example in Figure 6-31. A SID permits the user to identify the interfaces between any two subfunctions of the same function, including any relevant characteristics (e.g., test points), without the imposition of irrelevant detail. In addition, the SID allows the user to trace from one subfunction to another, through a complete, complex function diagram if necessary. Selection of key codes [A] or [B] on this SID example would obtain the sub-function diagrams illustrated in Figures 6-31 and 6-33, respectively.

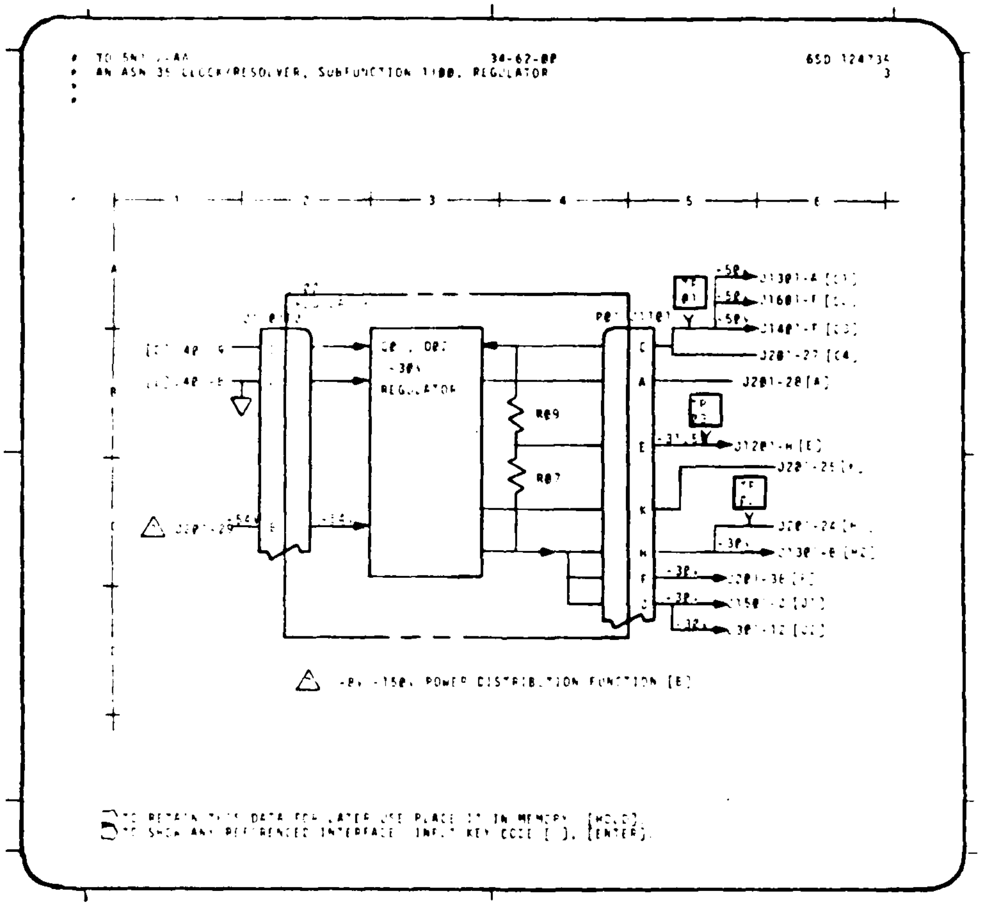


Figure 6-33. Example of VAMIS function diagram, Type 3 (subfunction diagram for high complexity schematic, Example 2).

Figure 6-33 shows another example of a subfunction diagram. This is the display that would result if the user selected key code [11] in the orientation diagram in Figure 6-29, or key code [B] in the subfunction interface diagram in Figure 6-32. The diagram shows all of the block 1100, Regulator functions and functional interfaces that are relevant to the Clock/Resolver function. The user can show a diagram of any particular interface, or go to a related functional diagram, by inputting the appropriate key code. Note that selection of key code [B] which follows the reference to the Power Distribution function would obtain the Type 1 diagram illustrated in Figure 6-25.

6.3.7.3 Main Diagrams. This subtype of the Type 3 function diagram comprises enlarged sections of the actual function diagram. The example in Figure 6-34 illustrates the display of a portion of a complex function diagram that might result from selection of letter code [H] from the orientation diagram in Figure 6-29. This display is equivalent to the subfunction diagram shown in Figure 6-33, but path tracing must be accomplished through use of the pan keys rather than by key code selection. Assuming that such a schematic has been drawn to meet the applicable specification requirements, additional format-related requirements for video display are minimal. They include legibility of main labels at the time of initial presentation, connection of multi-sheet schematics into a continuous diagram, and assembly of any notes for on-demand presentation.

The computer programming will have to edge-match the appropriate sections of the diagram both for initial presentation and as the user pans through it. If each section is prepared to fill a full frame at initial presentation, portions of up to 4 adjacent sections could be required for display at any given moment.

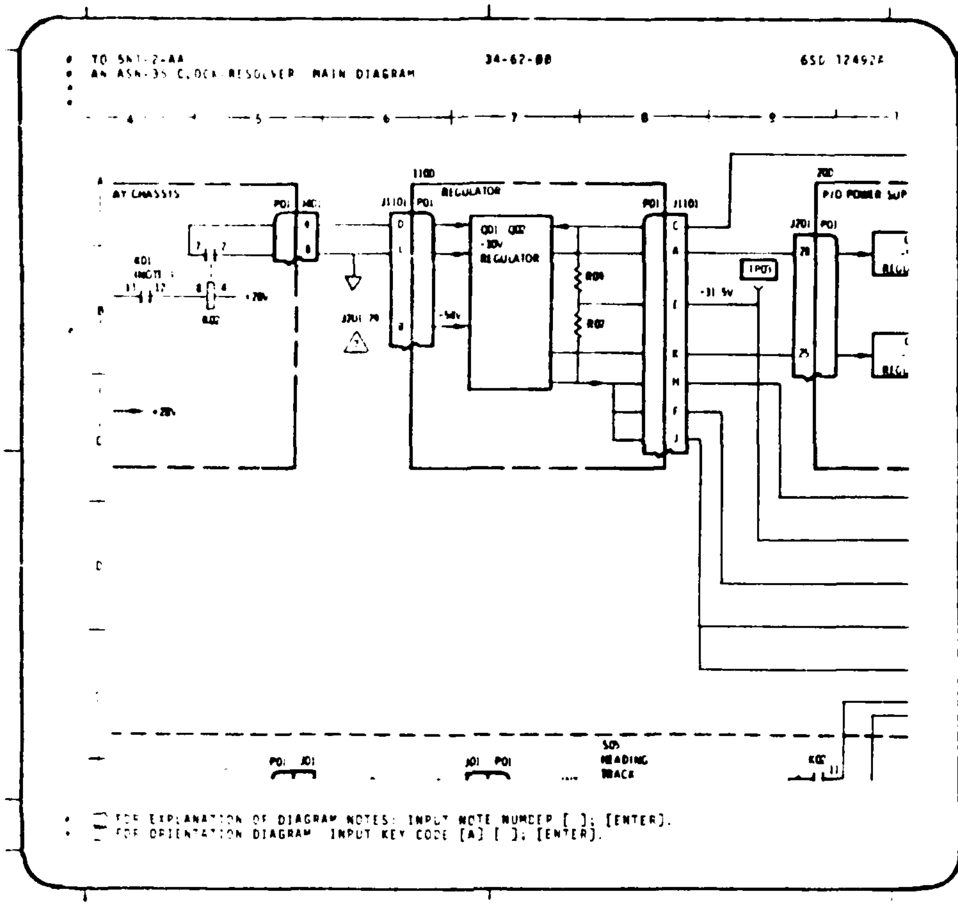


Figure 6-34. Example of VAMIS function diagram, Type 3 (high complexity; section of main diagram; Example 1).

Displaying notes which may be on the main diagram requires special treatment. The box in which such notes would normally be collected in a paper-based schematic would only rarely be visible on the screen, and panning back and forth in order to read the notes and return to the applicable diagram section is not feasible. The recommended solution to this problem is to have each note, including general notes, displayed in a window in the corner of the frame when requested by the user. While the note window is being displayed, the prompt would change to:

- FOR EXPLANATION OF DIAGRAM NOTES: INPUT NOTE NUMBER [ ]; [ENTER].

- TO ERASE NOTE WINDOW: INPUT SAME NOTE NUMBER [ ]; [ENTER].

This will permit the user to review any referenced note in the context of the diagram contents to which it applies, and then clear it when it is no longer needed.

Figure 6-35 presents a second example of the main diagram approach to Type 3 function diagrams. This example illustrates the display of a portion of a complex function diagram that might result from selection of coordinates [C10] from the orientation diagram in Figure 6-30. Note that the location coordinate scale visible in Figure 6-35 bears the same relationship to diagram contents as that in Figure 6-30. As in the first main diagram example, path tracing, if desired, can be accomplished through use of the screen control pan keys. In the example shown here, character size and style of the component labels do not meet the specified legibility criteria. In addition, some of the graphic coding used in the original paper copy may not be adequate for CRT presentation, e.g., the small "dot" patterns used for pneumatic pressure and retraction pressure, because of insufficient resolution. The legend for the graphic codes is placed in a window in one corner of the frame. It does not move in response to panning of the schematic. If the diagram contained notes, they would be presented and erased as described for Example 1.

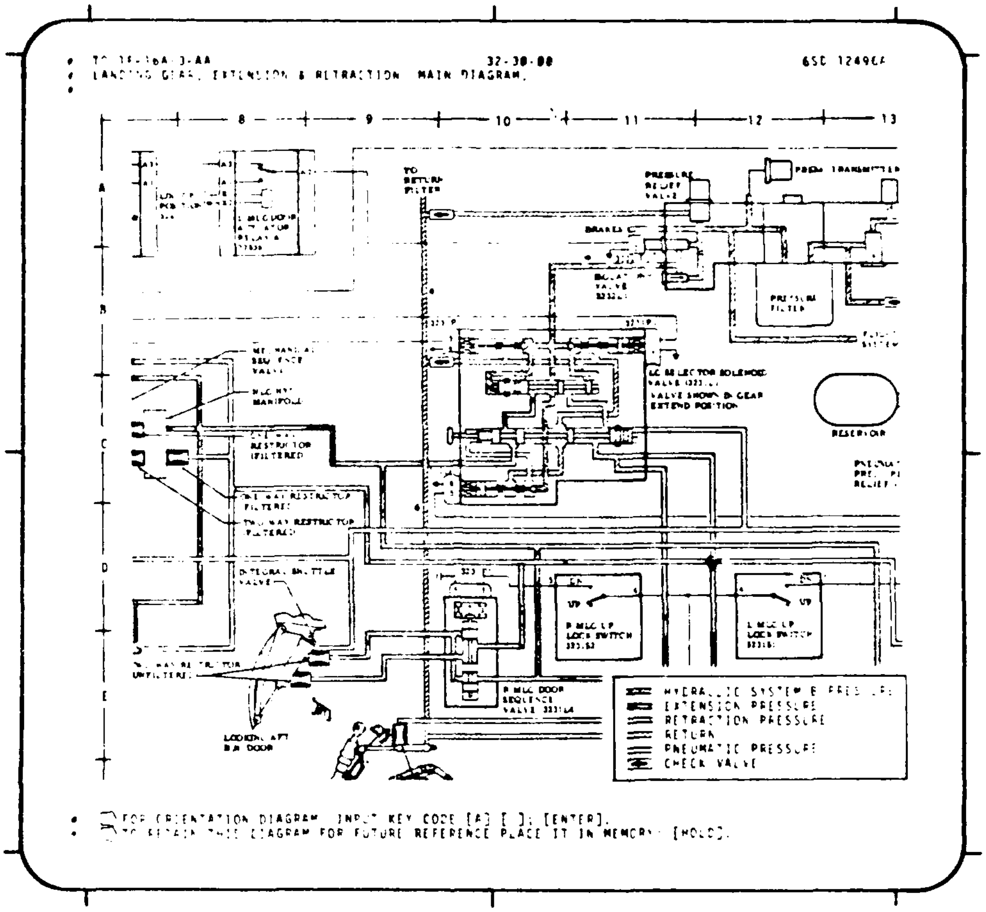


Figure 6-35. Example of VAMIS function diagram, Type 3 (high complexity; section of main diagram; Example 2).

6.4 OTHER PROCEDURAL SUPPORT POOL DATA

6.4.1 Introduction

Procedural support pool data encompass the types of data which a technician may want to have available either as a supplement to or, in the case of experienced technicians, as a substitute for the procedural track data. Two major types of procedural support pool data are Illustrated Parts Breakdowns and function diagrams, discussed in Subsections 6.2 and 6.3, respectively. This section discusses some of the remaining types of procedural support pool data which should be anticipated as necessary in a VAMIS-type system. These types include:

- Access and locator diagrams
- Test setup instructions
- Test specifications.

Procedural support data can be accessed by the user in either the standard mode or the user request mode of operation. In the standard mode, most efficient access is obtained by selecting the data wanted from the options list for the reference procedures frame. Alternately, the user can obtain the data via tables of contents (TOCs).

The guidance in Section 3.0 applies to procedural support data as well as other types of VAMIS data. In addition, data which are required for performance of maintenance should be included in the procedural instructions to the extent applicable so that the technician does not have to request the data. Applicability will often be determined by the track, or level of detail, of the procedures involved. Thus, a specific locator diagram for a part may be included in the illustration for a Track 3 procedure, but omitted in the other two tracks. Inclusion of specific support data in procedures does not eliminate the need to provide the data in pool, although the same basic data may be used in both places.

Since it is part of pool, procedural support data are normally prepared to Level 3 character size criteria. However, since by nature they may be used to support the performance of maintenance, the data should be legible when viewed from the work location. This can be accomplished by having all procedural support information on the frame (except the heading) subject to the zoom and pan controls, as is assumed in the examples in this section, or by preparing the information to Level 5 criteria.

6.4.2 Access and Locator Diagrams

Access and locator diagrams (ALDs) are used to help technicians find a particular part or assembly and, in some instances, to determine what other parts or assemblies interconnect with it, hide it, or are hidden by it. Although not as detailed as breakdown illustrations, access and locator diagrams are also useful in determining the sequence of removal/installation or disassembly/assembly if the detail is adequate.

ALDs should be prepared for each major assembly, as a minimum, and at a lower level if needed. To the extent feasible without causing too much congestion on the ALD frame, a particular ALD should be complete in the fewest number of frames. When more than one frame is needed, a message should be included in each frame noting the availability of additional data. Figures 6-36 and 6-37 illustrate examples of a two-frame ALD. When an ALD is accessed in the standard mode, the first frame of a multi-frame series will be displayed first. The user can move between the frames using the [FORWARD] and [REVERSE] keys on the control unit. Character size of legends in the illustration are not critical since the entire illustration can be zoomed up, panned, etc. for increased legibility of detail. Callouts are not normally used in ALDs since there is no text involved and using callouts requires additional visual search. Callouts may be used if they would reduce overall diagram complexity, but the referenced legends should always appear on the same frame as the

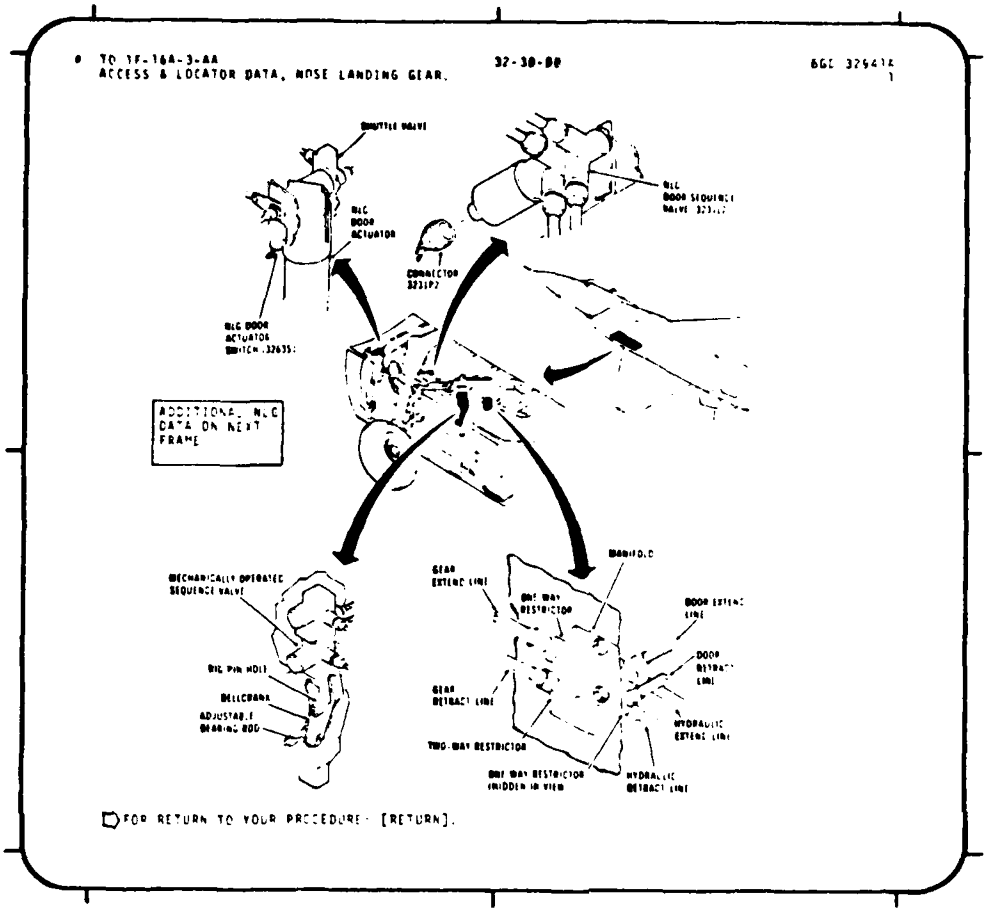


Figure 6-36. Example of VAMIS access and locator diagram (ALD) (first frame of two-frame ALD).

illustrated part, as shown in Figure 6-38. When ALDs use an inset for cross-referencing component names to the illustrated part, the inset must meet the character size criteria since it should not be subject to the panning and zoom controls.

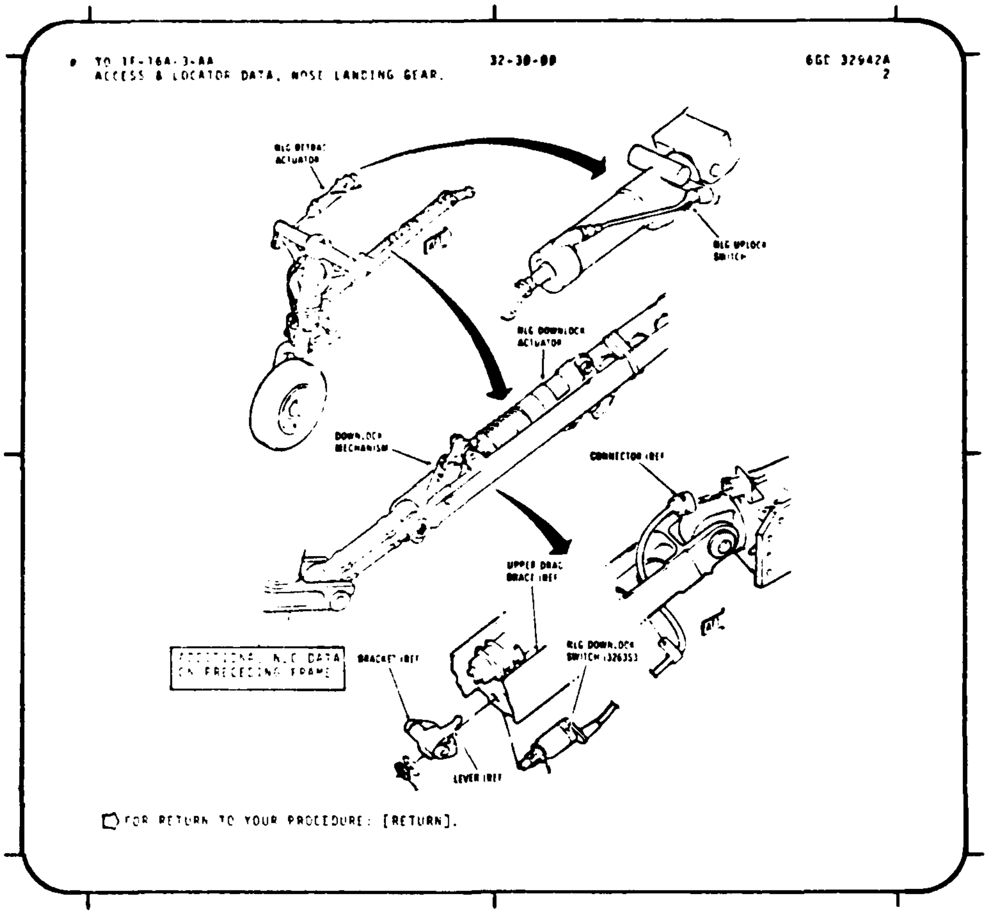


Figure 6-37. Example of VAMIS access and locator diagram (ALD) (second frame of two-frame ALD).

6.4.3 Test Setup Instructions

This type of data can cover a wide range of formats, from procedural text to illustrations, depending on the equipment to be tested and the means for testing. Test setup instructions should normally be integrated in Track 3 procedures, where applicable, and possibly in Track 2 procedures. Consequently, preparation of integrated instructions should follow the guidelines for the associated maintenance track. Test setup instructions for procedural support pool data should be prepared at the level of detail needed by users who do not have them integrated with their maintenance procedures. For example, if Track 3 procedures include test setup instructions, but Track 2 and Track 1 procedures do not, then test setup instructions in pool should be at the Track 2 level of detail so they are usable by both Track 2 and 1 technicians. In such a case, the options lists for Track 2 and Track 1 would include the test setup instruction entry, but the Track 3 options list would not.

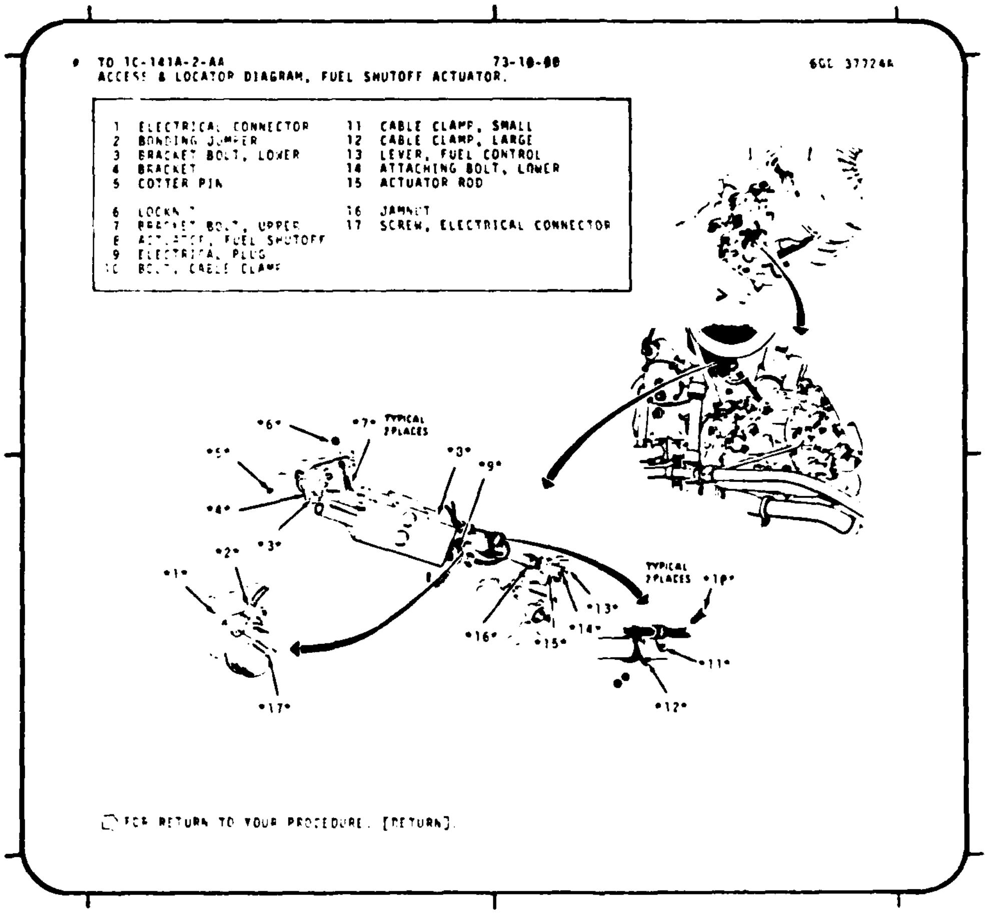


Figure 6-38. Example of VAMIS access and locator diagram (ALD) using legend callouts.

In all cases, the input conditions for a particular checkout or fault isolation procedure should include the need, where applicable, to set up the test equipment according to the appropriate instructions unless the instruction is fully integrated in the maintenance procedure. When there is doubt regarding proper placement of test setup instructions, preference is to include test setup instructions with the maintenance track procedures. If the test setup is unique to a particular test, it should be integrated with the test procedures. If the test setup is common to a number of different tests, it should be prepared as a separate task procedure covering all common setup requirements, with unique setup requirements in the individual test procedures (e.g., switch settings). Operating instructions for standard and special test equipment are generally not included in test setup instructions. Where applicable, these should be included in the pool reference data or, in some instances, in separate TOs which can be accessed as needed.

6.4.4 Test Specifications

Test specifications are generally of two types: (1) test specification tables that list quantitative values and tolerances, if applicable, which are acceptable for each listed test condition, and (2) diagrams such as waveform guides which illustrate how the test equipment (or the tested equipment) should respond to the test condition. As with test setup instructions, test specifications should be included in track procedures according to the needs of the user of that track data. Ordinarily, all three tracks of procedural data will include the appropriate test specifications, since even the most experienced technician should not be expected to accurately remember more than a few test specifications. In addition, there may be a need to provide a consolidated listing of test specifications for use by technicians who are troubleshooting from schematic diagrams or checking out a problem not covered by procedures. Such a composite listing might include normal values for a series of test points, for example, such as is illustrated in Figure 6-39.

TO 12R2-2ARC164-3-AA 23-20-00 6GC 773256

MAIN RECEIVER VOLTAGES, U-SERIES DEVICES. 2

CONDITIONS: NO SIGNAL INPUT; SQUELCH OPEN; MAIN ON; RCV MODE; WB; X-MODE DISABLED.
METHOD: MEASURE WITH HIGH IMPEDANCE (DIGITAL) VOLTMETER.

PIN	U1	U2	U3	U4	U5	U6
1	-11.02	+11.53	+3.99	+0.05	+1.91	0
2	0	+12.04	+5.76	+0.66	+1.91	+11.78
3	0	+5.76	+4.00	+0.05	0	0
4	-12.31	+11.13	0	+0.64	0	0
5	-11.10	-12.32	+11.76	0	+9.86	-12.31
6	0	+5.79	+11.76	+5.50	0	+1.00
7	+11.78	+5.80	+11.78	+1.33	+6.01	0
8	-0.59	+12.04	0	+1.33	+5.34	+11.78
9	-	+11.16	-	+0.79	+3.43	+10.97
10	-	0	-	+5.72	+3.43	0
11	-	-	-	+0.59	+5.34	-
12	-	-	-	+0.24	+4.25	-
13	-	-	-	+5.80	+0.37	-
14	-	-	-	+0.86	+1.65	-
15	-	-	-	+5.00	-	-
16	-	-	-	+12.04	-	-

VOLTAGES FOR Q-SERIES DEVICES ARE ON PRECEDING FRAME.

FOR RETURN TO YOUR PROCEDURE: [RETURN].

Figure 6-39. Example of VAMIS test specifications table in procedural support pool data.

SECTION 7.0
GUIDELINES FOR MAINTENANCE PROCEDURE FORMATS

7.1 GENERAL CONSIDERATIONS

Maintenance procedures in VAMIS are prepared at three levels of detail, or "tracks." By definition, maintenance procedures will include all procedural information that does not involve troubleshooting, checkout, fault-isolation, and test. The following types of maintenance activities are encompassed by this definition:

- Inspection
- Cleaning
- Disassembly or removal
- Assembly or installation
- Lubrication
- Alignment, adjustment, and calibration
- Pre-operational check
- Repair.

Each set of maintenance procedures will include the input conditions for performing the selected tasks, the procedures to be accomplished, and provisions for follow-on activities which may be necessary. Variations in level of detail for each of the three tracks may apply to all, or only part, of the data. (See subparagraph 1.3.1e for criteria which define each track.) Baseline requirements for maintenance procedure formats (discussed and illustrated in Subsection 2.2) start with the Job Guide format, from specifications MIL-M-38800A and MIL-M-83495, and are dependent on the dual-level, or "hybrid," format specified in MIL-M-38800A. Performance of a task analysis according to the modified methodology (Ref. 7) defined during this project is recommended. That methodology is based on tailoring the maintenance task identification and analysis methods and guidance of AFHRL-TR-79-50 (Ref. 5) and AFHRL TR-80-21 (Ref. 6) for greater applicability to a computer-based, three-track presentation system.

All procedural, i.e., track, data are prepared to meet the Level 5 viewing distance requirements. This includes both text, illustrations, and prompts, and should be achieved when the frame first appears on the display screen. The frame code "JG" is used on all frames of non-troubleshooting maintenance procedures.

Prior to preparation of VAMIS maintenance procedures, consideration should be given to the scope of the task to be performed, especially for assembly/disassembly, remove/install, and similar multipart tasks. Conventional paper-based TOs frequently describe (at some level of detail) the necessary performance in one direction, then summarize the other direction with a statement such as "reassemble in the reverse order." Most job guide-type procedures will actually describe the steps required for both directions, but still generally treat the two parts as a continuous task (i.e., first take it apart, then put it back together). In many cases this is actually what happens, but in many other cases the two parts are not continuous. For example, a unit may be partially disassembled in order to obtain a part which is sent off somewhere for testing. It may be some period of time before the part (or a replacement) is returned and the unit is reassembled, and a different technician may be involved. A computer-based presentation system provides an opportunity for scaling the data to the task scope which the technician actually needs, and using the system's accessing and prompting capabilities for linking the various needed parts.

As will be seen from the discussion and examples beginning in Subsection 7.2, the VAMIS approach is a compromise between complete splitting of such multipart tasks and the assumption that the task is continuous.

7.2 INPUT CONDITIONS FORMAT

The input conditions (IC) format is intended to identify the task to be performed, the equipment to which the particular task applies, the number and type(s) of personnel needed, and any special supplies and tools which may be required. Input conditions will also include description of any equipment conditions which must be satisfied prior to task initiation, and a summary of the procedure. Depending on the complexity of the task, the amount of such information to be provided, and the applicable track, input conditions may be presented on a single frame or in a series of frames. To the extent feasible, input conditions should be organized so that data to be presented to all three tracks are on common frames. This will reduce the number of individual, track-specific frames in the data base.

An example of a first frame of input conditions, applicable to Tracks 1, 2, and 3, is illustrated in Figure 7-1. This is the type of frame that would appear following task selection from a procedures TOC (see Figure 4-7). Since it is the first of a series of frames on a topic, a second-level title is used in the header to ensure that the technician is informed of the procedure selected. Since the same information is needed by all three tracks (even though an experienced, Track 1 technician may know most or all of it), it is combined on a common frame with a frame code identification of type 6.

This IC frame identifies the overall task, serial number applicability, personnel required, and supplies and special tools or equipment needed for task performance. To some extent the applicable serial numbers entry may be redundant information if the user has been presented with and made a selection from the model/series selection menu as the procedures were accessed (see subparagraph 4.3.3.1). As applicable, the frame shows whether the listed data apply to the remove phase or the install phase. This will permit the user, for example, to obtain only those supplies needed for the phase of the task intended to be performed. The supplies and tools list would be a likely candidate for printing out, if the system included a print capability (see Subsection 3.10), and may need a prompt to that effect. If the supplies and tools list will require more space than is available on the first IC frame, start the list on a new frame rather than break it in the middle of the list.

```
#  TO 1C-141A-2-AA                     73-10-00           6JG 03592C
#  C-141A ENGINE FUEL SYSTEM MAINTENANCE
#  TASK 4-3: FUEL PUMP FILTER ELEMENT REMOVAL & INSTALLATION. 1

#  INPUT CONDITIONS:                                  REMOVE   INSTALL

   • APPLICABLE SERIAL NUMBERS....ALL

#  • PERSONNEL REQUIRED........................          1         2
#    - SPECIALIST WILL BE REQUIRED TO MOTOR
#    AFFECTED ENGINE UPON REQUEST DURING FUEL
#    SYSTEM ACTIVATION & CHECKOUT.

   • SUPPLIES:
#    - ONE GALLON PLASTIC CONTAINER...........           1         -
#    - PETROLATUM GREASE, VV-P-236............           -         ✓
#    - O-RING PACKING, MS9021-135.............           -         ✓
#    - WIPING CLOTH OR TOWELS (WIPES).........           ✓         ✓

   • SPECIAL TOOLS AND TEST EQUIPMENT:
#    - MAINTENANCE STAND, TYPE B-4A (ALT:B-1A)           1         1
#    - TORQUE WRENCH, 500 INCH-POUNDS(CALIBRATED)-                 1




   ⇨ INPUT CONDITIONS CONTINUED: [FORWARD].
```

Figure 7-1. Example of VAMIS maintenance task input conditions frame (all tracks).

The next IC frame to appear in response to following the frame prompt should be the equipment conditions to be satisfied before initiating maintenance. Depending on the nature of the equipment conditions, this could be accomplished on another common IC frame or may require separate frames for each track. Figure 7-2 illustrates such a frame that is common to two of the tracks (Track 2 and 3).

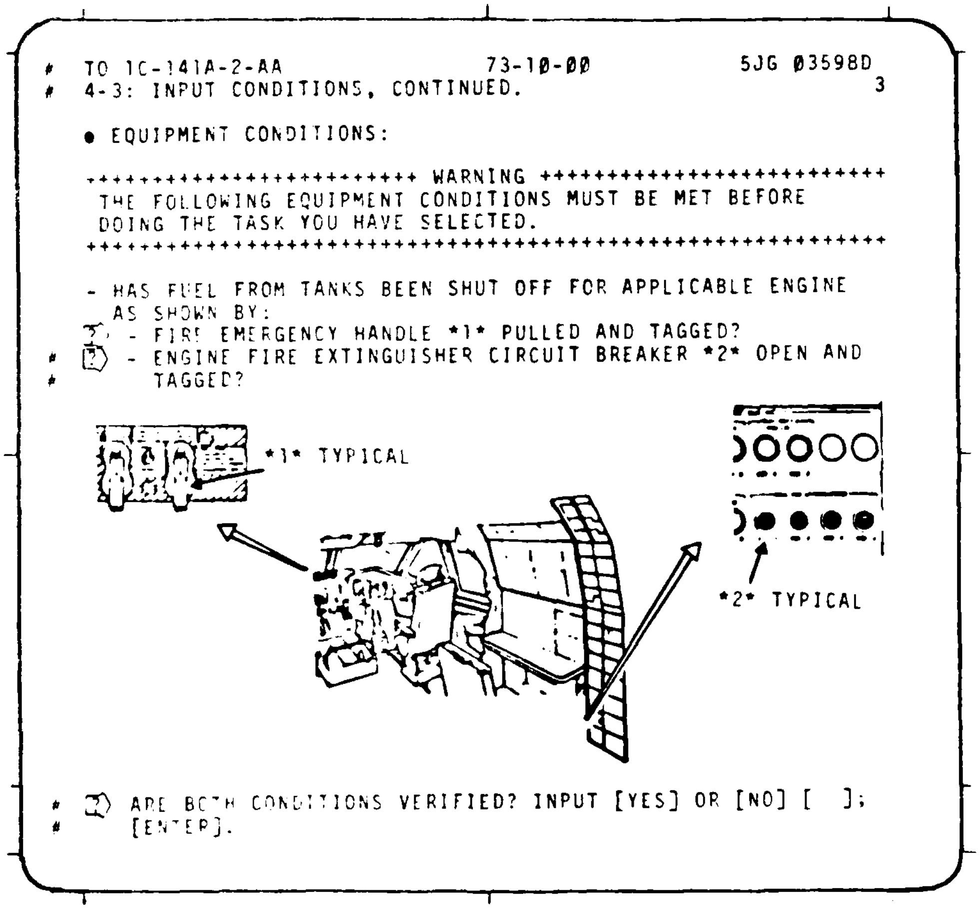


Figure 7-2. Example of VAMIS maintenance task input conditions continuation frame (Tracks 2 and 3).

In this example, the nature of the condition to be satisfied is significant enough to require detailed instructions for both of these tracks. The same basic information is displayed to the technician in Track 1, but in much less detail, as shown in Figure 7-3. The two equipment conditions listed on this Track 1 frame would require sequential frames for Tracks 3 and 2. Note that, regardless of track level, the technician is not permitted to access the next frame until equipment condition verification status has been registered according to the prompt. A "YES" input will access the next frame for the track. A "NO" input might automatically access a detailed verification procedure for Track 3 and an advisory message to Tracks 2 and 1 that verification must be accomplished before going further.

When accomplishment of all equipment conditions has been verified, the last IC frame is accessed. Again, skill level differences may require different "Summary of Procedure" frames for each track, and at least two different frames will be necessary. Comparison of the examples in Figure 7-4 and 7-5 shows only minor differences in the frame content of the Track 2 and 3 common frame and the Track 1 frame, respectively. The principal differences are the inclusion of a reminder to Tracks 2 and 3 that specific procedures should be accessed and followed. The experienced Track 1 technician, on the other hand, will normally have enough information in the summary to provide such guidance as may be needed. If more detail is needed, Track 2 or even Track 3 procedures can be obtained via the options list (see Figure 4-9).

```
#  TO 1C-141A-2-AA                    73-10-00            1JG 03594A
#  4-3: INPUT CONDITIONS, CONTINUED.                                 3
#

   • EQUIPMENT CONDITIONS:

   ++++++++++++++++++++++++ WARNING +++++++++++++++++++++++++
    THE FOLLOWING EQUIPMENT CONDITIONS MUST BE MET BEFORE
    DOING THE TASK YOU HAVE SELECTED.
   ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

#      LEFT-HAND AFT COWL DOOR OPENED PER TASK NUMBER 1-4?
#      FUEL FROM TANKS SHUT OFF AND DEICER FILTER DRAINED PER
       TASK NUMBER 1-4?

#     ARE BOTH CONDITIONS VERIFIED? INPUT [YES] OR [NO] [   ];
#     [ENTER].
```

Figure 7-3. Example of VAMIS maintenance task input conditions continuation frame (Track 1).

```
#  TO 1C-141A-2-AA                    73-10-00              5JG 03595A
#  4-3: INPUT CONDITIONS, CONTINUED                                  4
#

   ● SUMMARY OF PROCEDURE:
     - ENSURE APPLICABLE EQUIPMENT IS IN THE CORRECT CONDITION
       FOR MAINTENANCE.
     - REMOVE FILTER ELEMENT FROM THE FUEL PUMP.
     - DISASSEMBLE FUEL PUMP FILTER ELEMENT.
     - INSPECT AND CLEAN FUEL PUMP FILTER ELEMENT.
     - ASSEMBLE FUEL PUMP FILTER ELEMENT.
     - INSTALL FILTER ELEMENT IN THE FUEL PUMP.
     - ACTIVATE AND CHECKOUT FUEL SYSTEM.
     - PERFORM REQUIRED FOLLOW-ON MAINTENANCE.

   ● THIS PROCEDURE SHOULD BE PERFORMED USING THE SPECIFIC
     PROCEDURES WHICH FOLLOW.


  FOR NEXT FRAME: [FORWARD].
# FOR INSTALLATION PROCEDURES ONLY: [NEXT SEQUENCE].
```

Figure 7-4. Example of VAMIS maintenance task input conditions summary frame (Tracks 2 and 3).

```
• TO 1C-141A-2-AA              73-10-00            1JG 03596A
• 4-3: INPUT CONDITIONS, CONTINUED                          4
•

  • SUMMARY OF PROCEDURE:
    - ENSURE APPLICABLE EQUIPMENT IS IN THE CORRECT CONDITION
      FOR MAINTENANCE.
    - REMOVE FILTER ELEMENT FROM THE FUEL PUMP.
    - DISASSEMBLE FUEL PUMP FILTER ELEMENT.
    - INSPECT AND CLEAN FUEL PUMP FILTER ELEMENT.
    - ASSEMBLE FUEL PUMP FILTER ELEMENT.
    - INSTALL FILTER ELEMENT IN THE FUEL PUMP.
    - ACTIVATE AND CHECKOUT FUEL SYSTEM.
    - PERFORM REQUIRED FOLLOW-ON MAINTENANCE.

  IF YOU NEED MORE INFORMATION: [LIST OPTIONS].
```

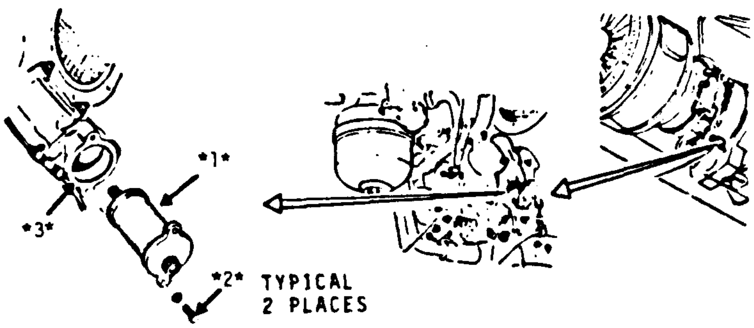
Figure 7-5. Example of VAMIS maintenance task input conditions summary frame (Track 1).

7.3 TRACK 3 MAINTENANCE PROCEDURES

Maintenance procedures for the least skilled and experienced technician are prepared at a very detailed, step-by-step level. Illustrations of the subject equipment are always provided, at the same level of detail, fully integrated with the procedural text. Figure 7-6 shows an example of a typical Track 3 maintenance procedure frame. On each such frame, instructions for accomplishing one subtask are presented in dual-level format;

i.e., a statement of what the subtask consists of and indentured below it, the step-by-step instructions for accomplishment. Each component or part mentioned in the text is keyed to a detailed illustration.

```
#  TO 1C-141A-2-AA              73-10-00             3JG 03487F
   4-3: REMOVE FUEL PUMP FILTER ELEMENT                        5


#  A. REMOVE FILTER ASSEMBLY FROM FUEL PUMP:
      1. POSITION CONTAINER BELOW FILTER *1* TO CATCH DRAINAGE.

   ------------------------- NOTE --------------------------
    WIPE ANY FUEL SPILLAGE FROM ENGINE WITH CLOTH OR TOWELS.
   ---------------------------------------------------------

      2. CUT SAFETY WIRE AND REMOVE 2 BOLTS *2* AND WASHERS.
      3. WITHDRAW FILTER ASSEMBLY *1* FROM CAVITY IN FUEL PUMP
         *3*.
```




```
   NEXT FRAME: [FORWARD].
```

Figure 7-6. Example of VAMIS maintenance procedure frame (Track 3).

Any applicable warnings, cautions, or notes which apply to the subtask are inserted in the text at the proper location. At this level of detail, many subtasks will require more than one frame to present the instruction. When this occurs, the subtask title is repeated on each successive frame and the step numbers continue in sequence. The illustration on each successive frame will also change, showing only the parts which are relevant to the step descriptions on the same frame.

Illustrations should be as simple as possible while still accurately representing the equipment. Line drawings are preferred with irrelevant detail eliminated. Shading, texture, and similar graphic detail should not be included unless it will help the technician locate and identify the part of interest. In many cases, as in the Figure 7-6 example, the illustration will be a combination of access and locator diagram (ALD) and parts breakdown illustration. When the procedure gets beyond the need for the ALD, it should no longer appear on the screen. When directional arrows are used, they should always be consistent with the step being performed. For example, when the subtask is describing installation of the filter assembly in the fuel pump, the ALD directional arrows should be reversed from that shown in Figure 7-6.

It should also be noted that the callouts used in the text and illustration are coded as "non-selectable." This will normally be the case in procedures, since the illustration should already be as complete as needed for the track level. On the rare occasions when some further data or illustrations associated with the part are to be provided on request, the callout should be coded as selectable (e.g., [ ]) and the prompt or a note should inform the user of what will be obtained by the selection.

7.4 TRACK 2 MAINTENANCE PROCEDURES

Procedures for conduct of maintenance by the technicians at the middle level of skill and experience will eliminate much, but not all, of the details which are characteristic of Track 3 procedures. As shown in the example in Figure 7-7, the text description is generally limited to one or more subtask statements (the upper level of the Track 3 dual-level instruction) and any appropriate warnings, cautions, and notes. Illustrations may also be used to supplement the text and, if so, should include the use of callouts in both text and illustrations.

Figure 7-8 illustrates a second example of a Track 2 maintenance procedure, the frame which would follow Figure 7-7 in our Track 2 scenario. The illustration has changed substantially to keep it consistent with the subject being covered by the text. This example also points up the flexibility for a VAMIS-type system to access the appropriate next frame, depending on what the technician needs to do when the end of a task phase (remove and inspect) has been reached. If the filter element (or a replacement) is to be installed, installation procedures will be provided without a break in continuity when the technician answers "YES." If the technician answers "NO," perhaps because a new filter element is needed but not available, the system will provide instructions for securing the equipment before leaving it, if any are needed. This might include ensuring that the cover is secure and that a tag-out flag is attached. At the conclusion of the procedure or follow-on maintenance activity, the system will display to the technician instructions for either "logging off" or for accessing some other part of the data base.

TO 1C-141A-2-AA 73-1Ø-ØØ 2JG Ø3521C
4-3: REMOVE FUEL PUMP FILTER ELEMENT 5
#

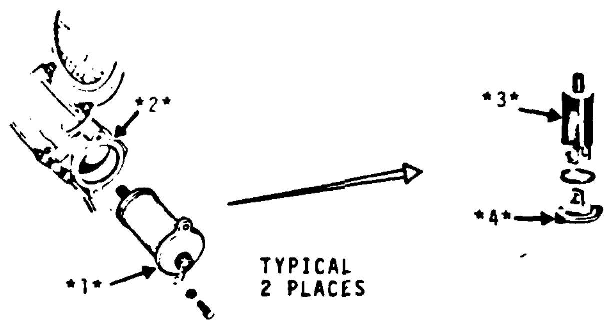
A. REMOVE FILTER ASSEMBLY *1* FROM FUEL PUMP CAVITY *2*.

-------------------------- NOTE --------------------------
CATCH DRAINAGE & WIPE SPILLAGE FROM ENGINE

B. DISASSEMBLE ELEMENT *3* FROM COVER *4*.

'''''''''''''''''''''''' CAUTION ''''''''''''''''''''''''
COVER FUEL PUMP OPENING *2* WITH COVER *4*.
''

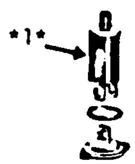
#



REMOVE AND INSPECT CONTINUED: [FORWARD].

Figure 7-7. Example of VAMIS maintenance procedure frame (Track 2).

```
# TO 1C-141A-2-AA                 73-1Ø-ØØ           2JG Ø3522A
# 4-3: REMOVE FUEL PUMP FILTER ELEMENT, CONTINUED.             6
#
# C. INSPECT ELEMENT *1* FOR CONTAMINATION & CLEAN IF NEEDED.

  ''''''''''''''''''''''''' CAUTION '''''''''''''''''''''''''
   INVESTIGATE CAUSE OF METAL OR RUBBER PARTICLES; FUEL SYSTEM
   MAY BE DAMAGED.
  '''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''

  END OF REMOVE AND INSPECT.

# (?) ARE YOU GOING TO INSTALL A FILTER ELEMENT NOW?
```




```
#

# (?) INPUT [YES] OR [NO]:[  ]; [ENTER].
```

Figure 7-8. Example of VAMIS maintenance procedure continuation frame (Track 2).

The Track 2 procedures formats discussed above have included both text and illustrations, appropriately associated through the use of callouts. For some kinds of maintenance tasks, it may be appropriate to provide text only, with no illustrations. Alternatively, there may be cases where only an illustration is needed, without text. If either of these alternatives is used, the level of detail of the information that is provided may need to be increased to assure comprehension by the technician.

7.5 TRACK 1 MAINTENANCE PROCEDURES

Experienced and highly skilled technicians need a minimum of procedural guidance for the conduct of routine maintenance tasks. In VAMIS it is planned that the Summary of Procedures (which is the last frame of the input conditions in each track) will, in effect, comprise the Track 1 procedure (see Figure 7-5). In some circumstances, however, it may be necessary to provide additional procedural guidance for Track 1, such as for a particularly complex calibration or alignment task. Rather than require the Track 1 technician to use Track 2 procedures, the following approach is recommended.

Track 1 should have the same Summary of Procedures IC frame as Tracks 2 and 3, followed by separate frames of procedural data deemed appropriate for a Track 1 user. These frames would include any applicable warnings, cautions, specifications, and diagrams necessary for task performance.

SECTION 8.0

GUIDELINES FOR TROUBLESHOOTING PROCEDURE FORMATS

8.1 GENERAL CONSIDERATIONS

Procedures for troubleshooting activities are also prepared at three levels of detail, or tracks. For a particular system, the levels of detail needed should be established in the same manner as for maintenance procedures (Section 7.0). In VAMIS, troubleshooting encompasses the following functions:

- Test and checkout
- Fault isolation.

Each set of troubleshooting procedures will include the input conditions for performing the selected task, test and checkout procedures, and fault isolation procedures. Differences in level of detail for the three tracks will apply to most of the data for a task, but some information may be at the same level of detail for more than one track. Requirements for the Logic Tree Troubleshooting Aids (LTTAs), which are the baseline format for VAMIS troubleshooting procedures, originate in specification MIL-M-38800A, supplemented by the formatting and preparation guidance in AFHRL TR-79-49 (Ref. 2). A troubleshooting task analysis should be performed prior to data preparation. The modified task analysis methodology (Ref. 7) defined during this project is appropriate. It is based on tailoring the maintenance task identification and analysis methods and guidance of AFHRL TR-79-50 (Ref. 5) and -80-21 (Ref. 6) for greater compatibility with a computer-based, three-track presentation system.

Troubleshooting data are procedural, or track, information and are subject to the level 5 viewing distance requirements. This applies to text, illustrations, and prompts, and should be achieved when the frame first appears on the display screen. The frame code "FI" is used on all frames of troubleshooting task information.

As explained in Subsection 2.3, LTTAs have two parts. The first part, termed checkout, is aimed at determining whether a fault exists and, if so, the part of the system which is involved. Checkout procedures are a linear series of checks for identifying a fault. Checkout ends, temporarily, when a fault is identified. If, for a given system, there is only one possible cause for the identified fault, then fault isolation has been accomplished simultaneously with fault identification and the next activity will be fault correction (e.g., repair, replacement, adjustment). In most cases, however, the cause of the problem will require further troubleshooting to isolate the fault to a particular component. When the fault has been identified using a system-level, or general, checkout procedure, checkout will often continue with a subsystem or assembly checkout before beginning actual fault isolation.

Fault isolation is the second part of an LTTA, accomplished with the use of logic trees. Whereas checkout procedures are linear, logic trees are "branching" and binary; that is, there are always two, but not more than two, possible next steps until the problem is isolated. The quantitative or qualitative results/ observations of one step determine which branch to follow for the next step.

8.2 INPUT CONDITIONS FORMAT

VAMIS troubleshooting procedures will use the same input conditions (IC) format described for maintenance procedures in Subsection 7.2. There are, however, some differences in both content and application in troubleshooting.

Separate input conditions data should be provided for a checkout task and each fault isolation task which may result from the checkout. Input conditions for a checkout task will only rarely apply in their entirety to a logic tree (LT) task. LTs may have some additional input conditions, and should always include completion of the checkout(s) which can lead to that logic tree.

Checkout and logic tree ICs will include not only equipment conditions, but may also include test setup conditions if applicable. Special test setup instructions can be incorporated either in the input conditions or as the first steps in the checkout. Standard test setup procedures should always be selectable from the options list for the IC frame which identifies the need for it. Checkout input conditions frames will include the "Summary of Procedure" frame (see Figure 7-4), but logic tree ICs will not. It would serve no useful purpose to summarize the fault isolation steps encompassed by a branching logic tree.

If the equipment system is using fault code reporting (see Subsection 8.6), the fault codes which are applicable should be listed as a category of input conditions for the checkout or fault isolation task, as applicable.

8.3 TRACK 3 TROUBLESHOOTING PROCEDURES

Checkout and fault isolation procedures for the least skilled and experienced technician are prepared at the same detailed, step-by-step level as Track 3 maintenance procedures. Very specific and detailed illustrations are always provided, fully integrated with the procedural text. This level of detail in LTTAs, and the resulting format characteristics, is termed enriched LTTA. The two parts are enriched checkout procedures and enriched logic trees.

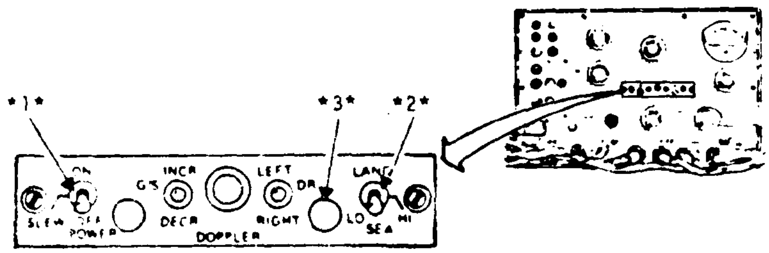
8.3.1 Enriched Checkout Procedures

Figure 8-1(a) illustrates an example of an enriched checkout procedure frame for use in Track 3 troubleshooting. The approach and format are the same as Track 3 maintenance procedure formats (see Subsection 7.3) in the use of dual-level subtask statements followed by step-by-step instructions for subtask performance. Text and illustrations are completely integrated through the use of callouts. Each subtask should start on a new frame. A subtask ends with a question which must be answered in order to proceed. A subtask may require multiple frames and should repeat the upper-level subtask statement on each frame. The question is not displayed until the last frame for a particular subtask.

The question should always be phrased so that a YES corresponds to an acceptable condition and a NO means that a problem exists. The prompt at the bottom of the frame uses the same symbol, ? , as marks the question, and the technician can go no further until the question is answered.

When the user enters the observed status of the equipment as a result of performing the steps and answering the question, the VAMIS system provides feedback in the prompt area to aid the technician in understanding the meaning of the check and the implications of the result. Alternate feedback messages are shown in Figures 8-1(b) and 8-1(c) for YES and NO responses, Series 10/6/50

```
#  TO 1ØP3-ASO-99-2-AA               26-22-Ø3              3FI Ø7254C
#  CHECKOUT 3-1: B. MANUAL GROUND SPEED SLEW CHECK                  2

#  1. CHECK MEMORY LAMP:
#    A. SET POWER SWITCH *1* TO SLEW.
#    B. SET TERRAIN SWITCH *2* TO LAND.
#    DOES MEMORY LAMP *3* LIGHT AND REMAIN LIT?
```



a.

```
#    INPUT EITHER [YES] OR [NO]: [  ]; [ENTER].
```

b.

```
     INPUT EITHER [YES] OR [NO]: [YES];[ENTER].
     MEMORY LAMP IS OKAY. CHECK LEFT SLEW: [FORWARD].
```

c.

```
     INPUT EITHER [YES] OR [NO]: [NO]; [ENTER].
     MEMORY CIRCUIT FAULT. FOR LT 3-2: [FORWARD].
```

Figure 8-1. Track 3 troubleshooting--example of enriched checkout frame.

respectively. In both cases, only the contents of the prompt area change through the addition of a feedback message for movement of the prompt marker. For the YES answer, the user is told what component was determined to be acceptable and what subtask is to be performed next. Since system logic assumes a YES answer is normal, the FORWARD function key can be used to obtain the next checkout subtask.

For the NO answer, the user is told what part of the system may be faulty and what procedures are needed to continue the trouble-shooting process, in this case a logic tree. Input of a NO instructs the system to depart from the normal, ordered sequence, and the FORWARD key is used to obtain the next appropriate frame.

Feedback messages used in this manner not only keep the technician informed of the meaning of the checkout actions, but also serve to provide frame-to-frame continuity. Since the Track 3 technician is seeing only very small "chunks" of the overall procedure on any one frame, the context and flow would not be apparent without such feedback.

8.3.2 Enriched Logic Tree

Track 3 fault isolation procedures are presented via enriched logic trees, an example of which is shown in Figure 8-2(a). As in Track 3 checkout procedures (and maintenance procedures), instructions are dual-level, step-by-step, with illustrations. However, LT subtasks are enclosed in "boxes." This practice serves the dual purpose of making a visual distinction between Track 3 LTs and checkouts, as well as improving the compatibility between Track 3 and Track 2 LTs.

Also as in Track 3 checkout procedures, feedback messages are used to provide the continuity of the logic tree and keep the

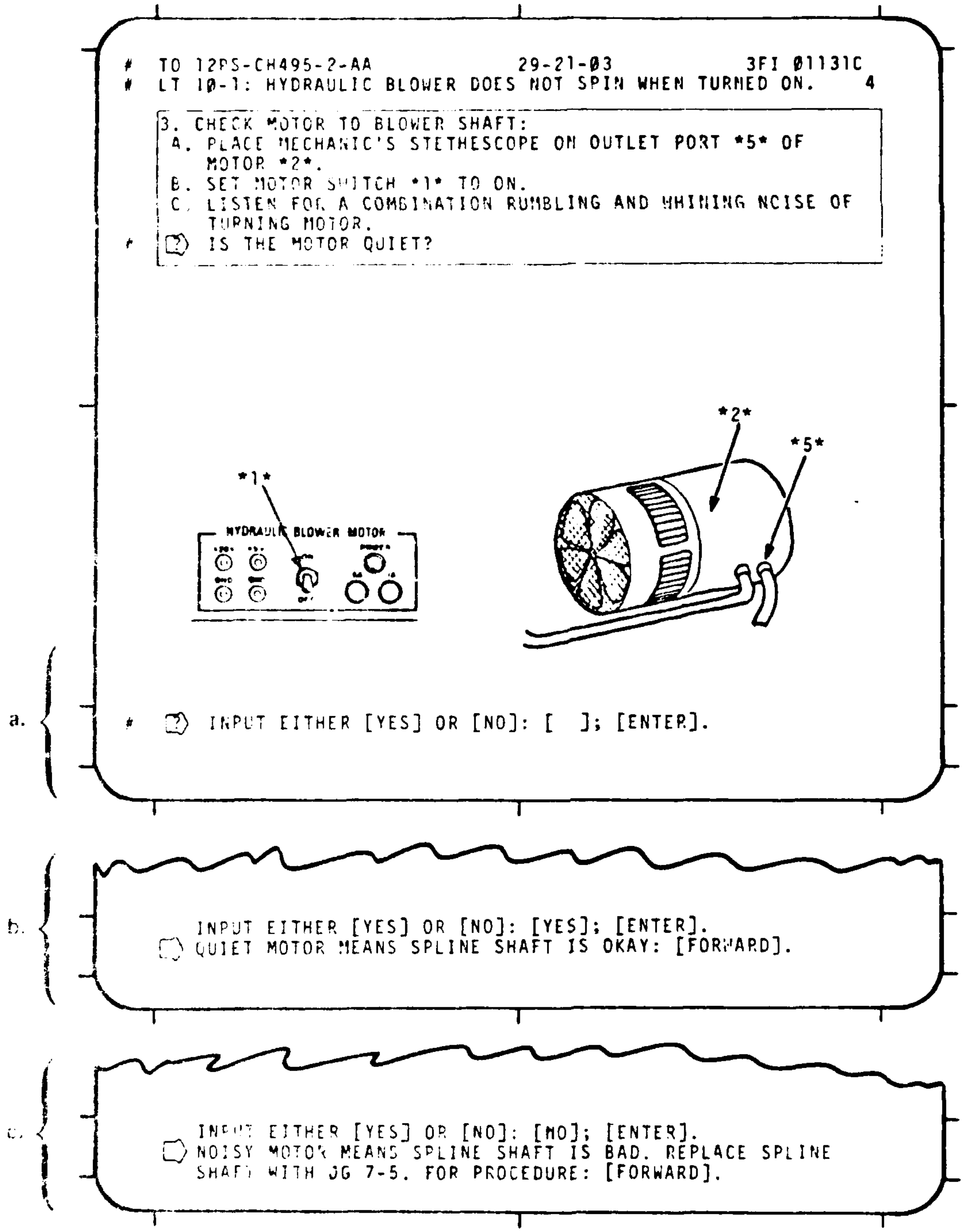


Figure 8-2. Track 3 troubleshooting--example of enriched logic tree frame.

technician apprised of the meaning of results of the checks (Figures 8-2(b) and 8-2(c)). Logic tree questions are also phrased so that a YES response corresponds to an acceptable condition and a NO response corresponds to an unacceptable condition, with one exception. In any logic tree, the last subtask in a branch should isolate two different faults, one from the YES response and the other from the NO. A properly constructed logic tree branch can never end with the possibility of a "no fault" condition, nor should it lead back to a logic tree step through which the technician has already passed. One of the binary responses may, however, result in going to a different LT for further fault isolation.

The examples in Figures 8-3 and 8-4 illustrate the continuation of the enriched LT shown in Figure 8-2(a) with implementation of the prompt/feedback in Figure 8-2(b). This shows the division of a lengthier step into a two-frame presentation.

8.4 TRACK 2 TROUBLESHOOTING FORMATS

Checkout procedures and logic trees for Track 2 are prepared at the middle level of detail, designated in AFHRL TR-79-49 (Ref. 2) as "minimally enriched."

8.4.1 Minimally Enriched Checkout Procedures

Figure 8-5 shows an example of a Track 2 checkout frame. Logic is the same as in Track 3 checkouts in that questions are phrased so that a NO response indicates that an unacceptable, or fault, condition exists. This example uses no illustration to support the text, on the assumption that a Track 2 technician is sufficiently knowledgeable of the equipment to know where the controls and indicators are located. Other tasks may make use of simple illustrations to the extent needed. Text provides the basic statement of the subtask (the upper level of the Track 3 dual level) followed by a brief statement of what to do and what to look for. Following the prompt will access a lower-level checkout procedure or the appropriate logic tree. Feedback messages are not used as a means of providing enrichment and continuity as in Track 3.

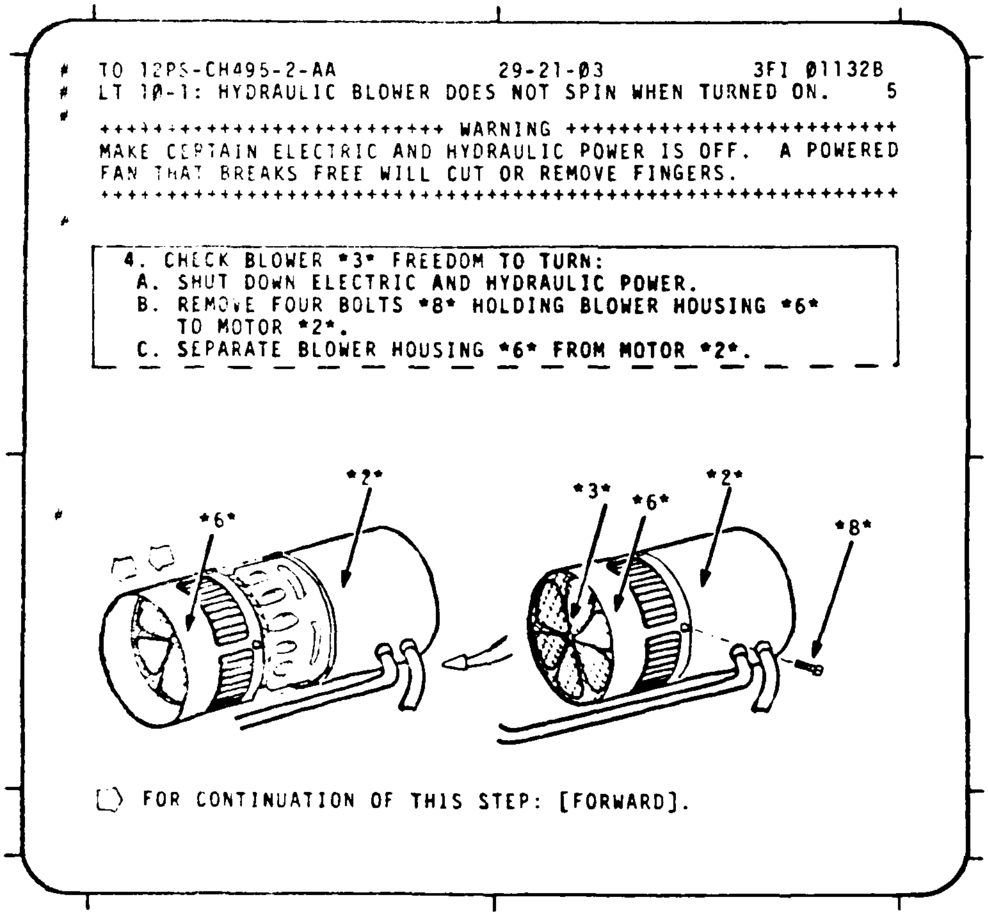
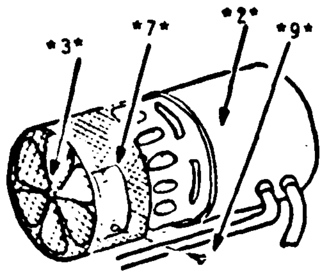


Figure 8-3. Track 3 troubleshooting--example of enriched logic tree frame, next frame presentation after entering NO input.

```
# TO 12PS-CH495-2-AA              29-21-Ø3             3FI Ø1133B
# LT 1Ø-1: HYDRAULIC BLOWER DOES NOT SPIN WHEN TURNED ON.     6
#
  +++++++++++++++++++++++++ WARNING +++++++++++++  ++++++++++
  MAKE CERTAIN ELECTRIC AND HYDRAULIC POWER IS OFF.  A POWERED
  FAN THAT BREAKS FREE WILL CUT OR REMOVE FINGERS.
  ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
#

    4. CHECK BLOWER *3* FREEDOM TO TURN (CONTINUED)
     D. REMOVE TWO SCREWS *9* FROM ACCESS PANEL *7*.
     E. OPEN BLOWER ACCESS PANEL *7*.
     F. REACH IN AND GRASP FAN BLADES *3*  AND TRY TO TURN
        BLOWER IN EITHER DIRECTION.
    [?> DID BLOWER TURN FREELY?
```




```
# [?> INPUT EITHER [YES] OR [NO]; [  ]; [ENTER].
```

Figure 8-4. Track 3 troubleshooting--example of enriched logic tree frame, continuation frame presentation.

Comparison of the Track 2 checkout procedure with that of Track 3 (see Figure 8-1) clearly shows the differences in level of detail, as well as the common approach except with regard to enrichment. If the Track 2 technician decided that more detailed guidance was needed, the choice is available on the options list (see Figure 4-9). It should be noted, however, that when "more detail" is selected, the system will access and display the first frame which is equivalent for the two tracks (i.e., Figure 8-1).

If the technician has already passed that point in the Track 2 procedure, he will need to repeat those steps in Track 3 until he gets to the equivalent place in the procedure.

```
# TO 10P3-ASQ-99-2-AA              26-22-03              2FI 02389B
# CHECKOUT 3-1: B. MANUAL GROUND SPEED SLEW CHECK.                 2
#
# 1. CHECK MEMORY LAMP:                                        IF NO
#    - SET POWER SWITCH TO SLEW AND TERRAIN SWITCH              [  ]
#      TO LAND.
#     DOES MEMORY LAMP LIGHT AND REMAIN LIT?............          A

# 2. CHECK LEFT SLEW:
#    - HOLD DR SWITCH TO LEFT FOR 25 TO 35 SECONDS, THEN
#      SWITCH TO CENTER.
#     DO THESE FOUR ACTIONS OCCUR TOGETHER?
#      1. MEMORY LAMP OFF (NOT LIGHTED)..................         B
#      2. MEMORY FLAG OFF (NOT VISIBLE)..................         C
#      3. ANTENNA ROTATES CCW SMOOTHLY AND
#         THEN STOPS SMOOTHLY............................         D
#      4. DRIFT ANGLE POINTER FOLLOWS ANTENNA............         E

# 3. CHECK RIGHT SLEW:
#    - HOLD DR SWITCH TO RIGHT FOR 25 TO 35 SECONDS, THEN
#      SWITCH TO CENTER.
#     DO THESE FOUR ACTIONS OCCUR TOGETHER?
#      1. MEMORY LAMP OFF (NOT LIGHTED)..................         F
#      2. MEMORY FLAG OFF (NOT VISIBLE)..................         G
#      3. ANTENNA ROTATES CW SMOOTHLY AND
#         THEN STOPS SMOOTHLY............................         H
       4. DRIFT ANGLE POINTER FOLLOWS ANTENNA............         J


#   INPUT KEY CODE FOR ANY NO ANSWER: [  ]; [ENTER].
    ALL CHECKS OKAY? [FORWARD].
```

Figure 8-5. Track 2 troubleshooting--example of checkout frame.

8.4.2 Minimally Enriched Logic Trees

Track 2 logic trees more closely resemble the traditional graphic logic tree in appearance, as shown in Figure 8-6. Questions which direct the test to be performed or observations to be made are placed in boxes, with arrows showing the path to be followed depending on the results of each subtask.

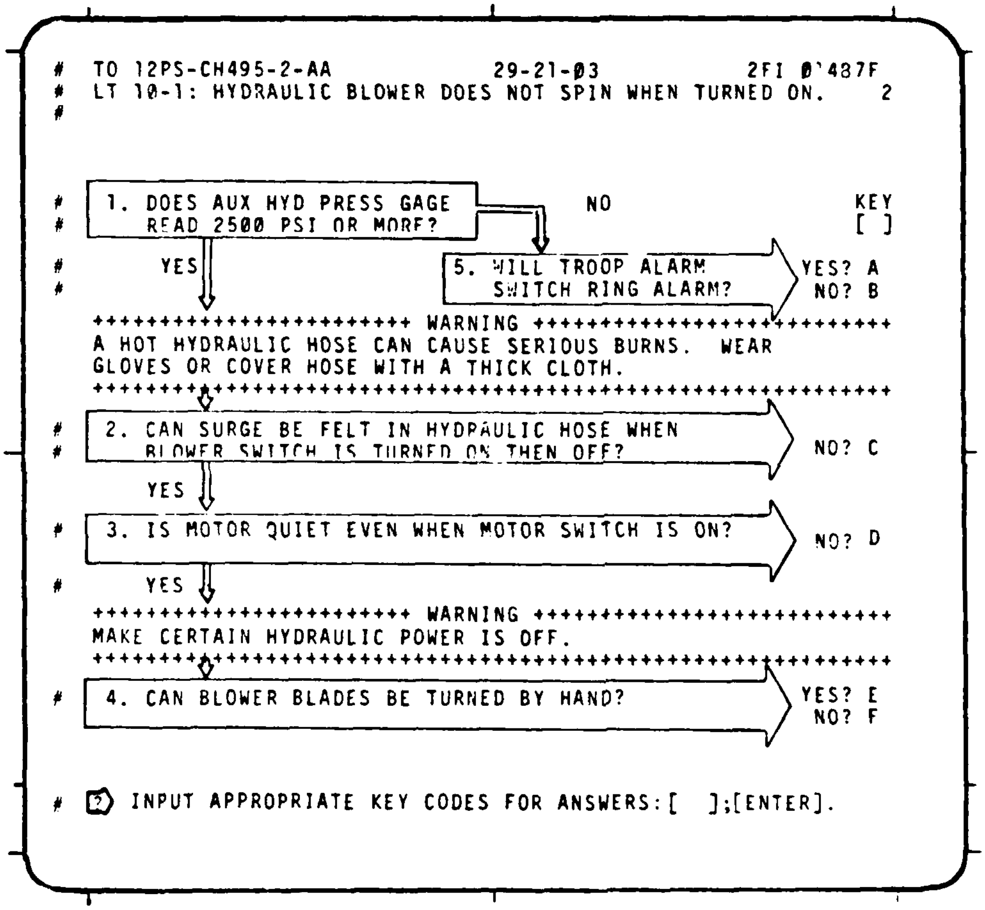


Figure 8-6. Track 2 troubleshooting--example of logic tree frame.

In general, a YES response directs the techician to continue down the tree, because the fault has not been isolated, while a NO will take the user out of that logic tree. Input of any key code will result in display of a feedback message which identifies the component determined to be at fault, or the logic tree to be used for continuing troubleshooting. This use of feedback is comparable to Track 3 logic trees.

8.5 TRACK 1 TROUBLESHOOTING FORMATS

Checkout and fault isolation procedures for the most skilled and experienced technician provide the least amount of detail. For both applications the format more closely approximates a simple checklist.

8.5.1 Track 1 Checkout Procedure

The checkout procedure for Track 1 lists the checks to be made, in the correct sequence, just as in the more detailed tracks. As shown in Figure 8-7, however, no guidance is provided regarding the location of the component or how the test/observation is to be accomplished. The only assistance is to show, for each check, what the correct status or indication should be. For any observed off-normal indication, the technician can access the appropriate lower-level checkout frame or logic checklist with input of a key code. No feedback is provided for identifying faulty items or disclosing the procedure that will be accessed.

```
#  TO 5N1-3-8-2-AA                 34-60-00            1FI 01842B
#  CHECKOUT 3-1: A. POWER TURN-ON AND DISTRIBUTION.                 2
#
#  CHECK        COMPONENT                               NORMAL STATUS/
#  [ ]                                                   INDICATION

#     1  AIR NAVIG MULTIPLE INDICATOR FLAG........ VISIBLE
#     2  OFF/MAN/AUTO SWITCH...................... MAN
#     3  AIR NAVIG MULTIPLE INDICATOR FLAG........ NOT VISIBLE
#     4  NAVIG COMPUTER BLOWER.................... OPERATING
#     5  TEST HARNESS, 115V AC SWITCH............. OFF
#
#     6  CONTROL INDICATOR OFF INDICATOR.......... LIGHTED
#     7  TEST HARNESS, 115V AC SWITCH............. ON
#     8  TEST HARNESS, TEST POINT B12(HOT)........ 26 VAC
#     9  TEST HARNESS, TEST POINT E6(RETURN)...... 26 VAC
#    10  TEST HARNESS, HEADING TRACK READOUT
         BETWEEN TEST POINTS D6 AND D7........... PRECISE NULL

*       FOR FI DATA: INPUT FAILED CHECK NUMBER [  ]; [ENTER].
        FOR CONTINUATION OF BENCH CHECK: [FORWARD].
```

Figure 8-7. Track 1 troubleshooting--example of bench checkout frame.

8.5.2 Track 1 Logic Checklist

Fault isolation procedures for Track 1 continue the checklist philosophy of the checkout procedure. Figure 8-8 illustrates the reduction of the Track 2 logic tree (Figure 8-7) into checklist format. This logic checklist contains only the bare essentials of symptom identification and status information, but is based on the same sequence of checks as in the logic tree. Branching sequences are reflected by indentured steps.

```
#  TO 12PS-CH495-2-AA              29-21-Ø3            1FI Ø2467C
#  LT 1Ø-1: HYDRAULIC BLOWER DOES NOT SPIN WHEN TURNED ON.      2

#  CHECK                                     PROBABLE FAULT IF:
#                                            YES       NO

#  1. AUX HYDRAULIC PRESS(25ØØ PSI)          -         -
#     - IF LESS: TROOP ALARM RINGS           CIRCUIT   AUX DC PWR
#                                            BREAKER

#  ++++++++++++++++++++++++ WARNING ++++++++++++++++++++++++
#     A HOT HYDRAULIC HOSE CAN CAUSE SERIOUS BURNS
#  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++

#  2. HYDRAULIC SURGE                        -        SOLENOID
#                                                     CONT VLV

#  3. MOTOR QUIET                            -        SPLINE SHAFT

#  ++++++++++++++++++++++++ WARNING ++++++++++++++++++++++++
#         MAKE CERTAIN HYDRAULIC POWER IS OFF
#  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++

#  4. BLOWER TURNS BY HAND                   MOTOR    BLOWER




#  ( ) FOR FOLLOW-ON DATA:[LIST OPTIONS].
```

Figure 8-8. Track 1 troubleshooting--example of troubleshooting data chart frame.

A feature of the logic checklist not found in the more detailed logic trees is pre-identification of faults resulting from the associated symptom. While this characteristic is somewhat similar to the symptom-cause tables in some conventional TOs and the troubleshooting data charts described in MIL-M-38800A, the sequencing of symptom checks according to the logic tree places this format in the LTTA family.

8.6 FAULT CODE REPORTING

VAMIS formats do not, at present, incorporate the use of fault code reporting as provided by specification MIL-M-83495. These fault codes are based partly on the numerical MIDAS code (see paragraph 3.8.3) to localize and report a fault. The fault code (e.g., "2920/A1B1Z") can then be used to identify the point of entry into a checkout procedure or logic tree for further fault isolation. The greatest advantage to fault code reporting such as this is when troubleshooting is partially accomplished by one organization but must be completed by a different organization. Since the fault code effectively identifies the point at which fault identification ended (in the first organization) it can be used as an index of where to start (in the second organization), eliminating the need to repeat the same troubleshooting steps. When this method of fault reporting is to be used, provisions should be made for inclusion of fault codes in the data for each organizational level affected. This may entail incorporating the appropriate fault code at the end of checkout steps and providing fault code index tables as a means of entering a checkout procedure or selecting an appropriate logic tree.

SECTION 9.0
INSTRUCTIONS FOR USING VAMIS

9.1 INTRODUCTION

A VAMIS-type system, like any other system or major equipment item in the USAF inventory, will require instructions for operation and maintenance. Presumably such instructions will be formalized as an Air Force TO, probably in the General Technical Order category, and be subject to all applicable TO requirements. VAMIS instructions and procedures will, however, be unique in several respects:

- The system that is the subject of the instructions will also be the means by which operating procedures and related information are presented to the user.
- The system could, ironically, be one of the few equipment systems for which maintenance instructions will be required both as paper-based TOs and automated procedures. Unless redundant systems are available in the applicable maintenance area, paper-based procedures will be needed for power-off maintenance and for fault isolation and repair when VAMIS is malfunctioning.

The materials in this section deal only with the consolidated operating procedures and guidance for the baseline system. Explanation of the use of frame prompts, feedback, and advisory messages is provided in Section 3.0 and will be incorporated, as appropriate, in the user instructions. VAMIS maintenance, fault isolation, and repair procedures are dependent on equipment configuration and characteristics that are beyond the scope of this project.

9.2 USER ORIENTATION

Instructions for use of the system, i.e., the users' guide, must satisfy the needs of a variety of user types. On the one hand, it must enable an individual with no prior knowledge of or experience with this or any similar system to become sufficiently familiar with its capabilities and characteristics to be able to use it in lieu of a paper-based TO for the performance of maintenance on other equipment. At the other extreme, the users' guide must provide assistance with specific problems and answers to specific questions, which even the most experienced user may have, without going through extensive search routines.

Since familiarity with VAMIS will, at least initially, be independent of skill levels of the using technicians, user guide information should be prepared for the worst case. Operating procedures and explanations should be prepared at a level of detail equivalent to Track 3. Maintenance procedures for the system, when prepared, should be at all three levels of detail, following the same criteria as for other TO maintenance procedures to be presented via VAMIS.

9.3 ACCESSING THE USERS' GUIDE

The need for access to the users' guide may, as is discussed in Section 4.0, be one of the first requirements when a potential user wants to sign-on the system. The system title frame, which was depicted in Figure 4-2, provides a means for any user (and especially "unauthorized" users) to obtain the users' guide. In addition, although not shown in the access paths illustrated in Figure 4-1, if the users' guide becomes a Technical Order in its own right, it would be listed in the master TOC, or list of TOs.

and could be accessed from that listing (see Figure 4-3). The third method of accessing the users' guide, and the one which is most important to qualified users, is from any options list in any of the TOs that are part of the data base. An example of an options list, with the users' guide as one of the available options, was presented in Figure 4-9.

Figure 9-1 illustrates the relationship between the contents of the users' guide for VAMIS and the other materials in the data base. Note that the system title frame and the master TOC are part of the users' guide, since they provide user guidance for accessing the system and its contents. Accordingly, these frames carry "AA" frame codes. Options lists that are related to specific system TOs, on the other hand, are not part of the users' guide even though they provide guidance to the user. The system title frame and the master TOC are the only users' guide frames that the individual technician will see on a routine basis.

9.4 USERS' GUIDE CONTENTS

As with most other TOs in the VAMIS data base, the users' guide will contain both procedural and non-procedural information. However, since the users' guide forms a part of the pool data for other TOs in the data base, all materials in the guide should be considered as pool. This will allow the RETURN key on the control unit to have a consistent function.

The users' guide will comprise a variety of front matter, procedural instructions, and reference materials. How much of these materials are presented to a particular user, and in what sequence, will be partly dependent on the reason for accessing the guide. The experienced user should be able to obtain needed

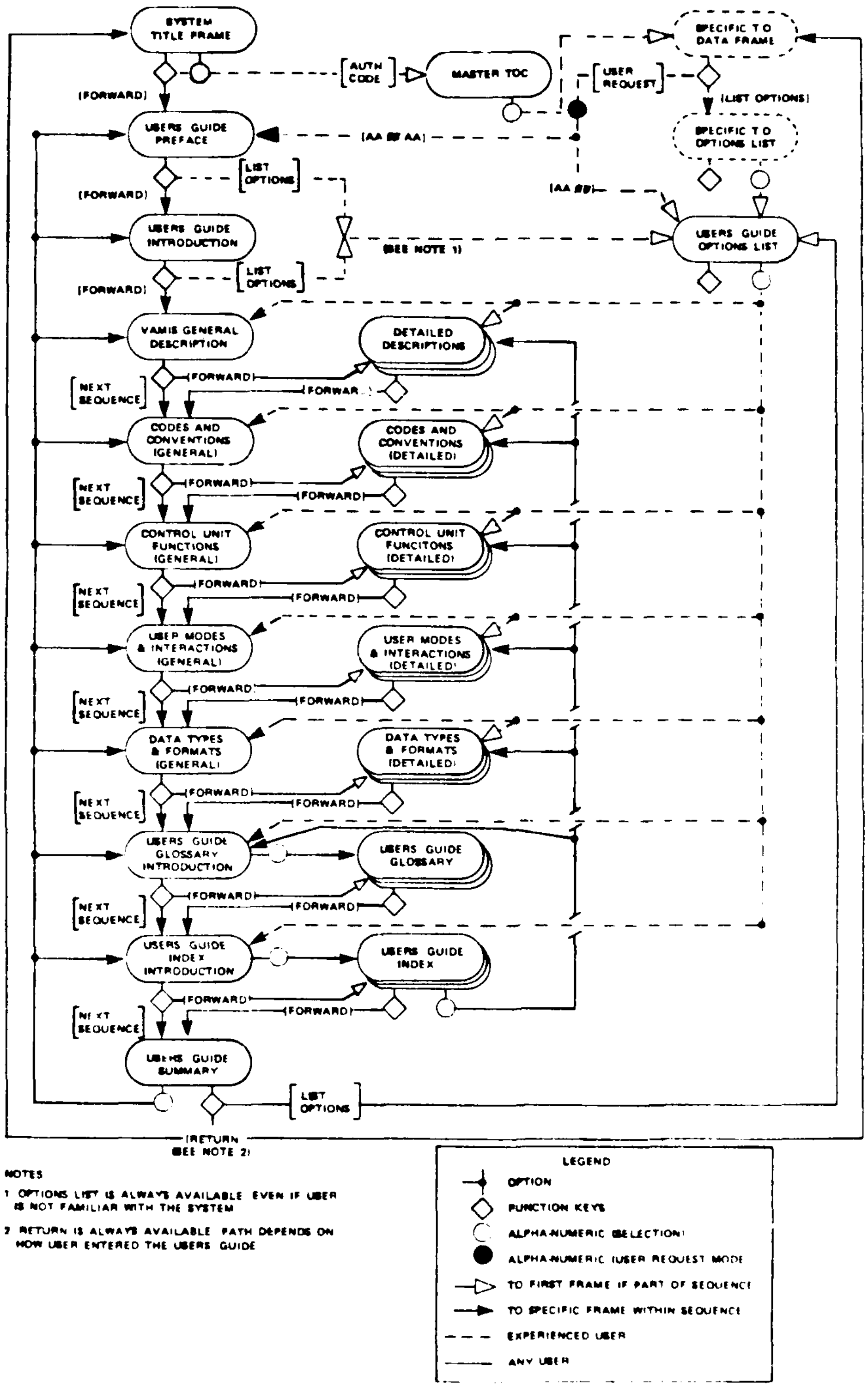
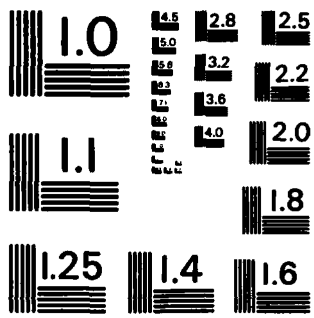


Figure 9-1. VAMIS users' guide access and return paths.

AD-A162 711 MAINTENANCE TECHNICAL MANUALS: FORMAT DESCRIPTIONS AND GUIDELINES FOR AUT..(U) BIOTECHNOLOGY INC FALLS CHURCH VA R G HATTERICK DEC 85 AFHRL-TP-85-46 4/4

UNCLASSIFIED F33615-82-C-0006 F/G 1/3 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

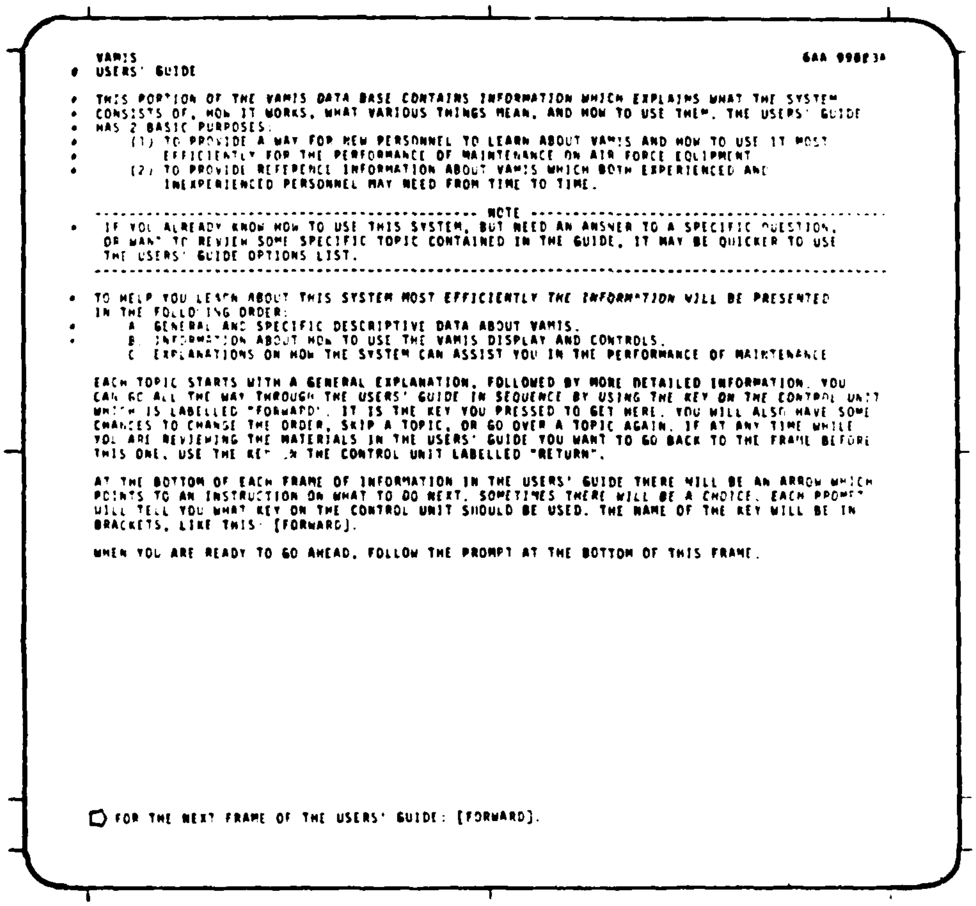
information by the most direct route feasible and then return directly to the origin of the request. The new, or inexperienced user, should first be presented with the data which are deemed most important to the learning process, and gradually work up to a complete understanding of the system. Figure 9-1 illustrates the basic interfaces of these two user types with respect to the data in the users' guide. Note that experienced users have access to the same data whether they enter the users' guide via an options list or from the system title frame. In addition, if desired, the experienced user can follow the same paths as are planned for an inexperienced user.

The types of information included in the users' guide are identified in Figure 9-1. Users who follow the "hardwired" sequence (by using the FORWARD key) will be introduced to each topic at a general level, and then be presented with details of that topic, before going on to the next topic. Users who are somewhat knowledgeable of the system, or who are not interested in details of all topics, can move sequentially from topic to topic by using the NEXT SEQUENCE key. Details for specific topics can then be reviewed with the FORWARD key. Experienced users who want specific information will normally access that information from the users' guide options list or index.

It should be noted that even though many users who have accessed the users' guide via the system title frame will have little or no knowledge of how to interact with it, no special restrictions are placed on control unit function availability <u>within</u> the users' guide. Prompting and more detailed instructions will be depended upon to lead the technician smoothly through the materials, and system design will prevent him/her from getting totally lost or getting outside the users' guide into some other part of the data base.

9.5 INTRODUCTORY MATERIALS

The initial frames of the users' guide are intended primarily for users who are new to VAMIS, having accessed the users' guide from the system title frame. The users' guide preface, an example of which is illustrated in Figure 9-2, lets the user know what part of the data base has been accessed, and what its purpose is. In addition, basic guidance about how to interact with the system controls and display is presented to reduce the likelihood of inexperienced users getting lost. The preface also reminds more experienced users that they can follow a more flexible path to obtain specific data if they prefer.



VAMIS 6AA 998E3A
USERS' GUIDE

THIS PORTION OF THE VAMIS DATA BASE CONTAINS INFORMATION WHICH EXPLAINS WHAT THE SYSTEM CONSISTS OF, HOW IT WORKS, WHAT VARIOUS THINGS MEAN, AND HOW TO USE THEM. THE USERS' GUIDE HAS 2 BASIC PURPOSES:

(1) TO PROVIDE A WAY FOR NEW PERSONNEL TO LEARN ABOUT VAMIS AND HOW TO USE IT MOST EFFICIENTLY FOR THE PERFORMANCE OF MAINTENANCE ON AIR FORCE EQUIPMENT

(2) TO PROVIDE REFERENCE INFORMATION ABOUT VAMIS WHICH BOTH EXPERIENCED AND INEXPERIENCED PERSONNEL MAY NEED FROM TIME TO TIME.

---------- NOTE ----------

IF YOU ALREADY KNOW HOW TO USE THIS SYSTEM, BUT NEED AN ANSWER TO A SPECIFIC QUESTION, OR WANT TO REVIEW SOME SPECIFIC TOPIC CONTAINED IN THE GUIDE, IT MAY BE QUICKER TO USE THE USERS' GUIDE OPTIONS LIST.

TO HELP YOU LEARN ABOUT THIS SYSTEM MOST EFFICIENTLY THE INFORMATION WILL BE PRESENTED IN THE FOLLOWING ORDER:

A GENERAL AND SPECIFIC DESCRIPTIVE DATA ABOUT VAMIS.
B. INFORMATION ABOUT HOW TO USE THE VAMIS DISPLAY AND CONTROLS.
C EXPLANATIONS ON HOW THE SYSTEM CAN ASSIST YOU IN THE PERFORMANCE OF MAINTENANCE

EACH TOPIC STARTS WITH A GENERAL EXPLANATION, FOLLOWED BY MORE DETAILED INFORMATION. YOU CAN GO ALL THE WAY THROUGH THE USERS' GUIDE IN SEQUENCE BY USING THE KEY ON THE CONTROL UNIT WHICH IS LABELLED "FORWARD". IT IS THE KEY YOU PRESSED TO GET HERE. YOU WILL ALSO HAVE SOME CHANCES TO CHANGE THE ORDER, SKIP A TOPIC, OR GO OVER A TOPIC AGAIN. IF AT ANY TIME WHILE YOU ARE REVIEWING THE MATERIALS IN THE USERS' GUIDE YOU WANT TO GO BACK TO THE FRAME BEFORE THIS ONE, USE THE KEY ON THE CONTROL UNIT LABELLED "RETURN".

AT THE BOTTOM OF EACH FRAME OF INFORMATION IN THE USERS' GUIDE THERE WILL BE AN ARROW WHICH POINTS TO AN INSTRUCTION ON WHAT TO DO NEXT. SOMETIMES THERE WILL BE A CHOICE. EACH PROMPT WILL TELL YOU WHAT KEY ON THE CONTROL UNIT SHOULD BE USED. THE NAME OF THE KEY WILL BE IN BRACKETS, LIKE THIS: [FORWARD].

WHEN YOU ARE READY TO GO AHEAD, FOLLOW THE PROMPT AT THE BOTTOM OF THIS FRAME.

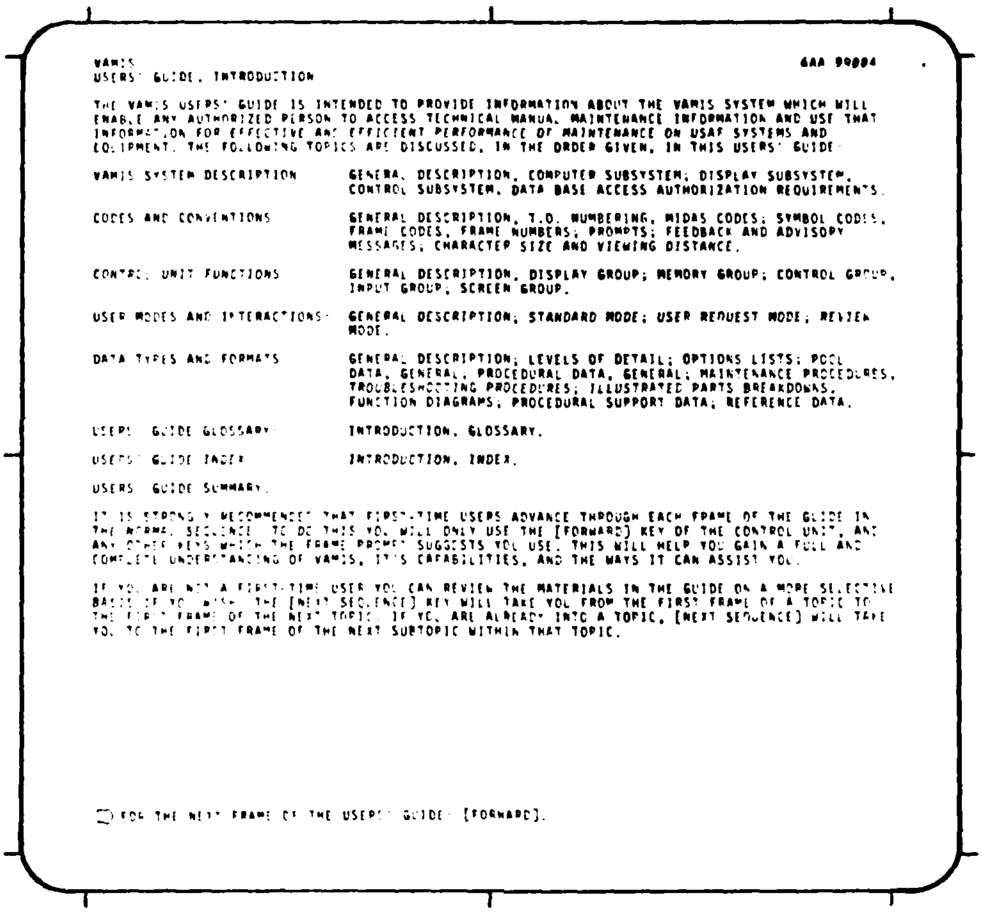
FOR THE NEXT FRAME OF THE USERS' GUIDE: [FORWARD].

Figure 9-2. Example of VAMIS users' guide preface frame.

The next frame of the users' guide, in the normal sequence, is the introduction, an example of which is presented in Figure 9-3. The introduction has two purposes:

1. Provide an overview of the contents of the users' guide so that users can anticipate the materials to be presented.

2. Provide guidance to new users on how best to utilize the users' guide for becoming acquainted with the system.



VAMIS — 6AA 99004

USERS' GUIDE, INTRODUCTION

THE VAMIS USERS' GUIDE IS INTENDED TO PROVIDE INFORMATION ABOUT THE VAMIS SYSTEM WHICH WILL ENABLE ANY AUTHORIZED PERSON TO ACCESS TECHNICAL MANUAL MAINTENANCE INFORMATION AND USE THAT INFORMATION FOR EFFECTIVE AND EFFICIENT PERFORMANCE OF MAINTENANCE ON USAF SYSTEMS AND EQUIPMENT. THE FOLLOWING TOPICS ARE DISCUSSED, IN THE ORDER GIVEN, IN THIS USERS' GUIDE:

VAMIS SYSTEM DESCRIPTION	GENERAL DESCRIPTION, COMPUTER SUBSYSTEM; DISPLAY SUBSYSTEM, CONTROL SUBSYSTEM, DATA BASE ACCESS AUTHORIZATION REQUIREMENTS.
CODES AND CONVENTIONS	GENERAL DESCRIPTION, T.O. NUMBERING, MIDAS CODES; SYMBOL CODES, FRAME CODES, FRAME NUMBERS; PROMPTS; FEEDBACK AND ADVISORY MESSAGES; CHARACTER SIZE AND VIEWING DISTANCE.
CONTROL UNIT FUNCTIONS	GENERAL DESCRIPTION; DISPLAY GROUP; MEMORY GROUP; CONTROL GROUP, INPUT GROUP; SCREEN GROUP.
USER MODES AND INTERACTIONS:	GENERAL DESCRIPTION; STANDARD MODE; USER REQUEST MODE; REVIEW MODE.
DATA TYPES AND FORMATS	GENERAL DESCRIPTION; LEVELS OF DETAIL; OPTIONS LISTS; POOL DATA, GENERAL; PROCEDURAL DATA, GENERAL; MAINTENANCE PROCEDURES, TROUBLESHOOTING PROCEDURES; ILLUSTRATED PARTS BREAKDOWNS, FUNCTION DIAGRAMS; PROCEDURAL SUPPORT DATA; REFERENCE DATA.
USERS' GUIDE GLOSSARY:	INTRODUCTION, GLOSSARY.
USERS' GUIDE INDEX	INTRODUCTION, INDEX.
USERS' GUIDE SUMMARY.	

IT IS STRONGLY RECOMMENDED THAT FIRST-TIME USERS ADVANCE THROUGH EACH FRAME OF THE GUIDE IN THE NORMAL SEQUENCE. TO DO THIS YOU WILL ONLY USE THE [FORWARD] KEY OF THE CONTROL UNIT, AND ANY OTHER KEYS WHICH THE FRAME PROMPT SUGGESTS YOU USE. THIS WILL HELP YOU GAIN A FULL AND COMPLETE UNDERSTANDING OF VAMIS, IT'S CAPABILITIES, AND THE WAYS IT CAN ASSIST YOU.

IF YOU ARE NOT A FIRST-TIME USER YOU CAN REVIEW THE MATERIALS IN THE GUIDE ON A MORE SELECTIVE BASIS IF YOU WISH. THE [NEXT SEQUENCE] KEY WILL TAKE YOU FROM THE FIRST FRAME OF A TOPIC TO THE FIRST FRAME OF THE NEXT TOPIC. IF YOU ARE ALREADY INTO A TOPIC, [NEXT SEQUENCE] WILL TAKE YOU TO THE FIRST FRAME OF THE NEXT SUBTOPIC WITHIN THAT TOPIC.

FOR THE NEXT FRAME OF THE USERS' GUIDE: [FORWARD].

Figure 9-3. Example of VAMIS users' guide introduction frame.

The content description is not unlike the users' guide options list, to be discussed later, or a typical table of contents. The principal difference is that no provisions are made for selecting a topic or subtopic, bypassing information which should be presented first. As mentioned above, and discussed in more detail in paragraph 9.7.2, the users' guide options list is available for that purpose for users who are knowledgeable enough to make use of it.

9.6 USERS' GUIDE DESCRIPTIVE DATA

The desc: ıptive data in the users' guide encompass:

- The system configuration and concept
- Codes and conventions
- Control unit functions
- User modes and interactions
- Data types and formats in the data base.

Each topic is presented at two levels, and begins with a frame which discusses the subject in general and identifies the principal subtopics. The general discussion should be complete in one frame, but is supported by additional frames of detailed descriptions, to the level needed to enable the user to gain a full understanding of that aspect of the system as it might pertain to his or her job. The prompt on each "general" frame will inform the user of his/her choices--to explore the subject in greater detail (by pressing FORWARD) or to go on to the next topic (by pressing NEXT SEQUENCE). If the individual elects the detailed discussion, progress through that part of the users' guide is primarily with the FORWARD key. At the last frame of the detailed discussion of each topic, the user is prompted that the sequence can be reviewed again (with REPEAT SEQUENCE) or the next topic can be obtained (with FORWARD). In some topics, because of their scope, the nodes which cue the prompts for REPEAT SEQUENCE are at the subtopic level (e.g., control unit functions).

In order to eliminate cross-referencing between topics and subtopics, and at the same time implement both the bilevel presentation of data and the sequential order of topic presentation, the users' guide will incorporate a fair amount of redundancy. For example, VAMIS detailed description frames covering the control unit may include some of the same information as is included in the control unit functions general frame.

9.6.1 VAMIS Descriptions

Figure 9-4 presents an example of a general description frame, with VAMIS as the baseline system of reference. At this level, the system is described only in general terms, stating what the system does, the major equipment items that comprise it, and generally how they interact. The remainder of the frame is used to prompt the user on what his/her primary action choices consist of and what should be done to obtain the available information.

Figure 9-5 illustrates an example of a frame of detailed description of the system comprising the hardwired sequences, which would be accessed from the general description frame by using the FORWARD key. Further use of the FORWARD key will continue the presentation of detailed description data or, if it is the last frame, will go on to the next topic. The user is also reminded that since this is the last frame of the subtopic, it can be reviewed by pressing REPEAT SEQUENCE.

VAMIS
USERS' GUIDE: SYSTEM GENERAL DESCRIPTION

6AA 99411
1

THE VERSATILE AUTOMATED MAINTENANCE INFORMATION SYSTEM (VAMIS) IS A COMPUTER-BASED SYSTEM FOR THE PREPARATION, STORAGE, AND PRESENTATION OF AIR FORCE TECHNICAL ORDERS FOR THE CONDUCT OF MAINTENANCE ON AIR FORCE SYSTEMS AND EQUIPMENT. THE SYSTEM HAS THREE PRIMARY SUBSYSTEMS:

- COMPUTER SUBSYSTEM
- DISPLAY SUBSYSTEM
- CONTROL SUBSYSTEM

THE COMPUTER SUBSYSTEM FOR VAMIS IS A DIGITAL EQUIPMENT CORPORATION VAX COMPUTER WITH ALL ASSOCIATED SOFTWARE AND FIRMWARE. THE COMPUTER SUBSYSTEM IS USED FOR THE PREPARATION, STORAGE AND MANAGEMENT OF ALL DATA IN THE VAMIS DATA BASE.

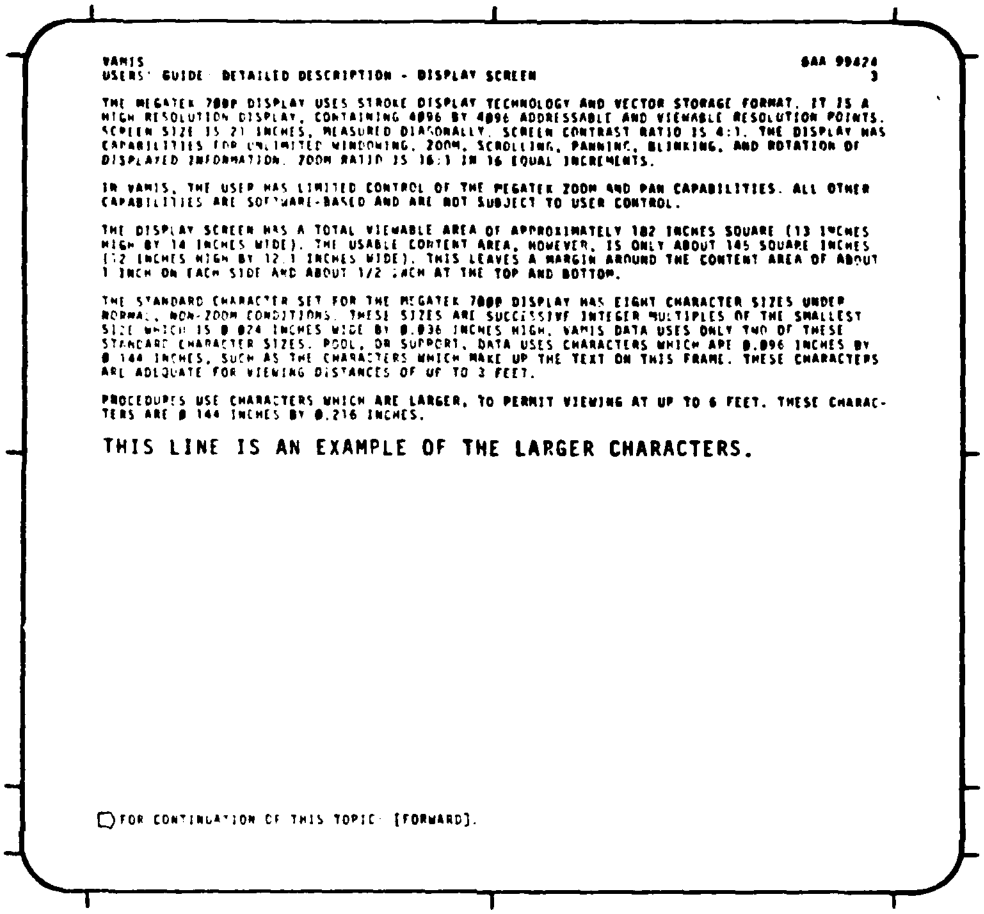
THE DISPLAY SUBSYSTEM FOR VAMIS IS A MEGATEK 7000 VIDEO DISPLAY TERMINAL. IT IS AN ACHROMATIC DISPLAY WITH HIGH RESOLUTION CAPABILITIES AND IS USED FOR BOTH PREPARATION AND PRESENTATION OF MAINTENANCE INFORMATION.

THE VAMIS CONTROL SUBSYSTEM CONSISTS OF A SPECIALLY-DESIGNED CONTROL UNIT AND A STANDARD MEGATEK 7000 VDT KEYBOARD. THE CONTROL UNIT IS SEMI-PORTABLE AND IS INTENDED FOR USE AS THE PRIMARY INTERFACE BETWEEN THE TECHNICIAN AND THE VAMIS DATA BASE, TO CONTROL THE PRESENTATION OF MAINTENANCE DATA. THE VDT KEYBOARD IS USED FOR PREPARATION OF INFORMATION TO BE INCLUDED IN THE DATA BASE, AS WELL AS FOR SUPERVISORY MANAGEMENT AND CONTROL OF THE SYSTEM.

DETAILED DESCRIPTIONS OF EACH SUBSYSTEM ARE PRESENTED IN THE FOLLOWING FRAMES OF THIS TOPIC.

FOR CONTINUATION OF THIS TOPIC: [FORWARD].

Figure 9-4. Example of VAMIS users' guide general description frame.



VAMIS
USERS' GUIDE DETAILED DESCRIPTION - DISPLAY SCREEN

0AA 99424
3

THE MEGATEK 7000 DISPLAY USES STROKE DISPLAY TECHNOLOGY AND VECTOR STORAGE FORMAT. IT IS A HIGH RESOLUTION DISPLAY, CONTAINING 4096 BY 4096 ADDRESSABLE AND VIEWABLE RESOLUTION POINTS. SCREEN SIZE IS 21 INCHES, MEASURED DIAGONALLY. SCREEN CONTRAST RATIO IS 4:1. THE DISPLAY HAS CAPABILITIES FOR UNLIMITED WINDOWING, ZOOM, SCROLLING, PANNING, BLINKING, AND ROTATION OF DISPLAYED INFORMATION. ZOOM RATIO IS 16:1 IN 16 EQUAL INCREMENTS.

IN VAMIS, THE USER HAS LIMITED CONTROL OF THE MEGATEK ZOOM AND PAN CAPABILITIES. ALL OTHER CAPABILITIES ARE SOFTWARE-BASED AND ARE NOT SUBJECT TO USER CONTROL.

THE DISPLAY SCREEN HAS A TOTAL VIEWABLE AREA OF APPROXIMATELY 182 INCHES SQUARE (13 INCHES HIGH BY 14 INCHES WIDE). THE USABLE CONTENT AREA, HOWEVER, IS ONLY ABOUT 145 SQUARE INCHES (12 INCHES HIGH BY 12.1 INCHES WIDE). THIS LEAVES A MARGIN AROUND THE CONTENT AREA OF ABOUT 1 INCH ON EACH SIDE AND ABOUT 1/2 INCH AT THE TOP AND BOTTOM.

THE STANDARD CHARACTER SET FOR THE MEGATEK 7000 DISPLAY HAS EIGHT CHARACTER SIZES UNDER NORMAL, NON-ZOOM CONDITIONS. THESE SIZES ARE SUCCESSIVE INTEGER MULTIPLES OF THE SMALLEST SIZE WHICH IS 0.024 INCHES WIDE BY 0.036 INCHES HIGH. VAMIS DATA USES ONLY TWO OF THESE STANDARD CHARACTER SIZES. POOL, OR SUPPORT, DATA USES CHARACTERS WHICH ARE 0.096 INCHES BY 0.144 INCHES, SUCH AS THE CHARACTERS WHICH MAKE UP THE TEXT ON THIS FRAME. THESE CHARACTERS ARE ADEQUATE FOR VIEWING DISTANCES OF UP TO 3 FEET.

PROCEDURES USE CHARACTERS WHICH ARE LARGER, TO PERMIT VIEWING AT UP TO 6 FEET. THESE CHARACTERS ARE 0.144 INCHES BY 0.216 INCHES.

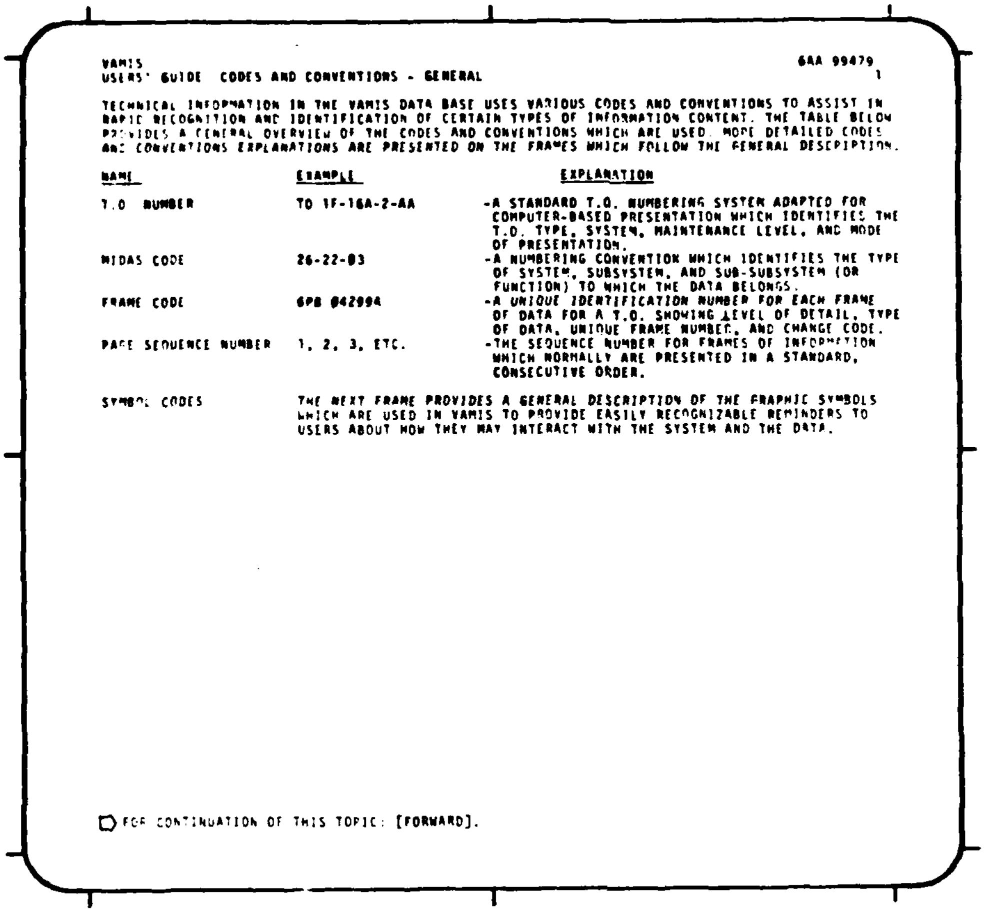
THIS LINE IS AN EXAMPLE OF THE LARGER CHARACTERS.

FOR CONTINUATION OF THIS TOPIC: [FORWARD].

Figure 9-5. Example of VAMIS users' guide detailed description frame.

9.6.2 VAMIS Codes and Conventions

In order for VAMIS users to begin to understand how to interact with the system, it is necessary for them to become familiar with the codes and conventions that are used on data frames and in prompts. With this information, the subsequent information in the users' guide will be easier to present and easier to use. An example of the general codes and conventions frame is shown in Figure 9-6, comprising an identification of the various codes, symbols, and other graphic and text conventions that are used.



VAMIS
USERS' GUIDE CODES AND CONVENTIONS - GENERAL

GAA 99479
1

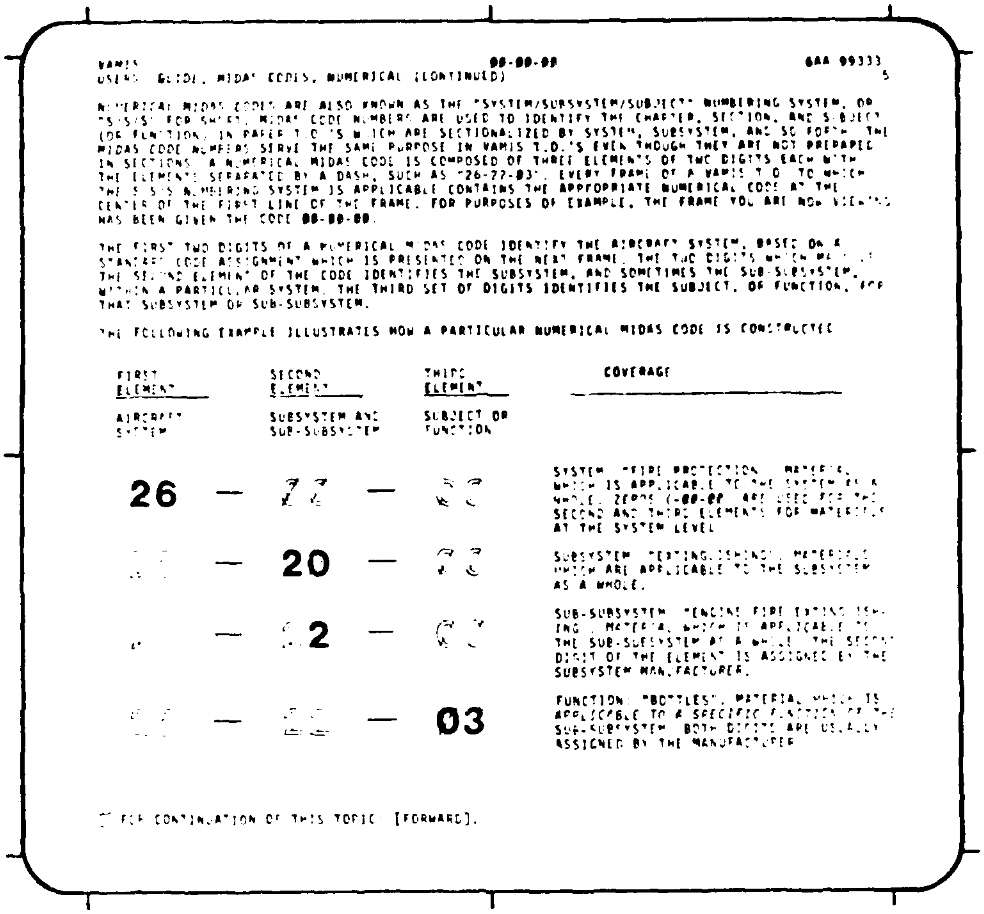
TECHNICAL INFORMATION IN THE VAMIS DATA BASE USES VARIOUS CODES AND CONVENTIONS TO ASSIST IN RAPID RECOGNITION AND IDENTIFICATION OF CERTAIN TYPES OF INFORMATION CONTENT. THE TABLE BELOW PROVIDES A GENERAL OVERVIEW OF THE CODES AND CONVENTIONS WHICH ARE USED. MORE DETAILED CODES AND CONVENTIONS EXPLANATIONS ARE PRESENTED ON THE FRAMES WHICH FOLLOW THE GENERAL DESCRIPTION.

NAME	EXAMPLE	EXPLANATION
T.O NUMBER	TO 1F-16A-2-AA	-A STANDARD T.O. NUMBERING SYSTEM ADAPTED FOR COMPUTER-BASED PRESENTATION WHICH IDENTIFIES THE T.O. TYPE, SYSTEM, MAINTENANCE LEVEL, AND MODE OF PRESENTATION.
MIDAS CODE	26-22-03	-A NUMBERING CONVENTION WHICH IDENTIFIES THE TYPE OF SYSTEM, SUBSYSTEM, AND SUB-SUBSYSTEM (OR FUNCTION) TO WHICH THE DATA BELONGS.
FRAME CODE	GPB 042994	-A *UNIQUE IDENTIFICATION* NUMBER FOR EACH FRAME OF DATA FOR A T.O. SHOWING LEVEL OF DETAIL, TYPE OF DATA, UNIQUE FRAME NUMBER, AND CHANGE CODE.
PAGE SEQUENCE NUMBER	1, 2, 3, ETC.	-THE SEQUENCE NUMBER FOR FRAMES OF INFORMATION WHICH NORMALLY ARE PRESENTED IN A STANDARD, CONSECUTIVE ORDER.
SYMBOL CODES	THE NEXT FRAME PROVIDES A GENERAL DESCRIPTION OF THE GRAPHIC SYMBOLS WHICH ARE USED IN VAMIS TO PROVIDE EASILY RECOGNIZABLE REMINDERS TO USERS ABOUT HOW THEY MAY INTERACT WITH THE SYSTEM AND THE DATA.	

FOR CONTINUATION OF THIS TOPIC: [FORWARD].

Figure 9-6. Example of VAMIS users' guide general codes and conventions frame.

Detailed descriptions of codes and conventions should normally be limited to one per frame unless, as shown in the example in Figure 9-7, the subject deals with variations or multiple uses of a single code or convention. Some subjects, such as an explanation of the MIDAS codes and their use in the system, may require more than one frame.



VAMIS 00-00-00 6AA 99333
USERS' GUIDE, MIDAS CODES, NUMERICAL (CONTINUED) 5

NUMERICAL MIDAS CODES ARE ALSO KNOWN AS THE "SYSTEM/SUBSYSTEM/SUBJECT" NUMBERING SYSTEM, OR "S/S/S" FOR SHORT. MIDAS CODE NUMBERS ARE USED TO IDENTIFY THE CHAPTER, SECTION, AND SUBJECT (OR FUNCTION) IN PAPER T.O.'S WHICH ARE SECTIONALIZED BY SYSTEM, SUBSYSTEM, AND SO FORTH. THE MIDAS CODE NUMBERS SERVE THE SAME PURPOSE IN VAMIS T.O.'S EVEN THOUGH THEY ARE NOT PREPARED IN SECTIONS. A NUMERICAL MIDAS CODE IS COMPOSED OF THREE ELEMENTS OF TWO DIGITS EACH WITH THE ELEMENTS SEPARATED BY A DASH, SUCH AS "26-22-03". EVERY FRAME OF A VAMIS T.O. TO WHICH THE S/S/S NUMBERING SYSTEM IS APPLICABLE CONTAINS THE APPROPRIATE NUMERICAL CODE AT THE CENTER OF THE FIRST LINE OF THE FRAME. FOR PURPOSES OF EXAMPLE, THE FRAME YOU ARE NOW VIEWING HAS BEEN GIVEN THE CODE 00-00-00.

THE FIRST TWO DIGITS OF A NUMERICAL MIDAS CODE IDENTIFY THE AIRCRAFT SYSTEM, BASED ON A STANDARD CODE ASSIGNMENT WHICH IS PRESENTED ON THE NEXT FRAME. THE TWO DIGITS WHICH MAKE UP THE SECOND ELEMENT OF THE CODE IDENTIFIES THE SUBSYSTEM, AND SOMETIMES THE SUB-SUBSYSTEM, WITHIN A PARTICULAR SYSTEM. THE THIRD SET OF DIGITS IDENTIFIES THE SUBJECT, OR FUNCTION, FOR THAT SUBSYSTEM OR SUB-SUBSYSTEM.

THE FOLLOWING EXAMPLE ILLUSTRATES HOW A PARTICULAR NUMERICAL MIDAS CODE IS CONSTRUCTED

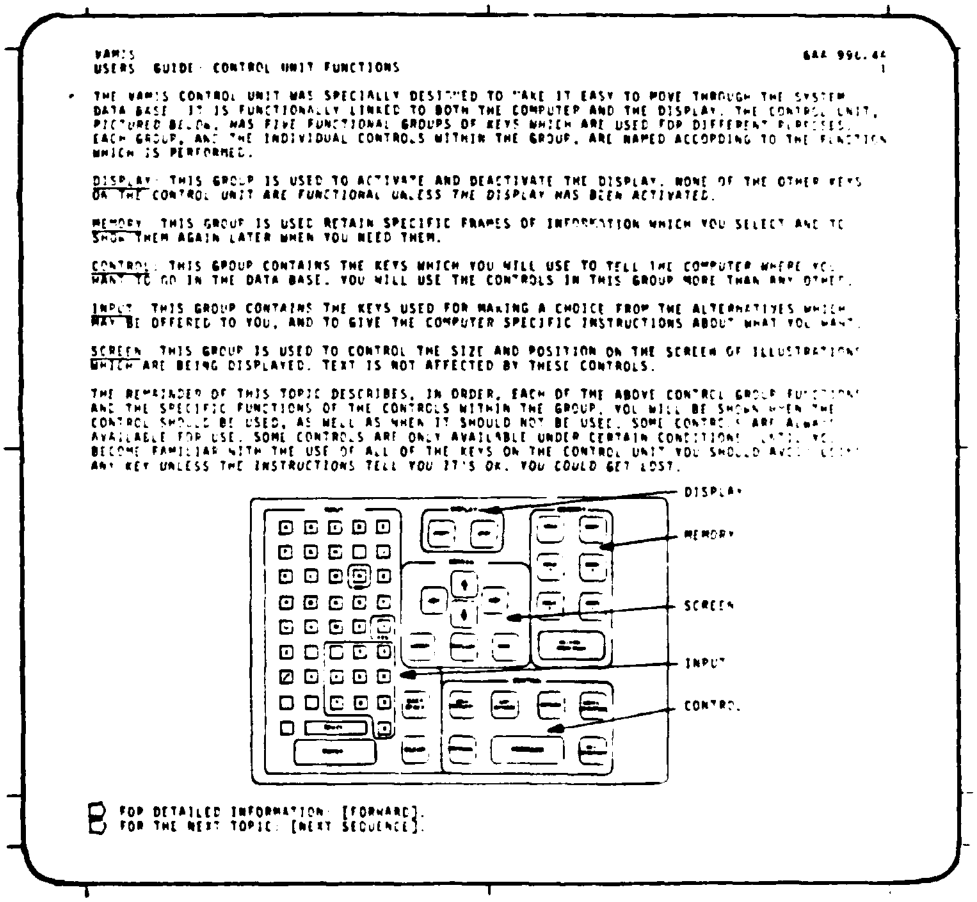
FIRST ELEMENT		SECOND ELEMENT		THIRD ELEMENT	COVERAGE
AIRCRAFT SYSTEM		SUBSYSTEM AND SUB-SUBSYSTEM		SUBJECT OR FUNCTION	
26	—	00	—	00	SYSTEM: "FIRE PROTECTION", MATERIAL WHICH IS APPLICABLE TO THE SYSTEM AS A WHOLE. ZEROS (-00-00) ARE USED FOR THE SECOND AND THIRD ELEMENTS FOR MATERIALS AT THE SYSTEM LEVEL
26	—	**20**	—	00	SUBSYSTEM: "EXTINGUISHING", MATERIALS WHICH ARE APPLICABLE TO THE SUBSYSTEM AS A WHOLE.
26	—	2**2**	—	00	SUB-SUBSYSTEM: "ENGINE FIRE EXTINGUISHING", MATERIAL WHICH IS APPLICABLE TO THE SUB-SUBSYSTEM AS A WHOLE. THE SECOND DIGIT OF THE ELEMENT IS ASSIGNED BY THE SUBSYSTEM MANUFACTURER.
26	—	22	—	**03**	FUNCTION: "BOTTLES", MATERIAL WHICH IS APPLICABLE TO A SPECIFIC FUNCTION OF THE SUB-SUBSYSTEM. BOTH DIGITS ARE USUALLY ASSIGNED BY THE MANUFACTURER

FOR CONTINUATION OF THIS TOPIC: [FORWARD].

Figure 9-7. Example of VAMIS users' guide detailed codes and conventions frame.

9.6.3 VAMIS Control Unit Functions

This topic in the users' guide is probably the most important to the user as far as knowing how to interface with the system is concerned. With the knowledge of what to expect from each key on the control unit under different conditions, and the preceding codes and conventions data, the technician can interact effectively (if not proficiently) with the system. Figure 9-8 provides an example of the general control unit functions explanation; Figure 9-9 shows an example of a detailed control unit functions description frame.



VAMIS
USERS GUIDE: CONTROL UNIT FUNCTIONS — 6AA 996.44 — 1

THE VAMIS CONTROL UNIT WAS SPECIALLY DESIGNED TO MAKE IT EASY TO MOVE THROUGH THE SYSTEM DATA BASE. IT IS FUNCTIONALLY LINKED TO BOTH THE COMPUTER AND THE DISPLAY. THE CONTROL UNIT, PICTURED BELOW, HAS FIVE FUNCTIONAL GROUPS OF KEYS WHICH ARE USED FOR DIFFERENT PURPOSES. EACH GROUP, AND THE INDIVIDUAL CONTROLS WITHIN THE GROUP, ARE NAMED ACCORDING TO THE FUNCTION WHICH IS PERFORMED.

DISPLAY: THIS GROUP IS USED TO ACTIVATE AND DEACTIVATE THE DISPLAY. NONE OF THE OTHER KEYS ON THE CONTROL UNIT ARE FUNCTIONAL UNLESS THE DISPLAY HAS BEEN ACTIVATED.

MEMORY: THIS GROUP IS USED RETAIN SPECIFIC FRAMES OF INFORMATION WHICH YOU SELECT AND TO SHOW THEM AGAIN LATER WHEN YOU NEED THEM.

CONTROL: THIS GROUP CONTAINS THE KEYS WHICH YOU WILL USE TO TELL THE COMPUTER WHERE YOU WANT TO GO IN THE DATA BASE. YOU WILL USE THE CONTROLS IN THIS GROUP MORE THAN ANY OTHER.

INPUT: THIS GROUP CONTAINS THE KEYS USED FOR MAKING A CHOICE FROM THE ALTERNATIVES WHICH MAY BE OFFERED TO YOU, AND TO GIVE THE COMPUTER SPECIFIC INSTRUCTIONS ABOUT WHAT YOU WANT.

SCREEN: THIS GROUP IS USED TO CONTROL THE SIZE AND POSITION ON THE SCREEN OF ILLUSTRATIONS WHICH ARE BEING DISPLAYED. TEXT IS NOT AFFECTED BY THESE CONTROLS.

THE REMAINDER OF THIS TOPIC DESCRIBES, IN ORDER, EACH OF THE ABOVE CONTROL GROUP FUNCTIONS AND THE SPECIFIC FUNCTIONS OF THE CONTROLS WITHIN THE GROUP. YOU WILL BE SHOWN WHEN THE CONTROL SHOULD BE USED, AS WELL AS WHEN IT SHOULD NOT BE USED. SOME CONTROLS ARE ALWAYS AVAILABLE FOR USE. SOME CONTROLS ARE ONLY AVAILABLE UNDER CERTAIN CONDITIONS. UNTIL YOU BECOME FAMILIAR WITH THE USE OF ALL OF THE KEYS ON THE CONTROL UNIT YOU SHOULD AVOID USING ANY KEY UNLESS THE INSTRUCTIONS TELL YOU IT'S OK. YOU COULD GET LOST.

FOR DETAILED INFORMATION: [FORWARD].
FOR THE NEXT TOPIC: [NEXT SEQUENCE].

Figure 9-8. Example of VAMIS users' guide general control unit functions frame.

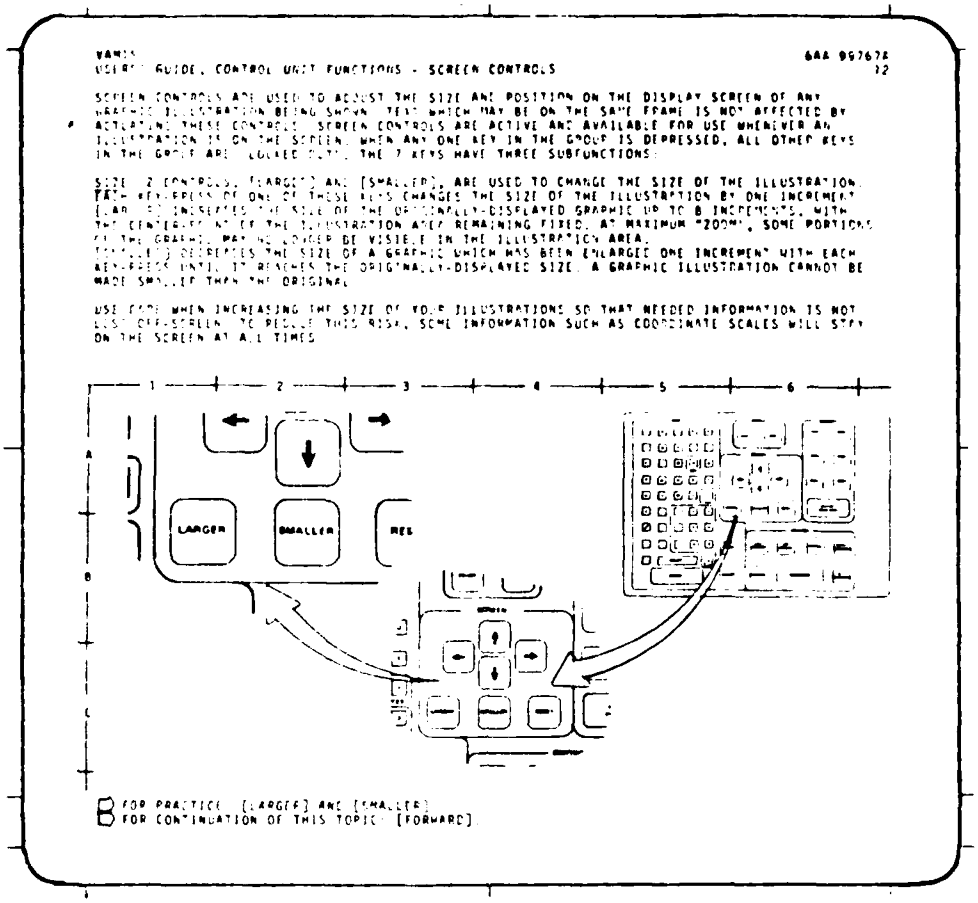


Figure 9-9. Example of VAMIS users' guide detailed control unit functions frame.

When users are reviewing explanations of control unit functions, there is a risk that they will want to try it to see if the control actually does what is described. For some controls this will have no significant effect (e.g., using input group keys while on a non-selection frame; the system will display an error message). For others, the display may change in some respects but should not cause a problem (e.g., the screen controls). However, some controls could, if actuated at the wrong time, especially by an unknowledgeable user, result in the user getting temporarily lost in the users' guide. In order to reduce this possibility, several precautions are needed. The initial detailed control unit functions frame will contain a caution notice advising the user of the potential problems that could result from indiscriminate actuation of the keys. Each individual frame will either inform the user that the control(s) being discussed can or should not be activated (see Figure 9-9), as applicable.

9.6.4 VAMIS User Modes and Interactions

The general frame on this topic will explain, as illustrated in Figure 9-10, the three modes of using the system. This will be followed by more detailed descriptions of each user mode, and the specific capabilities and limitations that exist in each mode. The remainder of this topic will be a series of guided practical exercises covering interactions in each mode of use. For this purpose, a special "closed" data base will be created so that the user can exercise each mode in a variety of ways without risk of getting lost.

To guide the exercises, an instruction frame explains what to do, as shown in the example in Figure 9-11. This example is based on the assumption that the user will already have received instruction on the basic control unit functions and the discussion of the purpose of the user request mode and how to use it. This frame guides the user through each step of the exercise, with feedback on errors.

VAMIS
USERS' GUIDE: USER MODES AND INTERACTIONS - GENERAL   6AA 998[illegible]
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VAMIS HAS THREE MODES OF USE AND INTERACTION WHICH ARE AVAILABLE TO YOU. THE MODES ARE COMPUTER-MANAGED BUT DEPEND ON SPECIFIC KINDS OF USER INPUT TO SUPPLY INFORMATION. YOU MAY CHANGE MODES AT ANY TIME. EACH OF THE THREE MODES (STANDARD; USER REQUEST; REVIEW) HAS SOME ADVANTAGES FOR PARTICULAR SITUATIONS, SO YOU SHOULD BECOME FAMILIAR WITH ALL THREE.

STANDARD MODE: THIS IS THE NORMAL MODE FOR VAMIS INTERACTION. THE SYSTEM WILL ALWAYS BE IN THIS MODE UNLESS YOU REQUEST ONE OF THE OTHER MODES. THE PRIMARY METHOD OF OBTAINING DATA IS FROM TABLES OF CONTENTS AND MENUS. INTERACTIONS WITH THE CONTROL UNIT ARE FAIRLY SIMPLE, AND ALL PORTIONS OF THE CONTROL PANEL ARE USED. CONTROL INPUTS ARE GUIDED BY THE PROMPTS WHICH APPEAR AT THE BOTTOM OF EACH FRAME OF DATA. CHOICES ARE MOST OFTEN TO ADVANCE TO THE NEXT FRAME IN AN ORDERED, LINEAR SEQUENCE, INDICATING A YES OR NO RESPONSE TO QUESTIONS, AND SELECTION OF DATA FROM TABLES OF CONTENTS, MENUS, AND OPTIONS LISTS.

USER REQUEST MODE: THIS FUNCTIONAL MODE IS ACTIVATED WHEN THE "USER REQUEST" KEY ON THE CONTROL UNIT IS PRESSED, FOLLOWING WHICH A SPECIAL PROMPT WILL APPEAR TO GUIDE THE USER IN MAKING A REQUEST. ALL REQUESTS ARE MADE USING THE "INPUT" GROUP OF KEYS ON THE CONTROL UNIT. THIS MODE IS HIGHLY INTERACTIVE AND ALLOWS THE KNOWLEDGEABLE USER TO SHORTCUT THE DATA ACQUISITION PROCESS BY BYPASSING MENUS AND TABLES OF CONTENTS. USERS CAN IDENTIFY THE INFORMATION WHICH IS WANTED AND THE SYSTEM WILL PROVIDE A SPECIFIC FRAME OF DATA WHICH MOST CLOSELY MATCHES THAT REQUEST, IF IT IS IN THE DATA BASE. AS SOON AS THE REQUESTED FRAME IS DISPLAYED, THE SYSTEM AUTOMATICALLY RETURNS TO THE STANDARD MODE. TO USE THIS MODE EFFECTIVELY, YOU MUST BE VERY FAMILIAR WITH VAMIS, THE TECHNICAL INFORMATION IN THE DATA BASE, AND THE ALLOWABLE CODES NEEDED TO MAKE YOUR REQUEST. INEXPERIENCED USERS SHOULD BE VERY CAUTIOUS ABOUT ENTERING THIS MODE OF USE.

REVIEW MODE: THIS MODE PROVIDES A BASIS FOR REVIEW OF THE TECHNICAL DATA BASE FOR PURPOSES OF FAMILIARIZATION OR TRAINING. IT IS NOT TO BE USED FOR PERFORMING MAINTENANCE. THE REVIEW MODE CAN BE SELECTED FROM ANY OPTIONS LIST. THE SYSTEM THEN BECOMES A PAGE TURNER, AND ALL DATA IS PRESENTED IN A PREDETERMINED ORDER. THE "INPUT GROUP" OF KEYS ON THE CONTROL UNIT IS INACTIVE, BUT MOST OTHER KEYS HAVE THEIR NORMAL FUNCTION. EACH FRAME SHOWN IN THIS MODE WILL ALSO NOTE THAT YOU ARE IN THE REVIEW MODE. YOU MAY LEAVE THE REVIEW MODE BY PRESSING "RETURN" OR "USER REQUEST" TO GO TO THE STANDARD OR USER REQUEST MODES, OR BY PRESSING "STOP" TO LOG OFF THE SYSTEM.

FOR DETAILED INFORMATION: [FORWARD].
FOR THE NEXT TOPIC: [NEXT SEQUENCE].

Figure 9-10. Example of VAMIS users' guide general user modes and interactions frame.

VAMIS
USERS' GUIDE: USER REQUEST MODE INTERACTIONS.

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14

EXERCISE NO. 12. OBTAINING DATA FOR A KNOWN PART NUMBER.

IN THIS EXERCISE THE USER REQUEST MODE IS USED TO OBTAIN VARIOUS DATA FOR A SPECIFIC PART, FOR WHICH YOU KNOW THE PART NUMBER. THE INPUT QUALIFIER IS "PN" FOR ALL TRIALS. THE CONTENT IDENTIFIER IS THE KNOWN PART NUMBER. THE OUTPUT QUALIFIER IDENTIFIES THE TYPE OF DATA YOU WANT TO OBTAIN. FOR THESE PRACTICE TRIALS, THE SYSTEM WILL ACCEPT ANY COMBINATION OF THE INPUT QUALIFIER, CONTENT IDENTIFIERS, AND OUTPUT QUALIFIERS SHOWN IN THE FOLLOWING TABLE

INPUT QUAL	CONTENT IDENTIFIER	OUTPUT QUAL	RESULT BASED ON OUTPUT QUALIFIER
PN	MBEU14B6H5	FI	FAULT ISOLATION PROCEDURE
	918856-802	GD	GENERAL DESCRIPTION
		GT	THEORY OF OPERATION
		JG	JOB GUIDE MAINTENANCE PROCEDURE
		PB	COMPOSITE PARTS BREAKDOWN
		RD	COMPOSITE PARTS BREAKDOWN
		SD	SCHEMATIC DIAGRAM
		WD	WIRING DIAGRAM
		(NONE)	SPECIAL OPTIONS LIST FOR THE PN

EACH TRIAL MUST START WITH [USER REQUEST]. WHEN THE SYSTEM ASKS FOR YOUR REQUEST, IN THE PROMPT AREA BELOW, INPUT THE INPUT QUALIFIER, THE CONTENT IDENTIFIER, AND THE OUTPUT QUALIFIER IN THE CORRECT SEQUENCE. THEN CHECK THE ACCURACY OF YOUR INPUT. IF THE SYSTEM DETECTS A MISTAKE, AN ERROR MESSAGE WILL BE SHOWN. IF YOU MAKE AN ERROR, USE [BACKSPACE] TO ERASE AND THEN INPUT THE CORRECT DATA, OR USE [CLEAR] AND START OVER. FOR THE FIRST COMBINATION IN THE ABOVE TABLE, THE PROMPT SHOULD LOOK LIKE THIS:

INPUT USER REQUEST: [PN MBEU14B6H5 FI]; [ENTER].

- WHEN THE DATA IS CORRECT: [ENTER]. THE RESULTS OF YOUR REQUEST WILL APPEAR, AT SLIGHTLY REDUCED SIZE, IN AN EXAMPLE FRAME. FOLLOW THE PROMPT AT THE BOTTOM OF THE EXAMPLE FRAME TO COME BACK HERE.

WHEN YOU ARE READY TO BEGIN: [USER REQUEST].

FOR PRACTICE TRIALS: FOLLOW INSTRUCTIONS ABOVE.
FOR NEXT EXERCISE: [FORWARD].

Figure 9-11. Example of VAMIS users' guide user modes and interactions instruction frame.

Example frames, as shown in Figure 9-12, will show the results of a successful practice trial using the appropriate frame(s) from the closed data base. The use of the RETURN key to get back to the instruction frame is appropriate since the example frames are, in effect, the pool data for users' guide procedures. It is, however, an exception to the rule for use of the RETURN key.

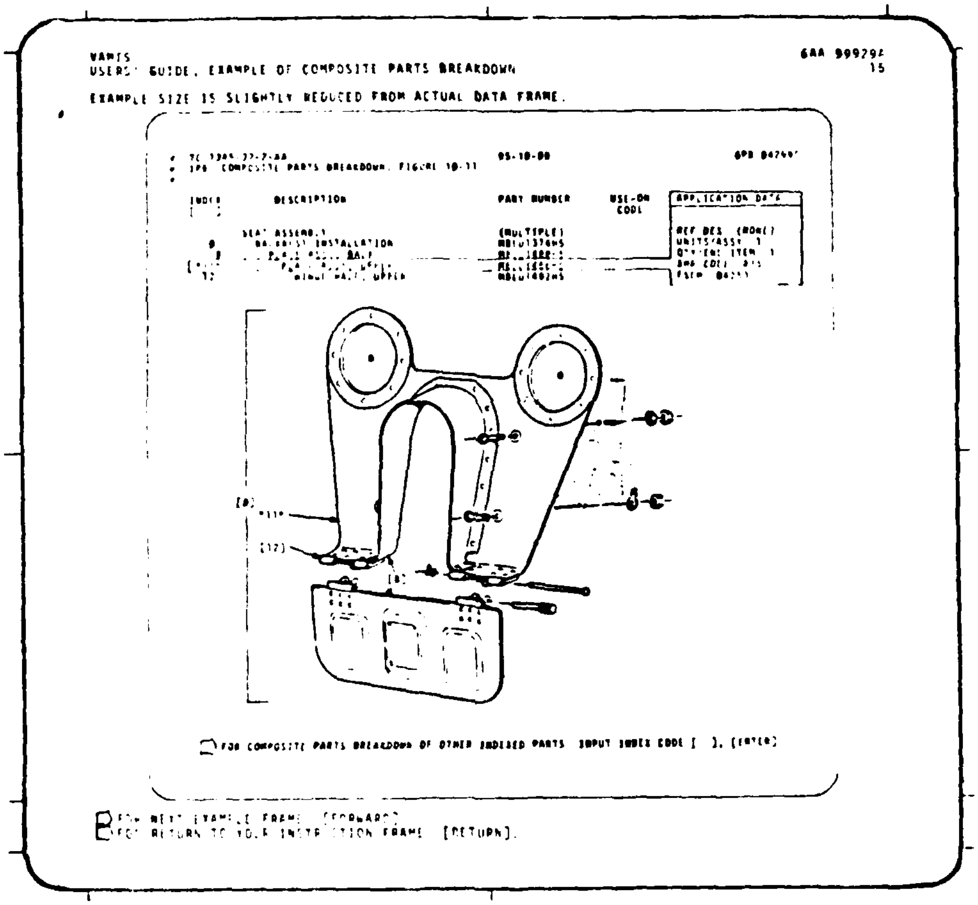


Figure 9-12. Example of VAMIS users' guide user modes and interactions example frame.

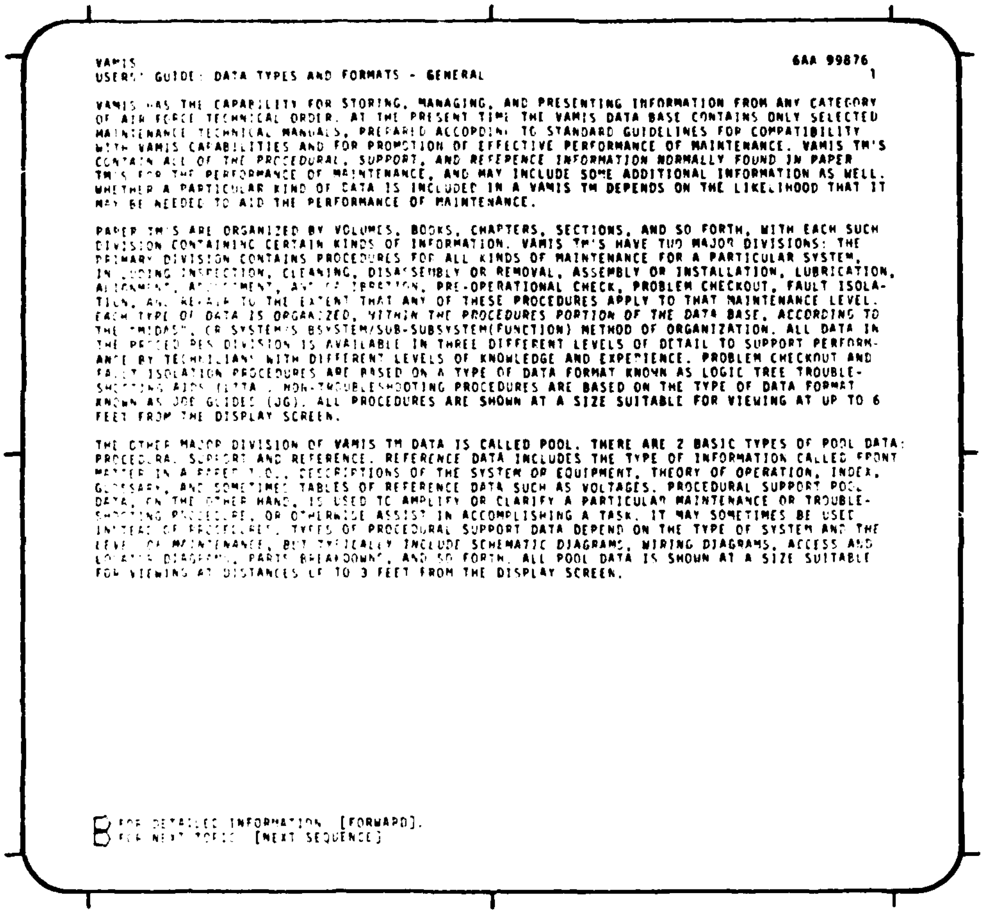
9.6.5 VAMIS Data Types and Formats

This topic is the last of the descriptive data in the users' guide. Those who have progressed through the topics preceding it in the ordered sequence should be familiar with the system and how to interact with it. This topic will cover the types of data that make up the individual TOs in the data base, how the data are formatted and why, and the ways the technician can use the various data types and formats for accomplishing maintenance.

Figure 9-13 illustrates an example of the general overview frame for this topic. The scope outlined in the example is, as mentioned previously, based on the data types and formats that form the baseline for the VAMIS definition project. If other data types and formats are eventually included, appropriate changes will be necessary.

Figure 9-14 shows an example of a frame of specific information included in the data types portion of this topic, describing levels of detail associated with procedural data. Subsequent frames on this subtopic should illustrate the differences between Tracks 1, 2, and 3 levels of detail.

Detailed descriptions and explanations of formats used in the system, and how they are intended to support the conduct of maintenance, should comprise the remainder of this topic in the users' guide. This discussion should be in some detail, encompassing most of the format type examples included in the preceding sections of this report. The method of presentation is similar to the approach used for the user modes and interactions guidance discussed in paragraph 9.6.4. For each format type, one or more discussion frames will describe the features and characteristics, with illustrations included as appropriate. Discussion frames will be supported by example frames, some of which will be the same as those supporting the user modes and interactions practice trials (see Figure 9-12).



VAMIS
USERS' GUIDE: DATA TYPES AND FORMATS - GENERAL

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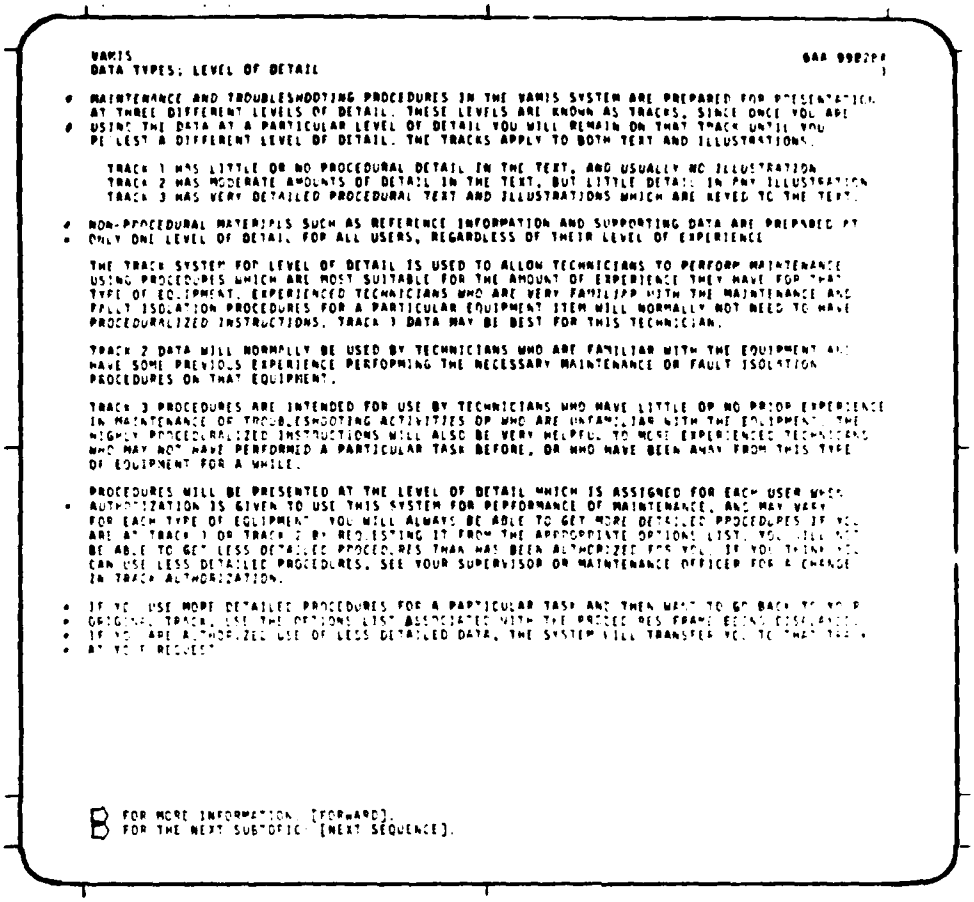
VAMIS HAS THE CAPABILITY FOR STORING, MANAGING, AND PRESENTING INFORMATION FROM ANY CATEGORY OF AIR FORCE TECHNICAL ORDER. AT THE PRESENT TIME THE VAMIS DATA BASE CONTAINS ONLY SELECTED MAINTENANCE TECHNICAL MANUALS, PREPARED ACCORDING TO STANDARD GUIDELINES FOR COMPATIBILITY WITH VAMIS CAPABILITIES AND FOR PROMOTION OF EFFECTIVE PERFORMANCE OF MAINTENANCE. VAMIS TM'S CONTAIN ALL OF THE PROCEDURAL, SUPPORT, AND REFERENCE INFORMATION NORMALLY FOUND IN PAPER TM'S FOR THE PERFORMANCE OF MAINTENANCE, AND MAY INCLUDE SOME ADDITIONAL INFORMATION AS WELL. WHETHER A PARTICULAR KIND OF DATA IS INCLUDED IN A VAMIS TM DEPENDS ON THE LIKELIHOOD THAT IT MAY BE NEEDED TO AID THE PERFORMANCE OF MAINTENANCE.

PAPER TM'S ARE ORGANIZED BY VOLUMES, BOOKS, CHAPTERS, SECTIONS, AND SO FORTH, WITH EACH SUCH DIVISION CONTAINING CERTAIN KINDS OF INFORMATION. VAMIS TM'S HAVE TWO MAJOR DIVISIONS: THE PRIMARY DIVISION CONTAINS PROCEDURES FOR ALL KINDS OF MAINTENANCE FOR A PARTICULAR SYSTEM, INCLUDING INSPECTION, CLEANING, DISASSEMBLY OR REMOVAL, ASSEMBLY OR INSTALLATION, LUBRICATION, ALIGNMENT, ADJUSTMENT, AND OPERATION, PRE-OPERATIONAL CHECK, PROBLEM CHECKOUT, FAULT ISOLATION, AND REPAIR TO THE EXTENT THAT ANY OF THESE PROCEDURES APPLY TO THAT MAINTENANCE LEVEL. EACH TYPE OF DATA IS ORGANIZED, WITHIN THE PROCEDURES PORTION OF THE DATA BASE, ACCORDING TO THE "MIDAS", OR SYSTEM/SUBSYSTEM/SUB-SUBSYSTEM(FUNCTION) METHOD OF ORGANIZATION. ALL DATA IN THE PROCEDURES DIVISION IS AVAILABLE IN THREE DIFFERENT LEVELS OF DETAIL TO SUPPORT PERFORMANCE BY TECHNICIANS WITH DIFFERENT LEVELS OF KNOWLEDGE AND EXPERIENCE. PROBLEM CHECKOUT AND FAULT ISOLATION PROCEDURES ARE BASED ON A TYPE OF DATA FORMAT KNOWN AS LOGIC TREE TROUBLESHOOTING AIDS (LTTA). NON-TROUBLESHOOTING PROCEDURES ARE BASED ON THE TYPE OF DATA FORMAT KNOWN AS JOB GUIDES (JG). ALL PROCEDURES ARE SHOWN AT A SIZE SUITABLE FOR VIEWING AT UP TO 6 FEET FROM THE DISPLAY SCREEN.

THE OTHER MAJOR DIVISION OF VAMIS TM DATA IS CALLED POOL. THERE ARE 2 BASIC TYPES OF POOL DATA: PROCEDURAL SUPPORT AND REFERENCE. REFERENCE DATA INCLUDES THE TYPE OF INFORMATION CALLED FRONT MATTER IN A PAPER T.O., DESCRIPTIONS OF THE SYSTEM OR EQUIPMENT, THEORY OF OPERATION, INDEX, GLOSSARY, AND SOMETIMES TABLES OF REFERENCE DATA SUCH AS VOLTAGES. PROCEDURAL SUPPORT POOL DATA, ON THE OTHER HAND, IS USED TO AMPLIFY OR CLARIFY A PARTICULAR MAINTENANCE OR TROUBLESHOOTING PROCEDURE, OR OTHERWISE ASSIST IN ACCOMPLISHING A TASK. IT MAY SOMETIMES BE USED INSTEAD OF PROCEDURES. TYPES OF PROCEDURAL SUPPORT DATA DEPEND ON THE TYPE OF SYSTEM AND THE LEVEL OF MAINTENANCE, BUT TYPICALLY INCLUDE SCHEMATIC DIAGRAMS, WIRING DIAGRAMS, ACCESS AND LOCATION DIAGRAMS, PARTS BREAKDOWNS, AND SO FORTH. ALL POOL DATA IS SHOWN AT A SIZE SUITABLE FOR VIEWING AT DISTANCES UP TO 3 FEET FROM THE DISPLAY SCREEN.

FOR DETAILED INFORMATION [FORWARD].
FOR NEXT TOPIC [NEXT SEQUENCE]

Figure 9-13. Example of VAMIS users' guide general data types and formats frame.



VAMIS
DATA TYPES; LEVEL OF DETAIL

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- MAINTENANCE AND TROUBLESHOOTING PROCEDURES IN THE VAMIS SYSTEM ARE PREPARED FOR PRESENTATION AT THREE DIFFERENT LEVELS OF DETAIL. THESE LEVELS ARE KNOWN AS TRACKS, SINCE ONCE YOU ARE USING THE DATA AT A PARTICULAR LEVEL OF DETAIL YOU WILL REMAIN ON THAT TRACK UNTIL YOU REQUEST A DIFFERENT LEVEL OF DETAIL. THE TRACKS APPLY TO BOTH TEXT AND ILLUSTRATIONS.

  TRACK 1 HAS LITTLE OR NO PROCEDURAL DETAIL IN THE TEXT, AND USUALLY NO ILLUSTRATION
  TRACK 2 HAS MODERATE AMOUNTS OF DETAIL IN THE TEXT, BUT LITTLE DETAIL IN ANY ILLUSTRATION
  TRACK 3 HAS VERY DETAILED PROCEDURAL TEXT AND ILLUSTRATIONS WHICH ARE KEYED TO THE TEXT.

- NON-PROCEDURAL MATERIALS SUCH AS REFERENCE INFORMATION AND SUPPORTING DATA ARE PREPARED AT ONLY ONE LEVEL OF DETAIL FOR ALL USERS, REGARDLESS OF THEIR LEVEL OF EXPERIENCE

THE TRACK SYSTEM FOR LEVEL OF DETAIL IS USED TO ALLOW TECHNICIANS TO PERFORM MAINTENANCE USING PROCEDURES WHICH ARE MOST SUITABLE FOR THE AMOUNT OF EXPERIENCE THEY HAVE FOR THAT TYPE OF EQUIPMENT. EXPERIENCED TECHNICIANS WHO ARE VERY FAMILIAR WITH THE MAINTENANCE AND FAULT ISOLATION PROCEDURES FOR A PARTICULAR EQUIPMENT ITEM WILL NORMALLY NOT NEED TO HAVE PROCEDURALIZED INSTRUCTIONS. TRACK 1 DATA MAY BE BEST FOR THIS TECHNICIAN.

TRACK 2 DATA WILL NORMALLY BE USED BY TECHNICIANS WHO ARE FAMILIAR WITH THE EQUIPMENT AND HAVE SOME PREVIOUS EXPERIENCE PERFORMING THE NECESSARY MAINTENANCE OR FAULT ISOLATION PROCEDURES ON THAT EQUIPMENT.

TRACK 3 PROCEDURES ARE INTENDED FOR USE BY TECHNICIANS WHO HAVE LITTLE OR NO PRIOR EXPERIENCE IN MAINTENANCE OR TROUBLESHOOTING ACTIVITIES OR WHO ARE UNFAMILIAR WITH THE EQUIPMENT. THE HIGHLY PROCEDURALIZED INSTRUCTIONS WILL ALSO BE VERY HELPFUL TO MORE EXPERIENCED TECHNICIANS WHO MAY NOT HAVE PERFORMED A PARTICULAR TASK BEFORE, OR WHO HAVE BEEN AWAY FROM THIS TYPE OF EQUIPMENT FOR A WHILE.

PROCEDURES WILL BE PRESENTED AT THE LEVEL OF DETAIL WHICH IS ASSIGNED FOR EACH USER WHEN AUTHORIZATION IS GIVEN TO USE THIS SYSTEM FOR PERFORMANCE OF MAINTENANCE, AND MAY VARY FOR EACH TYPE OF EQUIPMENT. YOU WILL ALWAYS BE ABLE TO GET MORE DETAILED PROCEDURES IF YOU ARE AT TRACK 1 OR TRACK 2 BY REQUESTING IT FROM THE APPROPRIATE OPTIONS LIST. YOU WILL NOT BE ABLE TO GET LESS DETAILED PROCEDURES THAN HAS BEEN AUTHORIZED FOR YOU. IF YOU THINK YOU CAN USE LESS DETAILED PROCEDURES, SEE YOUR SUPERVISOR OR MAINTENANCE OFFICER FOR A CHANGE IN TRACK AUTHORIZATION.

- IF YOU USE MORE DETAILED PROCEDURES FOR A PARTICULAR TASK AND THEN WANT TO GO BACK TO YOUR ORIGINAL TRACK, USE THE OPTIONS LIST ASSOCIATED WITH THE PROCEDURES FRAME BEING DISPLAYED. IF YOU ARE AUTHORIZED USE OF LESS DETAILED DATA, THE SYSTEM WILL TRANSFER YOU TO THAT TRACK AT YOUR REQUEST

B FOR MORE INFORMATION, [FORWARD].
FOR THE NEXT SUBTOPIC, [NEXT SEQUENCE].

Figure 9-14. Example of VAMIS users' guide detailed data types and formats frame (level of detail).

9.7 OTHER USERS' GUIDE DATA

The remaining information in the users' guide for VAMIS is, with one exception, unique to the users' guide only in terms of content. It is assumed that users who reach this point in the data base have either proceeded through the ordered sequence of explanations shown in Figure 9-1, and described above, or have entered the users' guide via a specific TO options list. In both cases, the user should have at least a basic understanding of how to interact with the system.

9.7.1 Users' Guide Glossary and Index

The glossary and index sections of the users' guide are identical in format and scope to the glossary and index portions of the specific TOs included in the VAMIS data base. These are discussed in Subsections 5.6 and 5.7 for glossaries and indexes, respectively. As with specific TOs, the contents of the users' guide glossary and index sections are based on the contents of the "reference TO," which in this case is the users' guide. Access to specific information in either the glossary or index is obtained only through the respective introduction frames.

9.7.2 Users' Guide Options List

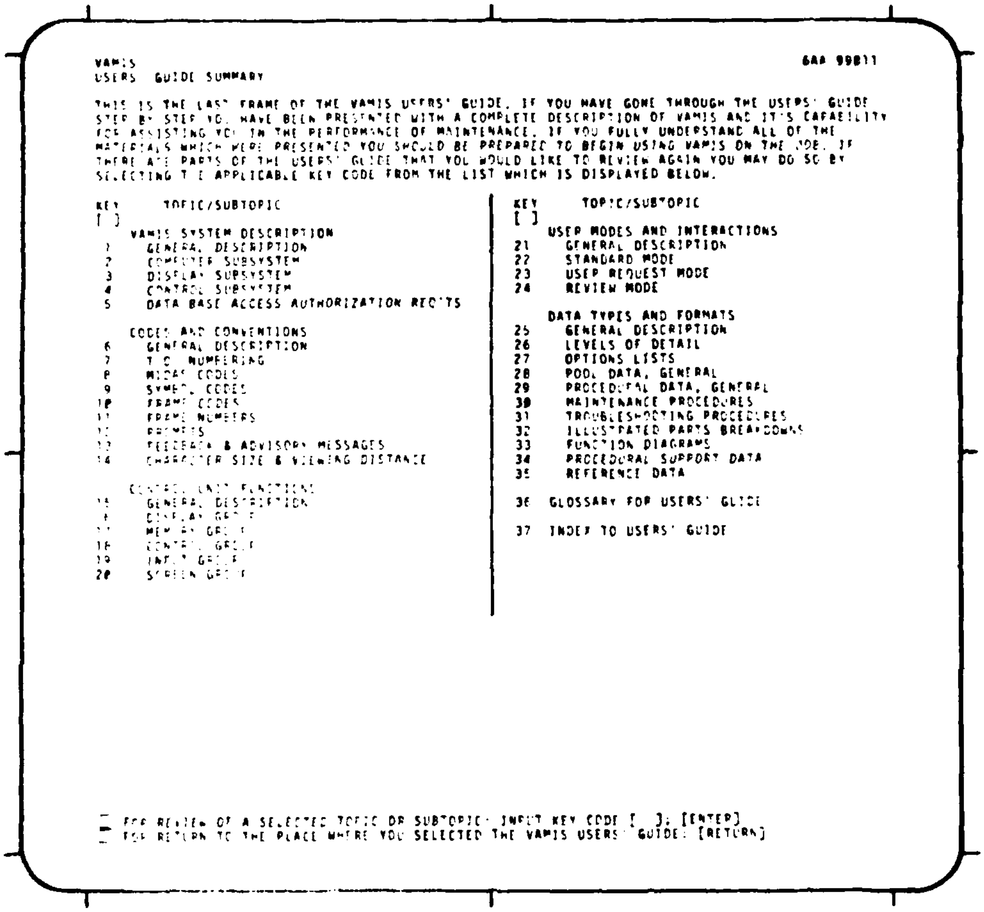
The options list for the users' guide is identical in concept to any other options list, an example of which is shown in Figure 4-9 in Section 4.0. Only three differences are noteworthy:

- The users' guide options list is singular, i.e., there is only one usable options list for the entire users' guide; whereas, specific TO options lists are unique to the individual procedural or pool data frame for which they were prepared.
- The users' guide options list is multiframe to permit greater inclusion of detail; whereas, specific TO options lists are single frame.
- The users' guide options list will include a specific prompt, as a concession to an inexperienced VAMIS user who may access it inadvertently or out of curiosity, for actuation of the RETURN key to get back to the reference frame.

The content of the users' guide options list should be at a level of detail that will allow the user to access subtopics of the guide. To access specific subjects, the use of the index will be required.

9.7.3 Users' Guide Summary

The summary frame, an example of which is presented in Figure 9-15, is unique to the users' guide in the VAMIS data base. Since the guide is intended, at least for new users, to be reviewed in an ordered sequence, the summary frame lets the user know that he/she has reached the end of the "manual" and what topics have been covered, and it is an easy method for getting back to any of the topics for further review. In a sense it is a table of contents placed at the end of the "document." It is expected that many users will, on their first exposure to the users' guide, not spend the time to go through each topic at the detailed level. The summary frame will promote going back to specific topics for more detailed information.



VAMIS
USERS GUIDE SUMMARY

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THIS IS THE LAST FRAME OF THE VAMIS USERS' GUIDE. IF YOU HAVE GONE THROUGH THE USERS' GUIDE STEP BY STEP YOU HAVE BEEN PRESENTED WITH A COMPLETE DESCRIPTION OF VAMIS AND IT'S CAPABILITY FOR ASSISTING YOU IN THE PERFORMANCE OF MAINTENANCE. IF YOU FULLY UNDERSTAND ALL OF THE MATERIALS WHICH WERE PRESENTED YOU SHOULD BE PREPARED TO BEGIN USING VAMIS ON THE JOB. IF THERE ARE PARTS OF THE USERS' GUIDE THAT YOU WOULD LIKE TO REVIEW AGAIN YOU MAY DO SO BY SELECTING THE APPLICABLE KEY CODE FROM THE LIST WHICH IS DISPLAYED BELOW.

KEY [ ]	TOPIC/SUBTOPIC
	VAMIS SYSTEM DESCRIPTION
1	GENERAL DESCRIPTION
2	COMPUTER SUBSYSTEM
3	DISPLAY SUBSYSTEM
4	CONTROL SUBSYSTEM
5	DATA BASE ACCESS AUTHORIZATION REQ'TS
	CODES AND CONVENTIONS
6	GENERAL DESCRIPTION
7	T.O. NUMBERING
8	MIDAS CODES
9	SYMBOL CODES
10	FRAME CODES
11	FRAME NUMBERS
12	PROMPTS
13	FEEDBACK & ADVISORY MESSAGES
14	CHARACTER SIZE & VIEWING DISTANCE
	CONTROL UNIT FUNCTIONS
15	GENERAL DESCRIPTION
16	DISPLAY GROUP
17	MEMORY GROUP
18	CONTROL GROUP
19	INPUT GROUP
20	SCREEN GROUP

KEY [ ]	TOPIC/SUBTOPIC
	USER MODES AND INTERACTIONS
21	GENERAL DESCRIPTION
22	STANDARD MODE
23	USER REQUEST MODE
24	REVIEW MODE
	DATA TYPES AND FORMATS
25	GENERAL DESCRIPTION
26	LEVELS OF DETAIL
27	OPTIONS LISTS
28	POOL DATA, GENERAL
29	PROCEDURAL DATA, GENERAL
30	MAINTENANCE PROCEDURES
31	TROUBLESHOOTING PROCEDURES
32	ILLUSTRATED PARTS BREAKDOWNS
33	FUNCTION DIAGRAMS
34	PROCEDURAL SUPPORT DATA
35	REFERENCE DATA
36	GLOSSARY FOR USERS' GUIDE
37	INDEX TO USERS' GUIDE

FOR REVIEW OF A SELECTED TOPIC OR SUBTOPIC: INPUT KEY CODE [ ]; [ENTER]
FOR RETURN TO THE PLACE WHERE YOU SELECTED THE VAMIS USERS' GUIDE: [RETURN]

Figure 9-15. Example of VAMIS users' guide summary frame.

REFERENCES

1. Hatterick, G.R., & Price, H.E. Technical order management and acquisition (AFHRL TR-80-50). Prepared under Contract F33615-78C-0016 for the Air Force Human Resources Laboratory by BioTechnology, Inc., May 1981. (AD-A099 705)

2. Mulligan, J.F. Draft military specification for logic tree troubleshooting aids: Organizational and intermediate maintenance (AFHRL-TR-79-49). Prepared under Contract F33615-78-C-0015 for the Air Force Human Resources Laboratory by Management and Technical Services Co., November 1979. (AD-A079 777)

3. Joyce, R.P., Chenzoff, A.P., Mulligan, J.F., & Mallory, W.J. Fully proceduralized job performance aids (AFHRL-TR-73-43).

   Vol. I: Draft military specification for organizational and intermediate maintenance (AD-775 702)
   Vol. II: Handbook for JPA developers (AD-775 705)
   Vol. III: Handbook for JPA managers and training specialists (AD-775 706)

   Prepared under Contract F33615-73-C-4033 for the Air Force Human Resources Laboratory by Applied Science Associates, 1973.

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6. Mulligan, J.F., & Bird, J.B. Guidance for maintenance task identification and analysis: Organizational and intermediate maintenance (AFHRL-TR-80-21). Prepared under Contract F33615-78-C-0015 for the Air Force Human Resources Laboratory by Management and Technical Services Co., June 1980. (AD-A089 918)

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9. Gould, G.D. Visual factors in the design of computer-controlled CRT displays. Human Factors, 1968, 10(4).

10. Frazier, T.W., Huang, S.Y., & Roth, J.T. Optimal formats for automated technical order system (Draft Final Report). Prepared under Contract F33615-78-C-0030 for the Air Force Human Resources Laboratory by Behavioral Technology Corp., December 1978.

11. Snyder, H.L., & Taylor, G.B. The sensitivity of response measures of alphanumeric legibility to variations in dot matrix display parameters. Human Factors, 1979, 21(4).

12. Air Force Systems Command. Human factors engineering (AFSC DH 1-3), Third Edition, 1980.

13. Nuclear Regulatory Commission. Guidelines for control room design reviews (NUREG-0700). 1981.

MILITARY SPECIFICATIONS

MIL-M-8910	Illustrated Parts Breakdown
MIL-C-9927A	Aeronautical Weapons Systems Organizational Maintenance Checklists
MIL-M-24100B	Equipment and Systems Functionally Oriented Maintenance Manuals (FOMM)
MIL-M-25095A	Avionics Equipment and Systems Intermediate Maintenance Instructions
MIL-C-38720A	Airborne Armament and Electronic Systems/ Equivalent Bench Check and Intermediate Maintenance Checklist
MIL-C-38778A	Checklist, Title Page, List of Effective Pages, Printing and Binders
MIL-M-38784A	General Style and Format
MIL-M-38799	Aircraft, Missile/Space, Ground Communications-Electronics-Meteorology (CEM) and Related Equipment, Sites, Systems and Facilities Schematic Block Diagrams (SBD) and Maintenance Dependency Charts
MIL-M-38800A	Aircraft, Missiles, and Non-Munition Accessories Organizational Maintenance Instructions
MIL-M-38807	Illustrated Parts Breakdown
MIL-M-63038A	Organizational or Aviation Unit, Direct Support or Aviation Intermediate, and General Support Maintenance
MIL-M-81927	Microform-Compatible Technical Manuals
MIL-M-81929	Microform-Compatible Illustrated Parts Breakdown (IPB)
MIL-M-83495	Aircraft, Missiles and Space Vehicles Organizational Maintenance

MILITARY STANDARDS

MIL-STD-863A	Wiring Data and System Schematic Diagrams
MIL-STD-1472C	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
DOD-STD-1685	Comprehensibility Standards for Technical Manuals

MILITARY HANDBOOKS

MIL-HDBK-242	Writer's Guide for MIL-M-24100B Functionally Oriented Maintenance Manuals (FOMM)
MIL-HDBK-63038-1	Technical Manual Writing Handbook

OTHER

NAVAIR 00-25-700	Technical Manual Preparation Guide for Technical Writers, Editors, and Illustrators

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